to devise convenient and suitable devices of the kinds mentioned. Let us have some new ways of permanent protection for buildings; and meanwhile, who will be the first to put up a light ladder, a coil of stout rope, treated with tungstate of soda or other fireproof wash, so as to be uninflammable, a respirator, and a self-lighting lantern, all in a case, which will take up less room than a Patent Office model? Inventors might contrive a trunk, satchel, or portmanteau, with these arrangements stowed away in a special receptacle, and containing besides a box for holding valuables, made of asbestos pasteboard, which will withstand even the heat of a fierce furnace fire for some time. Pocketbooks of this material might be made, which, if lost in a burning building, would stand a good chance of being found in the ruins; perhaps, however, with the contents destroyed, unless they contained coin.

OUR IRON SHIPBUILDING INDUSTRY.

Messrs. David Brown & Co., a London shipping house, has recently issued a circular, practically addressed to American shipowners, on the substitution of iron for wooden vessels, and on the supposed superior advantages existing in England for the construction of the former. After setting forth the advantages of the iron ships, the circular says: "It behoves American shipowners, therefore, to consider their disadvantageous position, in not being allowed to compete with those of all other countries by buying their ships in the cheapest market. The protective laws of the United States might serve the interests of shipbuilders if any builders pure and simple existed; but it does appear a hardship that the owners who, for the most part, now build their own ships, should be hampered by such restrictions, and have their shipping property confined to such ships as are built only in the United States. Iron ships in this country can now be built at about £13 10s. to £14 per ton, and with most profuse outfit."

It is true that American owners have not adopted iron sailing vessels to any such extent as have their English competitors; but there are reasons, notably the cheapness and abundance of wood in this country, the skill of our constructors in producing fast and durable vessels of that material, besides others, which tend to account for the slowness of the substitution. The assertion in the foregoing circular which calls, however, for an exposition of the facts, which carry with them its denial; is that relative to the absence of builders in the United States, and the further inference that England is the cheapest market. The New York *Tribune* has recently published a valuable review of our iron shipbuilding industry; and this, in connection with the elaborate report which *Engineering* has lately given of shipbuilding on the Clyde during the past year, forms the basis of the following:

Five years ago, in all the items that go to make up the cost of a ship, England possessed an incontestable advantage. Raw materials and labor were much cheaper than in the United States, while the facilities for shipbuilding were greatly superior. But in this short interval material changes have been accomplished. Shipbuilders in this country have erected rolling mills, furnaces, and shops; and a remarkably large amount of the best labor-saving machinery known has been invented and put in operation. One single builder, Mr. John Roach, has spent, including his original capital invested, some $2,000,000 in supplying his yards and shops; and other builders have not fallen behind in proportionate outlay. Again, the price of iron has been reduced. Five years ago, pig iron ranged from $45 to $70 per ton in the United States. Since then, our imports, in view of the progress made in the development of mines, have fallen from 800,000 to 165,000 tons, and the price is reduced to $18 per ton—as cheap as anywhere in the world. Copper has fallen so in price that we are now exporting it. The great item, however, is labor, the cost of which constitutes fully 60 per cent. of that of a steamer, and at least 50 per cent. of that of a sailing vessel; or, starting with the pig iron and sawn lumber, it is estimated to amount to 80 per cent. of the cost of a steam vessel. This we have reduced by the invention of new labor-saving machinery, which the English do not employ; and a reduction has also taken place owing to the general shrinkage in values, so that the price of labor here and in Europe is more nearly equalized. Mr. Laird, the great English shipbuilder, during his recent visit to this country, admitted that, with the appliances in use in American shipyards, it might be possible, all other things being the same, for Americans to produce as cheap a ship as the English, and even pay the men better wages. It is not a question of "might," however, for our builders are now standing ready to furnish the class of vessels, specified in Messrs. Brown's circular, at Clyde prices; and Mr. Roach offers within the present year to complete any number of iron sailing ships, from one to six, for the same price ($67.50 to $70 per ton), referred to, and in currency, and to deliver the vessels on the other side, provided he has the privilege of taking a cargo in them. He guarantees them further to receive the best ratings from European and American insurance companies.

Our iron shipbuilding industry began in 1868; and since that time there have been built for American owners 251 iron vessels of all sizes, having a total tonnage of 197,500. The annual aggregate of iron vessels now built in this country is over 30, worth from $12,000,000 to $15,000,000; and the business is rapidly expanding. These figures are of course small beside the immense totals of the Clyde industry, at present; but for the four years beginning with 1872, the returns shown by the latter are phenomenal, and the 1876 report indicates notable diminution. Vessels aggregating 224,000 tons were built in 1872; in 1874 the figures showed 266,000 tons; in 1876, 204,770 tons. It is suggestive to note that since 1873 the number of iron screw steamers built on the Clyde has steadily fallen off. Thus, in 1873, 125 were built; in 1874, 120; in 1875, 113; and last year but 83. Paddlewheel steamers show a slight increase, as follows: 1873, 14; 1874, 10; 1875, 13; and 1876, 16. Now in the face of this decline abroad, Roach alone reports the construction of 33 iron steamers, aggregating 68,150 tons, since 1872. This is an average of 13,630 tons per year for this builder, on these vessels alone (not counting all kinds, "from the tiniest yachts to ironclad ships of war," such as are included in the English reckoning); and this average, compared with the figures of individual English builders for 1876, would place the American concern third on the list—above John Elder & Co., and far ahead of the Napiers, whose total tonnage for 1876 was but 9,111.

It needs but a brief examination of Mr. Roach's tabular statement, showing how he has invested nearly $15,000,000 in iron shipbuilding within five years, to perceive how vastly profitable to the country this industry promises to become. Here, for instance, is the list of items of material and of necessary expenditures: Plate iron, angle iron, deck beams, rivets, bar iron and forgings, pig iron, steel, ingot copper, sheet copper and brass, tin, spelter, brass tubes and condenser tubes, iron boiler tubes, brass boiler tubes, lumber, paints, files, hardware, bolts, nuts, rubber, oil waste, etc., steam pumps, windlasses, boats, wire and manilla rope, sails, blocks, steam and gas pipe and fittings, anchors and chains, lead, plumbing, coal, improved facilities for manufacture, new inventions in machinery, sundries, lamps, hose, glass, masts, capstans, etc., and wages. Of Mr. Roach's $15,000,000, over $7,000,000, or about 50 per cent, have gone for wages alone; plate iron takes about 17 per cent, and wood, cotton, hemp, etc., costs about 5 per cent of the whole. Sifted down to the crude raw material, it will be found that 80 per cent of the total cost of a vessel for skilled labor is a low estimate, and that 90 per cent would be nearer. Inspection of the list also shows at once what a large number of trades are directly benefited.

It may be added that our iron ships are not merely a source of national prosperity, but an important addition to our naval strength. All are constructed so as to be adaptable as men-of-war in case of necessity. Should such need ever arise, the government has at its disposal, free of cost, 50 iron screw steamers capable of steaming at the rate of from 10 to 14 knots per hour. In ten days, in other words, a fleet of better and stronger vessels than the famous Alabama could be gathered and equipped for predatory warfare on an enemy's commerce.

THE ADVANCEMENT IN MICROSCOPY IN THE UNITED STATES.

To all who take interest in the progress of scientific investigation, it is a cheering sign that, in different parts of this country, the use of the microscope—that powerful appliance for investigating the secrets of Nature—is spreading rapidly by the establishment of microscopical societies in most of our large cities. At the late annual meeting of the American Association for the Advancement of Science, the members became acquainted with the Microscopical Society in New York city, which is in a very prosperous condition; and from time to time we notice, in various journals, reports of meetings of such societies which show that few of them are inferior in status to the Microscopical Society of this metropolis, of whose annual exhibition we gave an account in our issue of April 7. The accounts of the recent meetings in San Francisco deserve a place in our columns.

The San Francisco Microscopic Society has fifty resident and forty corresponding members; it holds semi-monthly meetings; and at the annual reception, twenty members exhibited their instruments before three hundred visitors. It has a library of two hundred and fifty volumes, and a cabinet of six hundred slides, besides much valuable apparatus —acquired by purchase and donation. It appears that the new Tolles objectives had previously not answered the expectations of the members, as a failure in resolving the details of some difficult diatoms was reported. Now, however, the President stated that, in justice to Mr. Tolles, it should be acknowledged that the fault did not lay in his objective, but in the members' inexperience, and that intercourse with experts in this special branch of work had rendered the solution so simple and easy that it caused wonder that it had ever appeared difficult. The one-tenth inch objective of Tolles most satisfactorily accomplishes all that was claimed for it; while the one-sixth immersion objective, by the same maker, gave a clearness of definition that was wonderful, and far surpassed anything which the President had ever witnessed. Not only this, but this glass possesses such ample working distance and such great penetration that it is admirably adapted for investigation upon animal and vegetable tissues, for which these qualifications, especially distance, are so necessary.

The President reported the formation of a class for instruction in microscopy, under the tuition of the librarian, Mr. Clark. The formation of such classes is of great importance, and was impossible a few years ago, when the microscope was regarded as a novelty and a toy, rather than as a tool for the acquirement of valuable and important knowledge.

This San Francisco society is likely to cause some rivalry and emulation among other associations; and the New York society must actively push the science of microscopy forward or it will be overshadowed by the growing institution on the Pacific side of this continent.

In Harvard University it has been concluded to establish classes for laboratory work with the microscope, with special instructions in its use for botanical study, the preparation of anatomical and other objects, etc. Professor Goodale has charge of the course on phenogamic botany, and Professor Farlow of that on cryptogamic botany. Their names are an ample guarantee of the excellence of this newly established department.

The microscopic societies in the United States are attracting attention in Europe; and in a microscopic journal published in London, England, we find accounts of meetings in some of our large towns. From Dunkirk, N. Y., it is reported that Professor J. Edward Smith, of Ohio, read a most interesting paper on "The Use and Abuse of the Microscope as an Instrument of Precision." He propounded several new ideas, such as the use of lenses of the widest angle of aperture for all kinds of work, and demonstrated practically his proposition by an exhibition of various objects, some of them illuminated by oblique light thrown at an angle of 75° from the axis of the instrument, and some by a diaphragm plate perforated with an aperture of $\frac{1}{100}$ of an inch in diameter, and with various amplifications from 500 to 2,000 diameters. Professor Smith also exhibited Tolles' $\frac{1}{10}$ and $\frac{1}{6}$ inch duplex objectives, of 180° air angle, and the President, G. E. Blackburn, M.D., a $\frac{1}{8}$ inch Tolles' immersion objective of 95° balsam angle. In view of the importance and value of some of the tests exhibited, a resolution of acknowledgment and commendation was drawn up and urged by the members and guests present. The report of the meeting is a very creditable indication of scientific progress in the young city of Dunkirk, which twenty-five years ago, when it was the first terminus of the Erie railroad, was a most insignificant country town. Had its growth and intellectual society, now realized, been predicted, the statement would have been deemed incredible.

For the benefit of those readers not conversant with the latest improvements in microscopic objectives, and therefore perhaps ignorant of the expressions "immersion objectives," "angle of aperture," "balsam angle," and "air angle," we will explain these terms.

The immersion objectives are lenses of which the extremity has to be used immersed in a minute drop of water, placed upon the slide. The advantages are that loss of light by two reflections, namely, from the upper surface of the slide and the lower surface of the lens, is done away with, as the water drop unites their two surfaces and makes the lower lens of the combination and the covering glass of the slide practically one body. Next, the distance is increased, and a powerful lens, of which otherwise the focal length would be too short to be used with a covering glass, may, by the immersion system, be used at a more convenient distance without changing the magnifying power. As a result of the short focal distance, the working distance is considerably increased; but the great advantage of these lenses is their wonderful clearness and definition, which are of the utmost importance in examining minute objects accurately, so as to obtain a correct idea of their structure and not to be misled by deceptive appearances to which ordinary lenses of short focus frequently give rise.

In regard to angle of aperture, we ought to state that experience has shown that central illumination often drowns minute details in a flood of light, and that objects can be better seen by oblique illumination; but with the latter, with ordinary lenses, the visible field is darkened. The makers of lenses have in some instances contracted them so that, even by very oblique illumination, the light reaches the eye, and the field remains bright. The extreme positions in which the light may be placed sideways from the axis of the instrument, and still be thrown in the axis, give us what is called the aperture; and the angle formed by the lines of these positions is the angle of aperture. The air angle is that obtained when the light passes through air only; the balsam angle is that obtained when the light passes through a slide of which the object is preserved in Canada balsam. As different fluids have different angles of refraction, they of course influence the angle of aperture.

We shall keep watch for news of further proceedings of these valuable societies, and hope to hear of the formation of new ones in all parts of this country.

TRIALS have been made in Rome of a solution of chloride of calcium as a substitute for water in laying dust in streets, and the results are said to have been highly satisfactory. The dampness communicated to the road remains for a whole week. The road remains damp without being muddy, presenting a hard surface, on which neither the wind nor the passing of pedestrians or horses has any effect.

C. M. writes to point out that minute objects photographed in large size by the help of a microscope are properly termed photo-micrographs; and that the minute photographs which require a microscope for their explanation are called micro-photographs.

E. N. L. writes to point out that a cracker-packing machine is needed, and a successful appliance of the kind would amply reward the inventor, especially as it would be useful in many trades in which similar articles have to be prepared for shipping.