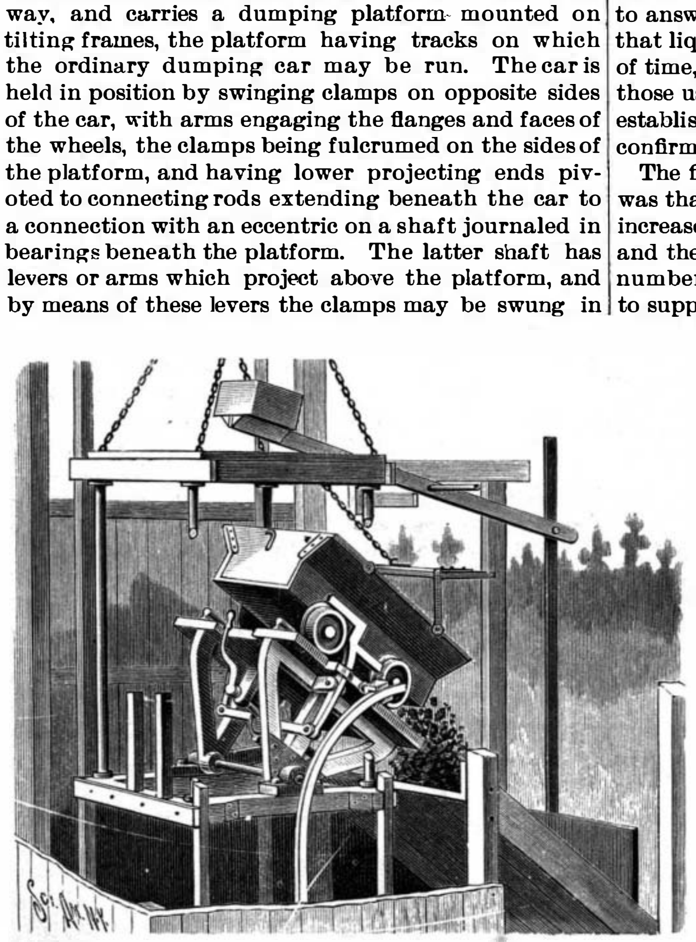
fitted up on each side, by means of movable frames in which they revolve. At one end of each roaster shaft is a gearing wheel which connects with a piece of shafting running the length of the ovens in the rear. This wheel geared to another on the rear shaft causes the roaster to revolve. From 200 to 400 pounds of dried chicory is put into a roaster with a quantity of olive oil or fat to prevent it from burning, where it revolves over a coke fire for about 1¾ hours, at the rate of 12 to 16 revolutions per minute. An iron carriage running on a track is then wheeled directly in front of the oven; the iron frame with roaster is then drawn from the oven on to the carriage, which is the same height and width as frame, and then wheeled away to the cooling floor, where the roaster is emptied and refilled again with dried chicory and run back over the track again to the oven, where it is replaced over the fire. The cooling floor is made of brick or cement and is about 30 feet square. After cooling, the chicory is put into the grinding machine. The material passes down through a hopper and between the teeth of a number of 8-inch rolls, which crush and grind the material into small particles, which is then conveyed by means of traveling cups to a wire bolt. The bolt is about 20 feet in length, the meshes of which run from about 4 to 40 to the inch. The ground material passes into this bolt, which revolves at the rate of 28 to 30 revolutions per minute, separating the fine particles from the coarse, which falls or sifts down through the netting to the openings at the bottom, and into the bags below. It is then packed into barrels and is ready for the market. In this country coffee is adulterated with about 2 per cent of chicory. Chicory is imported to this country in 100 to 150 pound bags, the average price being about 2½ cents per pound. Ground chicory brings about 5¼ cents per pound. The annual importation of chicory amounts to about 10,000,000 pounds. In San Joaquin County, California, about 400 acres are raised, furnishing in good years a profit of about $300 per acre. The root when dried brings about $200 per ton. The sketches were taken from the plant of the American Chicory Manufacturing Company, Jersey City.

APPARATUS FOR DUMPING COAL CARS, ETC.

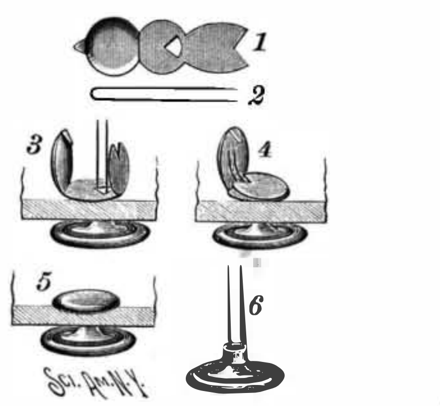
This is a strong and rapidly working apparatus, for use in connection with an ordinary car, to automatically dump the load into a chute when the car has been raised to the required height. It has been patented by Mr. William H. Barrett, of Weir, Kan. The elevator cage is operated by cables in the usual way, and carries a dumping platform mounted on tilting frames, the platform having tracks on which the ordinary dumping car may be run. The car is held in position by swinging clamps on opposite sides of the car, with arms engaging the flanges and faces of the wheels, the clamps being fulcrumed on the sides of the platform, and having lower projecting ends pivoted to connecting rods extending beneath the car to a connection with an eccentric on a shaft journaled in bearings beneath the platform. The latter shaft has levers or arms which project above the platform, and by means of these levers the clamps may be swung in or out. The dumping of the car is effected by guides on opposite sides of the elevator well, the guides curving outward toward the chute, and being clasped by shoes on opposite sides of the tilting platform. When the car and the platform are in a horizontal position the rear end of the car rests on posts on the cage, and the load is placed a little behind the center of gravity, so as to keep the car level. The car has at one end a swinging end gate engaged by a chain extending from the top of the cage, whereby the gate will be held up as the car is tilted in dumping, the gate again dropping to place as the car returns to horizontal position. The chute is also provided with a gate supported from the outer end of a lever on the inner end of which is a weight normally holding the gate raised. The inner end of the lever, extending into the elevator well, is lifted by the cage to close the chute at the time that the car is dumped, and the load is thus retained in the chute until the car starts downward, when the weight drops and the gate is lifted to permit the load to pass downward.



BARRETT'S DUMPING APPARATUS.

AN IMPROVED BUTTON FASTENER.

This is a simple device, readily applied for securing an ordinary style of buttons to garments. It has been patented by Mr. Robert Mowry Bell, of Santa Cruz, Cal. Figs. 1 and 2 show the clamp plate or blank and the fastening wire, Figs. 3 and 4 illustrating progressive stages in applying the fastener, the completed stage being represented in Fig. 5. The fastening wire, in the form of a staple, is passed through two of the holes of the button and through the fabric, a collar being employed as shown in Fig. 6, where desired. The ends of the wire having been passed through the nearly central opening in the clamp plate, the ears at each end of this plate are then folded down upon the central portion, the wire lying in the notch in one ear, and the tongue on the outer edge of the other ear being bent down under the central portion. The invention also provides for some variations in the form of the blanks.



BELL'S BUTTON FASTENER.

Professor Dewar on Liquid Air.

It is said that Faraday, when he was asked what was the use of certain of his discoveries, retorted with the conundrum, "What is the use of a baby?" Professor Dewar recently, at the Royal Institution, attempted to answer the question in a different way, by showing that liquid air—produced with so great an expenditure of time, skill and money—had distinct uses, although those uses were scientific ones, and were useful only as establishing a basis for new scientific theories or as confirming old ones.

The first scientific hypothesis to which he alluded was that as the metals decrease in temperature so they increase in conductivity; so there was every reason—and the experiments with liquid air had multiplied the number and increased the cogency of these reasons—to suppose that when the temperature of absolute zero of minus 274 deg. C. was reached, then the metals reached the point of absolute conductivity. Next to this the lecturer alluded to the uses to which liquid air had been put in establishing and confirming the refractive indices of oxygen air and nitrogen, and then proceeded to answer a number of interesting (if not burning) scientific questions.

How long, for instance, does it take for the mercury in a Torricellian vacuum to vaporize? It vaporizes at once, as the professor showed by painting the outside of a newly created vacuum bulb with a sponge dipped in liquid air, when it was seen that a tiny mirror of mercury was instantly formed on the glass. Does a low temperature make any difference to the absorption of light by a colored surface? It certainly does. Professor Dewar showed that a surface painted with red oxide of mercury, when cooled by the liquid air, changed its color from bright red to orange. Organic coloring matter changed also, but not so quickly. Had a low temperature any effect upon the conductivity of a vacuum tube? Yes; it had. All the vacuum tubes which Professor Dewar painted with liquid air at once began to resist the passage of electricity through them, because the intense cold froze the vapor, which, though imperceptible and imponderable and otherwise undetectable, nevertheless was an aid to conduction. Does a low temperature increase the cohesive power of metals? It did, as Professor Dewar offered (by the proxy of his indefatigable assistant) to show by experiment to anyone who waited till after the lecture. The tensile stress of iron increased at the temperature of liquid air from thirty-four tons per square inch (at ordinary temperature) to sixty-four tons, and every other metal increased its cohesive qualities similarly. The last experiment but one of the lecture answered decisively the vexed question whether metals increased their magnetic qualities at these low temperatures by showing that an iron bar magnet did so to the extent of 50 per cent. The last experiment of the lecture answered no question in particular, but it was the source of the greatest satisfaction to the professor, and aroused a burst of enthusiasm in his audience, which included much of fashionable and nearly all scientific London. He first liquefied in a test tube some of the air of the room, and then—a *tour de force*—solidified it.—*Daily Graphic, London.*

Cement Mortar.

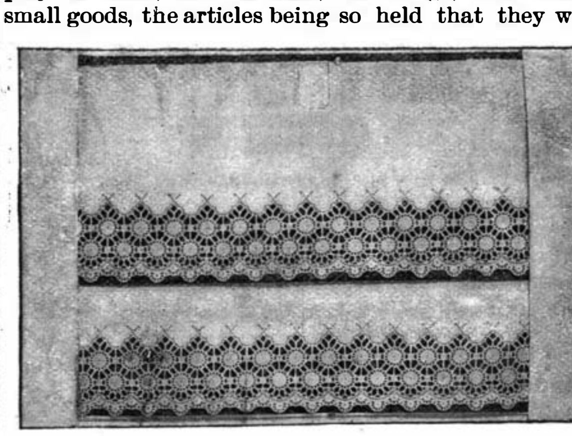
There is a common superstition, which probably retains its hold upon builders, says the *American Architect and Building News*, solely through the profit that they find in maintaining it, but which sometimes really imposes upon laymen, to the effect that cement mortar is improved, in cold weather, by the addition of lime to it. As the mason ingenuously explains to his employer, the heat developed by the lime in slaking keeps the cement warm, and thus prevents it from freezing; and, on this theory, the advent of a frosty day is utilized by multitudes of sharp builders to load the mortar, which they have agreed to make of sand and cement only, with a quantity of lime, which saves cement, and makes the mortar easy to work, but destroys its waterproof qualities and injures its strength and hardness more or less, according to the quantity used. It is hardly necessary to say that the influence of the lime in "warming" the mortar is purely mythical. Lime mortar, without cement, is not much injured by freezing, while cement mortar is totally ruined, so that a mortar containing a large proportion of lime would be harder, after freezing and thawing, than one containing cement only; but it would gain the qualities of lime mortar only as it lost those of cement mortar.

White Dextrine.

A writer in the *Wollen-Gewerbe* states that an entirely white dextrine, perfectly soluble in water, is now prepared by diluting 4 pounds and 6½ ounces nitric acid of 1·4 specific gravity with 317 quarts water in which 2,205 pounds of starch are stirred. This mass is formed into cakes, which are at first dried in the air and afterward at 176° Fahrenheit, and the cakes are then ground and the powder sifted, and heated from 212° to 230° Fahrenheit for one or one and a half hours; in external appearance, this preparation cannot be distinguished from starch flour, and is perfectly free from nitric acid. In the preparation of dextrine in the wet way, with diluted acid, it is remarked that the time at which the last of the starch has been converted into the dextrine must be carefully noted, as the continued influence of the acid causes the dextrine to become rapidly saccharose.

AN ENVELOPE FOR THE DISPLAY OF LACES, ETC.

This envelope is made of paper, cardboard, or other suitable material, in a very simple and inexpensive manner. Its sides are folded over part of the back from end to end, and from the back extend ends which fold over the sides at the ends, the ends having side flaps glued to the under side of the back. Openings or pockets are thus formed at the edges of the sides and ends, so that a portion of each piece of goods held by the envelope will be exposed for examination. The improvement has been patented by Mr. Charles J. Billwiller, Nos. 31 and 33 Walker Street, New York City, and is especially designed to facilitate the display of laces, embroideries, trimmings, and other small goods, the articles being so held that they will be kept clean and in good condition, and yet permit the retailer to cut off portions as desired.



BILLWILLER'S DISPLAY ENVELOPE.

Sour Bread.

L. Briant has investigated the nature of the acids contained in sour dough, and gives the results of a number of analyses. It appears that the bulk of the acidity of sour dough is due to lactic acid, but that a certain proportion, varying from one-third to one-fifth, consists of acetic acid, while in most cases the amount of butyric acid present is very small. In a future paper the author purposes dealing with the causes which lead to the production of sour bread.

The Bell Telephone Company.

To an inquirer about Bell Telephone Company earnings the Boston *Transcript* gives the following figures:

	Net income.	Year's increase.	Per cent gain.
1885	$1,809,996.48	....	....
1886	1,973,350.76	$163,354.28	9·0
1887	2,237,608.12	264,257.36	13·3
1888	2,436,463.56	198,855.44	8·9
1889	2,661,888.69	225,425.13	9·25
1890	2,869,418.35	207,529.66	7·8
1891	3,126,819.90	257,401.55	8·97
1892	3,411,679.78	284,854.88	9·11

It was figured that an increase of 9 per cent in 1893 would be tantamount to earning some 19 per cent on the whole $20,000,000 capital, although all of the new stock did not participate in all of the 1893 dividends. Here is another table of interest:

	Surplus earnings applicable to dividends.	Equals on stock per cent.
1885	$1,809,996.48	18·09
1886	1,973,350.76	19·73
1887	2,237,608.12	20·8
1888	2,436,463.56	24·25
1889	2,661,888,69	26·72
1890	2,869,418.35	22·95
1891	3,126,819.90	20·85
1892	3,411,674.78	19·49

The following is from a recent compilation of the *Boston Herald:*

The present company was organized in May, 1880, with an authorized capital of $10,000,000, and issued capital of $6,500,000. This was increased to $7,350,000 by giving a right to the National Bell Telephone Co.'s shareholders to subscribe for $850,000 stock at par. From that day until recently subscription privileges at par have been issued, and sundry extra and valuable rights have been given to shareholders. None of these is included here. The National Bell Telephone Company had a capital stock of $700,000. When it concluded to reorganize as the American Bell, it sold 500 shares in its treasury for $600 per share to meet its "immediate wants," presumably floating debt. It then gave each shareholder six shares for one and turned the property over to the new company for $6,500,000, taking pay in stock at par. The first year ended Feb. 28, 1880, and included two months of the National Bell year. In 1884 the fiscal year was changed to the calendar year, and covered but ten months. The total dividend payments and capital at the end of each year have been:

	Dividends.	Capital.
1880-81	$178,500	$7,350,000
1881-82	416,500	7,350,000
1882-83	595,000	7,350,000
1883-84	1,051,479	9,602,000
1884	1,440,315	9,602,000
1885	1,562,236	9,802,100
1886	1,568,336	9,802,100
1887	1,568,336	9,802,100
1888	1,789,878	9,962,100
1889	1,838,913	11,303,900
1890	2,213,913	12,500,000
1891	2,625,000	15,000,000
1892	2,919,080	17,500,000
1893	*3,337,500	20,000,000
Total	$23,106,096	....
Average per year	1,650,435	$11,209,035

* Estimated.

The company began paying extra dividends in 1884. They are included above, and in detail have been: 1884, $288,063; 1885, $392,044; 1886, $392,084; 1887, $392,084; 1888, $597,726; 1889, $600,000; 1890, $750,000; 1891, $900,000; 1892, $991,863; 1893, $1,125,000. The average regular and extra dividend per year has been $1,650,435. The average capital has been $11,209,035. The average rate of dividend has been 14·72 per cent.

Nitrate Deposits in Colombia.

In the December *Bulletin of the Bureau of the American Republics*, Mr. C. F. Z. Caracristi, C.E., gives the following report on the nitrate beds of the Val du Par, lying between the spur mountains of the Sierra Nevada de Santa Marta, in the Department of Magdalena, Republic of Colombia, South America.

The nitrate beds of Chile and Peru have, for a number of years, been coveted as properties of vast value, and have added not only to the wealth of the operators, but to that of the country in which they are found. "Potassium niter" is found in caves mixed with the stalagmitic formations that cover the walls and floor, and in this form was much sought for in the earlier days of American civilization. It was used then, as now, in the manufacture of gunpowder, and formed quite an industry, which has since disappeared; yet in India, where labor is cheap, the collection of sedimentary "saltpeter" continues. In the same country it is also obtained in large quantities, for exportation, by the evaporation of nitrogenous water collected from "seeps," after the same manner as salt is produced.

The niter produced in Chile, however, differs from the sedimentary nitrate, and is known in mineralogy as "nitrotine," or soda niter, and its component parts are nitrogen pentoxide 61·891 per cent, sodium (soda) 38·109 per cent = 100 per cent. It somewhat resembles niter (saltpeter), but more readily deliquefies and burns on coals with a yellow flame.

In the district of Tarapaca, a Peruvian province now occupied by Chile, it is found in the dry *pampas* extending over forty-five leagues. Here it is mixed with sodium bichloride (common salt), magnesium carbonate and shells of very recent origin. This nitrotine is converted into regular niter, or saltpeter, by the displacement of the sodium and the addition of the required amount of potassium. It is also found and worked in the great desert of Acatama, Chile; but in these regions it is found as an incrustation in the earth of decomposed porphyritic rock, and was doubtlessly of feldsparic and calcium origin. No shells are present, and no sign of sedimentary action is here visible. These beds have, of late years, attracted great attention, although they lie at a considerable distance from transportation. Nitrate is used largely in the industrial arts, is a splendid fertilizing medium, and is the base of nearly all known explosives, because the nitrogen pentoxide stands in mutual repulsion with all other substances. And while its atoms will readily combine with atoms of other bases, the least chemical convulsion will instantaneously bring about a separation of the two or more bases and produce explosion. It is the explosive base of gunpowder, guncotton, nitro-glycerine, americanite, giant powder, etc.

The nitrate deposits I discovered in Colombia are of a nature identical with those of Chile, and I have but little doubt that thorough exploration would show the deposits to be almost as extensive as those of that country. My own investigation showed the existence of about thirty miles square of nitrate beds, having a thickness of from one to ten feet.

The stratum carrying this niter is a bed of slaty gypsum (calcium sulphate), in which are embedded large quantities of shells (calcium carbonate), iron oxide, salt, and magnesia. The vein lies at a depth of from eight to twenty feet below the surface, and rests upon the carboniferous sandstone of the region. It is very evident that the deposit is of recent date, and that the nitrate was produced by the chemical reaction of vegetable and other substances operating on the lime in its various forms. The only visible difference between the nitrate of Colombia and Chile is that the nitrification has, in part, been produced by the phenomenal functions of the microscopic plant which is closely allied to the "bacteria" so common to the cave and Indian niter.

I would estimate the visible supply at over 7,372,800,000 tons of nitrate material, assaying from 1 to 13·50 per cent nitrate.

The carboniferous sandstone has prevented the filtration of the niter, and the gypsum has, in part, been a protection to the substance. The niter itself is of a yellowish or light brown color and is found in crustations between the slaty layers of calcium sulphate. In its purer state it is of a white color, translucent, micaceous, and arborescent, and sometimes transparent, and having a hardness of 1·96; gravity, 2·01. When crystals are found, the analysis is:

Nitrate of soda	23·90	per cent.
Chloride of soda	34·05	"
Sulphate of calcium	8·46	"
Sulphate of alumina	3·41	"
Magnesia	trace.	
Insoluble silica	24·68	"
Water	5·50	"
Total	100·00	"

But the average deposit, taking the vein as it comes without picking or other separation, would give the following average, which I consider very promising from a commercial standpoint:

Niter	11·406	per cent.
Calcium carbonate	32·516	"
Calcium sulphate	20·121	"
Silica	32·412	"
Calcium phosphate	2·500	"
Ferro-oxide	0·025	"
Vegetable matter and salt	1·020	"
Total	100·000	

The above shows plainly that the deposit is, in its crude state, a fertilizer of the best quality. The calcium phosphate is fossilized bone. I must also note that large quantities of iron pyrites are to be found in the archaic formation of the adjacent mountain, which give over 42 per cent sulphur and which would make the manufacture of fertilizer in the region a great industry.

The manufacture of nitric acid could also be made an industry of importance and profit.

The deposits lie at a distance of about sixty-five miles from the city of San Juan de la Cienaga and are, in part, on the waters of San Sebastian River, which flows into the great sea level lake of "Cienaga Grande." Navigating communication could be established with the nitrate beds by conducting the waters of the Aracataca River into the San Sebastian. This work would cost not in excess of $5,000, as a canyon already exists connecting the two rivers. By this work a draught of about six feet could be carried from the falls of San Sebastian River to Pueblo Viejio, from which point navigation communications already exist to Barranquilla and Santa Marta. When the Santa Marta Railroad shall be completed to the village of Fundacion, the niter beds will be only half a mile from the road. The road is now in running order from Santa Marta to Rio Frio, and about six miles are graded beyond Rio Frio in the direction of Rio Savilla. This leaves about thirty-five miles of road still to be built, at a cost of $105,000, to which amount the Colombian government, according to its original contract with Senor Don Manuel J. de Mier and his successors, is to contribute about $30,000.

It is quite obvious that the development of the nitrate industry on the Atlantic coast of South America would mean a great saving in the cost of transportation of the article to both Europe and North America, and the American farmer who has to buy fertilizers would be highly benefited by the advantages offered by the niter beds of Colombia. The reduction of the cost of fertilizer has been a question of great moment to the American farmer—so much so that in nearly all the agricultural States legislation has been enacted having in view the reduction of cost and the assurance of the purity of fertilizing compounds.

Investigation, made by State and federal authorities, has proved the fact beyond dispute that the agricultural possibilities of certain localities of the United States are largely restricted and governed by the cost and power of the fertilizer offered for sale. It is, therefore, obvious that the reduction of the cost of niter and other alien fertilizing substances would redound to the great advantage of the American farmer, with whom the question of cheap fertilizer is one of too much importance to be overestimated.

The cost of producing and delivering one ton of caliche, or crude niter, at Pueblo Viejio would be about $2.50, and the cost of shipment to the United States would be $3.80, delivered in New York, making a total of $6.30. This estimate is on the material in its crude state, and as it would take eleven tons of caliche to produce one ton of nitrate of soda, at a cost of $69.30, and the present market value would be only $50, it is evident that it would be necessary to separate the niter before shipping. I estimate the cost of separation, mining, and transportation to New York City at from $8.31 to $11 per ton. Then, besides the nitrate of sodium, we would have calcium phosphate (land plaster), an excellent fertilizer, 4,600 pounds, calcium phosphate 550 pounds, sodium bichloride (common salt), and vegetable matter 220 pounds. The above would be the residuum or by-products remaining after the refining process of the caliche has been gone through with. Or, to put it more plainly, we would have 7,370 pounds of fertilizing substances out of a possible 22,000 pounds, and of the residuum remaining, one-half would be calcium carbonate (ordinary lime).

In conclusion, I beg to state that I have every reason to believe that franchises or grants will be given by the Colombian government to any responsible individual or corporation that might guarantee to work the nitrate beds of that country.

Helping Street Cars up Hill.

A trolley line in Oil City, Penn., climbs a grade of nearly 14 per cent for almost 1,000 feet in one part of town. John B. Smithman, president of the company operating this line, has invented and patented a scheme for helping the cars up and down this slope. It consists of a counterpoise, lowered in a well, and connected by cable with the cars. A well is now being bored for this purpose, and is nearly finished. It is sunk from the top of the hill, and will go to a depth of 1,000 feet. The "balance," as it is called, will be a cylindrical iron bar, 4¾ inches in diameter and 40 feet long. A single car, Mr. Smithman estimates, weighs about seven tons, but on a 14 per cent grade it would require only one ton of vertical pull in the well to counterbalance it; and that is the weight so employed. A cable, running over a big, stout pulley, will connect the counterpoise with the car; and only one car at a time will be helped either up or down the hill; and, obviously, after an up trip the next one must be a down trip. The cable is attached to a "grip" on the car, and will run in a conduit. Mr. Smithman has invented a "differential" drum, which should render a hole half as deep as the grade is long available, but he will not use it in this first experiment. He has also thought of having a series of holes and weights where a grade is very long.—*N. Y. Tribune.*

Coating Aluminum.

At a recent meeting of the Berlin Physical Society Professor Neesen demonstrated a method of coating aluminum with other metals. This consists in dipping the aluminum in a solution of caustic potash or soda, or of hydrochloric acid, until bubbles of gas make their appearance on its surface, whereupon it is dipped into a solution of corrosive sublimate to amalgamate its surface. After a second dipping into caustic potash until bubbles of gas are evolved, the metal is placed in a solution of salt of the desired metal. A film of the latter is rapidly formed, and is so firmly adherent that, in the case of silver, gold, or copper, the plate can be rolled out or polished. When coating with gold or copper, it is well to first apply a layer of silver. When thus treated the aluminum may be soldered with ordinary zinc solder.