The Actual Number of Tubercle Bacilli which may be Present in Tuberculous Sputum.

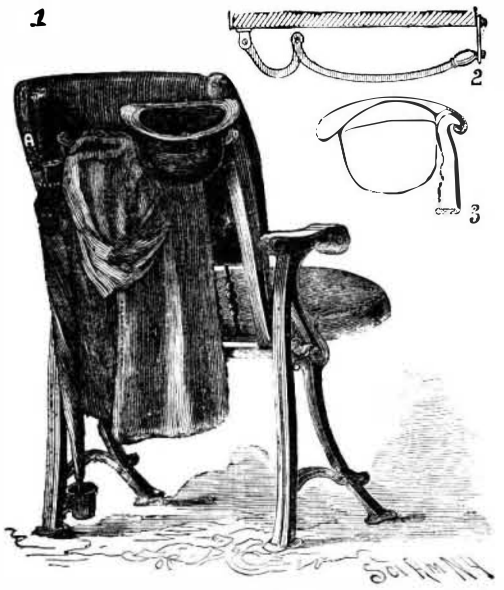
Dr. George H. F. Nuttall describes in the last number of the *Johns Hopkins Hospital Bulletin* a method by which he has been able to make accurate estimates of the actual numbers of tubercle bacilli present in tuberculous sputum. His communication is accompanied by cuts of the apparatus used. The methods heretofore employed for estimating simply the relative number of tubercle bacilli in sputum are condemned as unscientific. Nuttall's observations for the first time give us an idea of the enormous number of tubercle bacilli which a patient may expectorate in the course of twenty-four hours. In three cases undergoing the Koch treatment observations on the numbers of bacilli in the sputum were made every few days. In the first case the patient expectorated 2,000,000,000 bacilli during the twenty-four hours. After the patient was inoculated with tuberculin the number rose to between 3,000,000,000 and 4,000,000,000. After the inoculations ceased the number fell to what it had been originally. In the second case the number of bacilli varied between 20,000,000 and 165,000,000 on the days preceding the Koch inoculations, rose irregularly to 283,000,000 after the first inoculation, and fell to only 265,000 by the time the sixteenth inoculation had been reached. The third case showed a decrease from 70,000,000 before the inoculations to 12,000,000 and 19,000,000 after the treatment had been begun. A great rise in the number of tubercle bacilli in sputum was observed in the case of one patient (not undergoing the Koch treatment) to occur simultaneously with the appearance of elastic tissue. The number of bacilli in this case rose from between 300,000,000 and 400,000,000 to over 4,000,000,000. The accuracy of the method is shown by a number of test and culture experiments. Nuttall believes his method will prove valuable in any experiments where it is desirable to introduce a definite number of organisms into culture media, disinfectants, etc. In point of accuracy, it far surpasses the loop method generally employed. With such organisms as the tubercle bacillus this method will enable the experimenter to determine the number he is inoculating into an animal in a way that has not been possible hitherto. Inoculations made under such conditions will clearly show the difference in degree of virulence possessed by various organisms, as also the relation between the number of bacteria introduced and the progress of the disease. This method, finally, brings us a step nearer to solving the problem of the significance of involution and degeneration forms of bacteria.—*N. Y. Med. Jour.*

RACK ATTACHMENT FOR THEATER CHAIRS.

A novel rack for attachment to the backs of chairs or seats in theaters, public halls, and places is shown in the annexed engraving, Fig. 1 being a perspective view of a chair with the attachment applied, Fig. 2 a plan view of the attachment, and Fig. 3 a side elevation of the hat support.

This device affords a convenient support for a coat or other outer garment, a place for an umbrella or cane, and a standard for retaining a hat.

The principal part of the rack consists of a bar hinged at one end to one of the chair posts, curved outwardly for receiving the umbrella handle, and connected by a standard with the longer curved portion designed to receive a coat. The rack is pivoted to swing in an inclined plane, so that it will close automatically, and thus be prevented from offering any obstruction to a free passage through the row of seats.



HERMANN'S ATTACHMENT FOR THEATER CHAIRS.

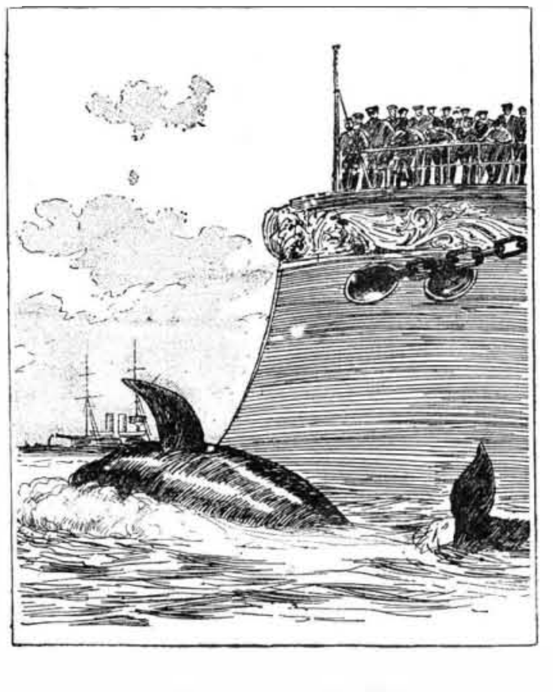
Although the rack is designed to close automatically, a hook is pivoted to the side of the chair for engaging the end of the rack arm and preventing it from swinging out accidentally.

To the free end of the rack arm is attached a standard, as shown in Fig. 3, having its upper end curved over to form a hook for receiving the turned-over portion of the hat brim, as shown in Fig. 3. To the leg of the chair below the curved portion of the rack designed for receiving the umbrella handle is secured a drip cup, in which the tip of the umbrella is placed.

This invention has been patented by Mr. George Hermann, 34 E. 10th St., New York.

A WARSHIP RAMS A WHALE.

While cruising with the Channel squadron, writes an officer of H. M. S. Immortalité, at nine o'clock on the morning of the 26th of May, in lat. 38 deg. 7 min. N, long. 9 deg. 19 min. W, steering S¼W (about



midway between Sardinia and the African coast), and going at a speed of thirteen knots, we struck a whale, about forty-five or fifty feet long, with our ram. It was unable to clear itself, which necessitated our going full speed astern, when the whale sank. It must have been asleep. At the same time we noticed another quite close on our starboard bow.

Fracture of the Clavicle from the "Kick" of a Rifle.

In the *Edinburgh Medical Journal*, Mr. James B. Simpson records the case of a member of a rifle club, a strongly built slate quarrier, thirty years old, who, after having fired several shots at 200 yards, feeling a "kick" not severe enough to cause actual pain, fired several more at 500 yards, lying down and resting on his elbows, and finally a shot at 600 yards, likewise in the prone posture. This shot broke the clavicle near its middle. The fracture was treated according to Sayre's method, and healed well. "When he recovered," says Mr. Simpson, "I asked the man to show me how he held his rifle while firing at 500 and 600 yards. On his raising the 'sight' and lying down and taking aim, the explanation of the fracture was clear. Instead of holding the butt of the rifle well on to his shoulder, he rested the upper end of the butt directly on the most prominent part of the clavicle. One could easily pass one's hand between the lower two-thirds of the butt and the man's chest, and it was therefore clear that when he fired all the force of the recoil came upon the clavicle. The farther he retired from the target, the more he necessarily elevated the muzzle of the rifle, and consequently the more did the upper end of the butt rest upon the clavicle, until at 600 yards so entirely was this the case that the bone gave way under the concentrated force."

Integrity of Quality.

Probably it is of as much importance to know how to retain a market as to know how to get it. Integrity of quality in goods is indispensable.

Not many years ago English manufacturers of cotton goods came near ruining valuable markets for such goods in the East, by sending to these markets miserable, sleazy, light weight goods loaded with size to give them artificial weight and the appearance of better cloth. These markets have never been the same to them since. Lost confidence is not easily restored. If, as a celebrated English statesman once remarked, "confidence is a plant of slow growth," it is certainly also a hard plant to nurse back into vigorous life when its roots have been cut by commercial deceit. A case in point occurs to us.

The late B. T. Babbitt, the famous and wealthy manufacturer of soap, established his business on the basis of strict commercial integrity, and his name was always honored among New York merchants. Some twenty years before his death, he made the European tour, leaving at the head of his business a young man of great energy and executive ability, but, as the sequel will show, of rather elastic principles. It was arranged with this deputy that in addition to his regular salary he might have during Mr. Babbitt's absence a certain share of all the profits of the business, whereupon immediately, as soon as his chief was out of sight, he put into practice a scheme of adulteration of the soap without a corresponding reduction of price. The soap selling freely upon the strength of its former reputation, the immediate returns were large, and the profits (?) divided unto the enterprising schemer from this selling out of his chief's business were, before Mr. Babbitt's return, enough to enable the trusted agent to retire with sufficient capital to start and conduct a large manufacturing business of his own. In narrating to the writer this disagreeable episode not many years after its occurrence, Mr. Babbitt said it cost him nearly a quarter of a million of dollars to remedy the injury to his business thus effected by a few months of sharp practice. He sent to his customers, all over the United States, letters requesting a return of the inferior goods, which he replaced with those of standard quality, and by a judicious but enormous expenditure in advertising gradually recovered the lost trade.

Cotton Oil in Lard.

The authors use Bechi-Hehner's silver nitrate test and Labiche's lead acetate reaction. For the former test 10 grms. of the filtered anhydrous lard are heated with 5 c. c. of silver nitrate solution (1 part silver nitrate, 200 alcohol, 40 ether, and 0·1 part nitric acid) in the water bath for fifteen minutes, shaking continually. The mixture, according to its proportion of cotton seed oil, turns more or less deeply reddish brown to black. Pure lard, poppy, olive, and sesame oils are not affected. For the Labiche test, 25 grms. of the clear melted sample are mixed with 25 c. c. of a solution of lead acetate, heated to 35°, and well mixed after the addition of 5 c. c. ammonia. The emulsion thus obtained, if cotton oil is present, soon shows a yellowish red color, which becomes more intense after standing for a day. Poppy-rape, sesame oils, and pure lard are not affected.—*A. Bujard and J. Waldbauer, Zeit. Ange. Chemie.*

GUNNER'S ARM REST.

An arm rest for the use of sportsmen and others in shooting offhand is shown in the annexed engraving. The rest is made portable, and when desired for use it is attached to an ordinary cartridge belt and supported by a strap extending over the shoulders.

The rest consists of three principal parts, a sleeve having a clip for engaging a loop on the belt, a ratchet bar sliding in the sleeve, and a U-shaped bar attached to the ratchet bar for receiving the arm of the gunner. The sleeve is provided with a spring bolt which strikes the clip and holds it on the loop of the belt, and it is also provided with a spring key which engages the ratchet bar so as to hold the arm loop at any desired height. In addition to the key, the sleeve is provided with a thumb screw which enters a groove in the back of the ratchet bar and prevents the ratchet bar from turning. It may also be used for clamping the bar, thus affording additional security.

The device may be extended by simply pulling the arm loop upward, but to reduce its length the spring key which engages the ratchet bar must be pressed before the bar can be moved downward. At the upper and lower ends of the ratchet bar there are square notches for receiving the spring key. When

SPROUL'S ARM REST FOR GUNNERS.

the key is in engagement with these notches, the bar is prevented from moving in either direction.

By the use of this device the arm is held steadily in an extended position, so that shooting may be done offhand as accurately as when firing over a stationary gun rest. For further particulars about this useful invention, address the patentee, Mr. Robert B. Sproul, or Mr. David S. Dickson, of Quartz, Montana.

ERRATUM.—In Mr. Wyatt's interesting article on phosphates in last issue, the analysis of South Carolina phosphates contained an error. "Phosphates of iron and alumina" should read oxides of iron and alumina.

The Phosphate Beds of Our Southern States.

BY FRANCIS WYATT, PH.D.

(*Continued from page* 407.)

THE FLORIDA PHOSPHATE DEPOSITS.

While, however, it is a very good thing to find abundant phosphate mines, such mines are of little value without the necessary capital for their exploitation. This capital not being forthcoming in the South, it has followed that our great Northern capitalists and bankers have been lately much attracted by tempting offers to share in the benefits of the discovery. Expert chemists and mining engineers have, therefore, had plenty of work in the "Land of Flowers," and my own examinations as one of these have extended during the last two years over every county on the Gulf of Mexico, from Tallahassee to Punta Gorda.

One of the first difficulties I encountered was the fact that up to date we have no record of a systematic or correct geological or topographical survey of the State. It will, consequently, be of interest to remark that, in its topographical aspect, Florida is low-lying and gently undulating, the highest point being not more than 250 feet, and the average about 80 feet above sea level.

The elevated points or ridges are composed entirely of sand, and are covered with a very luxuriant growth of tall pines. The depressions or valleys, especially when situated along the coast, are composed of a mixture of calcareous marls and sand, from which outcrop, at irregular and frequent intervals, large and small bowlders of limestones, sandstones, and phosphate rock. These valleys are principally known in the country as "hammock land," and are said to be very fertile. When uncultivated, however, they are covered with a dense, wild growth of vegetation, characteristic of the swamp. With the climatic conditions I shall make no attempt to deal, for they are too widely known, but of the geological aspect I may say that the entire State appears to be underlaid, at greatly varying depths, with upper Eocene limestone rock, and I am therefore of the opinion that the first emergence of Florida must be dated from that period.

During the succeeding Miocene submergence there was deposited upon these limestones, more especially in the cracks or fissures resulting from their drying up, a soft, finely disintegrated calcareous sediment or mud.

The gradual evaporation of these Miocene waters brought about the formation, principally in the neighborhood of the rock cavities and fissures, of large and small estuaries. These estuaries were replete, swarming with life and vegetable matter—fish, mollusks, reptiles, and marine plants. They were, besides, heavily charged with gases and acids, and their continuous concentration ultimately induced a multiplicity of readily conceivable processes of decomposition and final metamorphism.

In the estuaries and banks thus formed by the deposition and evaporation, or subsidence, of the Miocene seas we shall find the origin of our phosphate of lime, and, disregarding all other hypotheses, I consider that we are practically contemplating: 1. A foundation of Upper Eocene limestone rocks very much cracked up and fissured, the cracks having a general trend N. E. and S. W. 2. Irregular beds, pockets, or banks of Miocene deposits, dried and hardened by exposure, and alternately calcareous, sandy or marly; generally phosphatic, and sometimes entirely made up of decomposed organic debris, the phosphoric acid being combined with various bases (lime, magnesia, iron, alumina, etc.)

After the disappearance of the Miocene sea, there came some gigantic disturbances of the strata. There were upheavals and depressions. The underlying limestones were probably again split up, and the Miocene deposit was broken and hurled from the surface into yawning gaps, and from one fissure to another.

Now came the Pliocene periods or end of the Tertiary, and then the seas of Quaternary age, with their deposits and drifts of shells, sands, clays, marls, bowlders, and other transported materials, and the accompanying alternate or concurrent influences of cold, heat and pressure.

Taking the whole of these phenomena broadly into consideration, it must be concluded that those portions of the phosphatic Miocene crust which did not fall into permanent limestone fissures or caverns at the time of the disturbance of the strata became at length very thoroughly broken up and disintegrated. They were rolled about and intermixed with sand, clay, and marls, and were deposited with them in various mounds or depressions, in conformity with the violence of the waters, or with the uneven structure of the surface to which they were transported.

Occasionally this drifting mass found its way into very low-lying portions of the country, say into those regions where considerable depression was brought about by the sinking and settling of the recently disturbed mass. At other times it was rolled to and deposited on slightly higher points. In the first of these cases we find a vast and complete agglomeration, comparable to an immense pocket, of broken-up phosphate rock, finely divided phosphate debris, sands, clays, and marls, all heterogeneously mixed in together. In the second case, we find the phosphate in large bowlders, sometimes weighing several tons and intermixed with bu' -elatively small proportions of any foreign substances.

Considering these facts, I form the opinion that the feature in the Florida deposits of phosphate to be most particularly brought out is that the formation consists essentially of: 1. Original pockets or cavities in the limestone filled with hard and soft rock phosphates and *debris*. 2. Mounds or beaches, rolled up on the elevated points, and chiefly consisting of huge bowlders of phosphate rock. 3. Drift or disintegrated rock, covering immense areas, chiefly in Polk and De Soto Counties, and underlying Peace River and its tributaries.

At the present time the work of exploration or prospecting may be said to have extended all over the State in each of these varieties of the formation. Actual exploitation on the large scale by regular mining and hydraulic methods has been commenced at various points, and a very careful study of these workings has confirmed me in the theories I have just formulated.

In one of the mines, in Marion County, for example, there is an immense deposit of phosphatic material, proved, by actual experimental work, to extend over an area of several acres. It has shown itself to be a combination of the "original pocket" and the "mound" formation, and the superincumbent material, principally sand and marls, has an average depth of about 10 feet. The phosphate immediately underlies it, sometimes in the form of enormous bowlders of hard rock, cemented together with clay, sometimes in that of a white, plastic, or friable substance resembling kaolin, and probably produced by the natural disintegration of the hard rock by rolling, attrition, or concussion. The actual thickness of the entire bed is still somewhat uncertain, but the depth of the quarries is not more than 50 feet, and yet a little over two acres of the land have already yielded more than 20,000 tons of good ore, without signs of exhaustion.

Directly outside the limits of these quarries the "pockety" and "mound" formations seem to abruptly terminate, and the deposit assumes, over a wide area, the form of an unimportant drift, which sometimes crops out at the surface, and which has been followed in all directions over the immediate vicinity without leading to another pocket of similar value.

Identical geological phenomena being prevalent in nearly every section of the country, I consider myself warranted in declaring that the Florida land phosphates of high grade occur in beds of an essentially pockety, extremely capricious, uneven, and deceptive nature.

Sometimes the pockets will develop into enormous quarries, and will probably yield fabulous quantities of various merchantable qualities. At other times they will be entirely superficial, or will contain the phosphate in such a mixed condition as to render profitable exploitation impossible.

This capriciousness or uncertainty will be somewhat less in the case of the "pebble" or drift deposits, since they have been proved to exist at various depths and in varying thicknesses, with comparative regularity over a very extensive area.

The actual chief working center for this variety is Peace River, which rises in the high lake lands of Polk County and flows rapidly southward into the Gulf of Mexico. Its course is extremely irregular, and its bottom is a constant succession of shallows and deep basins.

Lakes Tsala, Opopka and Chillocohatchee, and Paines and Whidden creeks are its chief tributaries and the main sources of its phosphate deposits; the pebbles being washed out from their banks and borne along their beds by the torrential summer rains.

The exploitation of the pebbles is performed by means of a 10 inch centrifugal steam suction pump placed upon a barge. The pipe of the pump, having been adjusted by ropes and pulleys, is plunged ahead from the deck into the water. The mixture of sand and phosphate sucked up by it is brought into revolving screens of varying degrees of fineness, whence the sand is washed back into the river. The cleaned pebbles are discharged from the screens into scows and floated down to the "works," where, after being dried by hot air, they are once more screened and are then ready for market. The total cost of raising, washing, drying, screening and loading on the cars is one dollar and seventy-five cents.

Four or five companies are actively working on this plan, and several more are preparing to enter the field.

The pebbles, when freed from impurities and dried, are of a dark blue color, and are hard and smooth, varying in size from a grain of rice to about one inch in diameter. Their origin is proved by the microscope to be entirely organic, and they are intimately mixed up with the bones and teeth of numerous extinct species of animals, birds and fish.

These river deposits all proceed from the banks of sand and debris to which I have alluded as "drift," and which are situated on the higher lands in Polk County. Lakeland and Bartow may be taken as the central points of the dried-out deposits, the pebbles being of the same size, but of a lighter color. They are embedded in a matrix of sand and clay, in which they form the proportion of about 20 per cent in weight of the mass. The thickness of the deposit is exceedingly uneven; in some places it reaches 20 feet, while in others it dwindles down to a few inches.

As would be expected in this species of formation, the chemical composition of Florida phosphate is far from regular. In some regions perfectly white, in others blue, yellow or brown, it is in many instances practically free from iron and alumina, while at others it is heavily loaded with these commercially objectionable constituents. A large proportion of the land rock is very soft when damp, but becomes so hard when dried that it has long been used by the natives, ignorant of its other values, as a foundation or building stone.

The following averages are selected with care from the results of several hundreds of complete analyses made either by myself or by my assistants in Florida and New York. The samples in every case were taken from the exploratory pits in all the different counties and marked before leaving the ground with full details of their origin.

They have been classed as bowlders of hard rock phosphate, or cleaned, high grade material; bowlders and *debris*, or unselected material, merely freed from dirt; soft white phosphate, in which no bowlders are found; pebble phosphate from Peace River, as sent to market; pebble phosphate from Polk County drift beds, washed and screened.

	Phosphate of lime.	Oxides of iron and alumina.	Silica and silicates.	Carbonic acid.
Bowlders (carefully selected, 120 samples).	80·49	2·25	4·20	2·10
Bowlders and debris (237 samples)........	74·90	4·19	9·25	1·90
Soft white phosphate (148 samples)	65·15	9·20	5·47	4·27
Pebble from Peace River (84 samples)...	61 75	2·90	14·20	3·60
Pebble from drift beds, Polk Co. (92 samples)	67·25	3·00	10·40	1·70

I have now written enough to show that the point of most importance in the working of Florida phosphates, especially of the land deposits, will be the careful selection, by conscientious and capable superintendents, of the different qualities at the quarries. There being no present market for the highest grade in this country, it will all have to be shipped to Europe. The rock will, therefore, require to be crushed to a uniform size, to facilitate sampling, and then well washed and thoroughly dried, in order that all the iron and alumina so indiscriminately and unequally mixed up with it in the form of clay may be practically eliminated before shipment.

The maximum limit accepted by European buyers is 3 per cent, and nothing but experience in actual work, daily guided and controlled by the results of chemical analysis, can be relied upon to keep the material within these bounds. Even the most accomplished expert who examines the beds for the first time, and without a full knowledge of the variability of their composition in regard to this iron and alumina, would be sure to go wrong and commit the most fatal blunders. There can be no doubt that Florida is the theater of a big "boom," and that it is passing through a critical period of its history. Fertilizer manufacturers from all over the world are hurrying toward its sandy plains, in the hope of acquiring its phosphatic treasures. They find these scattered in all directions, as well in the rivers as in the lands, and so embarassingly variable in grade that they are brought to a halt by the questions: Where are the "bonanzas"? How are they to be found?

My own opinion of her phosphate mining, as will have been gathered from my remarks, is that it will prove extremely profitable to those who purchase and work its fields with judgment; but that it will certainly turn out in the highest degree disastrous to such as allow themselves to be led away by excited first impressions. The interior is still practically unsettled, and traveling is attended by the greatest difficulties and inconveniences. The negro labor is far from plentiful; there are few wagon roads suitable for transportation purposes; and the railroad facilities are altogether inadequate, the companies being poorly provided with freight cars. Under these circumstances, the natural difficulties or impediments to Florida phosphates are at present rather discouraging, and it is only when these have been cleared away, by the gradual development of the State, that the ores of all grades will begin to come forward in large quantities.

Their average richness in phosphoric acid is, on the whole, very satisfactory, though somewhat less than we were led to expect by the first reports, and a large proportion of the output will compare favorably with many other phosphates extremely popular with fertilizer manufacturers. Although more than a hundred companies have been already formed, with an aggregate capital of some $30,000,000 only 20,000 tons have yet been shipped to European ports. The bulk of this has, however, found a ready market at good prices, and it is quite certain that when speculation gives way to legitimate work, the constanly increasing demand will make of Florida the largest contributor to the world's supply.

DRAWING OF FINANCIAL BILLS BY THE CASANOVA APPARATUS.

The system of paying loans by obligations redeemable in a certain number of days through drawing lots has been greatly developed in our day, and is tending to increase to a still further degree. Some of these loans, those of the city of Paris, for example, are redeemable in a period of ninety-nine years; while others, such as the bonds issued on the occasion of the Universal Exposition of 1889, have fixed for such redemption a period of only seventy-five years. In certain cases, the obligation, issued generally at 500 francs, or at a slightly smaller figure, will be redeemable at 1,000 francs, and, in other cases, at its face value. Again, these annual drawings often include the distribution of prizes of more or less value, and which sometimes reach the respectable figure of 50,000, 100,000, and even 500,000 francs.

The simple *expose* that we have just given authorizes us now to claim that the operations that are to concur in the preparation and definitive establishment of the system of drawing such values, to which fate (sometimes ungrateful) may reserve a fortune under the form of a large prize, should be surrounded with the minutest and most mathematical precautions. Let a single one of the innumerable numbers (sometimes more than a million, as in the drawing of the prizes of the exposition bonds, which were 1,200,000 in number) be forgotten, and let the public by any means be apprised of the error, and we shall see our drawing exposed to just and very disquieting demands. Who knows whether or not the blind wheel of fortune stopped before the unfortunate forgotten number?

Were it a question of a simple lottery, there would be less trouble. A hidden sin is half pardoned; in this case it would be entirely so. In fact, the lottery differs from the drawing of redeemable bills in that, for the latter, the entire series of numbers, representing the corresponding subscribed obligations, must have made their exit from the wheel that contains them in a given period. If, for example, five hundred obligations are redeemed annually, the wheel will still have to contain, from the time of the last drawing, five hundred numbers, and not four hundred and ninety-nine, or even less. If the five hundred numbers are not presented to be called off, with entire accuracy, the putting of the numbers in the wheel has been imperfectly done in the beginning, or else former drawings have been incorrectly executed. In a word, there have been numbers forgotten or mislaid—forgotten at the moment of filling the wheel, or lost at the time of the annual drawings. There is no way out of this dilemma. On both hands, the operation will have been faulty, to the highest degree, and every bearer of a thrown-out obligation will have the right to render legally responsible for it the society, city or state that has assumed the reponsibility for it before its bond holders.

We frankly admit that we were never aware of the many inconveniences that we have just detailed until we had an opportunity of being present at a drawing—say at the putting of the tickets in the wheel, and at their extraction from their happy domicile. An opportunity of observing these curious operations was offered to us last year at the time of the fete that the Parisian press gave at the Continental Hotel for the benefit of a relief fund for widows and orphans. Aside from the fete itself, concert, ball, and exhibition we had got up a lottery of 15,000 tickets winning 587 different prizes. The drawing of these 587 prizes was done on March 15, in the presence of three delegates, Messrs. Victor and Henry Simond and Mr. Ranc. The putting of the numbers in the wheel had been effected on the previous evening by means of the Casanova apparatus, which we represent herewith. Everything proceeded wonderfully well, and Mr. Casanova had nothing to do but receive the best wishes of our *confreres*. As the press lottery was but a tombola, the 14,413 numbers remaining in the wheel were destroyed.

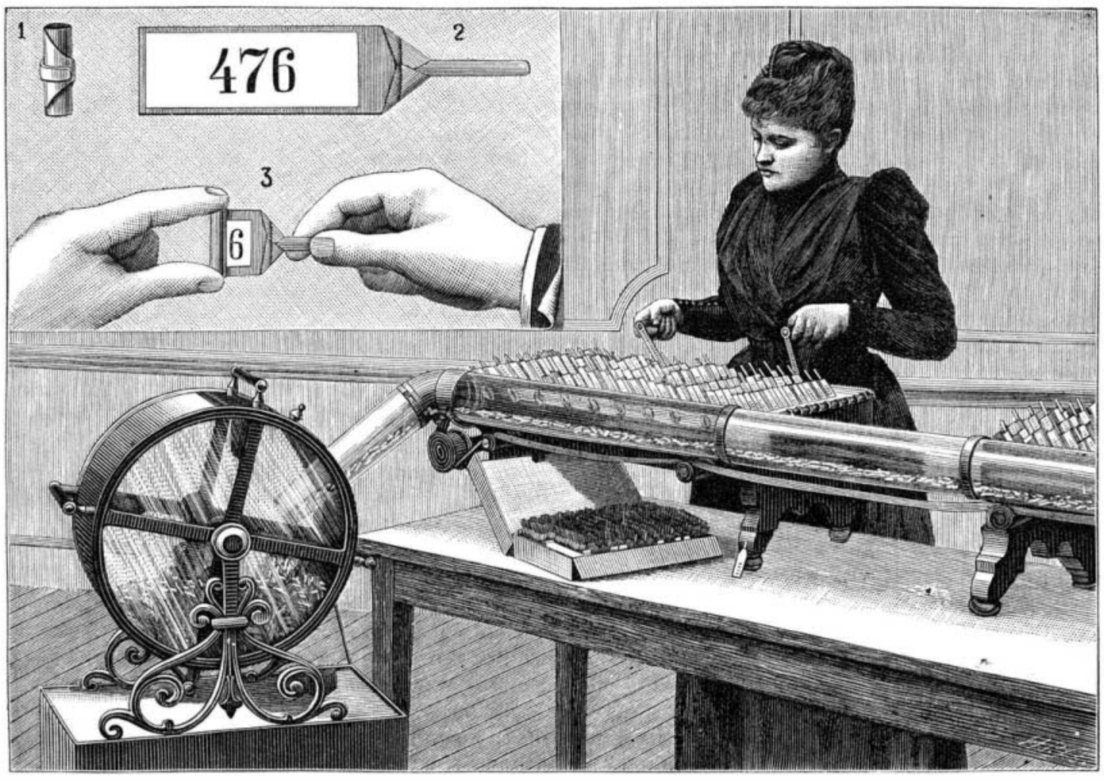


Fig. 1.—PUTTING THE NUMBERS OF A DRAWING INTO THE WHEEL, BY MEANS OF THE CASANOVA APPARATUS. 1. The number rolled up. 2. The number open. 3. The unrolling of the number.

Let us dwell in detail upon this wheel that we have just alluded to. It may be seen to the left of Fig. 1. It is about twenty-four inches in diameter. The two ends of it are of plate glass, that allow the numbers that it contains to be seen. The periphery of the wheel is of copper. Four handles permit of maneuvering it and of making it revolve in order to mix up the numbers, the dispersion of which is still further hastened by metal fans arranged within for this purpose.

The aperture that serves for the introduction of the numbers, and that will permit later on of taking them out at the epoch of the annual drawings, is, of course, carefully sealed after the numbers have been inserted and every time the effective numbers have been removed. The wheel is provided with two, or even three, locks, several keys to which are placed in the custody of those appointed to preside at the drawing.

Before everything else, then, it will be this wheel that it will be necessary to look after with the strictest attention. In the first place, not a number more, not a number less, between its glass ends. One more, that is difficult; one less, that has been seen. However this may be, absolute exactitude in the method of filling the wheel is necessary before all else. That is not all yet. Other misfortunes may happen. For example, at the time of a drawing, a delicate hand has been seen to enter the wheel, and draw two numbers therefrom. Two, be it understood, instead of one. The two unfortunate numbers, one of which might have been the winner, had got stuck together through their roughness, and were taken out as one. Which is to be put back into the wheel? Which shall be sacrificed when it has been so near the fortune? Solomon himself would have been perplexed—especially had he been the owner of several obligations, or even of but a single one! Along with exactitude in filling the wheel, it will be necessary to see also that the number itself be of intelligent and irreproachable make, and so established that it shall be irremissibly isolated from its neighbor, rolled artistically, with the figure perfectly legible and firmly glued. In a word, in the primitive operation, as well as in the annual operations, it is necessary to avoid every chance of irregularity and complaint.

We can now examine Mr. Casanova's system at our ease. In the first place, as to the number itself: This is admirably gotten up, and in such a way as not to be exposed to various inconveniences, and particularly to the inconvenience of bunching that we mentioned above. It is formed of a very light sheet of brass one and a half inches in length and a little over one-tenth of an inch in width, to which adheres a very light piece of linen carrying the figures, and which terminates in a small brass rod, which later on will be rolled around the sheet. The figures 1, 2, 3 in the corner of Fig. 1 show the number; unrolled completely at 2, and wholly rolled up at 1, as it is in the wheel.

At 3 the operator is unrolling the brass cylinder after its extraction from the wheel.

Now as to fitting the wheel. Let us refer for this to Fig. 1. Let us follow attentively the operations that are to carry the mechanically rolled numbers from the boxes in which they are primarily placed up to the wheel, in passing through the glass cylinder which we see in the foreground. The numbers, wholly open, are classified in advance by fifties, in boxes. As the apparatus consists of absolutely identical machines, each serving to put one hundred numbers in the wheel, we shall examine but one of them.

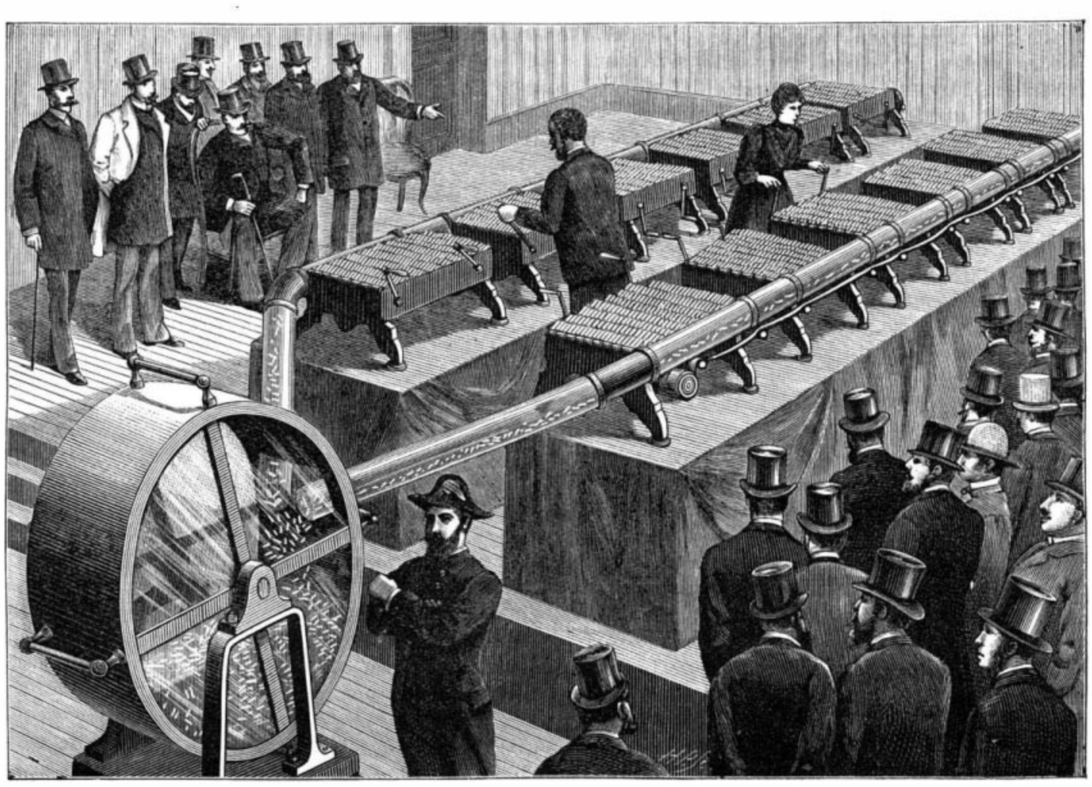


Fig. 2.—GENERAL VIEW OF THE PUTTING OF THE NUMBERS OF A DRAWING INTO THE WHEEL BY MEANS OF TWELVE CASANOVA APPARATUS OPERATING SIMULTANEOUSLY.

The operator, who has within reach the box of numbers to be put into the wheel, stands in front of a rectangular box, divided into ten equal parts by ten steel rods split lengthwise, and equidistant from each other.

In the longitudinal slit in the rods, the operator fixes the metallic numbers, ten to a rod—say a hundred numbers to ten rods. Fig. 1 represents the phase of the operation in which these hundred numbers are thus stuck in the slit in the rods, the brass tail of the number being upward.

So much for the placing of the tickets. At this moment, an examiner sees to it that these hundred tickets are complete in their place, that not a single one of them is missing, and that they belong to the same hundred series. He can read them, or ask the operator to point out to him or even to deliver to him any number of the hundred. Briefly, the minutest verification is at his disposal, and no chance exists of seeing a number doubled or absent or blank.

Second operation: the rolling of the numbers. As each of the ten rods that carry the numbers is movable around its axis, it is capable, through a winch within reach of the operator, of making as many re-