enemy's intermediate battery; and thirdly, a numerous battery of 3-inch, 12- or 14-pounder guns, whose province it would be to smother the enemy with a storm of projectiles, and effect that general demoralization of the enemy's aim, which results from the concussion and indescribable din, to say nothing of the wreckage, of a storm of bursting shell. It seems to us that these conditions are excellently realized in the battery of the majority design of the Board on Construction. At the same time it is undeniable that Rear Admiral Bradford makes out a strong case in his minority report for the *tactical* advantages to be gained by mounting a numerous 8-inch battery in double- and single-decked turrets. The Bradford design has the advantage of possessing an overwhelming power of attack; although it gains this by the adoption of principles of construction that expose the vessel to the risk of a sudden disablement of a large portion of its main armament. The Bowles design, on the other hand, though less formidable for offense, is relatively simpler, less liable to quick disablement by a few well-placed shell, and with its larger secondary battery of 3-pounder guns, and the more rapid fire of its intermediate battery of 7-inch guns, would, in a given time, deliver many more aimed shots than the minority type of vessel.

However, after every argument has been made, one cannot but feel how purely theoretical is the whole question of battleship design. Only the test of a grueling fight between ships of opposite type could determine their respective merits. The Spanish-American war should have furnished the naval constructor with much of the proved data for which he is ever looking; but unfortunately the one-sided character of the engagements rendered the technical lessons of the war altogether meager and disappointing.

VARIOUS USES OF PAPER.

BY GEORGE E. WALSH.

Paper manufacturers have developed their industry in two ways in recent years, and the results justify all the labor and experiment carried on through the application of science and chemistry. The application of machinery to cheapen the process of converting the raw material into different grades of paper has enormously stimulated paper production in this country, and the various processes employed have often been described.

But a no less important expansion of the paper industry has been in increasing the manifold uses to which paper can be put. Here, too, science has been the chief agent, and it has wrought remarkable changes and improvements. Chemistry has been laboring in this field for two decades, and from the laboratory have come discoveries that have made possible the numerous side-products of the paper trade that are now manufactured on a large scale.

One of the things in the paper industry that seemed almost incredible a number of years ago was the manufacture of car wheels. It seemed incomprehensible to the lay mind that wheels made of compressed paper would stand the strain better than wheels made of steel. But the manufacture of paper wheels is no longer a novelty, and they are made in a great variety of sizes and shapes for use on roller skates up to heavy car wheels. After the car wheels made of paper were announced somebody applied paper to the construction of hollow telegraph poles, which were designed to take the place of those which had heretofore disgraced our streets and highways. But paper telegraph poles have never proved of any great value except to illustrate to the skeptical what can be done with paper.

There have in recent years been made of paper, water and sewer mains which promise to be of value. These are hardened and treated chemically so that they are more impervious to water than some of the iron and earthenware mains. It remains to be proved by actual test whether they can outlast some of the latter. The announcement was made a few years ago that paper window panes had actually been made and used, but these were much like the oyster-shell window panes of the Filipino huts. They may admit a certain amount of light to brighten up the interior, but they could never be looked through with any degree of satisfaction. Still, a semi-opaque glass is often needed for the ceilings of public buildings, where the light admitted must be dimmed and diffused in passing through the substance. Paper window panes have been used in this way with more or less success.

We are not only the greatest producers of paper in the world, but we have adapted it to more practical uses than any other nation. Our machinery for making paper, and for converting it into useful articles of commerce, surpasses that of any two European nations, and even in France and Germany, where the refinement of paper finishing has for years reached the high-water mark, our machinery is largely used. In fact, it might be said with considerable truth that our paper machinery has outstripped our paper production, and great as the latter is, the former eclipses it in extent and variety.

By means of improved machinery and new chemical processes wood pulp can be drawn out into the thinnest imaginable sheets. In this spinning and squeezing the paper does not lose its toughness. Thus thin paper napkins and table cloths are produced and printed with fancy borders and patterns. Some of these articles are almost as tough as linen in resisting the attempt to tear them. Of course, they will not stand wetting and soon lose their toughness when moistened. But otherwise they make serviceable substitutes for table linen. Likewise the paper vests and paper underclothing and lining of winter suits are prepared for practical use, and they accomplish nearly all that is claimed for them. The paper vests and lining are made so thin that their weight is practically nothing, and yet they keep out the wind and cold. They are chemically treated, so that they will last a long time. They are also manufactured so that they do not make the rustling sound usually characteristic of paper, and they are pliable enough not to stand out or bulge the cloth in any way.

Waterproofing, and more recently fireproofing, of paper have occupied the attention of chemists and practical paper makers. Paper made waterproof and as fine as the ordinary napkins and table cloths would prove a boon to many lines of industries, especially at restaurants and hotels. It is said that public eating houses are waiting anxiously for durable paper napkins and table cloths. Waterproof paper is made to-day, but not in such a way as to be valuable for table use. Waterproof paper sheets are frequently glued to cloth, and in this way the latter is rendered impervious to moisture. This waterproof paper is good, however, only for limited lines of articles.

Lately the paper pulp mills have been experimenting with fireproof paper. In fireproofing wood it has been found necessary to inject into it under great pressure non-inflammable chemicals, and thus either drive out or neutralize the inflammable material of the wood. It has been found that these fireproofing substances can be introduced into the paper pulp much easier than they can be injected into wood. Many attempts have been made to mix the right chemicals in the paper pulp to render the paper made therefrom fireproof. Not a little success has been attained in these experiments. In fact, the experiments in producing fireproof paper paved the way for making fireproof wood. The wood pulp that is compressed into molds for general household uses, such as for wainscoting, dadoes, ceilings and moldings, can be made fireproof in the same way as the paper. The fireproofing material is introduced and mixed with the wood pulp when the latter is in a soft, pliable condition, and when hardened through hydraulic pressure the chemicals remain in the wood.

This is one of the most interesting lines of experiments yet attempted by the wood pulp mills. It opens up a world of new possibilities. Should they succeed in producing perfect fireproof wood pulp there would be nothing to prevent them from furnishing our builders and marine architects with nearly all the interior wood trimmings in pressed material. The demand for such fireproof wood pulp products would be extensive. Our Navy Department is demanding such material for their battleships and cruisers, and the builders of the great skyscrapers in our cities are just as anxiously looking around for the same thing. If fireproof wood pulp could be produced satisfactorily it would enter into our daily lives in innumerable ways.

When we consider the great number of household articles already made of wood pulp, it can readily be understood that a fireproofing process for paper and wood would be immediately of great value to all. The interior trimmings of railroad cars, ferryboats, ocean and river steamers, public halls and hotels are nearly all made of hard wood treated with oil, so that it is more inflammable than in the natural state. All this trimming of wood forms a daily menace to thousands of people, and should a fire occur it would sweep irresistibly through these handsome steamship saloons and parlor cars. The whole trade is merely waiting for the proper fireproof wood to make revolutionary changes in its methods.

There are innumerable smaller trades built up in recent years as the result of improvements in manufacturing paper. Thus in the electric light business compressed paper, chemically prepared, is of great value, and it is employed for insulating purposes on a large scale. Paper is in increasing demand for packing perishable goods. Butter, cheese and similar products packed in waterproof oiled paper will keep twice as long as when wrapped in any other substance. This packing paper is rendered absolutely air-tight. Druggists use large quantities of it for wrapping around the corks of their bottles, and even in sealing up boxes of medicine which need to be kept from the air as much as possible. In this way results are obtained which cannot be approached by any other cheap material. Filter papers are also articles of considerable commercial value. Thousands of tons of fine filtering paper are used every year in the drug trade.

SCIENCE NOTES

The Olympic Theater at Vincenza has been reopened with the Œdipus of Sophocles. We illustrated this wonderful building in the SCIENTIFIC AMERICAN for July 16, 1898.

The Baldwin-Ziegler expedition sailed on the exploring ship "America" from Vardoe July 31, the vessel's course being shaped for Cape Flora, where Mr. Baldwin hopes to join the "Frithjof" and "Belgica." Mr. Baldwin intends to push as far north as possible to establish winter quarters. He has 426 dogs and 16 ponies with him.

The Arctic expeditions of 1901 include the Baldwin-Ziegler expedition, the Russian expedition under Admiral Makaroff, the Canadian expedition, the German expedition, the joint expedition by the Duke of Abruzzi and Nansen, Peary's Greenland expedition, the Stein Ellesmere Land expedition, a Russian expedition in the Kara Sea, to work to the eastward along the Siberian coast, and an expedition to Franz-Josef Land.

Count de la Vaulx, the aeronaut who will attempt to cross the Mediterranean in a balloon in the middle of August, has arrived in Toulon to superintend the preparatory arrangements. Many prominent persons have contributed to the cost of the experiment. An immense balloon shed opening toward the sea will first be constructed. A carrier pigeon post will be established along the coast from Barcelona to Nice, and at Corsican and Algerian ports, with which the aeronaut will communicate.

The New York Police Department has adopted a button invented by a woman, Mrs. Dudley F. Phelps. She has been working on the invention for many years. The button requires no sewing of any kind and can be taken off, cleaned and put back again without tearing the cloth. When she designed the button she had in mind particularly the requirements of uniforms. Two small prongs pierce the material of the uniform and on these fits the top like a glove fastener, which makes the whole thing perfectly secure.

A London firm of photographic apparatus makers, during the sojourn of the Moorish ambassadors, constructed a camera for the Sultan of Morocco at a cost of $10,500. The instrument is of the quarter plate size (3¼ x 4¼) and differs in no respect as regards the fittings from the ordinary camera made by this firm for general purposes. The metal work of the camera is constructed of gold, including the screws, and also the holders for retaining the plates. The instrument occupied the services of ten men for four months, the polishing of the base boards alone requiring eight weeks to accomplish. About 150 ounces of gold have been utilized and the instrument weighs 13 pounds instead of 5 pounds, the weight of the same camera for ordinary use. It is a combination hand and stand camera with double extension racking out from the center and rising front. It has but one lens, a Zeiss working at *f* 6.3. It gives two different foci, and it is stated that the powerful actinic light of Morocco will render the open aperture sufficiently rapid for the focal plane shutter, permitting an exposure of 1-1000th part of a second being given. The iris diaphragm, stopping down to *f* 45, will enable the lens to be employed for interior or sharply defined photography. Another camera was also made by the same firm—half plate in size—but in this instance silver is employed instead of gold for embellishing it. The cost of the second camera was $4,500. The Sultan of Morocco is stated to be an expert amateur photographer.

H. Becquerel has confirmed, by an unpleasant experience, the fact first noted by Walkoff and Giesel, that the rays of radium have an energetic and peculiar action on the skin. Having carried in his waistcoat pocket for several periods, equal in all to about six hours, a cardboard box enclosing a small sealed tube containing a few decigrammes of intensely active radiferous barium chloride, in ten days' time a red mark corresponding to this tube was apparent on the skin; inflammation followed, the skin peeled off and left a suppurating sore, which did not heal for a month. A second burn subsequently appeared in a place corresponding to the opposite corner of the pocket where the tube had been carried on another occasion. P. Curie has had the same experience after exposing his arm for a longer period to a less active specimen. The reddening of the skin at first apparent gradually assumed the character of a burn; after desquamation a persistent suppurating sore was left which was not healed fifty-six days after the exposure. In addition to these severe "burns" the experimenters find that their hands, exposed to the rays in the course of their investigations, have a tendency to desquamate, the tips of the fingers which have held tubes or capsules containing very active radiferous material often become hard and painful; in one case the inflammation lasted for fifteen days and ended by the loss of the skin; and the painful sensation has not yet disappeared, after the lapse of two months.—Comptes Rendus.