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ZAPON, A SUBSTITUTE FOR LACQUER.

An important feature of all fine mechanical or ornamental work is the final finish. Beauty of design is insufficient to secure a pleasing result where finish is neglected. Lacquering has usually been resorted to for beautifying and protecting metallic surfaces, but lacquer requires a dexterous hand for its successful application, and it is not permanent under all conditions.

It will be of interest to our readers to know that a superior substitute for lacquer, known as zapon, has been perfected by the Frederick Crane Chemical Company, of Short Hills, N. J. This new article is being largely used by manufacturers of metallic goods and instrument makers. It is also used on sheet metal ware and on wood. It is flexible, very permanent and not easily scratched. It has other advantages which will be appreciated by the novice, *i. e.*, it dries without heat, and does not show streaks or brush marks.

Zapon is made both colorless and of all colors. It is used on brass, copper, silver, iron and other metals, and is applied either with a brush or by dipping. Among the products of this establishment are brilliant and black enameloid, the first being an excellent substitute for baking japan, and the second—the dead—is applicable to artistic iron work and to various uses in connection with photography and optical instruments.

HOW TO ESTIMATE OUR WORK ON WAR VESSELS.

Now that we have made so substantial a commencement on our new navy, it may be interesting to ask, What has been actually accomplished by foreign powers in expending immense sums on war ships during the past twenty-five years, while we have done comparatively nothing? The triple-screw protected cruiser, No. 12, for which the contract has recently been awarded, to be of 7,400 tons displacement, with a horse power in excess of 20,000 and a speed of not less than 21 knots, marks the present limit of our investment in this line of vessels, and, with the contracts at the same time awarded for three large armored battle ships, we substantially enter the field in which the great European powers have been competing against each other ever since the guns of the little Monitor were heard in Hampton Roads. Of the other armored vessels being built, it may be said that, although not intended as the equals of first-class foreign war ships, they will, owing to their more modern construction, fill a very important minor position, while in high-speed cruisers our place will probably be second only to that of Great Britain.

The absence of any practical tests, in actual war, of the great ships on which so much has been expended by England, Italy, France and Germany, leaves open a wild field for judgment as to what their ultimate efficiency will be. A valuable aid in forming such judgment, however, is afforded by a paper recently published by W. Laird Cowles, entitled "Naval Warfare, 1860-1889, and Some of its Lessons."* The writer considers the subject under the divisions, (1) speed, (2) the ram, (3) high explosives and torpedoes, (4) armor, and (5) guns and their role in action.

The experience of the vessels in the war between Chili and Peru is quoted to show that speed is important to enable a ship to bring her enemy into action, but will never enable her to beat him. The Huascar rammed the Esmeralda and sank her, but not until the latter's engines had been rendered powerless, while the 12 knot Independencia tried to ram the 5 knot Covadonga, but the slower craft easily slipped away, leaving her enemy to run upon a rock. In the battle off Lissa, in 1866, when over forty vessels were engaged, many efforts were made at ramming, but the only successful one was upon a vessel, the Re d'Italia, previously disabled by gun fire. Many incidents of our own war and of the Franco German war are also quoted to show that a ship, so long as she can keep way on her, and can steer, need not fear an enemy's ram, while if ramming is tried before the enemy is disabled, the vessel trying it may be torpedoed in passing, and has added liabilities to other injuries.

Torpedoes, as thus far employed, are declared to be almost as fatal to their users as to those against whom they are used. In the war between Chili and Peru the Huascar endeavored to use a Lay torpedo, which turned back on its course, and would have struck the vessel from which it was sent, had not an officer jumped overboard and guided the machine aside, after which the commander buried the rest of his torpedoes in the cemetery at Iquique. The author's conclusion is that with good care and a careful lookout a ship not actually in action with other ships can generally protect herself from torpedoes.

As regards armor protection, it is difficult to overrate its value, provided the armor be thick enough to absolutely keep out heavy projectiles, and especially shells, while it is hard to overrate its danger if the armor be so weak as to permit projectiles either to pierce or shatter it. The ship's engines and boilers should be protected at all hazards, as a modern ship that cannot move in action is doomed, no matter how powerful she may be; but all armor has such definite limitations—all of which may be overcome by the heaviest guns—that armor is at best only a compromise. Speed, the ram, and high explosives, are accounted factors of secondary importance, while the main factor has conspicuously been gun fire.

This is divided into two kinds, that from slow and heavy guns, to act against the enemy's material, while the light gun fire includes that from quick-firing and machine guns and from rifles—to deter the enemy from manning his light guns, to throw a hail of projectiles into his ports, and to riddle his unarmored ports. This is a business which to be successful must be thoroughly carried out by one party to the action from the very commencement of an engagement, when even the heavy guns of its opponent can only be fought with difficulty, and therefore it is claimed that, where two forces are otherwise anywhere nearly equal, the force which earliest obtains and preserves the superiority in light gun fire will ultimately be the victor. The quick-firing gun, however, is not only a gun to work against the enemy's men, but takes rank among pieces designed to pierce armor. The fire from a six inch quick-firing gun is capable also of disabling the heaviest guns when the projectile is rightly directed, for many of these heavy guns are of such great size that they have to be largely if not wholly unprotected. The general conclusion is, therefore, that too many very heavy guns have been employed, greatly to the detriment of the ship's efficiency—that a ten inch gun, which will pierce a thickness of twenty inches of armor at 1,000 yards, is practically about as large as should be employed on a ship, and that there should be few guns of such size, and a larger proportion of machine and quick-firing guns.

As singularly confirming these views, the British Admiral of the Fleet Sir Thomas Symonds writes that, besides their inferior compound plates, British ironclads have "other faulty arrangements greatly detracting from the fighting power and safety of ships wrongly classed as ironclads, in which untrustworthy monster guns have been mounted in enormously heavy turrets and barbettes, and thick patches of armor added to protect their unreliable hydraulic machinery. The awful overweighting of our modern battle ships with monster ammunition, etc., also reduces greatly their seagoing safety. Whether we regard our guns, our ships, or our armor, the lack of a wise and definite policy is evident."

Perhaps it is not so strange that what all would acknowledge to be a "wise and definite policy" has not heretofore been settled upon, for the whole period of the modern war vessel has been an exceptionally transition one, as have all processes connected with the manufacture of iron and steel. It may well be presumed, however, that the expensive experiments and costly mistakes of our neighbors across the Atlantic will be fully availed of in the construction of our new navy, the delay in commencing substantial work upon which for so many years has been so generally deprecated.

* SCIENTIFIC AMERICAN SUPPLEMENT, No. 772.

DR. KOCH'S CURE FOR CONSUMPTION.

Great interest is being everywhere manifested in the reports now coming from Europe concerning the alleged discovery by Prof. Koch, of Berlin, of a method for the cure of consumption by inoculation. Dr. Koch announced his discovery of the tubercle bacillus as a living germ in 1882, and it now appears that he has so far succeeded in producing the tubercular bacillus as to be willing to employ it practically on those afflicted with consumption, although it is announced that only leading bacteriologists and physicians can be admitted to a knowledge of the preparation of the lymph, as it requires the most thorough care and a high degree of skill.

It is said that about one fourth of all the deaths occurring among human beings during adult life are caused by consumption, or pulmonary tuberculosis, a disease of the same nature also prevailing to a great extent among cattle. It is produced by living germs finding their way into the body, generally attacking the lungs first, where they multiply under favorable conditions and throw off new growths, the discharges from which contain also the living germs. The latter, however, do not grow outside of the human or animal body, except under artificial conditions, although they may long retain their vitality, to again reproduce themselves when received into the body. It is thus that consumption is most often produced by breathing air in which these germs are suspended as dust.

It is on these germs that Dr. Koch has been experimenting to produce, by artificial propagation, a bacillus of milder form, which, on being introduced into the system, as by inoculation, would overcome and eradicate the more dangerous bacilli causing the disease. The experiments have been substantially in the same line with those of Pasteur relative to the cure of hydrophobia, Dr. Koch having been one of the first to acknowledge the efforts of Pasteur in this field, and having aided largely in the successful development of the Pasteur theory and practice.

The Charity Hospital, at Berlin, has been the scene of Prof. Koch's experimental work, although it is said that he has already had many patients of high social standing, and achieved some remarkable success. The accounts thus far received say that the patients have been pledged to secrecy as to the method of treatment, which would be somewhat strange were it not for the fact that the announcement is also made that Dr. Koch is preparing for publication a work fully explaining his discovery. It may well be that he is afraid more harm than good would come from the getting abroad of any partial or incomplete understanding of it, which might lead incapable or indiscreet practitioners into ineffective attempts to follow his line of practice. It is said that in cases now under treatment a change for the better is observed after five or six injections of lymph, within a fortnight, although one case of long standing required a month to effect an improvement. From four to eight weeks is thought to be the time that will be required to effect an ordinary cure. It is announced that before six months all the patients now under cure will have passed through the period of observation, and that then Prof. Koch will be able to publish his discovery to the world.

Highs and Lows in the Atmosphere.

H. A. HAZEN.

It is intended in this paper to set forth some facts tending to answer the question, What are HIGHS (elevations) and LOWS (depressions) in the atmosphere? The term anticyclone for a high pressure area seems a misnomer, and the term cyclone, for a storm, first applied by Piddington to the violent storms in the seas north and south of the equator, should be used in connection with these storms. These terms here suggested apply exactly to what we see on our weather maps and, till we know more about the mechanism of these phenomena, they may be regarded the most concise and satisfactory that can be used. The so-called permanent HIGHS and LOWS, for example, the winter HIGH in Siberia and the permanent LOW over Iceland, are not included in this discussion, nor are thunder storms, tornadoes, water spouts or any such phenomena included, since they are known to be secondaries usually 400 or 500 miles to the southeast of the center of a general LOW and have very few of its characteristics.

Every one is familiar with these HIGHS and LOWS as they move rapidly or slowly one after another across the country. We are taught that in a HIGH the air is denser and cooler; this has a tendency to cause a flow of air to its center and there to raise th pressure. If anything, there is a slight tendency downward in the air, and this also serves to raise the pressure. There is also a tendency to whirl from left to right. In a LOW the air is less dense, it is much heated, is full of moisture, and there is generally an uprush in the center as well as a whirl about it; all these conditions serve to diminish the pressure. Also the uprush at the center carries moist heated air to the cooler upper regions, and by expansion a still farther cooling is effected, which causes a condensation of the moisture and precipitation. This condensation, however, liberates latent heat, and this in turn heats the air and causes greater rarefaction, which in its turn causes a greater uprush, and this may continue till a most violent disturbance ensues. The fact that rain does not fall at the center, where Espy supposed it did, but 400 miles or more to the east and southeast in the United States, while in England a little more falls to the west than to the east of the center, would seem a serious objection to this view.

We may consider this whole question under several propositions:

1. *Highs and Lows have a common progression or velocity.*—This seems self-evident, for, if they had not, the one would overflow the other. It is not intended to imply that these conditions 2,000 miles apart, more or less, have a common velocity, but, as they pass along one after the other, their movement must be practically the same, and when the velocity of one changes, the other must also.

2. *There is no whirl in either, a few thousand feet above the earth.*—Observations of clouds have shown this fact beyond a doubt, but the records for over seventeen years at the station on Mt. Washington, N. H., 6,300 ft. in height, are absolutely conclusive on this point. There is no veering of the wind at this station such as is noted at the earth's surface, in fact, an east or northeast wind is a most rare phenomenon; over 90 per cent. of the winds are from a westerly direction. Some have gone so far as to declare that this proves that the centers of the great majority of HIGHS and LOWS must be below 6,300 ft. Imagine a disk 6,300 ft. high and 3,000,000 ft. in diameter whirling round and round, and at the same time carried horizontally from west to east. Suppose we heat up the front (east) part of the disk, how many minutes will it be before the whirl will carry this warmer part around to the west and bring the cooler to the east? Now we know that the east and southeast part of this LOW continues warmer than any other part, and the west and northwest cooler, a condition which would be impossible if there were a whirl.

3. *The centers are far above our highest mountains.*—This proposition is of great importance, and if it could be positively settled, would clear away many difficulties. It is thought by some that since in a LOW there is a great increase of temperature in the lower layers, there must be a relative increase in pressure as we rise in the atmosphere, and hence in a very short distance we would reach the so-called "neutral plane," above which there would be an increase of pressure. Observations show that no such condition exists, and that, on the passage of a LOW, the pressure falls just as much at Pike's Peak, for example, relative to its height, 14,134 ft., as at the base. This shows that the condition making the change in pressure is far above three miles in height. It will be shown shortly that temperature changes with HIGHS and LOWS on our highest mountains are exactly the same as at the base, and this also proves that the center of the condition producing the changes must be far above these mountains.

4. *There is no movement of air or moisture particles by air currents in a vertical direction in them.*

The theory of an uprush in a LOW is the most tenaciously held of any in meteorology. It is the *primum mobile* of all views of storm generation. There is not one scintilla of evidence that such an uprush exists except in imagination. One or two reasons for denying this have already been given, one other only is here noted from many. Since there is friction with the earth, the lower part of this uprush would lag far behind the upper, and in a very few minutes the verticality of the uprush, upon which alone its integrity depends, would be entirely obliterated and the whole movement quickly brought to rest. To say, as some do, that the upper part of this uprush separates off and goes gyrating ahead of the lower part, and afterward communicates its gyrations through a frictionless medium to the earth, seems very strained. Computation has shown that it would require over 20 years for such gyrations to pass vertically through 300 feet in a frictionless medium.

5. *There is no extended horizontal transference by air currents of material particles in them.*

This is probably the most important proposition of all that can be advanced, and it will be the one hardest to accept by those who have been taught that our LOWS are enormous whirls transported in the drift of the upper atmosphere. The truth of this proposition is shown by the fact that while the LOW travels, in the United States, in winter, at the rate of 35 miles per hour, the wind rarely attains half that, and even then the wind does not blow steadily from the west. It is easy to see that if the wind were blowing at the rate of 35 miles per hour in front and toward the LOW, the velocity of particles in the LOW toward the east would just counterbalance this motion, while on the west side, if the wind blew straight toward the center, the velocity should be 70 miles per hour, but we know that the wind velocity is nearly uniform on all sides. Again, in a HIGH having the same velocity, about 35 miles per hour, there is almost a dead calm. In this journal for January 18 of the present year I have shown that one of the most important characteristics of a storm is an enormous increase in the dew point or amount of moisture over thousands of square miles in front, while there is as great a decrease in the rear. These effects are in no wise due to heat, winds, evaporation or any other cause acting at the earth. I have also found that the diminution in the rear cannot be due to the advance of a HIGH with cold dry winds, because it often takes place when that does not follow up the LOW.

It is probable that this drying takes place at some height in the atmosphere first and works down. Whatever it is, it cannot be due to the onward movement of air particles, now full of moisture and almost immediately after with the moisture sucked out, as it were. It is well known that it is one of the most difficult things to either saturate air or deprive it of its moisture.

It would seem as though such transference of particles were improbable, but it may be asked, how can the changes be brought about by the HIGH and LOW if they do not travel? May we not consider these phenomena the result of another action? Suppose we have two spheres 1,000 feet in diameter carried through the air at a height of 1,000 feet, the one very hot and the other very cold, and we had thermometers delicate enough to register changes in temperature of the air at the earth, the resulting phenomena would be exactly those that we now observe on the passage of a LOW and HIGH.

6. *They are almost entirely independent of the drift of the atmosphere, though they may affect that.*

It will be conceded, on all sides, that the clouds drift in the atmosphere. This drift is almost invariably from west to east, but we often notice our HIGHS and LOWS changing position from north to south. The best proof of this proposition, perhaps, is to be found in mountain observations. As a HIGH approaches, the drift or wind at the mountain station dies down and becomes about half the apparent motion of the HIGH, while with the approach of a LOW the drift increases to nearly double the motion of the LOW (see *Journal of Franklin Institute,* July, 1888). Now, as we have just seen, the progression of the HIGH is practically the same as that of the LOW, so that, if anything, the drift of the atmosphere is changed by the progress of HIGHS and LOWS instead of their motion being dependent upon the drift.

7. *They are independent of temperature changes both above and below, and, in fact, bring about the latter.*

This proposition comes next to 5 in importance, and is really established by that. If it can be sustained, it gives the death blow to most modern theories of the generation of the HIGHS and LOWS. We find exactly the same temperature changes at our highest stations as at the base, and hence it is very evident that the center of influence in the HIGH or LOW must be far above our highest station, or more than three miles above the earth. It is possible that the conditions producing our HIGHS and LOWS extend to the limits of the atmosphere. We are taught that the sun heats up a limited portion of the earth, and this in turn heats the air, and the air above is heated layer by layer; while there may be a limited action of this kind, yet it is evident that that could not account for more than a small fraction of the heat in our LOWS, and it would not account at all for the cooling in the HIGH. Some think that the air near the earth becomes heated, and this starts a rush of air upward, but it is very evident that such a motion of a warmed particle cannot be maintained as we have seen under 4.

8. *They are independent of direct heat influence from the sun.*

This is plain in the case of HIGHS, since they show a lack of heat, and it is also true for LOWS, since they have a continued heat action through the night. The fluctuations in temperature on the advance of a LOW are much greater in winter than in summer, though it is plain that the sun's influence is very much greater in the latter case.

It will be seen at once that these 8 propositions are largely negative, and that we have advanced very little in our studies regarding HIGHS and LOWS. It is plain that nearly all of them are most intimately connected, and must stand or fall together. No attempt has been made to theorize, but it has been my desire to present facts as simply as possible. If any one has been led to think of these things, and will enter upon a discussion of this interpretation of the facts, I shall be entirely satisfied.

Anchoring Bolts into Stone.

The *Engineering and Building Record* quotes from a letter to the Troy *Polytechnic* some interesting particulars about the usefulness of various substances for anchoring bolts into stone. It was necessary in the construction of an elevated railway, in a place where the line led over rock, to anchor the foundation by bolts to the ledge, and in view of the expense and other objectionable qualities of sulphur and lead for this purpose, it was resolved to try whether cement could not be made available.

To test the question 14 holes were drilled in a ledge of limestone rock, all 42 in. deep, and bolts, some ¾ in. and some 1 in., were set in the holes. Around four of the bolts sulphur was then poured, lead was put in around four more, and Portland cement, mixed neat, around the remaining ones. Two weeks later the bolts were pulled by a powerful lever. Out of those run with sulphur, one was drawn out under a strain of 12,000 lb. With the others the iron yielded before the sulphur gave way. Three of the bolts calked with lead also broke in place, one pulling out; but of those set in cement, one yielded slightly and then broke, while all the others broke in place, showing that Portland cement is not only cheaper for setting iron into stone, as well as less likely to corrode the iron, but is stronger and much more easily applied. This account reminds us, the journal above referred to adds, of a little experience of our own, which has a certain interest.

In the construction of a building where external anchors are used, some of the bolts, which were built through the walls, were sent, by a mistake of the maker, with the ends cut for wood screws, instead of being threaded for a nut. As the work was being hurried, and there was not time to wait for others, they were used, on the assurance of the maker that he could fit nuts to them. After the walls were ready for the anchors, it was found that no machine was made which would tap an iron nut to fit a wood screw, and the manufacturer made nuts of Babbitt metal which were forced on the screw. They were rejected by the architect on account of the softness of the metal, and a bolt, with the nut, was tested at the Watertown Arsenal, on the Emery testing machine, to determine the resistance of the nut. The bolt was pulled in one direction, and the nut in the opposite one, and neither yielded until a force of 5,600 lb. had been applied, when the nut burst, the threads stripped, and the bolt pulled out. The bolt was ¾ in., somewhat deeply cut, so that the resistance of the nut was about three-quarters of the strength of the bolt, and if it had been made thicker, the iron would probably have yielded before the soft Babbitt metal.

UTILIZING scrap steel rod by welding it and drawing it into fence wire is one of the recent successes of electric welding.