BREECH-LOADING FIREARMS.

We herewith publish the second of a series of three classes of breech-loaders, the illustrations of which are selected from Mr. E. H. Knight's "American Mechanical Dictionary." The arms shown were recommended by the U. S. army commission in 1873.

In the engravings, R, is the Springfield arm, having a breech block hinged to the upper edge of the barrel and swinging upward and forward. The indorsement of the board as the best, all things considered, entitles it to an honorable place in the series of examples. R is a side view of the gun, with the breech block, *d*, thrown up; *a* is the bottom of the receiver, *c* the breech pin, with its circular recess to receive the cam latch, *f*, which locks the breech block in place; *g* is the cam latch spring, *h* is the firing pin, which transmits the blow of the hammer to the priming of the cartridge, and is pressed back by a spiral spring after the delivery of the blow; *j* is the cartridge shell ejector, *k* its spring; *l* an incline which tips up the ejected shell so as to throw it out of the receiver. R¹ is a top view of the gun with block closed. R² is a section with the breech block closed. The dotted lines show the block raised.

The breech block is raised upward and forward in the act of opening by a thumb piece, *m*, which releases it by turning up the cam latch out of its recess in the breech pin. When fully open, it discloses the chamber, or rear end of the barrel, ready for the insertion of the charge contained in a copper cartridge case, holding seventy grains of musket powder, and firing a bullet $\frac{45}{100}$ of an inch in diameter and weighing about 400 grains. When the breech block is closed, it is held down and braced against the effort of the heaviest charges by the cam latch, which flies into place in closing. The piece is fired by the ordinary side lock taken from the old muzzle-loaders. In opening the piece after firing, the breech block strikes the lump on top of the extractor, and revolves it so as to carry the now empty cartridge shell to the rear. After passing a certain point, the spiral spring in front of the extractor is released, and accelerates its motion, so that the cartridge is thrown sharply against the beveled surface of the ejector stud, by which it is deflected upward and expelled from the gun.

S S′ are two views of the Elliot carbine recommended by the same board for trial in the field, as exhibiting "remarkable facility of manipulation in requiring but one hand to work it." This arm has a breech block hinged to the breech pin and operated by the hammer. Fig. S shows the gun in loading position and S′ in the position "ready to fire." After firing, the hammer, *d*, is pulled back to the position shown in S, and in so doing draws by the yoke, *b*, upon the breech block, *a*, to which it is pivoted at *c*. This pulls down the front end of the breech block, exposing the rear of the barrel for the insertion of the cartridge. Having done this work, the pin, *e*, of the yoke slips out of the socket, *f*, into the lower portion of the groove, while the lower branch of the yoke engages over the pin, *g*, so that, when the hammer is again pulled back, the breech block is pushed up again into the position shown at S′, where the hammer is on full cock and the arm ready to fire; *h* is a strap which works the retractor, so that the shell is ejected as the breech block is pulled down. S shows the cartridge ejector pulled out; S″ shows it in its bed. One pull on the hammer depresses the breech block and ejects the empty shell; another pull closes the breech block and puts the hammer in position for firing; a pull on the trigger fires the arm.

T T′ are two positions of the Ward-Burton gun, which is on the bolt principle, like the Prussian needle gun and the French Chassepot. This gun, in its magazine form, was also recommended "for farther trial in the field." This gun, having been fired, is opened by raising the handle, *a*, of the bolt and withdrawing it directly rearward; the position is shown in Fig. T′ in the engraving. As the cartridge shell is pulled out by the spring hook on the upper edge of its flanged rim, the pin which rests against its lower portion comes in contact with the front end of the trigger pin, which tips it up and throws it out of the receiver. Another cartridge is then introduced by hand or by automatic devices from the magazine, and pushed into the bore of the gun by the longitudinal forward motion of the bolt. Near the head of the bolt is seen a part of the sectional screw which engages with a corresponding section within the gun when the piece is closed, and the handle turned down into place, so as to support the bolt against the force of the discharge. The firing pin is an axial spring pin released from the bolt by a downward pull by means of the trigger and lever. Fig. T is the position "ready to fire," the driving spring being condensed and ready to act. Fig. T shows the bolt withdrawn and the cartridge tumbling out. When the bolt is withdrawn, the sleeve of the firing pin is so far retracted that a shoulder catches behind the trigger. When the bolt is pushed home, driving the cartridge into the barrel, it leaves the shoulder of the firing pin resting against the trigger, as shown in Fig T

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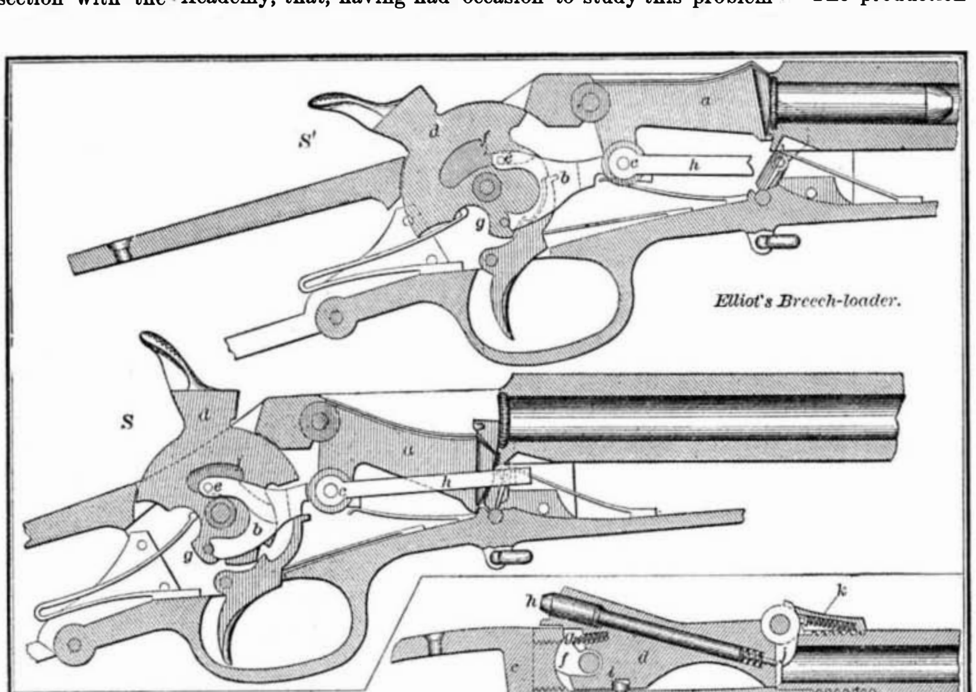

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Astronomical Photography.

The facility and precision with which photography represents luminous phenomena in their miuute details renders this application of optics more and more important in the sciences of observation, and especially astronomy. But photography could not take a regular place in observatories unless the photographic apparatus had the same simplicity and theoretical perfection as the instruments used for current observations. M. Cornu states, in a note to the Paris Academy, that, having had occasion to study this problem in connection with the transit observations, and later at the request of the Council of the Paris Observatory, he has found a solution of it as complete as possible. The negatives he had to lay before the Academy would, he trusted, justify this opinion.

It is the peculiarity of this method that it does not require any special instrument, any telescope, and may at once be adopted for photographical observations by means of a purely mechanical arrangement, which does not at all affect the optical qualities of the instrument; the two lenses which compose the objective have merely to be separated to an extent depending on the nature of the glasses, but rarely exceeding 1½ per cent of the focal distance. This operation shortens this distance about 6 to 8 per cent. Theory and experience prove that the original achromatism of the visible rays is transformed into achromatism of the chemical rays, which is necessary to the perfection of photographic images. Direct and precise measurement has shown that this slight separation of the glasses does not cause any aberration in the images.

This method has succeeded perfectly at the Paris Observatory with the large equatorial of the eastern tower, the objective of which is 14·934 inches in aperture, and 29·13 feet in focal distance. By a very simple arrangement the glasses can be separated, and the instrument may be employed for optical as well as for photographic observations. The photographic adjustment does not present any inconvenience in observation of faint stars. M. Cornu states that he easily observed Uranus, and at least one of his satellites, without finding it necessary to re-establish optical achromatism.

At the principal focus of this instrument are obtained direct photographic images of the sun and of the moon, measuring nearly 3·42 inches in diameter: images which might be easily magnified by means of the eyepiece so as to give negatives of more than 39 inches in diameter. The images thus enlarged gain, perhaps, in artistic effect, but they lose in distinctness.

Alcoholic Solution of Shellac.

The production of a clear alcoholic solution of shellac has been the subject of numerous experiments, but hitherto none has turned out satisfactory except slow filtration. As is known, by digestion of one part of shellac with six or seven parts of 70 per cent alcohol, a solution is obtained which, when warm, is almost clear, but upon cooling becomes turbid, and is only partially clear after standing a week. The plan of pouring sufficient alcohol over coarsely powdered shellac to form a thin paste, yields, upon the addition of more alcohol after the lapse of eight or ten hours, a liquor that does not deposit any more, but which is not clear. Another method suggested, of boiling the alcoholic shellac solution with animal charcoal, gives a clearer liquid, but there is always loss through absorption by the animal charcoal.

The object sought by the author was to obtain a clear alcoholic solution in a short time without much loss. Previous communications upon the substance occurring in shellac to the extent of five per cent, which renders its alcoholic solutions turbid, and is described by some authors as wax, and by others as a fat acid, suggested an attempt to effect its removal before dissolving the shellac. The shellac, therefore, was boiled with water, from one to five per cent of soda or ammonia being added, but without satisfactory result; a somewhat larger addition of the alkali caused the solution of the shellac. The author next prepared a solution with one part of shellac and six parts of 90 per cent alcohol at the ordinary temperature, which was effected with frequent shaking in ten or twelve hours. To this he added carbonate of magnesia to about half the weight of the shellac used, and heated the mixture to 140° Fah. The solution so obtained cleared more rapidly than a solution to which magnesia had not been added, and filtered in less time; but it did not supply what was sought. When powdered chalk was substituted for magnesia, the solution, after standing some hours, became three fourths clear, while the lower turbid portion could be rapidly filtered. It only required a little alcohol to wash the filter, and a clear alcoholic solution of shellac was obtained. Further experiments, for instance with sulphate of baryta, did not give a better result. When such a solution is made on a large scale it would be best filtered through felt.

Notwithstanding that the object of the author had thus been attained, one or two other experiments were tried. To three parts of the above mentioned shellac solution one part of petroleum ether was added, and the mixture was vigorously shaken. After standing a few moments the liquid separated in two layers; the upper light colored layer was the petroleum ether with the wax dissolved in it, the lower yellow brown layer was a clear solution of shellac with only a little petroleum ether adhering. Upon allowing the petroleum ether to evaporate spontaneously, the wax that had been dissolved out of the shellac was obtained as a white residuum. By using alcohol at 95 per cent to dissolve the shellac, and then adding petroleum ether, a perfectly clear solution was obtained that only separated into two layers after water was added. Consequently an alcohol weaker than 90 per cent should be used.

The shellac solution obtained by means of petroleum ether, however, has the advantage that the shellac is left, after evaporation, in a coarser form, and easily separates; this may be obviated by adding one to three per cent of Venice turpentine.—*A. Peltz, in Pharmaceutische Zeitschrift für Russland.*