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Contents:

(Illustrations are indicated by an Asterisk.)

THE LAWS OF EXPANSION.

The constituents of heat have long remained a problem for scientific men; but up to the present time no satisfactory solution of its peculiar nature has been accepted by the world at large, although very many ingenious theories have been promulgated respecting it. While this is true of heat itself, its action upon matter—solid and liquid—is, in some cases, well understood, and the laws relating to expansion are clearly defined.

The general fact that most bodies expand under heat is well known; the proportion and nature of the change however, which takes place in the object heated, is not alike in every case. Different solids or substances of dissimilar nature expand unequally, but as a rule, uniformly, and resume their former shapes and dimensions when cooled. This statement, however, must be qualified by the remark that there are exceptions in the case of certain metals, as iron, steel, and brass. While the assertion made above is theoretically correct, the fact is unimpeachable that the metals specified do enlarge permanently in bulk with successive heatings, so that it is perfectly possible to remedy spoiled, or damaged work in the machine-shop by this method—that is reheating. To illustrate this in a practical manner, take a crank pin for instance, that has been turned too small in the conical end, so that while it fills the hole in the crank it does not fit it; let this pin be heated and cooled in water three times (not so that scale will form), and it will be found that the metal has gained in size, having absorbed some element that caused its fibers to swell and so enlarge the diameter. Ligneous or woody substances also expand more sideways than lengthwise, and, when greatly heated, *contract* permanently and remain fixed. Argillaceous or clayey substances, such as pottery, contract by heat; in this case chemical changes take place, which alter the nature of the material. Lead is an utter exception to the general law of expansion, as, when under the influence of heat, the particles of metal slide over each other, and do not return to their former shape when cooled. Lead pipes when used to convey hot water, become permanently elongated, as may be seen by examining those that have been in use for years, in most cases the fastenings will be found loosened and the pipes distorted. Bath-tubs and other vessels lined with lead have the same shriveled or wrinkled-up appearance, showing that the metal has undergone alteration in form since it was first applied.

The amount of expansion in solids between the extremes of zero and the boiling point of water (212°), is comparatively little; zinc, one of the most easily affected by heat, elongating but 1-340th of its length, glass expands only about one-third of this quantity during a similar heat. The following list exhibits the ratio of expansion between different metals in the order in which they are named:—zinc, lead, tin, silver, brass, gold, copper, bismuth, iron, steel, antimony platinum and glass. This is also very nearly the order of the compressibility of metals.

When expansion is uncompensated for in machinery, a tremendous disturbance takes place, often causing it to cease its functions entirely; steam pipes are torn and twisted from their fastenings; bed-plates broken and shafts bent by this uncontrollable force. An iron rod, one square inch in section, when raised from 32° to 212° expands with a force of 35,847 pounds, or it exerts a force of 199·15 pounds for every degree (Fahrenheit) that the temperature is increased. Some phenomena observed in daily life may be traced to the laws of expansion, as, for instance, spikes driven into wood gradually enlarge the holes and loosen themselves by the changes in temperature they undergo. Iron and platinum wires may be cemented firmly to glass without danger of breaking, because they expand in nearly the same ratio; but gold, silver, or copper cannot, because their degree of expansion varies from that of glass. So also railroad tracks must be laid with a space between the rail ends, otherwise the whole line would be disturbed; accidents have frequently occurred from this cause. The same features are also observed in iron bridges. Time-measurers suffer much from unequal expansion, as where it is uncompensated for, a great change is observed in the record. Almost every material thing on the globe is affected by expansion, or the influence of heat, at some period or another; and yet the physics of this mighty agent are still undiscovered.

SUBMARINE FIRING.—ARE ARMOR-PLATES WORTHLESS?

On another page will be found a communication from Mr. R. B. Forbes, giving a very interesting account of some experiments made by him in firing cannon under water, the results according with those of the experiments in England on the hulk *Griper*, already related in the SCIENTIFIC AMERICAN, and with those made still earlier in Jersey City, a full account of which we published at the time. These experiments demonstrate conclusively that cannon may be fired under water; and that the shot, after passing through at least 20 feet of water, will penetrate the side of an ordinary ship. The *Griper* experiment showed that a loaded shell may, by submarine firing, be driven through 20 feet of water and then through six half-inch plates of iron—a resistance far greater than is offered by the bottoms of any of our ships of war.

These facts established, it necessarily follows that if any vessel provided with even a single shell-gun arranged for firing under the surface, can approach within 20 feet of the most powerful iron-clad in the world, she can sink the mailed monster. Here then is the question of the attack and defense of ships disturbed by a new element which revolutionizes the problem. We shall doubtless have a series of inventions for placing, loading, and discharging the submarine guns, with new forms of projectiles for passing through the water, and swift ships for bringing the new artillery alongside of the enemy. The maritime Powers will have, too, an opportunity of commencing again the laborious and costly task of rebuilding their navies. We would suggest the wisdom of expending little on the new styles of vessels for the sake of durability, as no one can tell how soon some other discovery may work another revolution in naval warfare.

DISTILLED WATER FOR HIGH PRESSURE ENGINES.

Mr. Norman Wiard, of this city, is just finishing four very light-draft steamboats for the Government; and, though the engines are high-pressure, the steam is condensed and used over, in order to avoid the deposit of scale or the necessity of frequent "blowing out." The condensers consist of a series of small copper tubes placed in the water outside of the boat, so disposed as to injure as little as possible the model of the vessel, and protected by wooden slats. The exhaust pipe terminates in these tubes, and the water of condensation is pumped back into the boiler.

To supply the unavoidable waste, the steam, before it is condensed, is made to evaporate a fresh supply of water. The evaporator is formed by cutting a rectangular opening through the bottom of the boat, 4 feet long and a foot wide, and covering this opening with a steam-tight copper box, 3 feet high, the box having no bottom so that the water rises to the same height in this that it does outside of the vessel. This box is filled with a number of small copper tubes, and through these the steam is led on its way to the condenser. As the water in the box is boiled and evaporated, the steam resulting from the evaporation is carried by a pipe into the condenser, while a fresh supply of water rises upward through the opening in the bottom of the boat. Thus a portion of the river is boiled as the boat runs along. It is found that the evaporator not only supplies the steam lost by leakage, but also furnishes distilled water for drinking and cooking by the crew.

There is no doubt that this is a most effectual plan for preventing the deposit of scale and sediment in the boiler, and the question is whether this advantage will be counterbalanced by an increase of back pressure in the exhaust. It would be interesting to compare some indicator cards from Mr. Wiard's engines with cards from similar engines exhausting into the open air.

WINES, ALMONDS, AND OLIVES IN CALIFORNIA.

At the meeting of the Farmers' Club of the American Institute, on Tuesday, Feb. 17th, Mr. Robinson informed the Club that Col. Haraszthy was present—one of the most extensive grape growers in the country, a man who was extending his vineyards at the rate of 500 acres per year.

Col. Haraszthy, on being invited by the Chair, gave the following account of his operations:—"When I went to California, it was supposed that the vine could be grown only on land that could be irrigated; but I determined to try it on the dry land, and I planted 40 acres. I told them that I would irrigate with the plow. My vines grew very well, and at the end of three years I had a very fine crop of grapes. The practicability of growing vines on the worthless uplands being thus demonstrated, my example was widely followed, and now there are 14,000 acres in California planted in vine yards. This year the State will turn out from 12 to 20 millions of gallons of wine."

Mr. Carpenter:—"Will Col. Haraszthy tell us what variety of grapes he prefers?"

Col. Haraszthy:—"I have imported about 1,400 varieties from Europe and Asia, but many of these are synonyms, and there are in fact but 350 distinct varieties. About 70 of these have fruited, and they are all perfectly successful."

Mr. Carpenter:—"Have you tried the Catawba and Delaware?"

Col. Haraszthy:—"Yes, and the Isabella and Scuppemong. They do very well, but the fruit is not to be compared to the fine imported varieties."

Mr. Carpenter:—"On this side of the continent we are unable to raise the European grapes, except under glass, in consequence of the mildew. Have you ever been troubled with mildew?"

Col. Haraszthy:—"In some very damp places on the edge of swamps the mildew has been observed, but not to do any harm. Our climate is too dry for the mildew."

Dr. Trimble:—"Will the Colonel please to give us a description of his mode of culture?"

Col. Haraszthy:—"I plant the vines 8 feet apart, both ways; and they are plowed between eight times—four each way. I commence plowing in January, and finish in June. The vines are then allowed to ramble all over the ground like squash vines. After the grapes are gathered, the vines are pruned; and the limbs cut off are gathered and burned. The yield is from 500 to 2,000 gallons of wine to the acre."

Mr. Williams:—"How do you make the wine?"

Col. Haraszthy:—"I have a 12-horse-power steam engine for crushing the grapes. The juice that first runs out without any pressing, is first gathered in small vats, holding 500 gallons each, where the sand, &c. is allowed to settle, to prevent any earthy taste. It is then pumped into vats holding 4,000 gallons each, where it ferments. My cellars for the fermenting vats are dug on the side hill, into the solid rock."

Dr. Trimble:—"What is the best grape for wine?"

Col. Haraszthy:—"It depends upon the kind of wine that you want to make. The Epergne makes champagne, the Johannisberg wine is made from the Risling grape, and the Noiree and Pignon make the Burgundy wine. I will defy anybody to tell my champagne from the Cliquot."

Mr. Carpenter:—"Do you raise the Black Hamburgh?"