

engine worked under 200 pounds boiler pressure, and making nearly, if not quite, 1,000 feet of piston speed per minute; each one of the details under strain is twisted, pushed, pulled and pounded, as one may say, in all directions at each revolution, possibly 100 times a minute. Does it not require a metal of faultless integrity to hold on, not for one voyage, but for year after year with very few failures? Locomotives making high speed with heavy loads are subjected to still heavier tests of the strength of details, for not only are they driven faster, but they have to sustain shocks and jars which are absent in marine engines; but instances of failure, compared to the number of engines in use, are few.

The physical qualities demanded for steel used in marine boilers by the United States Treasury rules would seem to be very exacting, inasmuch as they require a tensile strength of 60,000 pounds per square inch in the best, an elongation of 25 per cent in two inches for plates of quarter-inch thickness, and that the metal be capable of being bent on itself (doubled over) so that the inner radius of the bend shall be only one and one-half times the thickness of the plate, which must be heated to a low cherry red and quenched in water of 82 degs. F. As a matter of fact American boiler plate will stand much severer tests than this; plates half an inch and even thicker can be bent down flat cold so that the parts touch each other, without showing the least "craze" or fatigue on the inner or outer parts of the bend; withal, they will stand a very high heat for flanging purposes or dishing. We have seen plates flogged in a former by mauls, dished out like the crown of a derby hat, and reduced in thickness from three-eighths of an inch to three-sixteenths of an inch at the finishing edges—over a diameter of four feet—without a flaw in the whole plate. This was stock ordered from the mill, taken as it ran, and by no means a special steel.

Wholly aside from the benefits constructing engineers derive from having such material is the security that engineers in charge of ships feel when running at high speeds. When iron was used this feeling did not exist, for there was never any certainty that there were not internal flaws that would give away suddenly under severe duty; but modern steel is so homogeneous in its structure that the percentage of failure from the cause named is very low.

#### AMERICAN ADULTERATED FABRICS AND TESTS.

American looms and dye pits turn out to-day about every variety of fabric for modern need and luxury, and with the rapidly expanding textile industries in cotton, wool, silk, linen, and worsted goods, the time seems approaching when we will be nearly able to supply the world with these products. It was not so many years ago that American looms were comparatively few and unimportant, especially for the more expensive grades of goods, and most of the expensive weaves were imported. But through the introduction of improved machinery and the invention of new methods of weaving and dyeing, we have become within a few decades one of the leading textile manufacturing countries of the world.

Positive genius of a high order has been expended in inventing methods of weaving shoddy and adulterated goods in this country. This has not been with the idea of deceiving or defrauding any one, but simply to meet a legitimate demand. But there should be understood more generally a clear knowledge of the difference between the genuine and adulterated textile goods. If this were thoroughly comprehended, there would be less attempt to deceive, and the purchaser would know what he was paying for. The machinery invented to manufacture these so-called shoddy goods usually adulterate them in the warp yarn and not in the weft. The two-ply yarns are formed by twisting a wool and cotton or silk and cotton yarn together, and if the warp is examined and the yarns untwisted the cotton can be detected. Cotton being the cheapest fiber we have, it is used most extensively in all the adulterated goods. Cotton is cheaper, and also less durable. If the yarns of the warp are removed, and they are tested by fire, it is easy to determine if there is much cotton in the material. In some goods part cotton is better than the pure wool or silk; but in fabrics where it should not be its presence can be detected by burning two or three of the warp yarns. The cotton yarns will flash up quickly and burn rapidly without much odor, but the wool yarns will emit a burnt-hair odor and burn slowly. So sure is this test that it is impossible for any intelligent person to be deceived.

Some of the weaves are so ingeniously put together that it is difficult even for expert buyers and manufacturers to detect the cotton absolutely without some kind of test. The goods are finished off so that they appear as good as the genuine. Expert buyers sometimes test the goods with acids. A sample an inch square of the fabric is taken for the test. This is laid in a porcelain dish, and a 50 per cent solution of sulphuric acid is poured over it. The dish is held over a slow fire for a short time until the cloth be-

gins to undergo a slight change in color. Then, when the solution has cooled off, the cloth will show up the presence of cotton, and also the relative amount in it. The acid solution dissolves the cotton and works havoc with it. If the fabric is all cotton there will be very little left in the dish except a muddy sediment, and if mostly cotton, with some wool in it, the cloth will fall all apart. If it presents a sieve-like appearance cotton is woven in with the wool to a moderate extent. It is only when the fabric comes out of the acid test whole that it can be pronounced all-wool. The effect of the acid on the wool is merely to turn it a dirty red color.

Alpaca, worsted mohair, and shoddy are tested in the same way as wool; but silk will hardly yield so readily to this chemical test. The difference, however, is chiefly in the kind of acid. A 5 per cent solution of nitric acid should be employed for testing silk. Pull from the edge of the silk cloth a number of yarns, making sure that they are from the warp and not from the weft, and dip these one by one in the solution. In this case if they are cotton yarns they will undergo no change, but if they are silk they will turn yellow. If there is any further doubt the weft yarns can be tested in the same way. Any other vegetable fiber besides cotton will show no change when dipped in the nitric acid solution, but silk always will.

In the manufacture of silk goods such tests are quite necessary to-day, for many grades of cheap satins and heavy silks are made which would deceive any except the experts. Some of these have the cotton mixed in with the warp yarns, and by means of patent processes of finishing its presence cannot be detected. Other grades have a cotton back and a pure-silk face. Usually this is so apparent that there is no attempt made to deceive. If such is the case a drop of the acid solution on the back and another on the face would reveal the story. A fiber known as artificial silk is sometimes used to adulterate pure silk goods, and the ordinary silk test described does not affect it. But this so-called artificial silk is a chemical production, and it is so inflammable that it is only necessary to apply a match to a piece of the goods to make it burn violently and reveal the deception.

In linen goods cotton cannot be detected by any of the above tests, and in fact it is here that the greatest difficulty is experienced. Our towels, crashes and heavy damasks are often adulterated with cotton, and it is quite necessary to be able to tell the difference between the pure linen goods and the adulterated. Even pure linen will sometimes pass for pure cotton, so artful are the processes of manufacture. Yet in the case of a handkerchief, a simple process will suffice. Moisten the finger and press it against the handkerchief. If it is pure linen the fabric will absorb the moisture quickly and make it wet on the opposite side. If it is all cotton the absorption of the moisture will be slow, and it will take a good deal to make the wet pass through to the opposite side.

But when the linen fabric has only a portion of its yarns of cotton, it is necessary to resort to an acid test. A 5 per cent solution of caustic potash or caustic soda should be used for this purpose. In half a gill of water dissolve a piece about the size of a walnut. After this has stood a few moments dip the warp yarns of the linen and cotton fabric in it. They should be left in the liquid for about fifteen minutes. The solution will make the cotton yarn contract and, if anything, increase its strength, but it softens and makes very pliable the linen yarns. Thus the material will readily pull apart if all linen, and it will be strong and firm if cotton. By immersing a piece of the fabric in the solution it should pull apart easily if made of part cotton and linen, but remain strong if all cotton.

Mercerized cotton is one of the new process goods that looks a good deal like silk and has a luster all of its own. When it passes as mercerized cotton it is well known, and no deception is intended, but it is often used in knit underwear goods, hosiery and gloves under other names, and thus may sometimes be passed off on the unsuspecting as pure or part silk goods. The silk test, however, will reveal the cotton in the material. More recently successful efforts have been made to dye mercerized cotton. Mercerized cotton is now dyed in nearly all the prevailing shades, but the work is a delicate one and requires careful manipulation. This makes the use of the prepared fabric more general than ever, and also opens the way for deceiving the purchaser who takes his goods on faith from dishonest dealers.

#### BARON NORDENSKJÖLD DEAD.

Baron Nordenskjöld, the Arctic explorer and discoverer of the Northeast Passage, died at Stockholm on August 12. He was a Finn by birth, and received a scientific education. He accompanied an exploring party to Spitzbergen in 1858, after having been appointed Professor in the Royal Museum of Stockholm. He made other trips to Stockholm in 1861, 1864 and 1868. He visited Greenland in 1870 and 1875.

In 1876 he made arrangements for his successful attempt to accomplish the Northeast Passage. In July, 1878, he started in the "Vega". The vessel wintered near Behring Strait, and was free of ice in July, 1879, reaching Japan on September 2 of that year. In 1883 he made a second voyage to Greenland, and succeeded in penetrating with the ship through the dangerous ice barrier along the east coast of that country south of the polar circle.

#### SCIENCE NOTES.

The use of sun bonnets as a head covering for horses in summer is very much on the increase, both in this country and in England. Straw seems to be the favored material, but in England wire framework covered with light calico is also used.

The Council of the University of Birmingham, England, has appointed W. J. Ashley, Professor of Economics at Harvard University, to be the incumbent of the first organizing chair of the future Faculty of Commerce. Such a faculty appears for the first time in university history.

The Agricultural Society of Italy has offered prizes of nearly \$200 for a reliable method of ascertaining the quality of sulphur and of mixtures of sulphur with sulphate of copper. Sulphur is largely used in Italy for diseases of plants, and much of the product sold is inferior. The competition is international.

Encke's comet, which has just returned to visibility, was observed by Dr. William R. Brooks at the Smith Observatory, Geneva, N. Y., on the morning of August 11. At that time it was in Gemini about ten degrees west of Castor. Its position at 3 o'clock was right ascension 6h. 35m. 30s.; declination north, 31 deg. 17m. The comet is moving in a southeasterly direction and approaching the sun. On August 11 it was just visible in the 3-inch finder of the 10-inch equatorial, and as the comet is increasing in brightness it will be observable with quite moderate apertures. The comet is globular in form, and at present without a tail. Professor Brooks says that a short tail may be thrown out as the comet approaches perihelion. Encke's comet has the shortest period of any known comet—three and one-third years.

The Census Bureau has made public its figures giving the population by sex, nativity, and color of a group of states, including Indiana, Iowa, Kansas, and Indian Territory, the results being as follows: Indiana—Males, 1,285,404; females, 1,231,058; native, 2,374,341; foreign, 142,121; white, 2,458,532; colored, 57,960. Of the colored 207 are Chinese, 5 Japanese, 243 Indians and the remainder negroes. Indian Territory—Males, 208,952; females, 183,108; native, 387,202; white, 302,680; colored, 89,380. Of those classified as colored 36,853 are negroes, 27 Chinese, 1,107 Indians taxed, and 51,393 Indians not taxed. Iowa—Males, 1,156,849; females, 1,075,004; native, 1,925,933; foreign, 305,920; white, 2,218,667; colored, 13,186, including 12,693 negroes, 104 Chinese, 7 Japanese, and 382 Indians. Kansas—Males, 768,716; females, 701,779; native, 1,343,810; foreign, 126,685; white, 1,416,319; colored, 54,176, including 52,003 negroes, 39 Chinese, 4 Japanese and 2,130 Indians. The Census Office also issued a bulletin on the manufacturing industries of the four Territories of Arizona, New Mexico, Oklahoma, and Indian Territory, showing an aggregate product of \$37,897,103. Arizona leads with a product of \$21,315,169, of which amount \$12,286,517 was the output of the copper smelters. The total product for New Mexico is \$5,605,795; for Indian Territory, \$3,892,181, and for Oklahoma, \$7,083,938.—Bradstreets.

That driest of all the American States, Arizona, has just come into possession of a seaport, observes the Cincinnati Times-Star. A steamship line has been chartered to ply on the Colorado River from the Gulf of California to Yuma. This little city, situated in the midst of an arid desert, and parched by the eternal sun of the Southwest, thus comes into direct communication by sea with the outside world. At the present time only the smaller class of vessels can navigate the lower waters of the Colorado. It is hoped, however, that the work of dredging the stream will be soon undertaken, and that in time the larger seagoing vessels will be enabled to advance to the wharves of Yuma. The opening of Arizona and southwestern California to direct communication with the sea cannot fail to be of immense advantage to this region. The country is extremely fertile. Only a little irrigation is required to make Arizona one of the most productive states in the Union. Irrigation schemes have formerly been hampered, however, by the lack of suitable facilities for the cheap transportation for the state's products to the seaboard. With the opening of a waterway to the sea Arizona should show a marvelous development. What has been done in California can be done again in Arizona. And when the change takes place the opening up of a waterway to Yuma will have played an all-important part in the development of Uncle Sam's great territory.