to the lower end of a lever; through the upper end of each lever is an adjustable set screw that bears against a bar which has the same taper that the cutter shank is to have. The upper end of the levers are connected by a spring to insure a constant bearing of the set screws on the taper bar, so that, as the taper bar is moved automatically, the cutters will be uniformly opened while cutting the taper. Opposite the form tool on the slide rest is a special tool post, pivoted in its center and operated by a lever, so that two form cutters and one cutting-off tool can be used. On this machine from sixty to eighty shank cutter blanks are made in eight hours.

When set up for any cutter, a year's supply of the blanks is made direct from 10-foot bars of round steel. The operation of setting up for any cutter is very simple. After leaving this machine, the operations are centering, cutting the teeth, tempering and grinding. This system has materially reduced the cost of all shank cutters, of which an unusual variety are rendered necessary by the irregular cuts required on some of the components, notably the receiver.

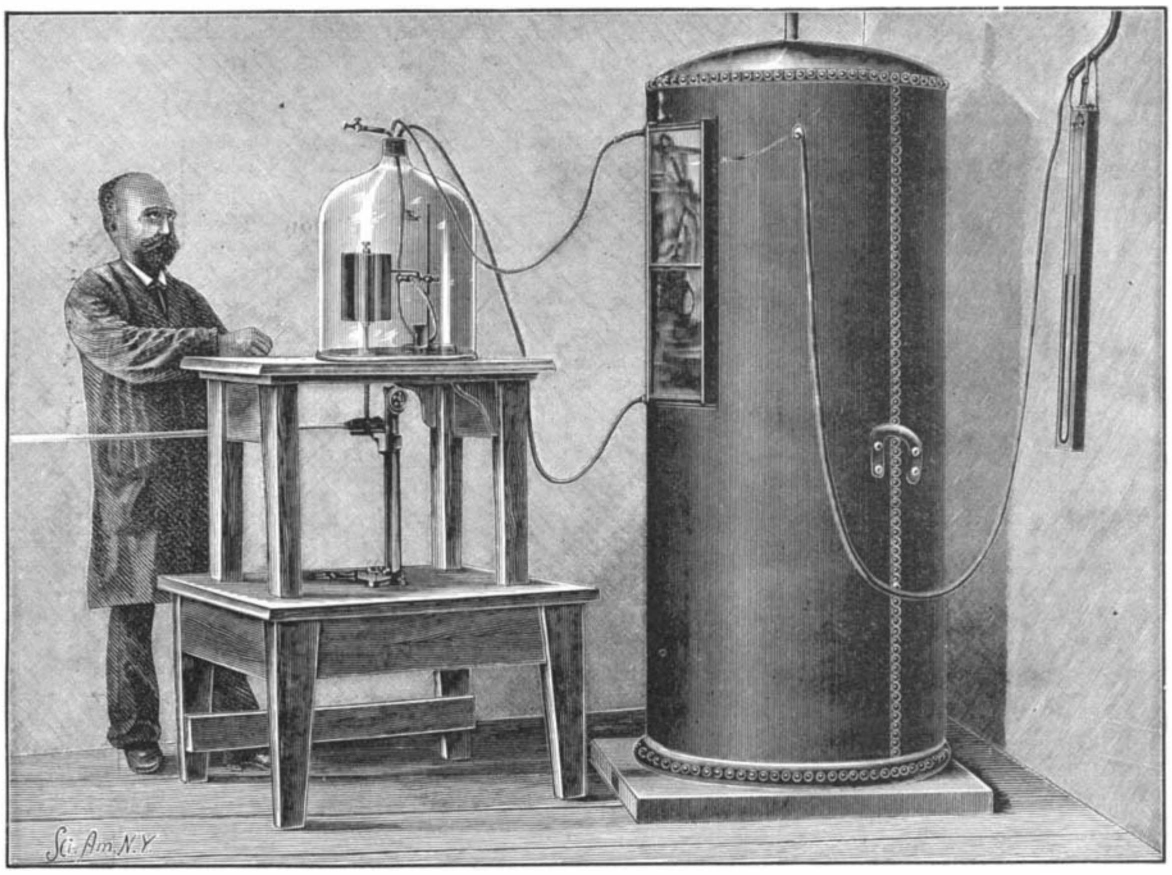

Fig. 1.—PNEUMATIC CHAMBER AND OTHER APPARATUS USED IN REGISTERING THE PULSATIONS OF THE BRAIN IN RAREFIED AIR.

CASE-HARDENING AND TEMPERING. — Most of the working parts, such as the receiver, bolt, gate, side plate, sleeve, and cocking mechanism are case-hardened. They are packed in powdered burnt bone in cast iron boxes, and heated to a cherry red and then plunged into a bath of lard oil. It should be noted that in this operation a little cyanide of potassium is placed on the first locking joint of the bolt to give it special hardness. The lug receives the full shock of the recoil, and if it is not hardened it is liable to upset. This actually happened in the case of some of the Spanish Mausers, and by allowing the cartridge to project slightly beyond the breech, the upsetting resulted in the rupture of the walls of the cartridge shell where it projected beyond the breech. The extractor, firing pin, and striker and all small springs are tempered by heating to a cherry red, cooling in oil, and drawing to a spring temper.

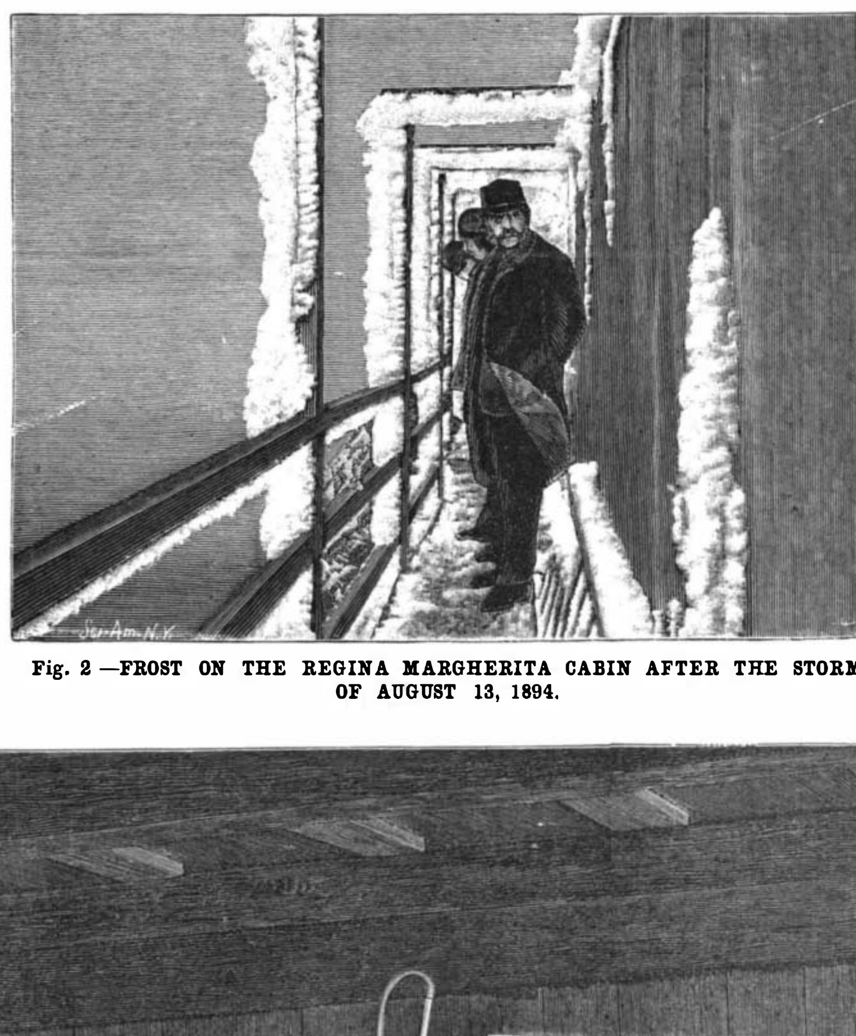

Fig. 2.—FROST ON THE REGINA MARGHERITA CABIN AFTER THE STORM OF AUGUST 13, 1894.

BROWNING THE BARRELS.—The process of browning the barrels involves several distinct operations. After the bore has been oiled and carefully plugged at each end the barrel is boiled for 10 minutes in lime water. The lime is then brushed off, and a coat of browning material applied with a sponge, after which the barrels are put for 5 minutes in a cabinet, in which the temperature ranges from 80° damp to 90° dry. The barrels are allowed to cool in the cabinet and are then boiled again, this time for from 5 to 7 minutes. They are then put on a revolving wire brush. A second browning coat is applied and the barrels are again placed in the cabinet, where they are exposed for 4 hours to a temperature of from 80° to 70°. This is followed by a third and fourth coat which are repetitions of the second coat.

MAKING THE STOCK.—The stock is turned out of the best selected walnut, which is delivered at the armory sawn to the rough shape shown in Fig. 9. It is first rough-turned in a machine which carries a cast iron former, of the shape to which the piece is to be roughed down. The rotary cutters and the tracing wheel are carried on a swinging lever, the cutters being driven by a belt. The next operation is to slot out the stock for the insertion of the receiver preparatory to cutting out the longitudinal bed for the barrel, Fig. 10. The bedding is done in the machine shown in Fig. 3, which is provided with six vertical cutters, and two horizontal cutters. Each cutter is provided with its own former, so that the finished stock is certain to receive the barrel and receiver with a snug fit when they are clamped together. In the illustration the machine is shown cutting out the half-round groove for the barrel. The operator guides the cutter 7 to form the proper taper to match the barrel with his right hand, while he traverses the barrel by means of the crank handle shown in his left hand.

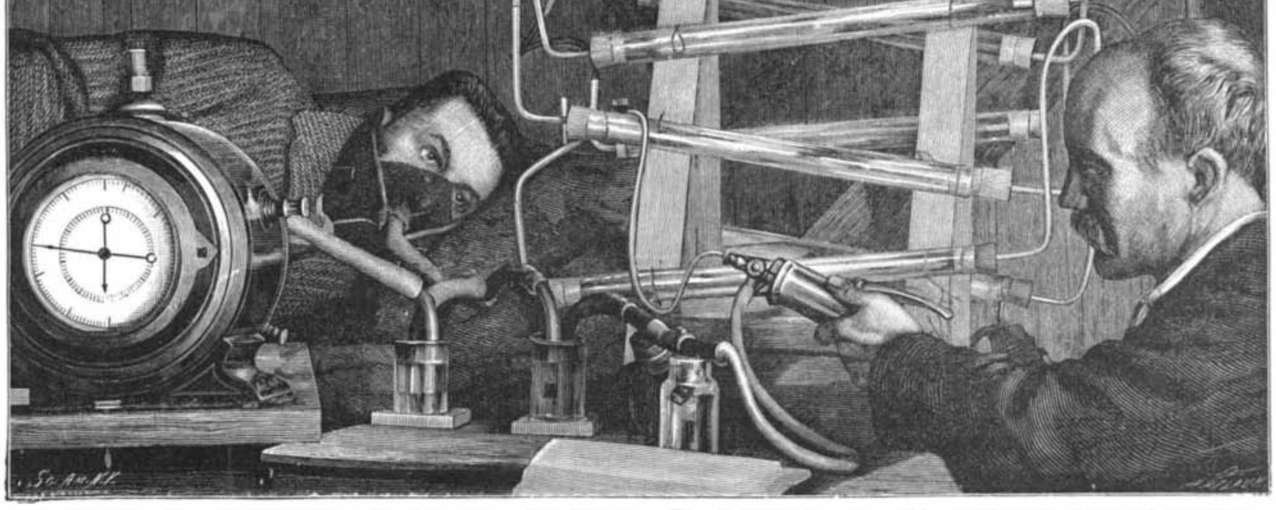

Fig. 3.—APPARATUS FOR MEASURING THE VOLUME OF AIR INHALED AND THE CARBONIC ACID EXHALED.

FINAL INSPECTION AND TEST. — After the various parts have been assembled into the finished rifle a final and very careful inspection is made by special experts. The bore is examined by means of the little mirror, Fig. 8, which is slipped into the receiver at the base of the barrel and presents a clear image of the bore as shown in the illustration. As we have stated, every barrel has already undergone a test of 70,000 pounds to the square inch in the chamber, and to determine the ultimate strength of the guns, ten or more rifles out of every lot made from a certain delivery of steel are tested up to 100,000 pounds to the square inch. This is two and a half times greater than the service pressure. Illustration Fig. 1 shows one of the very few rifles that have failed to stand this supreme test, and in this case the examination revealed a slight flaw in the stock.

THE KRAG-JORGENSEN IN THE WAR.—At the conclusion of the Spanish-American war, when the army was gathered at Camp Wyckoff, a special board of ordnance officers was ordered to assemble at the camp and gather statistics as to the behavior of our rifles, field artillery, etc. Every officer at the camp was requested to report any case of failure in guns or ammunition. It speaks volumes for the excellent workmanship put into our new rifle that not a single case of failure or even of miss-fire was reported.

THE PHYSIOLOGY OF MAN ON THE ALPS.

A short time ago a most interesting book on the Physiology of Man on the Alps ("Fisiologia dell' uomo sulle Alpi) appeared simultaneously in Milan, Paris and Leipsic, where it was published in Italian, French and German respectively, and it has now been translated into English. The author, Prof. Angelo Mosso, had already given much study to the subject, but was desirous of testing certain theories in regard to Alpine physiology which would require a residence of several weeks on the summit of Monte Rosa, and therefore, feeling sure that he could never accomplish his end with the assistance of only his guides and porters, he applied to the Minister of War for a detachment of ten soldiers under the command of a military physician, to stay with him on the mountain as long as might be necessary. His request was granted, and he went to

Ivrea, where several soldiers of the Alpine regiment volunteered to accompany him, and they proved a most efficient aid. After completing his arrangements, his first month, from June 19 to July 11, 1894, was passed in a preliminary study of his men for the purpose of becoming well acquainted with their physical condition. He divided them into two companies, one containing the most robust men and the other those of average strength; one division ascended the mountain slowly with Prof. Mosso, traveling at the rate of about 3,700 feet per week, while the other division took only three days to make the entire journey to the top of Monte Rosa, where they found the first section of the expedition established in the Regina Margherita cabin, 14,952 feet above the level of the sea. In this way Prof. Mosso ascertained the effect on the human organism of a sudden and of a gradual change from the atmosphere of a low level to that of a high mountain—from the atmosphere in which men ordinarily live, to air that is very much rarefied.

In all his investigations Prof. Mosso took every precaution to avoid the mistake common to all scientists who had previously made a study of mountain sickness and kindred phenomena; that is, the failure to distinguish between the effects of fatigue and cold and those of barometric depression. He even invented instruments to assist him in his investigations, one of which was the ergograph, with which he measured and registered the contractions of the muscles, in order to ascertain the amount of mechanical work done by them and its connection with the weakness experienced at great altitudes. The results of his experiments seem to show that after a person has become acclimated and rested, his muscles are capable of performing quite as much work at an altitude of 14,960 feet as at a lower level, but that the nerve centers do not perform their part as well, causing difficulty in breathing, palpitation of the heart, etc., so that the functions of the muscles are seriously interfered with, although the barometric depression does not act directly on the muscles themselves. The Professor admits, however, that a certain poison is produced in the muscles by fatigue, which acts on the cardiac and respiratory centers, but he maintains that difficulty in breathing and palpitations are not due to contractions of the muscles. On account of the very complex nature of the closely related phenomena affecting the different organs, it is often extremely difficult to distinguish the cause from the effect.

It has often been stated that respiration was more frequent and deeper on the mountains, but Prof. Mosso proves the incorrectness of this theory, asserting that the experiments on which it is based must have been made on persons who were fatigued, not in a state of rest, so that it was impossible to determine the effect of the rarefied air alone. It has also been stated that the lungs did not take in the normal quantity of air, nor did they throw off the necessary amount of carbonic acid; and knowing that a candle burns with less light on the summit of Monte Rosa, Prof. Mosso and his brother determined to ascertain whether the flame of life was also less intense than at a lower level, but they found that there is very little difference in the quantity of air inhaled or of carbonic acid exhaled at a great height and at a much lower level; that is, if a person is in a state of repose. The instruments used in this experiment are shown in Fig. 3. The meter, seen at the left of the engraving, is similar to those used in houses for measuring illuminating gas, but is more sensitive and exact, being arranged to indicate the hundredth part of a liter. Prof. Mosso may have been the first to use such a meter in the study of the respiration of human beings, but the gutta percha mask shown in connection with it has been used for more than twenty years. Nevertheless, the Professor has found it more convenient than other means which have sometimes been substituted for it, and he, therefore, carried six such masks up Monte Rosa. As a rule, a mask must be provided for each individual, but in some cases, where faces are similar in shape, the same mask will serve for two or three persons. The mask is hermetically sealed to the face by cement which is applied along the edges of the mask. The person to be experimented upon lies down, his head being slightly raised on a rubber cushion. The tube which is connected with the mask is bifurcated, and the two branches lead to separate valves. The air inhaled passes into the meter, and then through the first valve, to the lungs; the air exhaled passes through the second valve, and if the quantity of carbonic acid is to be tested before leaving the apparatus, it passes to an elastic rubber bag, and then to a third valve. By means of a hand pump connected with the rubber bag a given quantity of the exhaled air is thrown through six glass tubes filled with aqueous solution of barium hydrate for fixing the carbonic acid, which was found by Prof. Mosso's brother to be about the same in quantity whether measured at a great height or on a lower level. It will, of course, be understood that the part of the apparatus last described will not be required in simply measuring the quantity of air inhaled. These experiments seem to show that the body is not an economic machine that adapts itself to circumstances; the chemical processes cannot be modified, and even in a rarefied atmosphere the organism demands the normal ration of oxygen. Dr. Loevy and Herr Zuntz found that the consumption of oxygen, when the muscles were at work, was greater on Monte Rosa than at Berlin, and also that the Alpine climate tended to cause a change in the substance of which the human organism is composed, but failed to find any effect that seemed to indicate a lack of oxygen, and therefore concluded that it is not lack of oxygen that incapacitates man for work at high altitudes. In rising to great heights a bird will, perhaps, use more muscular force, in proportion to its size, than any other animal would be capable of exerting even at sea-level, and yet birds require less oxygen than other living creatures.

Having satisfied himself that the disturbances in the performance of the functions of the organs of respiration and of the heart were due to chemical derangement of the nerve centers, Prof. Mosso undertook to show that the somnolence, hemorrhages, etc., often experienced by mountain climbers, were attributable to the same cause, for he could not accept the theories that they were caused by a disturbance of the circulation of the blood in the brain—either cerebral congestion or anemia, due to the atmospheric depression. For this purpose he was desirous of securing the presence on Monte Rosa of some one whose skull had been fractured, but was unable to do so, and therefore had to content himself with experiments made in a pneumatic chamber, like that shown in Fig. 1, which consists of a cylinder made as boilers are constructed, but with one end rounded and the other end open. The lower open end is provided with a heavy iron ring, over which is placed a rubber ring that rests on a slab of marble, thus closing the cylinders hermetically. The cylinder is large enough to allow a man to stand comfortably in it, having a capacity of about 36 cubic feet, and the interior is lighted by a window of very thick glass. The cylinder is counterbalanced so that it can be easily raised and lowered by means of the handles provided on the sides. Instead of an ordinary pneumatic pump, Prof. Mosso used a pump driven by a gas motor. While the air in the cylinder was being rarefied, it was being constantly renewed by the admission of a current of fresh air through a valve, which is not shown, in larger quantities than a man can use; but this did not interfere with the rarefaction, although the inflow was constant, because the quantity of air exhausted by the pump was greater than the quantity admitted. The pressure was registered by two manometers, one on the inside and the other on the outside of the cylinder. When necessary the air was cooled by being passed over a coil of pipe containing a cooling mixture.

In one of his experiments a boy who had a pulsating scar where his skull had been broken by a fall, was placed in the cylinder with a little cap of gutta percha over the wound. The edges of the cap were hermetically sealed by means of vaseline, and the pulsations of the brain were transmitted by means of air, through a rubber tube attached to the gutta percha cap, to a recording tympanum or diaphragm in a recording apparatus outside of the pneumatic chamber, shown at the left of the engraving. This latter apparatus consisted of a glass bell having a capacity of about two cubic feet, the edges of which were polished and hermetically sealed on the marble slab, on which it stood, by a little grease. Inside the bell there was a recording cylinder, the shaft of which was revolved from outside of the bell, the lower end of the shaft being provided with a grooved pulley carrying a cord that also passed over a similar pulley on the shaft of a clockwork, from which motion is transmitted to the cylinder. Where the shaft passes into the bell the latter is hermetically sealed by a metal tube lined with oakum coated with grease. By this arrangement, the recording apparatus can be controlled without the knowledge of the person in the pneumatic chamber. As the pneumatic chamber and the bell are connected by a rubber tube, the air is the same in both. The other rubber tube shown is the one which carries the pulsations of the brain to the recording apparatus. A water valve placed inside of the bell in connection with this tube permits the air in the cap and over the brain to expand gradually as the barometric pressure decreases. In this manner Prof. Mosso could follow the cerebral pulsations without entering the chamber, where his presence would have interfered seriously with the result of the experiment on account of the change in the air produced by the breath of two persons. As it was, the experiment was a success and proved that the vaso-motor center of the brain, as well as the respiratory and cardiac centers, is less active in rarefied air, again proving that disturbances caused by rarefaction of the air are not of a mechanical nature.

Prof. Mosso also used this pneumatic chamber in experimenting with artificial air—air which had been diluted by the addition of an unusual quantity of nitrogen—and found that when inhaled it produced the same effects as natural barometric depression, thus proving by still another method that it is not the mechanical action or diminution of the weight of the atmosphere that produces mountain sickness, but its rarefaction, which causes a change in the tissue of the nervous system. During these experiments he noted the same acceleration in the movement of the heart and the same change in the movements of the organs of respiration that he had so often noticed on Monte Rosa.

The conclusion drawn from all this investigation and study is that the characteristic changes observed in the sensitiveness, the intelligence, and the manner in which the physical organs perform their functions when people ascend to a great height, whether as aeronauts or as mountain climbers, cannot be explained by the existence of cerebral anemia or congestion. There is a sufficiency of blood in the brain, and, in fact, the circulation is almost normal even at a height of 18,000 feet.

Prof. Mosso's book treats of the effects of cold, wind, sleep, and in fact all that may cause a change in the human organism when so far above the ordinary levels of the earth, and the space he gives to nourishment, fasting, disturbance of the digestion, etc., giving the scientific reasons for following certain hygienic rules, makes it especially useful to Alpinists. It met with such a warm reception from the general public, as well as scientists, that the first edition was exhausted in a month, but the second edition was delayed until last year on account of the author's desire to include the results of further investigations, so that the book as it now appears might almost be considered a new work. Something has been added to each chapter, and there are three entirely new chapters, the last of which is devoted to the stations and the new observatory on Monte Rosa, which latter he compares with the observatory built by France on Mont Blanc at a much greater expense. The Italian observatory will owe its existence to Queen Margherita, of Italy, who, having followed the investigations of Prof. Mosso and others with the greatest interest, and knowing that scientists felt the need of a suitable observatory for the study of the Alps, the heavens, physical phenomena, and life above the line of perpetual snow, took the initiative by contributing 4,000 lire (about $780) toward the new observatory, which will be constructed by enlarging the Regina Margherita Cabin on Point Gnifetti—a height of 14,952 feet—in which Prof. Mosso made many of his experiments described in this book, and which was visited and inaugurated by the Queen on August 18, 1893. Her great love of science has prompted her to consecrate this mountain to the study of nature, and doubtless Prof. Mosso and many others will give to the world much useful and interesting information, the results of investigations which have been rendered possible by her beneficence.

Congress of Journalists.

A congress of journalists was recently held at Rome on the Palatine Hill, amid the ruins of the palace of the Caesars. The tables for the banquet was spread beneath an enormous tent. Antique amphoræ laden with flowers were placed about, and on the tables themselves were urns, antique statuettes, etc. The banquet was carried out under the directions of Signor Baccelli, the Minister of Public Instruction, who has recently done so much for archæology by the excavation of hitherto untouched parts of the Forum. Prince Ruspoli, the Syndic of Rome, in his speech called to mind the fact that journalism originated at Rome in the person of Julius Caesar, who was the first to make public the debates in the Senate by means of the Acta Urbis.

A GREAT manufacturing concern of Dayton, O., has notified its employés that henceforth preference will be given to young applicants for employment who have had a kindergarten training, and after 1915 no applications for employment will be considered unless the applicant has had a kindergarten training. The company has conducted kindergartens for the benefit of children of their employés for a number of years and has observed the results. The educational classes and other enterprises which have been carried on for the benefit of the employés has resulted, in six years, in completely transforming a poor factory suburb into a pretty residence district. If corporations would emulate the Dayton experiment, they would find that in a few years all the money they had invested was returned to them. It does not need a statesman to see that social disorders which are liable to cost so much in the end can be cured at the root by properly educating the less fortunate citizens.

A CURIOUS invention for the protection of bank checks has recently been patented. It consists of a number of disks, so that any combination of numbers may be formed. The characters are heated to branding temperature by means of electricity, and, on being pressed to the surface of a check or similar paper, the amount named thereon is burned by a process which defies the usual methods resorted to by check raisers. Devices are provided so that the work can be done quickly.