of the guns, and from the fact that it required a strain of 20,600, lb. to remove the keeper—when the current was on. The current was furnished by a 20 arc light Weston dynamo.

"The lines of force were very appreciable when a piece of iron was held in the hand, five or six feet distant from the poles, and some very interesting points were noticed, among which was a neutral point about 7½ inches from the face of the muzzle of each gun. Small pieces of wire were projected outward with considerable velocity, and then drawn back after reaching a point some two feet from the muzzle. Watches were of course stopped when accidentally brought near the guns."

The Sanitary Qualities of Artificial Butter.

BY JACOB R. LUDLOW, M.D., EASTON, PA.

The late Professor Hughes Bennett is quoted as saying that the great cause of the prevalence of pulmonary phthisis was the scarcity of good butter and the abundance of pastry cooks. The butter supply has always been inadequate. Years ago farmers and laboring men used pickled pork and bacon as fat foods, and butter only as a luxury. But nowadays everybody eats butter, whether he live in a shanty or in a palace, and the demand is so great that if we were dependent exclusively on the cow for our butter, the price would exclude it from the tables of all except those in comfortable circumstances.

Within a few years science and art have given us a substitute in oleomargarine and butterine. The skill and success that have been shown in its manufacture are quite phenomenal. It is really a triumph in its way. It is much better and more wholesome than much of the butter found in the markets. It has brought down the price of butter fully fifty per cent. The quality is uniform and the sources of supply inexhaustible. It is really a boon to the poor man and the man in moderate circumstances. Yet it is denounced and misrepresented by the dairy interest, because its extended use has diminished their profits.

It is called "stuff" and "nasty," and attempts are made to excite prejudice against it as unwholesome. Laws are passed taxing it, and more or less prohibiting its manufacture and sale. These laws and methods have chiefly one effect: they raise the price of butter, whether dairy or factory, on the consumer. They never will prevent its manufacture and sale. So long as men can make artificial butter which cannot be distinguished from dairy butter by sight, taste, or smell, so long will it be made and sold, and legal restrictions advance the price without diminishing the profits of its manufacture.

In the interest of the masses, I think the profession should protest against unnecessarily adding to the cost of a food so valuable and important. The rich man may enjoy his gilt-edged butter, but without this aid the poor man must be forced to use the inferior grades of dairy butter, strong, garlicky, carelessly made, and often unwholesome.

The wise fools calling themselves reformers, who, a few years ago, went about lecturing upon the injurious nature of fat as a food, did a great deal of harm in exciting a prejudice against fat ham, bacon, pickled pork, and other forms of wholesome fats; and now a delicately prepared fat, so closely resembling butter as to be easily substituted for it, is to be driven, if possible, from the market, for the sole purpose of adding to the profits of a special industry. Congress had better subsidize the dairy interest from the surplus in the treasury than to collect this additional tax directly from the people.

It is proposed to reduce the tariff on sugar. This would very likely not reduce the price of sugar to the consumer, and if it did, so much the worse. Sugar is too cheap already, and too much is eaten for the good of the public stomach, while a palatable fat food, which the people need, is discountenanced by a prohibitory price.

I have no interest, pecuniary or otherwise, in either dairy-made or artificial butter, but as a practitioner of medicine my attention is called to forms of food that may not make a recourse to cod liver oil so often a necessity.—*Medical and Surgical Reporter.*

AN illustration of the practical usefulness of bacteriology was furnished recently in this city. An Italian steamer arrived loaded with immigrants. There had been no cholera on board, but, as the vessel reached this port, a suspicious case of diarrhœa occurred in a child. The symptoms were not perfectly typical of cholera. Some of the dejections were taken, and sterilized tubes were inoculated and taken to the Carnegie Laboratory in this city. It would take four days to develop the cultures, and the question arose whether the steamer should be delayed for that period of time. It was finally decided to do so. The cultures developed in the way characteristic of Asiatic cholera, and the diagnosis was made. Subsequently other cases of cholera appeared, and the culture diagnosis was abundantly confirmed. But no more striking example of the utility of scientific studies could be furnished than the one referred to.—*Medical Record.*

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 628.

For the Week Ending January 14, 1888.

Price 10 cents. For sale by all newsdealers.

THE BARBED WIRE PATENT DECLARED INVALID.

This famous patent has at last been declared invalid in Circuit Court proceedings. The rights were founded on the Glidden patent, No. 157,124, dated November 24, 1874. Hitherto it has met with no legal reverses, though numerous attempts have been made to overturn it. The last decision, rendered by Judge Shiras, in Iowa, declares it void for want of novelty.

The grounds afforded by the proofs for the decision are interesting. They illustrate the precarious tenure of a patent under the existing laws, yet in the life of fourteen years that the patent has enjoyed, an adequate reward to satisfy the equities of the case has doubtless been reaped by the owners.

The defendants in the suit averred that as early as 1859 a prior inventor named Morley had devised a barbed wire fence, and had constructed and exhibited it at a fair in Delhi, Iowa. Witnesses were produced who swore that they had seen it. One had been injured by contact with the barbs; another one had his horse cut by them; the blacksmith who had made it testified clearly to such fact. A sample of the material about a foot long and with two barbs still attached was produced as the only piece left of the original wire.

The witness who averred that he had been injured showed the scars, and the fact of their presence on his face was entered on the record by the examiner. All this testimony related to a period now nearly thirty years past. The details of the testimony are quite dramatic. The record occupies about 10,000 typewritten pages.

This reversal of preceding judgments probably means that the patent is extinguished, practically, forever. The case has been appealed to the Supreme Court, but in the ordinary course will not be reached for three years. This will be within a few months of the term of the patent, and will end the whole question, except as regards the collection of arrears of damages.

Great rejoicing, it is said, will follow this decision. The farmers are supposed to be greatly benefited by it. The contrary is the case. They will receive no benefit worth mentioning as regards reduction of price. By the intelligent exploiting of the patent, which embodied undoubtedly a *bona fide* invention on the part of Glidden, the farming world was immensely enriched. The farmers, not the patentee or owners of the patent, have secured the greatest good from the cheap and efficient form of fence that it supplied. It would seem a hardship that the patent should expire on account of the unused and dormant invention of thirty years ago, were it not that large royalties have already been collected. Except for this, abstract justice would seem absent from the results of the recent trial.

The illustration the matter affords of the actual good done to communities by patents is valuable. In 1859 the wire was invented and shown in public applied to fence construction. But it was not patented, and hence nearly faded from human knowledge. But when a later inventor reinvented it and patented it, he became at once a benefactor to his kind. When patented, which, etymologically, means laid open to the world, it at once became one of the most valuable franchises the country has seen, the value of which was in exact relation to the good it did to the farming community; as they used it largely, they afforded a measure of its worth.

It is proper that if the proofs are good, the patent should expire. But it has during its life been a source of profit to the users of the fence, and not of injury. It has given them what they never had before, it has cheapened fencing immensely, it has solved the problem of inclosing the vast prairies of the West, and for the good it has done, the trifling royalties are but an insignificant remuneration.

THE DESTRUCTION OF THE GREAT LUMBER RAFT.

The great timber raft, whose departure from Nova Scotia was chronicled by us December 24, has gone to pieces and is irreclaimably lost. On December 8 the structure left its port in tow of the steamship Miranda. The ingenious nature of the construction adopted became evident at an early period of the trip. The captain of the towing ship found that if he relaxed his pull upon the tow lines in a seaway, the logs would work loose. This was the precise feature the patentee and inventor had striven to secure. All went well until a position south and east of Nantucket was reached. Here a severe gale proved too much for the two cables and connections with which it was towed. First, a fifteen inch steel hawser broke, and shortly afterward its companion pulled away the bits to which it had been secured. The raft was now entirely disconnected from the steamer, and in five minutes was out of sight. This occurred on December 17. The Miranda immediately steered west and reached her destination in safety.

As great fears were entertained for incoming vessels, which might be sunk by colliding with the raft, the navy steamer Enterprise and the revenue cutter Grant set out to find the raft and warn vessels of its possible proximity. The Enterprise was successful in her quest, as she found the debris of the raft. It was completely broken up, and the logs were scattered over an im-

mense area of water. Every day will drift them farther apart. It is believed that there is now no danger to navigation to be apprehended.

This feature of easy destructibility when not towed is beneficial as regards the danger such a craft might be to ships if it was abandoned. It also emphasizes the need of a better arrangement for towing. Certainly, where so many thousand dollars were at stake, it would seem advisable to have two steamers connected to the center cable. On the maintenance of the strain on this cable the integrity of the craft is entirely dependent.

It is stated that the enterprising owner has not given up the idea of rafting timber by the ocean. Another attempt, it is anticipated, will be made next year. With sufficient provision for towing, and with fairer weather, there is not the least reason to doubt a successful issue.

DISCOVERY OF PLATINUM IN THE SUN'S ATMOSPHERE.

Professor C. C. Hutchins and Professor E. L. Holden, of the Harvard University Physical Laboratory, have begun a most interesting work pertaining to observations on the chemical constitution of the sun, which has already led to some remarkable results.

For the purposes of the new investigation they were supplied by Professor John Trowbridge with one of Professor Rowland's magnificent diffraction gratings, ruled on a concave of speculum metal, 21½ ft. radius of curvature, 14,438 lines to the inch, ruled surface 6 inches by 2 inches. The settings of the grating and of the photographic apparatus are such that the center of the photo-sensitive plate may be almost instantly set to within a single wave length of any given line in the spectrum.

For the purposes of spectrum comparison, a powerful electric lamp is used, the lower carbon being of cup shape. So intense is the heat that any ordinary compound placed within the cup is at once reduced to the metallic state.

The general arrangement and construction of the apparatus, as a whole, is such that any desired section of the sun's spectrum may be photographed on the upper half of the photo-plate. The sun light may then be shut off, and a photo made on the lower half of the plate of the spectrum of any substance inflamed in the electric light. The spectra thus obtained are then examined at leisure by a magnifying glass, and any coincidences between the solar and metallic lines noted according to their wave lengths.

The observations so far made by the authors convince them that the whole matter of coincidences of metallic and solar lines needs re-examination, and that something more than the mere coincidence of two or three lines out of many is required to establish even the probability of the presence of a metal in the sun.

The results obtained appear to cast doubt upon the existence in the sun of quite a number of elements before regarded as certainly existing in the great luminary.

An interesting result of these researches, described in SCIENTIFIC AMERICAN SUPPLEMENT, No. 628, is the discovery of platinum in the sun.

The Tinning and Retinning Industry.

Tin is an almost silvery white, highly lustrous, non-elastic metal, softer than silver and harder than lead, malleable at ordinary temperature into thin tin foil, and so ductile that it can be drawn into fine, very flexible wire, which, however, breaks under a weight of less than one ton per square inch, and is so brittle as to be broken by a blow or fall. It is not appreciably affected in density by hammering, is fusible at 442°, burns in air at high temperature, with white light; is volatile at a very high temperature; comparatively indifferent to air or moisture at ordinary temperatures; and is a good conductor of heat and electricity.

The Romans employed tin for lining vessels of copper in which were cooked articles which would corrode the copper. Silver was also used for the same purpose, and afterward an alloy of lead and tin, known as pewter. The tinned vessels were known as *vasa stannea*. Pliny, referring to this tinning process, says the pure tin was always given the preference, the mixture of lead being considered a deteriorating adulteration.

The process employed by the ancient Romans was an immersion, similar to that practiced at the present day.

The art of tinning plate iron was invented in Bohemia, and carried from thence into Saxony in 1620, and other parts of Germany, whence all Europe was supplied until the end of the seventeenth century. The manufacture was begun in England, under Yarranton, in 1675.

Iron may be coated with zinc first, and then very readily tinned by dipping into the fused metal, since tin and zinc have a common affinity.

The process of tinning as used for small iron and other articles in Chicago shops is very simple. The articles to be tinned are generally immersed for a few minutes in a tub of dilute acid, then scooped into a wire basket, dipped into the melting pot containing pure molten tin, given two or three vigorous shakes, then taken out, and the contents dumped upon the floor or into a receptacle.

The principal business in the tin plating industry in Chicago is conducted by the Adams & Westlake Co. and the Chicago Stamping Co., and is confined wholly to what is known as "retinning." In the process of forming stamped tinware, flat sheets of metal are placed in powerful presses and forced by means of dies into shape. This shaping process and enormous pressure on the metal completely disintegrates the tin coating, breaking the fibers, and rendering the surface of the wares fractured, rough, and unfinished. This defect is remedied by replating, which reincorporates and reunites the surface, correcting all fractuosity, and making the ware bright and new. The ware to be replated is dipped into a caldron of boiling tallow, so hot that the original tin plating is softened up and melted from the surface of the sheet iron. Then the article so treated is dipped into a pot of fused tin, where it takes on a new coating of that metal. It is then dropped a second time into the grease pot, which has the effect of evenly distributing the coating of tin, taking off the superfluous metal. It is then put into a box of bran, where it is cleansed of the thickest of the grease, and finished by being rolled in flour and middlings, which completely cleanses the ware, leaving it smooth and bright.—*Amer. Artisan.*

Progress of American Railways.

According to the *Railway Age*, the year 1887 has surpassed all other years in the extent of railway mileage constructed in the United States. When, six months ago, the prediction was made in these columns that the total new mileage for the year "would not be less than 10,000 miles, with the likelihood of surpassing the record of 1882, the year of greatest railway construction in the history of the country," it was not generally believed. But the figures obtained by careful investigation throughout the year, and confirmed by official information, now prove the prediction to have been more than warranted. Our returns show that during 1887, 12,724 miles of new main line track were added to the railway system of the United States, no account being taken in this of the hundreds of miles of side track built, nor of the thousands of miles of main line tracks relaid.

While the search has been unusually thorough and the totals corroborate the record kept from week to week, it is not improbable that some scattering additions may yet be received, so that it is safe to state that during 1887 nearly, if not quite, 13,000 miles of new main line track were constructed. When, in 1882, during a period of extraordinary activity, 11,568 miles of new road were built, it was generally believed that these figures would not again be equaled. In the following year, 1883, the new construction fell to 6,741 miles, in 1884 to 3,825, and in 1885 to 3,608 miles.

The year 1886 witnessed a considerable revival of activity, and 9,000 miles of new road were built—a greater mileage than in any previous year with the exceptions of 1881 and 1882, and now 1887 has witnessed the building of more miles of railway than 1886 and 1885 combined, and not much less than 1885, 1884, and 1883 together.

The number of different lines constructed is surprisingly large, aggregating, after deducting for the duplicating of roads lying in two or more States, 364 lines. Of course the number of companies building these lines was very much less than this, but the new mileage consists of main lines and branches ramifying in all directions, and supplying facilities for transportation to innumerable communities and to vastly extended regions.

The greater part of this prodigious increase of railways has taken place in a few Western States. New England and New York contribute scarcely anything to the grand total. The great Middle States add very little, and the additions in the Southern States are not as large as many anticipated, although Alabama presents a fine record with over 500 miles, Georgia adds 230 miles, Florida nearly 200, and Kentucky and North Carolina each a little less than that. The Northwestern States have shown very considerable activity, but the great rush of railway building has been in the central belt west of the Missouri River. Kansas leads with the total of 2,070 miles. Nebraska comes next, with 1,101 miles, almost equaled by Texas, with 1,055 miles. Four States and two Territories—namely, Kansas, Texas, Nebraska, Colorado, Dakota, and Montana—together show an addition of over 6,400 miles, or about one-half of the entire year's mileage of the country. The only States from which no new construction is reported are Vermont, Connecticut, Rhode Island, and Nevada.

Many of the lines have been built through comparatively level country, requiring but little grading and bridge building, but, on the other hand, many other lines have been very costly. Moreover, several of the companies have purchased costly terminal facilities in large cities, while nearly all have made extensive purchases of equipment. It is probably fair to assume that the total cost of roadway, bridges, station buildings, terminal facilities, and equipment of these new lines averaged $25,000 per mile, at which rate it appears that not far from $325,000,000 have been expended on the lines completed during the year. But even this prodigious sum does not by any means cover all the outlay for new construction, as a large amount of grading and bridge building has been done on extensions where the track has not yet been laid. Evidently the work of the railway builder in 1887 has necessarily had a powerful influence on the financial condition of the country. The money which has thus been expended has temporarily employed a large army of workmen, and it has also furnished permanent employment to another great army, probably aggregating, at the average of five employes to a mile of road, about 65,000 persons.

The railway mileage of the United States at the commencement of 1887 was stated to be 137,986 miles. The extensions for the year here recorded increase it to 150,710 miles, and it may be said that, in round numbers, the United States to-day has 151,000 miles of railway lines.

Recent Naval Inventions.

Lieutenant Hovgaard, of the Danish navy, has made a notable addition to the literature of submarine and torpedo warfare in a book just published, in which he gives a description of a submarine boat which he has designed, which shall be able to dive below the surface at any moment, continue her course under water for a considerable distance, and remain there for many hours, retaining the while her capacity for continuing her work. For driving her machinery he employs steam above water and electricity in stowage batteries under water. The transverse section throughout the vessel is oval, the greatest axis being horizontal and the vertical axis just sufficient to give the necessary head room. The entrance is full, and the run long and fine. Such a form will give poor surface speed, but is the best for propulsion when totally submerged, while on the surface or awash her steering power will be very good, and the shape gives the utmost strength. Two screws sunk in protecting wells give vertical motion, while various ingenious arrangements of screw propellers, rudders, and pumps, all of them working automatically, preserve the direction, both vertical and horizontal, as well as the trim of the vessel. The cost of such a vessel the inventor puts at $250,000.

Lieutenant Boyer, of H. M. S. Malabar, has recently been experimenting in telephonic communication at sea. The signaling apparatus of his invention consists of a gong fixed against the side of the vessel below the water line. A straight tube leads from this gong to the bridge, and in its interior is a rod, by which the hammer can be worked, and the striking may be in accordance with the Morse code. In the center of the gong is fixed a telephone, connected by means of wires running up the tube to a second telephone on the bridge. This forms the receiver. If two ships be fitted with this combination, it is maintained that it is only necessary for one to rap out her message by striking her gong and for the other to receive it on her telephone. The sound waves from the transmitting gong traverse the intervening water and vibrate the diaphragm of the submerged telephone at a distance. These vibrations excite currents in the latter, which, in traversing the second or observing telephone, reproduce the original sounds.

Is Clay a Mineral?

A most curious suit was recently presented before the English House of Lords for adjudication, in which the above question was the issue. The corporation of Glasgow purchased some land at Westham for water works and conduits, and erected thereon a reservoir. In the deed there was a clause included that stipulated for the seller a reservation of "the whole coal and other minerals." Coal seems not to be present underneath the reservoir, but merchantable clay is there, and to it the representative of the original vender lays claim, The land in the immediate vicinity has been worked for clay almost up to the boundary of the reservoir, and the right of extending the workings regardless of their effects upon the corporation's structures is claimed. Various decisions have been reached in the Scotch courts, and now the case has at last reached the final tribunal. The contestant offers to relinquish his title to the clay for the modest sum of £10,000, only £1,000 less than he originally received for the property.

The scientific fact that clay is a mineral is admitted, and also, under the railway clauses act, it is conceded that it may be considered such. The Scottish courts present at least a majority of opinion against the corporation. The point that clay is an ore of aluminum strongly indicates that it is in the economical sense a mineral. It will be interesting to see whether the Scotch baillies will prove to have been outwitted by an over-clever seller.

FLEXIBLE MUCILAGE.—To 20 parts of alcohol add 1 part of salicylic acid, 3 parts of soft soap, and 3 parts of glycerine. Shake well, and then add a mucilage made of 93 parts of gum arabic and 180 parts of water. This is said to keep well, and to be thoroughly elastic,