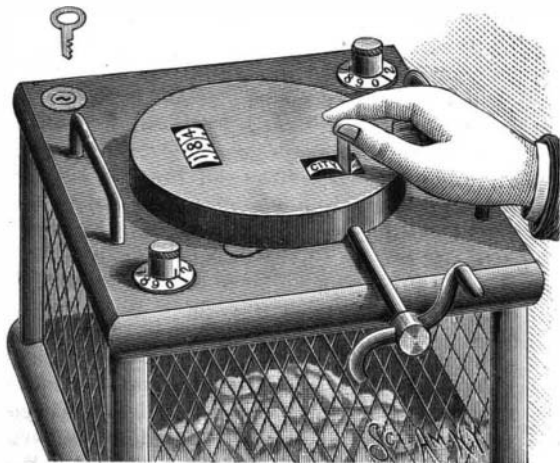


THE NEW JERSEY BALLOT BOX.

We illustrate the new style of ballot box used in the late election in the State of New Jersey. It was ordered to be used by State enactment. The bill which bore the serial number 317 was introduced into the lower house on March 17 of the present year. It passed the house March 29, and on April 6 passed the senate. So far nearly \$20,000 have been expended by the State upon the boxes. From all accounts their use does not seem to have been an unmixed blessing.

The box is of general cubical shape, with glass sides,



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protected by wire netting. Its top is secured in place by three locks. One of these opens with a key which is held by one of the inspectors. The other two locks are keyless combination locks. Each of the other inspectors locks one of these, using a private combination known only to himself. Thus the box cannot be opened except by concurrent action of all three.

About the center of the cover is the aperture for introduction of the ballot. This is a small opening filled up by portions of two tangential rollers or wheels. To introduce a ballot it has to be thrust endways between the two rollers. Then on turning a handle it is drawn down, and the voter can see it fall into the box beneath. In effecting this rotation, an inscription is printed upon the ballot. The desired word, the name of the county, for instance, is carried in raised characters by one of the wheels that draw the ballots down. As the wheel rotates and feeds the ballot into the box, it also impresses upon it the inscription.

By this rotation, registering machinery is put in operation that registers one for every ballot introduced. At the same time a bell is rung, thus notifying all within hearing that a ballot has been received. This multiplication of precautions is designed to prevent fraud. Thus every ballot had to show printed upon it the inscription upon the feeding wheel. This prevented the mixture of additional ballots. The total number introduced were recorded by the counting mechanism. This number was supposed to tally with the total number in the box. No ballot could be introduced surreptitiously, as the bell was arranged so as to ring for each rotation of the feeding wheel.

In practice, however, the box was found somewhat deficient. The men who had to manipulate it did not always possess the due degree of intelligence, and sometimes a deadlock was threatened. The ballot box company supplied instructors to teach the proper manipulation at three dollars per day. In some instances, it is said, the boxes were fully locked and the combinations were forgotten. In other cases the inspectors could not cope with the combination locks, and the keys alone were used. Sometimes the ballots proved too long to pass into the box at one revolution of the feeding wheel. This left two courses open to the inspectors. One was to leave the ballot between the rollers, and only to introduce it with the next one. This, of course, was objectionable. The other course was to turn the handle until it dropped into the box. This gave a double registry on the counter and two rings of the bell for one ballot.

All these troubles indicate that the box is far from being a perfect success. But it serves to indicate an advance, and certainly presents some excellent features. It would certainly seem that, with all its deficiencies, it would tend to secure the ballots from alteration or disturbance, and would operate to a considerable extent to procure a more perfect protection against fraud. All that can be said of it is that perfection has not yet been attained.

THE *Reno Journal* says that the practice of smoking opium is becoming almost as prevalent among the Pacific coast Indians as among the Chinese from whom they have learned it.

OTTO VON GUERICKE'S VACUUM GUN.

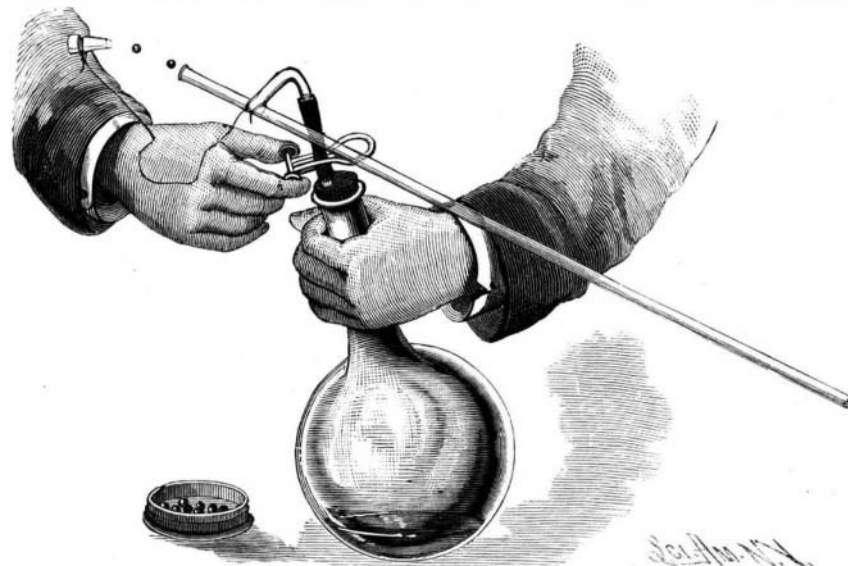
T. O'CONNOR SLOANE, PH.D.

The ingenious old burgomaster of Magdeburg is renowned as the inventor of the air pump and as the originator of many experiments in natural philosophy. In his curious book on the Magdeburg experiments, a work published in the latter half of the seventeenth

century, the experiment is illustrated, of which the one we here describe is a simplification. In many of his experiments on the pressure of the air and the effects of vacua, he first produced by the air pump a vacuum in a spherical vessel, and used the vacuum thus obtained for some operations conducted without or away from the air pump. In one instance he connected his exhausted sphere to the base of a cylinder which a piston tightly fitted. On opening communication between the two, the piston was held down by atmospheric pressure so as to resist the efforts of a very great number of men, who are depicted in one of the quaint wood cuts as attempting to pull it up. For his gun he adopted the same system. As he shows the apparatus, it is constructed of metal, with a large spherical vacuum chamber. As illustrated here, it is supposed to be constructed of glass, a round bottom flask maintaining the vacuum.

The experiment illustrates in an interesting manner the laws of momentum of solids and the atmospheric pressure. It is an example of the scientific work of over two hundred years ago. It is described in the same book in which the description of the Magdeburg hemispheres was first given. The version of it here shown is somewhat simplified. By atmospheric pressure, bullets are driven through a tube and out of its

end with high velocity. The tube from which the bullets are projected is about three feet long. It may be made of metal or of glass. It must be of even diameter and have a smooth interior. Near its front end a short piece of tube is connected at right angles to it. This tube may be bent, but such bending is not absolutely necessary. The object of its curvature



OTTO VON GUERICKE'S VACUUM GUN.

will be seen later. The other end of the long tube is slightly reduced in diameter. This should be as slight as possible, provided it is sufficient to prevent a bullet which fits the tube from falling out.

A round bottom flask is provided. It should be of three pints capacity for a tube three feet long by one-quarter inch diameter. A tightly fitting cork with a short piece of glass tube of the same size as the piece projecting from the longer one is adapted to the flask. A rubber connecting tube with pinch cock, a plug of wood fitting the end of the projecting tube, and some bullets, complete the apparatus. The plug should be secured by a short cord, to prevent its loss when the bullets are discharged. It must fit air tight, yet be easily expelled. This result is best secured by giving it a conical shape or by inclining the sides considerably. The bullets should fit the tube so as to run up and down it freely, yet should not have much windage.

To perform the experiment, a vacuum is first produced in the flask. To do this a little water is introduced, the cork is put in place in its neck, the rubber connecting tube is slipped over the tube passing through the cork, and the pinch cock is removed or wedged open. The water is now heated until it boils. After a few minutes' ebullition, steam will issue from the rubber tube. When this has continued so long that it seems certain that all the air is expelled—five minutes should be enough—the pinch cock is put in place and tightly closed, and at the same instant the flask is removed from the source of heat. It is allowed to cool. The cooling may be accelerated by pouring cold water over it, or by dipping it into the same. It is now connected to the long tube as shown. If the projecting tube to which the rubber one is joined were straight, there would be danger that the bullets would drop into it or even into the flask. It is therefore better to have it curved.

Two or three bullets are now introduced and allowed to roll down to the lower end of the projection tube, whence they are prevented from escaping by the slight contraction already spoken of. The plug is put into the other end, and all is ready. The tube is pointed in such a direction that the escaping bullets will do no harm, and the pinch cock is suddenly opened to its full extent.

The air at once rushes into the flask from the lower end of the tube, driving along with its current the bullets. With a pressure of nearly fifteen pounds to the square inch to actuate it, the air enters the flask with high velocity. The bullets go along with the current as far as the communicating tube that leads into the flask, and then, owing to their high momentum, rush past the opening, strike the end of the plug, expelling it from its place, and fly out of the tube. This is all done in an instant, of course. The bullets pass through the tube and are driven out with such velocity that the eye cannot follow their course. They can be projected thus to a great distance. They may even possess sufficient energy to pierce pasteboard.

A simpler way of illustrating the experiment is to use the long tube with bullets and plug alone, the mouth and lungs producing the suction. By placing one or two bullets in the

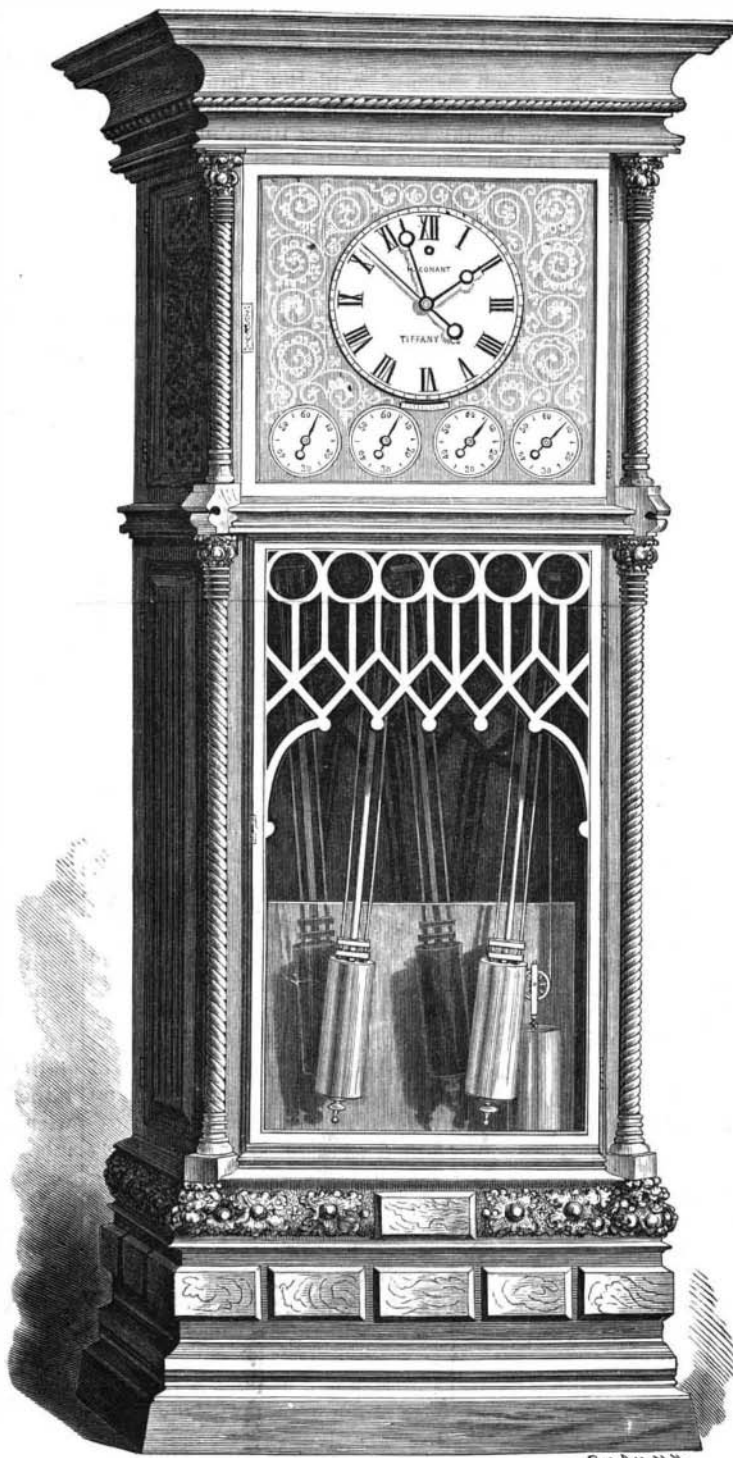


Fig. 1.—CONANT'S ISOCHRONAL CLOCK.