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,