Sloe and strawberry tea are perhaps the best substitutes for the Chinese production. There are also Mexican tea, a Brazil ian tea—the aromatic *capitão da matto*—a Santa Fé tea, Indian tea, Toolsie tea; beside tea made from the leaves of scores of other plants, however, unlike the above, have never come even into a limited use.

In the face of gigantic statistics relating to its consumption, and of the great profusion with which Nature has provided the herbs suitable for the beverage, it is a little startling to find that tea is, after all, a poison, one capable of producing functional nervous disarrangements when taken in excess. It exerts an astringent action; and by the presence in it of an organic substance, *theine*, it exercises its special influence. "In poverty-stricken districts," says Dr. Richardson, in "Diseases of Modern Life," "among the women who take tea at every meal, an extremely nervous semi-hysterical condition from the action of tea is all but universal. In London and other fashionable centers, in which the custom of tea drinking in the afternoon has lately been revived under the old name of 'the drum' (kettledrum is the society name for these social parties in the United States), these same nervous symptoms have been developed in the richer classes of society, who, unfortunately, too often seek to counteract the mischief by resorting to alcoholic stimulants. "The maladies caused by tea are deficiency of saliva, destruction of taste for food, biliousness, nausea, nervousness (often extreme), and nightmare whenever sleep is obtained." A formidable indictment, truly, for the harmless looking and fragrant contents of one's tea caddy. It is more pleasant to contemplate the reverse of the picture, and agree with a Chinese writer that "drinking it tends to clear away all impurities, drives off drowsiness, removes or prevents headache," or with Dr. Edward Smith in his recent work on Foods, in which he says that the beverage stimulates respiration, and "powerfully promotes the assimilation and transformation of other foods."

To enter into all the varied details of tea culture would be far to transcend our present limits. An excellent idea, however, of a tea farm will be obtained from the large engraving given herewith, which is taken from photographs of new plantations near Dargeeling, in British Sikkim, India. Tea flourishes best on mountain slopes where there is plenty of rain, but where the water does not stagnate about the roots of the plant, and where the annual mean temperature varies from 68° to 76°. These conditions are fulfilled especially in those parts of Sikkim which are situated from 2,000 to 4,000 feet above the sea, and the tea produced is of exceptionally fine flavor. The tea seed is planted by drills in what are termed nurseries; and when the plant has grown to be 3 or 4 inches in hight, it is transplanted finally into a garden. The leaf is plucked by women and children from the middle of March up to November, when the cold sea son has begun, and cultivation commences. The leaves are then rolled into a form called a dullah; and after these have fermented and turned brown, they are broken up and placed in a bamboo vessel over a sharp, clear, charcoal fire until roasted. The tea then passes to women, who pick out all red leaves and stalks. It then goes to the sifter, who separates the different kinds of tea. After this it is again returned to another set of women, who fan out all chaffy leaves by shaking it up in a round shell bamboo basket. The tea is then heated over a slow fire, and finally packed for transportation. No. 1 of our engravings is a general view of the plantation; 2 represents the leaves being weighed; 3 shows the hands employed in plucking the leaf. In 4, the leaves are being rolled; in 5, they are represented in large baskets, withering in the sun; 6 shows the rerolling operation by machine; 7, withering in the factory; and 8, a machine for sorting the various kinds.

Few articles of commerce are more adulterated than tea. The London *Times*, in 1873, published some interesting revelations on this subject, and once stated that, "out of twenty samples, nineteen were found to be adulterated with plumbago, lie tea, iron filings, and sand. Since tea naturally contains a large quantity of tannin, there are thus brought together the two chief constituents which enter into the composition of ink, and by appropriate treatment a bottle of good ink actually was made from the tea in question." The London *Medical Examiner*, of recent date, very fully examines the various adulterations of the Chinese leaf, and says that these, for the most part, consist in redrying and refiring exhausted leaves. It is quite impossible to tell to what extent this is done, as the leaves can be made to look as good as new, and can be mixed with fresh ones without much chance of detection. Another method, practised in Canton, is the production of scented and green teas from the leaves of other plants. Whole chops of tea, consisting of 1,000 packages each, and called Canton gunpowder tea, have been exported, composed entirely of rose leaves painted green. The facing powder used in these cases is Prussian blue and sulphate of lime or gypsum. Willow leaves are frequently employed as adulterants; and an ingenious fraud, capable of deceiving even experienced tea dealers, is perpetrated by boiling rice and dropping the conjee or rice water into tea dust. This done, it is impossible to tell the quality of the article until the liquor is distilled from it.

A wreck brings a great and profitable harvest to tea dryers. Several years ago, the steamer St. Petersburgh was lost with a cargo of tea, and after being immersed for sixty days the chests were regained. The tea was rather salty to the taste; but as many thousand barrels full were obtained, it is probable that it was all revamped and sold to the retail trade.

Three words as to making tea by way of conclusion, and these are: Don't boil it; to do so is a barbarism. Theine in tea, like caffein in coffee, is a volatile principle which boiling drives off, leaving only a decoction of the bitter astringent residue, for which we know no better name than liquid headache generator. It is a strong stomach that can withstand more than a pint of the simmered abomination, sold in most restaurants under the name of tea. Tea well made is fragrant, aromatic, and exceedingly grateful to the taste; tea badly made has a flavor like boiled brooms. The rule for making good tea is first to scald the teapot, put in the tea, pour on fiercely boiling water, cover tightly, and if green tea, serve immediately, or if black tea, stand near a fire for five minutes. Certainly no rule could be simpler than this; and yet in the average household, there is none for which the Irish handmaid entertains a more profound contempt.

NEW METHOD FOR THE DETECTION OF NICKEL IN THE PRESENCE OF COBALT.

BY MALVERN W. ILES, PH.B., SCHOOL OF MINES, COLUMBIA COLLEGE, NEW YORK CITY.

In October, 1875, I began comparative experiments upon various nickel and cobalt salts, in hopes of detecting some characteristic difference, which would serve for qualitative purposes. I was soon surprised at the intimate relationship existing between these elements; and although I was not led to believe that nickel and cobalt were one and the same element, as has been thought by some chemists, yet I will unhesitatingly state that a search for qualitative and quantitative methods for these metals has been as great a source of annoyance to chemists as was the discovery of these elements in an ore by any of the old German miners, who attributed their occurrence to the evil spirits *Kobold* and *Nick*.

The literature upon these metals alone would fill volumes; yet all that is known in regard to this subject has not yet been made public, since the metallurgical treatment of nickel and cobalt ores is kept in the greatest secrecy. Long before I had completed my researches into the literature of the subject, and before I had performed the various qualitative reactions suggested, I was overwhelmed with the magnitude of the undertaking. My investigations have, however, led to the discovery of a new and yet undescribed salt of nickel, eminently characteristic of this element. Its formation could, I think, be more advantageously applied upon a metallurgical scale than in the qualitative laboratory. The qualitative method which I suggest, which has been successfully used at the School of Mines for some time, may be stated as follows: Remove the metals precipitated by hydrochloric acid and hydrosulphuric acid as usual; then add ammonium chloride, ammonic hydrate, and ammonium sulphide; the precipitate may contain aluminic and chromic hydroxides, also zinc, manganese, iron, nickel, and cobalt sulphides. Treat the precipitate with dilute hydrochloric acid, and gently warm; all the metals will be dissolved as chlorides, except the nickel and cobalt sulphides, which will remain as a more or less granular black residue. In order to insure the complete removal of the other metals, especially iron, which would interfere with the subsequent proceedings, it will generally be found advisable to wash the black residue several times with warm dilute hydrochloric acid. The residue is next tested in a borax bead. If it is brown, the student may safely conclude the absence of cobalt, and only the presence of nickel.

Since, however, the beginner in qualitative analysis frequently mistakes a dark residue of iron sulphide, which often occurs at this point, mechanically enclosed in the separated sulphur, for a residue which contains nickel or cobalt sulphide, it is generally advisable to recommend that, in case a brown bead is obtained, to dissolve a small portion of the residue in dilute *aqua regia*, and test for iron by the addi tion of potassium ferrocyanide. In case iron has been found, the remaining residue is to be digested several times with dilute hydrochloric acid, until no reaction for iron is obtained or the residue completely dissolved. If a blue bead has been obtained, indicative of cobalt, then nickel is to be looked for in the following manner:

(*a*) Dissolve the black residue in as small a quantity of concentrated nitric acid as possible; evaporate almost to dryness (this step should not be overlooked, since the next step taken is the addition of ammonia, which would have to be added in considerable quantity if the nitric acid was not at least partially expelled). (*b*) Add ammonic hydrate until the nickel and cobalt hydroxides are dissolved. (*c*) Add glycerin, $\frac{1}{10}$ or $\frac{1}{12}$ of the volume of the liquid upon which the experiment is made. Heat until the solution has acquired a purple or rose tint. (*d*) Filter. (*e*) Add potassium ferricyanide in slight excess, and heat to boiling for a few minutes; a light red precipitate, or a white flocculent precipitate, which soon settles, indicates nickel. If the am monia be quite strong, or if considerable has been added, boil several minutes. A few drops of dilute hydrochloric acid will shorten the operation; but its use is not to be recommended in a qualitative laboratory, since the students are too apt to continue adding the acid till acid reaction ensues, in which case the cobalt will be precipitated. Even a large amount of cobalt, treated as above, remains perfectly clear.

When potassium ferricyanide is added (*e*), the solution acquires a beautiful red tint, similar to the coloration produced when ammonium sulpho-cyanide is added to a ferric salt. When this red tint is very intense, it is very advisable to dilute the solution slightly, in order that the analyst may easily see through the liquid; and then, on heating, in case nickel is present, a cloudiness will occur at the top of the test tube, which soon spreads through the entire liquid; and then, on heating still further, distinct floccules will make their appearance, which settle readily, having no tendency to adhere to the sides of the test tube. In case nickel is not present, the liquid clears up considerably.

I have been greatly aided in studying the chemical changes that take place by Professors Gibbs and Genth's "Researches upon the Ammonia-Cobalt Bases," from which I take the following: "An ammoniacal solution of chloride or cobalt (also nitrate?) absorbs oxygen readily from the air, becomes at first brown, and then gradually passes through various shades of color to a deep red." This solution "leaves upon the filter a quantity of hydrate of sesquioxide of cobalt, which is sometimes almost inappreciable, sometimes in comparatively large amounts." The glycerin, I think, plays no important part until the addition of the potassium ferricyanide. Since, however, a large number of samples of glycerin contain some lime, which can easily be detected with the spectroscope, and also since the ammonic hydrate invariably contains some ammonium carbonate, there will be a slight precipitate of calcium carbonate, after the addition of the glycerin and the application of heat. We see, therefore, from the above that the filtration (*d*) has a two-fold object: First, the removal of $Co_2(HO)_6$, and second, the removal of $Ca\,CO_3$.

The facility with which alkaline solutions of many of the metallic protoxides, say Professors Gibbs and Genth, absorb oxygen from the air attracted the attention of chemists at an early period. The proto-salts of iron, manganese, and cobalt are particularly remarkable in this respect. The object, then, of the boiling (*c*) is twofold: 1. The separation of $Ca\,CO_3$. 2. The formation of purpero-cobalt.

"The salts of purpero-cobalt are often found among the direct products of the oxidation of ammoniacal solutions of cobalt. They are often formed from the salts of roseo-cobalt by heating or by boiling, or with strong acids, the cobalt passing, as we conceive, from one modification to another. The salts of purpero-cobalt are distinguished by a fine violet red or purple color, which is common to nearly all of them, and which is very different from the comparatively dull red of the salts of roseo-cobalt."—*Researches upon the Ammonia-Cobalt Bases.*

Professor Gibbs' explanation of the action of ammonia on a protoxide of cobalt may be briefly stated as follows: "The protoxide is converted into sesquioxide of cobalt, which, at the instant of its formation, unites with a certain number of equivalents of ammonia, so as to form an integral portion. The new base partakes, in some measure, of the properties of the alkalies, the peculiar character of the salts of cobalt being wanting."

There are various other elements that form compounds analogous to the ammonia-cobalt bases. For example, Claus obtained ammonia-rhodium and ammonia-iridium, bases corresponding to roseo-cobalt, and, like this, triacid bases. Professors Gibbs and Genth say: "We have made many experiment in this direction, without, as yet, interesting results. Iron and manganese promised to afford similar classes of compounds; yet, in their behavior towards ammonia and oxygen, the proto-salts of these metals exhibit no analogy to those of cobalt. With chromium, the case may be different; but we cannot as yet pronounce, with certainty, on this point. Experiments with nickel failed entirely, and yielded ammonia salts of the protoxide."

In regard to the precipitation of cobalt with potassium nitrite, Dr. Fleitman says (*American Chemist*, November, 1875, page 193): "In the case when less than 1 part cobalt in 100 parts nickel is present, the precipitation of the former by $K\,NO_2$ is by no means accurate." Professor Wolcott Gibbs says, in regard to this subject: "The complete precipitation requires 48 hours, and rarely succeeds, unless in experienced hands."—*Chemical News*, March 17, 1865, also *American Journal of Science and Arts*, January, 1865.

I have found, when the amount of cobalt is large, that 48 hours is not long enough. Yet this method of separating cobalt from nickel is the one upon which very great stress is laid by nearly all the writers on chemistry. It is the one placed in the hands of beginners in the science of chemistry. No one, however, seems to raise a cry of objection except the poor tortured qualitative student, who finds, at the expiration of the 48 hours, that something is wrong; no yellow precipitate has formed; and even if a yellow precipitate has formed, in the filtrate, when evaporated to dryness and the residue tested in a borax bead, very frequently a beautiful cobalt blue looms up, beautiful in itself, but most aggravating to behold at this stage of his expended patience!

The French Exposition of 1878.

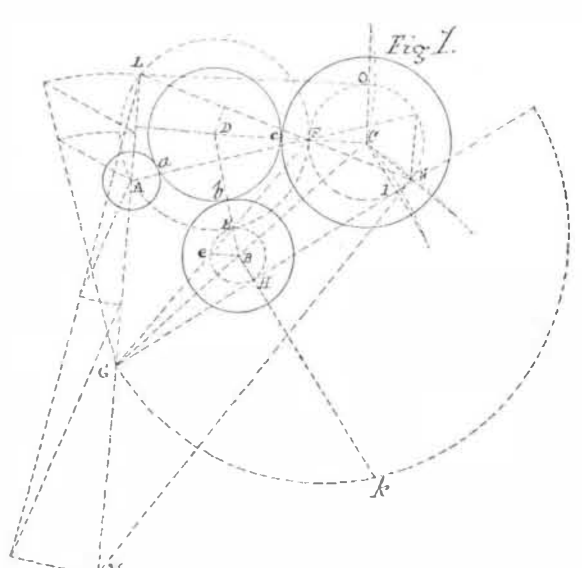
A law has been passed by the French Legislature, decreeing the opening of an International Exposition in Paris, on May 1, 1878, and the continuance of the same to October 31, of the same year. A commission has been appointed to make preliminary preparations; and of this, a sub-committee under M. Viollet-le-Duc, the celebrated French architect, was charged with the devising of a project for the grand buildings. M. Viollet-le-Duc's committee has reported as follows:

"Your sub-commission thought that it was necessary to have the covered space amount to 2,255,000 square feet in the Champ de Mars, and that it was proper to adopt rectilinear dispositions of the inclosure, forming a compact whole, which might be easily divided off according to the nature of the products exhibited in one direction and according to the nationality of the exhibitors in the other, a sort of Pythagorean table, upon which, on following one direction, a range of similar products might be inspected, while on taking an opposite direction to the first the nationalities would show their different merchandise. In the middle of this vast building are to be arranged saloons to receive an exposition of objects of art submitted by masters in every country, of models and of drawings of art more especially relating to industry, and perhaps a retrospective exposition. This principal building, which will occupy the middle part of the Champ de Mars, will be joined to the other buildings of the Exposition, by means of a large covered gallery that will cross the quays and the bridge of Jena at some distance above the ground, so as to allow free circulation to foot passengers and carriages to pass under it. This gallery will be bordered by spaces reserved to exhibitors whose works have a mixed character, such as objects fit for teaching, for libraries, and for typographers. This vast gallery will serve as the center, while buildings, disposed in an amphitheater on the Trocadero, will contain exhibitions of agriculture, horticulture, the training of domestic animals, the products of agriculture and mineral exploitation, and engines relating to the navigation of rivers and seas. These buildings on the Trocadero will occupy a surface covering 512,500 square feet, with intermediate courts and gardens. On the summit of the Trocadero and in covered communication with the gallery, there will be a great saloon erected, able to hold 10,000 persons, comprising the tribunes, and which will be intended for concerts, for testing the musical instruments, for public *réunions*, and for the solemnities of the opening and the distribution of prizes. Between the Military School on one side and the quay on the other and the buildings of the Champ de Mars, gardens will be planted, and will contain *cafés* and restaurants, none of which will be suffered to exist under any pretext within the inclosure itself of the palace. The rectilinear disposition of the roofs in plan and section for the palace of the Champ de Mars will have the advantage of making an economical structure, and of allowing the buildings to be erected in haste and to be pulled down in the same way, as well as to be used afterwards for other purposes, so that the sale of the materials after the close of the Exposition will be easy and profitable. These constructions should be in iron, filled in with bricks and masonry. As to the buildings of the Trocadero, they could in most cases be built in timber, as also the gallery of communication. This gallery, well constructed, should be a fine architectural work of an original aspect, particularly at its passage over the bridge, where it could partly be arranged with trusses, leaving the arches completely independent.

"The beautiful outlines of the Trocadero give us a reason for erecting picturesque buildings, which will be crowned by the grand saloon, from the top of the platform of which visitors will enjoy a ravishing panorama."

AN OLD PROBLEM.

In a recent letter a correspondent asked for an explanation of the method of drawing a circle tangent to any three given circles. Intending to refer him to some good treatise on practical geometry, we examined the principal ones, and found that they contained no mention of this question. On making further investigation, we ascertained that it was a celebrated problem among the ancient geometers, and was



subsequently solved by Vieta, and later by Sir Isaac Newton. It is contained in some foreign works on geometry, and a solution is given in Hutton's "Mathematical Recreations," which seems, however, to be incorrect. It is probable, therefore, that the solution is not generally accessible; and as the problem is unusually interesting and instructive, we lay it before our readers, in as simple a form as possible. The problem itself may be of little importance, but the principles upon which its solution depends are of general utility in geometrical constructions.

The construction in question is one of a class in which the solution is best obtained by indirect methods, changing the nature of the problem by successive steps in order to simplify it. As it is not at once evident what those steps should be, it will be advantageous to make the supposition that the problem has been solved, and see if some conditions can be obtained which may be fulfilled by construction. If such conditions can be discovered, it will, of course, be easy to make the required construction. It may be added that this method is of general application to all intricate geometrical problems.

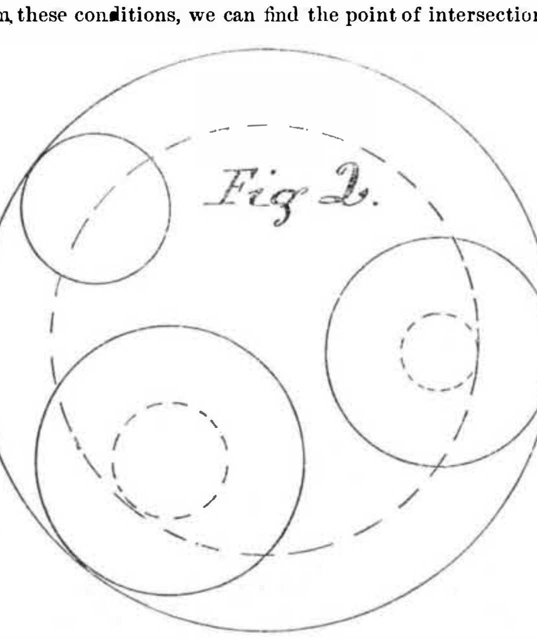
Referring to Fig. 1, the three given circles have their centers at A, B, C, with radii, A*a*, B*b*, C*c*. Suppose that D, the center of the required tangent circle, is known; it is evident that this will also be the center of a circle with radius, DF, passing through the center, A, of the smallest circle, and tangent to two circles with centers at B and C, and radii, BE, CF Hence, by the use of these auxiliary circles, the problem can be changed into another, in which it is required to draw a circle through a given point, and tangent to two given circles. Suppose this to be done, and draw the line, GHN, tangent to the two auxiliary circles; draw also the line, CBG, through the centers of the auxiliary circles, the line, GEF, through the points of tangency of these circles with the required circle, the line, GAL, through the center of the small circle, and the radius, B*e*. Then, from the principles of geometry, we obtain the relations:

$$\frac{GC}{GB}=\frac{GF}{Ge}=\frac{GF\times GE}{Ge\times GE}=\frac{GL\times GA}{(GH)^2}$$

From these conditions we can find a point, L, in the circumference of the required circle. so that, if the circle is drawn through the points, L and A, and tangent to one of the auxiliary circles, it will also be tangent to the other; hence the original problem can be reduced to the case in which it is required to draw a circle through two given points, and tangent to a given circle. Suppose the circle with radius, CF, is the given circle, and that the required construction is made. Through the point of contact, F, draw the straight lines, LFN and AF; at N, draw a tangent, NM, to the given circle, produce the line, LA, to its intersection with the tangent at M; and from L, draw the tangent, LO, to the given circle. Then we will have the relations:

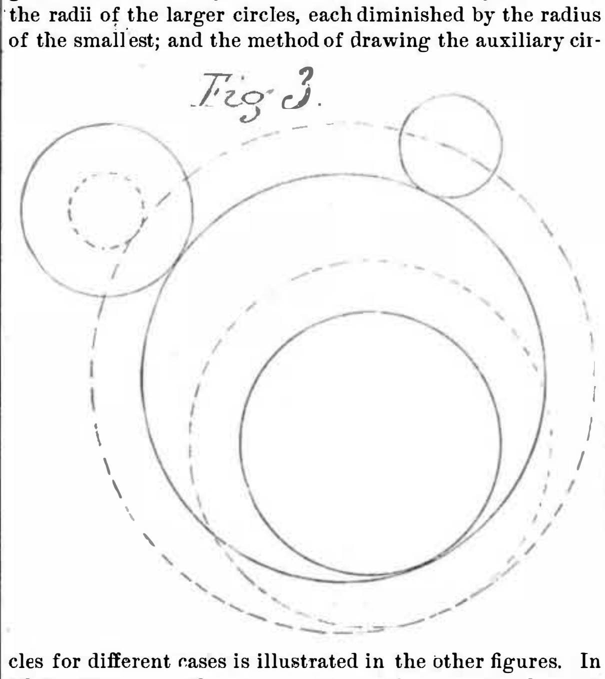
$$\frac{LA}{LF}=\frac{LN}{LM}, \text{ or } LA\times LM=LF\times LN=(LO)^2$$

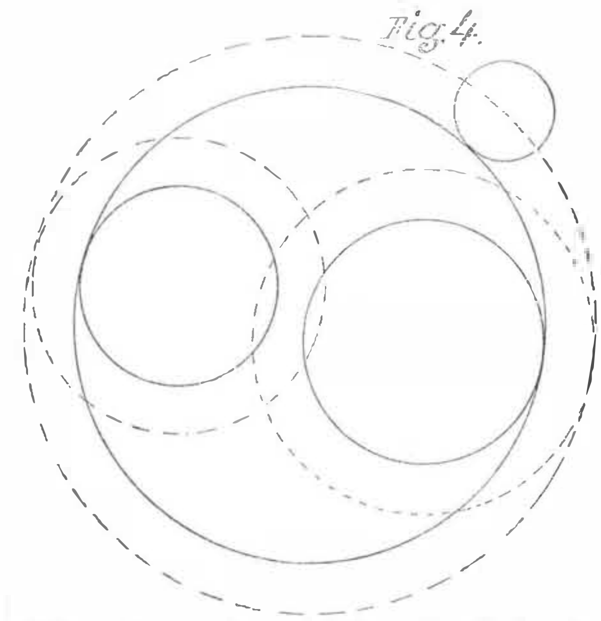
From these conditions, we can find the point of intersection,



M, the point of tangency, N, and the point of contact, F, so that the original problem is finally reduced to the simple one of finding the center of a circle which shall pass through three given points, A, L, F. The reader may find it profitable to verify the geometrical principles which have been stated above. We now pass to the method of making the construction, having shown the principles involved. All the auxiliary constructions are given in the figure, except such a simple one as the bisection of a line; but it has not been thought necessary to explain the methods of making them, as they will be found in an elementary text book. The reader will find it instructive to make the constructions as they are detailed below.

We have given the three circles in full lines, with centers at A, B, and C. It is evident that the problem admits of several solutions, as the tangent circle may touch the given circles externally, internally, or some of them internally and some externally. Several of these cases are illustrated in Figs. 2, 3, and 4. In any case, the first thing to do is to draw two auxiliary circles, whose centers are coincident with the centers of the two larger circles, and whose radii are such that a circle drawn from the same center as the required tangent circle, and passing through the center of the smallest of the given circles, will be tangent to the auxiliary circles. In Fig. 1, where the given circles touch the tangent circle externally, the radii of the auxiliary circles are the radii of the larger circles, each diminished by the radius of the smallest; and the method of drawing the auxiliary circles for different cases is illustrated in the other figures. In whatever manner the tangent circle is drawn, after the auxiliary circles are properly proportioned, the rest of the construction is the same for all cases; so that, in the remainder of the explanation, reference is made to Fig. 1.





Having drawn the auxiliary circles, with radii BE, CF, draw IH, tangent to both circles, and produce this tangent to its intersection with a line, CBG, drawn through the centers of the auxiliary circles. From G, the point of intersection, draw a straight line through A, the smallest of the given circles, and prolong it indefinitely. Next find the length of HK, the side of a square whose area is to the area of the square constructed upon GH as the line, GI, is to the line, GH. Then, considering GA to be one side of a rectangle whose area is equal to the square constructed upon HK, find the other side, GL; and the point, L, so determined, will be a point of the circle whose center we wish to find. We have now reached that part of the problem in which it is required to draw a circle through the points, L and A, and tangent to the circle whose radius is CF. Produce the line, LG, indefinitely; and from L, draw a tangent, LO, to the given circle. Find LM, the second side of a rectangle of which LA is the other side, and whose area is equal to the square constructed upon LO. From M, so determined, draw a tangent, MN, to the given circle, and connect the point of tangency, N, with the point, L. F, the point in which this last line cuts the given circle, is the point of contact of the given and required circles; so that it only remains to find D, the center of a circle passing through the points, A, L, and F.

We have been greatly interested in bringing the above problem to its present shape, in which it can be readily illustrated by a single figure, and many of our readers may be equally interested in repeating the construction. It will be necessary to use great care in all the steps, in order to secure satisfactory results. As it is not improbable that there are other solutions known to some of our readers, we may add that we will be glad to hear from any of them who think they can improve upon the method explained above.

Cleaning Silver Watch Dials.

Take about a teaspoonful of saltpeter and mix it with about two dessert spoonfuls of finely powdered charcoal; willow coal is the best. Let these be ground together with a little water on a piece of slate, with the blade of a knife; then by the aid of a camel's hair pencil, spread a portion of the mixture evenly over the surface of the dial, which must then be laid on a piece of charcoal; and with a blowpipe and the clear flame of a lamp or gas jet, it must be made just red hot, and kept so till the wet powder has ceased to fly about; it must then be thrown from the charcoal, hot as it is, into a mixture of sulphuric acid and water (in the proportion of about one fluid ounce of acid to three half pints of water); it will then have a snow-white appearance, and must be washed with brush and soap in clean soft water and put into fine sawdust, or, what is better, rose wood raspings, till quite dry.

New Drawing Instrument.

The Hartford Curve Scribe Company has recently exhibited to us an ingenious instrument for drawing curves and scroll ornaments, for use of designers, wood carvers, etc. It consists of an attachment to the ordinary compasses, in which is a small wheel, the periphery of which rests on the paper in place of the pen or pencil point. So long as the plane of the wheel is at right angles to its axis, it describes a complete circle when the compasses are turned; but the slightest inclination from that angle causes the line drawn to curve out or in, according to the direction and degree in which it is moved from the right angle. It is an efficient instrument for its purpose, and will be found a great help to pattern makers and designers. See advertisement on another page.

The East River Bridge.

The question of continuing work on the East river bridge will shortly be argued before the United States Circuit Court in this city. A lessee of one of the United States bouded warehouses, situated on the river side above the piers of the bridge, has presented a petition for an injunction, restraining the Mayors of New York and Brooklyn, the bridge company, and others interested from building the bridge "over the East River at the hight of 135 feet above mean high water, or at any other hight that shall obstruct, impair, or injuriously modify the navigation of said river." The petitioner declares that the structure would irreparably injure his business.