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SCIENTIFIC AMERICAN SUPPLEMENT

No. 601.

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ACCESSION OF THE UNITED STATES TO THE INDUSTRIAL UNION.

The following announcement is made in *La Propriete Industrielle*, the official organ of the International Bureau of the Union: "From a communication addressed to the Federal Council of Switzerland by the United States minister at Berne, the date of the accession of the United States to the Union for the protection of industrial property has been fixed for May 30, 1887." According to the above, the United States is now a member of the Union, and our citizens are entitled to the enjoyment of all its benefits. The fact, we presume, will be soon proclaimed by the President.

It is difficult at the present time to foresee all the results, advantageous or the contrary, that may accrue to us from this membership. It has been very extensively published in the daily press that, under the laws of the Union, all American patentees would enjoy a priority of time for seven months after the date of their American patents, during which they could take patents in all the several countries covered by the Union. But this is an error, as the laws of the Union provide for a priority of seven months, not from the date of the patent, but from the date of the *application for the patent*.

As the business of our patent office is considerably in arrears, in some classes more than seven months in arrears, in such cases the Union affords no benefit. In other classes the arrearage is not more than two or three months. In these cases the Union will be of some benefit.

The other laws of the Union relate chiefly to trade marks, concerning which the protection accorded to the members of the Union is full and satisfactory.

The following are the present members of the Industrial Union: Belgium, Brazil, Spain, France, Guatemala, Italy, the Netherlands, Portugal, Salvador, Servia, Switzerland, Great Britain, Mexico, Sweden, Norway, Paraguay, Uruguay, Roumania, Tunis, the United States.

In the official statement of the articles of the convention, published in the *Patent Office Gazette* of May 24, 1887, it was stated that Germany was a member of the Union; but this we believe to be an error. Germany, we are informed, has not yet become a member.

USE OF THE SIREN IN MARINE SIGNALING.

In certain cases, as in fogs and tempests, optic telegraphy is impossible. Cannons have long been employed in these cases. A slightly violent wind makes them nearly useless, and even in good weather they are of little use, because of the difficulty of sufficiently multiplying their detonations, as to whose number there are no certain and invariable agreements.

As for the ordinary whistle, these can only serve as toys, and could they be employed in signaling, the steam whistle, already much used, would be preferable. Here, too, the lack of agreement as to meaning of signals operates to restrict their use.

For some little time, ocean vessels owned by the large shipping companies have been provided with an instrument giving sounds of wonderful height and intensity. We speak of the siren. The siren, invented by Cagnard de la Tour, has been greatly modified, and steam has replaced the original currents of air. Applied to the same uses, the siren leaves far behind it the cannon, ordinary whistle, and steam whistle. Nothing remains but to fix a certain and invariable standard of comparison.

We give below the ideas emanating from M. Edme Genglaire, student of the naval school of medicine at Toulon.

The siren being in communication with the boiler, the current of steam can be governed by an ordinary valve. The sounds produced vary in height and intensity in proportion to the quantity of steam emitted, so that sounds of any given pitch can be obtained. A set of resonators completes the apparatus.

It is well known that two identical resonators vibrate together for the same sound and for that only. Starting with this principle, in two similar frames containing several resonators, the corresponding resonators will vibrate or sound only when the note corresponding to them is produced. The siren will produce these sounds causing vibrations in the resonators, and two distant ships, or a shore station and a ship, or two land stations, supplied with sirens of similar model and identical frames of resonators, could most conveniently communicate. For this end each resonator should have attached to it an invariable signification, the same for all the frames.

All the navy and commercial vessels possessing sirens and a frame carrying the same number of resonators, each marked with a number having its signification, will be prepared to communicate with each other or with the shore. It must be remembered that these acoustic effects can be conveyed intelligibly to an immense distance by the aid of the siren and the additional apparatus. The apparatus, moreover, does not cost much for establishment.

The preceding theory being admitted, the following is the practical way of carrying it out as proposed by M. Genglaire:

In front of each resonator will be placed two metallic reeds; one rigid, the other thin and producing extended oscillations with the least effort. Each of these pieces of steel communicates with one pole of a battery by means of the circuit wire. When the resonator vibrates, the thin reed oscillates, touches the other bar, and the two poles of the battery being connected, an electric bell rings, thus giving a signal, so that the call, whether from ship or shore, can be recognized, while the bell of the signaling station by its sounds shows that the desired vibration or note has been produced.—*Electricite.*

THE ECONOMICAL DISPOSITION OF PRIMARY BATTERIES.

The true action of a primary galvanic battery in some of its features is not generally comprehended, even by those familiar with the ordinary phenomena of electricity. The size of a battery, and the direct effects of varying it, and the deleterious effects of internal resistance, are among the factors least grasped. At the present day the error is sometimes made of supposing that the size of a cell affects its electromotive force, and internal resistance is often spoken of as a beneficial element.

Yet if the subject be brought down to facts, the case is a very clear one. The electromotive force is quite independent of dimensions, and a cell the size of a percussion cap will produce as high electromotive force as the largest made. This, to many, sounds a truism, yet it is by no means universally realized. But on the subject of resistance a more firmly fixed misconception prevails to a considerable extent. It is often asserted that low resistance batteries are not wanted. The truth is that they are wanted, and that the invention of a non-polarizing or constant and low resistance battery would be a valuable contribution to the resources of the electric engineer. The source of the error on the subject of resistance is doubtless due to the universal application of Ohm's law for fixing the number of cells in a battery for given external resistance.

By simple mathematical demonstrations it is proved that the most economical distribution of battery, as far as the number of cells is concerned, is attained when the internal, or battery, resistance and the resistance of the external circuit are equal. Thus with ten ohms resistance on the outer circuit, enough cells should be provided to have the same resistance internally. This, however, refers only to the number of cells, and not to their economic working. This limitation is very generally overlooked. The arrangement of battery so as to make internal and external resistance the same is considered the ultimatum, and the low resistance of cells is held not to be a specific advantage.

The ordinary calculation of the number of cells required to supply a circuit may be used as an example. Suppose a difference of potential of 35 volts is to be maintained between the extremities of an external circuit of 40 ohms resistance, giving a current of 0·875 ampere, and assume each cell of the given battery to yield 1·75 volts with an internal resistance of 1 ohm. In making the calculation, it is at first taken for granted that the internal resistance of the battery must be 40 ohms. Therefore the total resistance to be overcome is 80 ohms, so that the effective voltage of the battery is reduced one half. Dividing, therefore, 35 volts by 0·875 volt, the dividend 40 is the number of cells that must be arranged in series. Then, as these will have a resistance of 40 ohms, the problem is solved, and this is treated as the most advantageous possible arrangement. This it is far from being; it is the best arrangement of forty elements in the given circuit. It contains the minimum number of elements that will maintain the given current through the circuit, but it is not an economical arrangement as regards consumption of material.

The battery in the case cited having exactly the same resistance as the external circuit, absorbs one half of the current. One half of the electrical energy disappears in forcing the current through the battery. This represents fifty per cent of the chemicals and zinc which is actually wasted or spent on useless work. A battery run on this principle by no fair principle can be compared with a steam boiler, to settle the point of efficiency. It is doing only a shade over half the useful work that it is capable of. To compare the cost of a battery with any other prime generator, it must work under widely different circumstances from that instanced. Its difference of potential, and at the same time its resistance, must be lowered. This can be done by increasing the number of elements and arranging them in several parallel series.

The battery and circuit above cited having a resistance of 80 ohms with 70 volts difference of potential in the battery, maintains a current of 0·875 ampere. By arranging four such series of cells in parallel, the internal resistance would be reduced to 10 ohms, the total resistance to 50 ohms, and a current of 1·4 amperes would be produced. To reduce this to 0·875 ampere, four parallel series of twenty-three cells each would be required. This is an increase in cells. The total number is 92 instead of 40. But as the battery would only have one seventh the resistance of the whole circuit, it would absorb one seventh instead of one half the electrical energy, thus indicating at once a saving of nearly 50 per cent in consumption of zinc and chemicals. The limit of efficiency is approximated to by using a little over double the original number of cells.

In all applications of primary batteries to motors, this principle should be kept in mind. In storage batteries it has received a high development. They have such low internal resistance that it is treated as of no value, or as zero. It is for this reason that they have become of no practical value. Were they of high resistance, and were they used so as to possess within themselves one half the total resistance, then, instead of developing an electric efficiency of 85 to 90 per cent, they would give a return of only 42½ to 45 per cent of the charging current. Their constructors in order to obtain a commercial efficiency were obliged to construct them of low resistance. But the inventors of primary batteries having their minds fixed on other considerations, such as economy of space, rather than economy of material consumed, have overlooked the evil effects of high resistance.

The resistance may be reduced by bringing the plates closer together. In the primary battery the solution of a metal has to be provided for, and the difficulties due to the low rate of diffusion of liquids have prevented too near an approach of the plates to each other. In the storage battery this trouble is of course absent. But it is clear that in low resistance lies the hope for a future use of the primary battery for small powers or for electric launches. So many points tell in favor of the primary battery that it seems a pity that it cannot be more generally used. But it can never be economically employed if the minimum number of cells only is adopted as the basis of installment.

Photography in Natural Colors.

A very remarkable chemical paper by M. Cary Lea is now in course of publication in the *American Journal of Science*, in which the author gives the results of his laborious and extensive investigations concerning the salts of silver and their relations to the photographic image. The ease with which the author produces the most splendid colors, their richness and variety, is really marvelous. He reaches the gratifying conclusion that photography in natural colors is now among the possibilities of science. We give a few extracts from the concluding portions of his paper:

Almost any silver solution brought into contact with almost any reducing agent, and then treated with HCl, gives rise to the formation of photo-chloride. Almost any chlorizing influence brought to bear on metallic silver has the same result. Or when silver is brought into contact with almost any oxidizing agent and HCl, it may be said without exaggeration that the number of reactions that lead to the formation of photo-chloride is much larger than that of those leading to production of normal chloride.

Exposed to ordinary diffused light, all the bright shades of silver photo-chloride quickly change to purple and purple black. The darker shades are more slowly influenced.

Mercuric chloride gradually changes it to a dirty white.

Mercuric [nitrate dissolves it] easily and completely, but apparently with decomposition, as it can only be recovered as white chloride.

Potassic chloride seems to be without effect.

Potassic bromide soon converts it to a dull lilac, which at the end of twelve hours showed no further change.

In contact with potassic iodide, the color instantly changes to blue gray; this change is produced by a quantity of iodide too small to dissolve even a trace of silver; the filtrate is not darkened by ammonium sulphide. With a larger quantity, silver is dissolved abundantly. By acting with renewed iodide solution, the substance continually darkens and diminishes until only a few black points, barely visible, are left.

Treated with dilute solution of potassium chlorate and HCl, the red substance gradually passes to pink, to flesh color, and finally to pure white.

The action of heat on the photo-chloride is very curious; its tendency is generally toward redness. Specimens appearing quite black are rendered distinctly purple or chocolate by heating to 212° Fah. in a drying oven. Often when the substance first separates by addition of HCl, it is pure gray; this gray will often be changed to pink by simply heating to 212°. (This happens when a gray form is produced; if the grayness is due to admixed metallic silver, it is only removed by boiling with nitric acid.)

The somewhat surprising change of color which is often seen when the crude substance is boiled with nitric acid (sometimes from dull dark gray to crimson) is due to three concurrent actions—that of the mere heat, the removal of the silver, and the breaking up of uncombined subchloride.

RELATIONS OF PHOTO-CHLORIDE TO HELIOCHROMY.

The photo-chloride was examined both with the spectrum and under colored glass.

The rose colored form of photo-chloride was that which gave the best effect. In the violet of the spectrum it assumed a pure violet color, in the blue it acquired a slate blue, in green and yellow a bleaching influence was shown, in the red it remained unchanged. The maximum effect was about the line F, with another maximum at the end of the visible violet, less marked than the one at F.

Under colored glass the colors obtained were brighter; under two thicknesses of dark ruby glass the red became brighter and richer. Under blue glass some specimens gave a fair blue, others merely gray. Under cobalt a deep blue was easily obtained, and under manganese violet a fine violet, very distinct in shade from the cobalt. Green produced but little effect; yellow was sometimes faintly reproduced, but rarely. But the yellow glass of commerce, even the dark yellow, lets through portions of nearly the whole spectrum, as can readily be seen by testing it with the spectroscope.

The dark purple forms of chloride do not give as good results as the rose and coppery shades. These last have many points of resemblance with the material of Becquerel's films—resemblance of color, probably of composition, as far as we can judge of the constitution of those films from their origin; they were far too attenuated to admit of analysis; and resemblance in the curious way in which their color is affected by heat, so that the conclusion seems inevitable that they are at least closely related.

There is certainly here a great and most interesting field for experiment; hardly any two specimens of photo-chloride give exactly the same results with colored light, and this suggests great possibilities. There is the very great advantage in this method over any previous, that the material is easily obtained in any desired quantity, and in a condition most favorable for experiment.

The action of light on proto-chloride can be a good deal affected by placing other substances in contact with it. Any substance capable of giving up chlorine seems to influence the action somewhat; ferric chloride often acts favorably, also stannic and cupric chlorides.

Evidently an important point in all heliochromic processes is that as white light must be represented by white in the image, it is an essential condition that white light must exert a bleaching action on the sensitive substance employed. Red chloride does not bleach but darkens in white light, but the property of bleaching, to a very considerable extent, may be conferred on it by certain other chlorides, and particularly by lead chloride and zinc chloride.

This I look upon as very important.

Another matter of interest is exaltation of sensitiveness, and this I find is accomplished in quite a remarkable way by sodium salicylate, the presence of which at least trebles the action of light on these substances, and probably on others.

I am persuaded that in the reactions which have been here described lies the future of heliochromy, and that in some form or other this beautiful red chloride is destined to lead eventually to the reproduction of natural colors.

Employers' Liability.

In many cases of injury to workingmen running machinery, it is difficult to decide which party is to be held responsible, or whether it is attributable to mere unavoidable accident, which it was impossible to caution or guard against. Each of the parties wants to shift the responsibility upon the other, the employe to recover damages from the employer, and the latter to shirk such obligation. Where the case is not quite plain, or is not settled by compromise, endless lawsuits are frequently the consequence. The legislative bodies of the various States and of all industrial countries have endeavored, therefore, to define, the liability of employers; and building inspectors, factory inspectors, boiler inspectors, and a number of other similar functionaries have been appointed to see that the laws are observed and that the regulations regarding precautionary measures to prevent accidents in factories are complied with. But the more numerous and the more specialized such enactments become, the less security they afford to the parties concerned, and the wider a field do they open for legal trickery and the more loopholes for evasion.

The fact is, the very oldest part of our common law affords the best common sense as to the proper standpoints for judging of such liability, and there is perhaps more danger that legislators will, by statute, limit and impair the efficacy of the common law than that they will improve upon it by newly devised regulations. The English government has lately been collecting information as to the law in relation to this matter in other countries, and the reports seem to confirm the idea that in no other country are the provisions of the law so generally sound and wholesome as in France. All such questions in France are still regulated by common law, and its provisions concerning them are thus formulated by the civil code:

ART. 1382. Any action whatever of a man which causes an injury to another obliges the person by whose fault the injury has occurred to repair it.

ART. 1383. Everybody is responsible for the injury he has caused, not only by his action, but also by his negligence and imprudence.

ART. 1384. A man is responsible, not only for the injury he has caused by his own action, but also for that which is caused by the action of persons for whom he is answerable, or of things in his charge.

The father, or the mother, after the decease of the husband, are responsible for the injury caused by their children [here the Roman law has: also guardians for injuries caused by their charges.—ED.] who live with them, being minors.

Masters and employers for the injury caused by their servants [Roman: slaves] and overseers in the performance of the functions in which they have employed them.

Tutors and artisans for the injury caused by their pupils or apprentices during the time they are under their supervision.

This responsibility is incurred unless the father, mother (guardian, masters, and employers), tutor, or artisan prove that they could not prevent the action which gives rise to the responsibility.

ART. 1385. The owner of an animal, or the person using it, is responsible, so long as it is being used by him, for the injury which the animal has caused, whether the animal was in his charge or whether it had strayed or escaped.

ART. 1386. The owner of a building is responsible for the damage caused by its fall, when such fall has taken place in consequence of defective maintenance or faulty construction.

The principles laid down in these articles are almost verbatim translations of the Roman law, and are also nearly in the same wording contained in the old Prussian "Landrecht" compiled by Suarez, under the reign of Frederick II. They would undoubtedly be held as good common law in all our courts to-day, where not limited by some statute. They include, in fact, all cases of reponsibility imaginable, and our law makers have actually nothing more to do than to make regulations in reference to the use of steam power and machinery, whose violation puts the owner, employer, or overseer in a position of responsibility analogous to the owner of a building, animal, slave, etc., after the Roman law.

Uses of Slate.

Slate is not confined to its use as a roofing material by any means, but, on the contrary, is probably more universally used than any other stone. In composition and texture, it is admirably adapted to the reception of carved and moulded designs, is susceptible of a high polish, and possesses great power of resistance to the principal destructive elements, besides having the additional merit of wide range of color, embracing black, dark blue, purple, purple clouded green, gray clouded green, light green, and a clear, bright red. The scope of consumption is rapidly expanding, and among the uses to which slate is applied the following may be enumerated: Flagging, flooring, floor tiles, moulding for tiles, vestibule trimmings, slabs, etc., wainscoting, mantels, hearthstones, steps, risers, platforms, sills and lintels, turned balusters, laundry and bath tubs, sinks and wash trays, meat and watertanks, refrigerator and cooling room shelves, cistern linings, brewers' vats, mangers, butchers' and curriers' tables, bar fixtures, billiard table beds, urinals, school slates and blackboards, countertops, vault work, grave linings and covers, and memorial tablets. Of the above, no record of production or value can be obtained that would prove at all useful as a basis for estimates. Possibly, a faint idea of the proportions devoted to these various uses might be obtained from the production of the Slatington (Pa.) section, where, besides an output of 108,000 squares * of roofing slate, there were also made (in 1885), in round numbers, 39,900 cases of school slates, 31,850 pieces, or 1,430 cases, or 27 carloads, of flagging, 5,900 cases of blackboards, 30 cases of mantels and hearths, and 47 car loads of shaved slate.—*Mineral Resources of United States.*

A New Light for Instantaneous Photographs.

At a recent meeting of the Berlin Physical Society, Prof. C. W. Vogel communicated the most recent discovery in connection with instantaneous photography, by which it is now possible to obtain instantaneous photographs not only at night, but also in the darkest places. Messrs. Goedicke and Miethe have prepared a mixture of pulverized magnesium, chloride of potash, and sulphide of antimony, which when ignited produces an explosive, lightning-like illumination of such intensity that by means of it an instantaneous photograph can be taken. The speaker then gave a demonstration of the discovery by taking photographs of several persons present. He used the artificial light, of which each flash lasted one-fortieth of a second, and in a few minutes produced a picture during the meeting. The powders, as prepared by the discoverers, cost only a few pfennigs each, and will hence readily come into general use.

* A "square" is 100 square feet, weighs 600 lb., and covers the same area as 1,000 shingles.