COLUMBUS' EGG.

THE accompanying engravings represent an object which is being sold in the London bazars at a very moderate price. It is made of tin, is painted red, and is called "Christopher Columbus' Egg," because those who do not know how it is constructed cannot make it stand up on the projecting part situated at the base. This egg, which it is impossible to open, is hollow, and contains a leaden ball which causes it to fall over on its side, unless it (the ball) is in the longer axis.

The sections in Figs. 2 and 3 explain the construction, and show how the ball is brought into the desired position to cause an equilibrium.

FIG. 1.—COLUMBUS' EGG.

Corresponding to the point where the two halves of the egg are soldered together, there is internally a partition that has the form of a channel of semicircular section which runs around the tube, T. The ball, B, when the egg is held vertically, is capable of revolving around this tube, T, and, as long as it remains in the channel, will cause the egg to fall every time the operator endeavors to make it stand on its base, C. The egg can stand upright only on condition that the ball be made to pass from the upper to the lower compartment, in which case it will take the position, B'', at the base of the egg. This result is reached as follows: The central tube contains, just beneath its upper extremity, an aperture, B', that forms a communication between the two compartments, and that is sufficiently large to allow the ball to pass through. Two small guides start from the side of the egg, and follow the contours of the partition up to the orifice in the central tube. On a line with the orifice, and on the outside of the egg, there is a small and scarcely visible point, o. If the egg be sufficiently inclined toward this latter, as

in Fig. 3, the ball will take the position, B, at the beginning of the guides leading to the orifice, B'. If, at this moment, the egg be gently turned back in the opposite direction, the ball, being kept in the plane formed by the point, o, and the egg's axis, will run along the guides and drop through the orifice into the lower compartment. When the egg is righted, the ball will take the position, B'', at its base, and the egg will then stand upright. By turning the egg upside down, the ball may be made to enter the upper compartment again, and things will then be as before.

With a little practice and skill, it is not even necessary to look for the position of the point, o, and thus run the risk of showing the uninitiated how the trick is done. On giving the egg a slight angular motion, the hand will feel the passage of the ball over the slight projection formed by the guides; the ball will naturally seat itself upon the latter, and the double motion above mentioned will accomplish the desired result. Effected in this way, and the hand being

down, and no earthquake shock has, as yet, done it an injury. We are indebted for our picture to *La Ilustracion Española*.

THE ACTION OF METALS ON ACIDS.

By HENRY E. ARMSTRONG.

OUR knowledge of the nature of alloys is at present very limited. It is supposed that some metals are capable of combining, but that others form mere mixtures when fused together, the alloy being, as it were, "a solidified solution of the one metal in the other." This differentiation is based on the study of physical properties of alloys in comparison with those of the constituent metals. In certain cases—but these are very few in number—the actual composition of the compound may be deduced. Thus, in the case of the tin-copper alloys, abrupt changes in electrical conductivity correspond to compounds of the formula SnCu, and

FIGS. 2 AND 3.—DETAILS OF CONSTRUCTION.

covered with a handkerchief, the mode of operating will not be perceived by the uninitiated spectator.—*La Nature*.

THE PORTUGUESE ROYAL CARRIAGE.

WE give an engraving made directly from a photograph of the celebrated royal carriage of Portugal, which has been carefully preserved, and is now in good running order. It belongs to the precious possessions of the King of Portugal. This carriage was built in the time of the illustrious monarch Don Juan V., who began his reign in the year 1705, and continued to govern with discretion and prudence for forty-five years. The ancient vehicle was constructed in the highest style of both decorative and practical art, being made even stronger than "the wonderful one-hoss shay," which "ran for a hundred years to a day." The Portuguese carriage is more than a hundred and fifty years old, is in fine condition, and is still used in all grand processions of the court. It is so strong in every part that it can't break

SnCu, and the curve of conductivity for the tin-gold alloys also exhibits a striking series of maxima and minima, from which the existence of definite compounds may be inferred. It appeared possible that, by dissolving alloys in a liquid capable of acting on both metals, and determining the electromotive force between the alloy and a less positive metal, evidence of the existence of definite compounds might be obtained if the alloy dissolved as a whole. At Dr. Armstrong's suggestion a number of determinations of this kind have been made by Messrs. Holland Crompton and W. E. Sumpner, students of the Central Institution, but the investigation is as yet far from being completed. They have measured the E.M.F. between the alloys and platinum in nitric acid by means of an electrometer. The general result is that the method is inapplicable, since the alloys do not as a rule behave as wholes. The E.M.F. observed in several cases is very nearly that between the less positive metal of the alloy and platinum, the more positive constituent dissolving independently and giving rise to a local circuit. Thus, in the case of copper-

THE PORTUGUESE ROYAL CARRIAGE.

zinc alloys the E.M.F. is very nearly that of copper as long as the alloy contains not much less than about 5 per cent. of copper; the tin-zinc and tin-copper alloys also have an E.M.F. near to that of the less positive metal until alloys are reached containing but a small proportion of this constituent. In mercury-zinc alloys the more positive metal determines the electromotive force; this apparently is also true of the lead-tin alloys. Slight changes have been observed which, if confirmed by further experiments, are probably significant; thus in the tin-zinc alloys the E.M.F. gradually rises from that of tin as the amount of this metal in the alloy diminishes; it is conceivable that this may be because the zinc acts as a diluent, and separates the more complex tin molecules into simpler more active molecules. On the other hand, the E.M.F. of copper in bronze is slightly lower than that of pure copper, and that of copper in the copper-zinc alloys rich in zinc is also a little lower than that of pure copper; this may be due to the loss of energy in the formation of the alloy.

Dr. Armstrong then pointed out that although the method described was of little value, owing to the irregularity in the behavior of alloys toward a solvent capable of attacking both metals, more was to be hoped from the employment of a solvent capable of acting upon only one, recent experiments by Mr. Laurie having shown that the E.M.F. between zinc-copper alloys and cuprous iodide in a solution of iodine and zinc iodide is about that of zinc until the alloy has the composition CuZn_2 , when the E.M.F. suddenly falls to very nearly that of copper. Sodium and potassium exhibit a much lower E.M.F. when alloyed with mercury, according to Hockin and Taylor, and it is probable that the examination of a graduated series of their amalgams will afford indications of the composition of the compounds formed.

The E.M.F. between a given metal and platinum in nitric acid varies with the concentration of the acid. The following results were obtained with copper:

Acid of rel. den.	Vol.	E.M.F.
1.5	1.5	0.98
3 vols. 1.5 + 1 vol. 1.42	1.42	0.84
1 vol. 1.5 + 1 vol. 1.42	1.42	0.63
1 vol. 1.42	1.42	0.57
1 vol. 1.42 + 1 vol. water	1.42	0.75
1 vol. 1.42 + 3 vols.	1.42	0.81
1 vol. 1.42 + 7 vols.	1.42	0.81

These results appear to be entirely confirmatory of the conclusions already arrived at by Ackworth and Armstrong (*Trans.*, 1877), who found that the reduction of nitric acid was carried further—as indicated by the amount of nitrous oxide and nitrogen produced—when copper is dissolved in highly diluted nitric acid. The high E.M.F. observed on using the most concentrated acid is probably due to the fact that the initial product of reduction, nitrous acid, remains in solution. If the acid be less concentrated, the nitrous acid is more or less broken up:

The considerable rise in E.M.F. as dilution proceeds not improbably arises from the complex molecules of nitric acid being in part resolved into simpler more active molecules. The results also illustrate the importance of supplementing the chemical method of examining complex cases of change, such as are involved in the action of metals on nitric acid by the electrical method. No appreciable action takes place during the time requisite to measure E.M.F., and therefore the solution remains practically unchanged in composition, whereas it is continuously changing during the entire course of a chemical experiment.

Referring to the action of metals generally on acids, Dr. Armstrong pointed out that it is probably impossible for the chemist to pronounce definitely in favor either of the modern view that the metal directly displaces the hydrogen of the acid, or of the older view that the metal displaces the hydrogen from water—the resulting oxide and the acid then interacting to form a salt; the decision of this question must apparently depend upon the determination of the nature of the phenomena during electrolysis of an acid solution. If the acid alone be the electrolyte, then doubtless the modern view is the correct one; but if both water and acid are electrolyzed, and in proportions which vary according to the conditions, then both the old and new view of the nature of the action between a metal and the solution of an acid are correct, and the two kinds of change may go on side by side. The view put forward by Dr. Divers, that silver, copper, and mercury exercise an altogether peculiar action on nitric acid, “decomposing the nitric acid into hydroxyl and nitroxyl, and combining with these radicals to form hydroxide and nitrite, which by secondary reactions become water, nitrous acid, and metal nitrate,” does not appear to be compatible with the view that the interaction of a metal and an acid is essentially a case of electrolysis, there being no reason to suppose that nitric acid can be electrolyzed into hydroxyl and nitroxyl; it is not supported by the observations here described on the E.M.F. of copper in acids of various strengths, which show that more depends on the state of the acid than on the metal; and, lastly, silver is incapable of acting on nitric acid, although it readily enters into interaction with the weaker electrolyte, nitrous acid.—*Pro. Chem. Society.*

FACSIMILE TELEGRAPHY.

MOST of the facsimile processes come under the head of chemical telegraphs, and are based upon the decomposition of a solution, usually of iodine, by the passage of a current. They all require special apparatus of a more or less complex nature, and hence are not adapted for every day rough-and-ready work. Recently, however, Lieutenant Glen and Lieutenant-Colonel Melville, of the English army, have independently hit upon an ingenious system by which the ordinary operation of telegraphing may be made to serve the purpose of reproducing sketches and plans. Strictly speaking, the system is not a facsimile in the true sense of the word; but by its means very fair reproductions can be obtained, and its value in some situations and circumstances may be considerable. The method consists of either drawing the design to be transmitted on ruled paper, divided into little squares by vertical and horizontal lines, or laying a transparent paper, tracing cloth, or other transparent sheet, which must be so divided by lines into squares, over the drawing. The squares

in each compartment, as shown in Fig. 1, are denoted, respectively, by pairs of letters, the alphabet running down the outer side for the horizontal rows of squares, and along the top for the squares in vertical series. A corresponding paper, which may be of a different scale if convenient, is kept at the receiving station. The operator at the transmitting station can thus indicate by alphabetical letters to the receiving station any point on the paper falling in the center of any of the squares; the person at the receiving station will apply his pencil to that point, and will then be directed to the next point, drawing a line with the pencil, and so on to form a complete outline drawing.

Figs. 2 and 3 show fancy portraits, the one being the original, the other the transmitted copy.

Patches of shading, of the several darker or lighter tints shown in Fig. 4, may be put in by special direc-

FIG. 1.

tions, the transmitting signs for which must be preconcerted.

Paper ruled with squares of any size, large or small, may be used according to the purpose and nature of the drawing; but in the “sectional paper” adopted by one of the inventors, the parallel ruled lines are set one-eighth of an inch apart, giving sixty-four little squares to one square inch. Where greater minuteness of delineation is required, there is a way of getting several exact points within each little square, as well as its central point. This is obtained by setting two additional letters, instead of one letter only, at the head of each vertical column of squares, and at the end of each horizontal row of squares, practically subdividing each square into four. The sender of the message, when the drawing is so large as to extend over a number of quadrangles, must apprise the recipient of it which is the particular quadrangle or division of the paper that he has in hand; but this is easily done by prefix signal letters. The scale of the map or plan is also to be stated, which will suffice to the recipient for learning the measurement of all distances within the plan.

FIG. 2.

We refer those who desire a more minute description to the April quarterly publication of the Journal of the Royal United Service Institution.

HISTORY OF THE ELECTRICAL ART IN THE UNITED STATES PATENT OFFICE.*

By C. J. KINTNER.

I ONCE heard a member of Congress say to some of his constituents who were doing Washington city, from the tourists' standpoint: “Go first to the Smithsonian Institution, where you will see all that God ever made; go thence to the Patent Office, where you will see all that man ever made.”

This advice, although given in jest, contained, at least so far as the Patent Office is concerned, much more truth than the speaker imagined.

The American patent system virtually dates its origin from the Constitution, in the eighth section of the first article of which our forefathers inculcated these words: “Congress shall have the power to promote the progress of science and the useful arts by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries.”

Out of this grew legislation concerning patents as early as 1790, when the first revised statutes became law.

No organized system of granting patents was developed until 1836, when the Patent Office sprang into

* A lecture delivered before the Franklin Institute, January 25, 1886.—*Franklin Journal.*

existence, and the law was amended so as to develop substantially the system in vogue to-day. From that time to the present, just a half a century ago, there have been no material changes in the revised statutes, and there has resulted from this wise legislation the most wonderful advance in the arts and industries the civilized world ever knew.

I am invited to address you to-night, upon the historical electrical apparatus of the United States Patent Office.

You will pardon me if I broaden the scope of my remarks to such an extent as to include or make them commensurate with the growth of the electrical art as developed in and by our patent system.

In the Patent Office we recognize and protect by patent all inventions and discoveries coming under any one of the following classifications: (1) an art; (2) a

FIG. 4.

machine; (3) an article of manufacture; and (4) any improvement upon any one of the foregoing.

The limited time at my disposal will not permit me to give definitions of these statutory classifications, so I will simply indicate to you that the Patent Office recognizes about twenty-four classifications in the arts, beginning with the oldest art known to man, agriculture, following with the arts of textiles, metal working, etc., and ending with the youngest and to us the most interesting—electricity. Each of these arts is divided into classes and each class into sub-classes for the convenience of search and for the sake of an orderly arrangement of the records in the office.

One principal examiner has charge of each art, and is supplied with from four to eight assistants, dependent upon the demand of his art.

The electrical branch of the office prior to 1881 embraced one sub-class known as Class 36, Electricity, under the Division of Philosophical Instruments. In that year the rapid growth in the matter of electrical inventions made it necessary to make a new classification, and philosophical instruments were taken by an-

FIG. 3.

other examiner, electricity constituting an entire class, which has since become the most important art in the Patent Office.

The introduction of the telephone, based upon Alexander Graham Bell's patent, No. 174,365, March 7, 1876, gave a new and wonderful impetus to inventions in electrical appliances. There had been prior to that time marked progress in telegraphs, and much ingenuity had been displayed by inventors in simplifying the methods of telegraphic communication by developing apparatus adapted for use between inexperienced operators by automatic, stylographic, and printing telegraphs; but when this new and wonderful invention sprang into existence, it seemed to instill new life into the inventive genius of the world. Prior to 1876, less than 2,000 patents had been granted on electrical appliances of all kinds.

So rapid has been the development that each year necessitates new classification, and a thorough reorganization of the entire classification was effected during the past year, creating in place of one class, nine, as follows:

Class 171, *Generation*.—Embracing all kinds of apparatus for the generation of electricity.

Class 172, *Motive Power*.—Including electric motors, transmission of power, etc.

Class 173, *Conductors*.—Including all means of conveying electricity from point to point, and all apparatus for in any way facilitating the transmission of current without interruption.

Class 174, *Medical and Surgical*.—Including all applications of electricity for sanitary purposes.