Correspondence.

The Absolute Zero.

To the Editor of the SCIENTIFIC AMERICAN:

In the detailed description of Prof. Olszewski's attempt to liquefy helium, given on page 17299 of the SUPPLEMENT of September 26, a noticeable fact is that he arrived within 9° C. of the so-called absolute zero point of temperature.

The accepted value of this point, —273° C., is based on the observed fact that the volume of a gas increases or decreases the $\frac{1}{273}$ part for each degree Centigrade of increase or decrease of temperature. Then the further assumption was made that this change of volume is regular for the "permanent" gases over the whole range of temperature. Hence, at —273° C. the molecules of the gas should be in contact.

But, judging by analogy from the expansion of solids and liquids, we should also expect the change of volume of gases to vary according to a parabolic law, having their greatest change at and near the point of liquefaction. This view is strongly supported by the fact that, if we calculate the mechanical equivalent of heat by using the only known expansion of air between 0° and 100° C., instead of the assumed double volume at 273° C., we will obtain a value, viz., 776·4 foot pounds or 42,642 gramme-centimeters, which is nearly that of Griffiths and which is now extensively used.

Some years ago, while studying molecular physics, I discovered such a parabolic relation. By using the accepted terms it may be thus stated. It can be shown that the square of the mean free path varies directly with the absolute temperature in the gaseous condition. But the mean free path of the molecule is equivalent to the diameter of the mean free space occupied by the molecules. For convenience, we can call this space the molecular volume, because the total aggregation of these minute volumes makes the given gaseous volume; then the free path becomes the cube root of the molecular volume. By substitution in the above, we then get the new relation. The two-thirds power of the molecular volume varies directly as the absolute temperature; hence, their aggregation, the gaseous volume, will also vary in the same way—$V^{\frac{2}{3}} : V'^{\frac{2}{3}} :: T : T'$.

When we make the calculation with the foregoing data of Regnault, from 0° to 100° C., we get as the absolute temperature of 0° C., the freezing point, $1^{\frac{2}{3}} : 1·3665^{\frac{2}{3}} :: T : T + 100° \therefore T$ for air is 432·113°; for hydrogen, it is 431·921°.

In my paper on helium, published in the SUPPLEMENT of June 22, 1895, page 16948, which was written on the announcement of its discovery, I made the mistake of giving helium the second place on the curve instead of the third. By making it the third element, and judging by the fact that at —264° C. helium shows no signs of liquefying, then its deduced liquefying point in my paper, viz., —332° C., which is 68° C. lower than the above, does not seem improbable.

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Systematic Inspection of Material.*

It would seem that it ought to be completely superfluous to tell a man that it was advisable for him to know what he was buying, or that it would pay him to ascertain whether or not he was getting full value for his money. It will require but a very superficial observation, however, to show that the contrary is the case, and that it will be necessary not only to tell him, but in many cases the most convincing arguments will be ineffectual.

The facility with which all classes of nostrums are foisted on the community, and the difficulty of obtaining reliable material, go to show that very few realize the necessity of knowing when the material they buy is what it should be.

No more valuable move has been made, of recent years, by our railroads, than a recognition of the fact that it was necessary to know accurately the character of the material they were using, both in track and rolling stock; so that at the present time all first-class roads either have a testing bureau, as a special department of their own organization, or employ one of the numerous testing bureaus.

The fact that the leading engineers have, for years, required careful and systematic tests of material on all important work, that on the Continent testing bureaus have been established under governmental supervision, and the number of independent testing bureaus in this country, proves the practical necessity for the systematic examination and testing of the materials of construction.

This demand comes from two quarters: 1st. The necessity of protecting human beings from injury or death. 2d. The necessity, especially at the present time, for practicing the utmost economy.

It is scarcely necessary to discuss, or to advance arguments, to prove the necessity for taking every precaution to prevent the injury or death of a human being. While this has been treated as an economic problem more than once, that phase need scarcely be discussed here, for its value as a factor in the design of any structure will depend entirely upon the moral condition of those in charge of the work.

The value of systematic testing, from an economic standpoint, however, is open to fuller discussion, and brings up more interesting questions.

In conversation with an engineer the other day on this subject, he told me that he was satisfied that he had been compelled, recently, to use from 15 to 20 per cent more material in a building than was necessary, on account of the impossibility of having the material carefully tested, and this in face of the fact that especially good prices had been paid for it. The saving on a few such buildings would have equipped a testing laboratory.

In a recent investigation of the strength of cements, a sample of cement, which sold for $5 per barrel, when mixed with one-half sand, showed a greater tensile strength than did a sample of another cement selling for $3.50 per barrel, when used neat; and yet enormous quantities of this cheap cement are used.

The author has again and again seen lubricants sold to private consumers, under some high-sounding name, at from 50 to 75 cents a gallon, which were nothing but plain petroleum products, worth, probably, at the most, 20 cents per gallon. One cannot blame an oil salesman for taking advantage of such a snap, but it is rather hard on the man who foots the bills. A considerable portion of the lubricants sold to small consumers are not worth one-half what is paid for them. In fact, it may be taken as a rule that in every branch of trade more or less chicanery and fraud are deliberately practiced, the only safeguard against which is the careful examination of the material.

But it will be argued that one can deal with honest manufacturers only. While it is unquestionably good policy to have no dealings whatever with dishonest parties, yet this does not remedy the matter.

A manufacturer or dealer may be as honest as possible, but that does not prevent his employes from making mistakes, or from willfully shipping defective material to cover their own errors. We might, perhaps, locate dishonest dealers, but it would be impossible to locate the ignorant, careless, or dishonest employe.

The amount of material with defects, which it is inconceivable that any sane person could fail to see, which is shipped by the most reputable concerns, proves that the honesty of the head of a concern does not insure the honesty of his subordinates, although it may go a long way toward it.

We have, therefore, to avoid not only the dishonesty of the manufacturers, but also the dishonesty and carelessness and ignorance of their subordinates.

In a steel mill a forging may be piped; if carefully plugged, the chances are that nothing will be heard of it until the failure of the forging reveals the hidden flaw; too late, however, to trace it back and place the responsibility where it belongs.

It has been held, and by the majority believed, that it is necessary to have inspected and tested the materials used on only the more important structures, such as bridges, office buildings, etc., where there is danger to life or limb of the occupants. While it is undeniably true that such material should be inspected, it is also true that, as a rule, greater economies can be effected by inspecting other kinds of materials, where the results of the failure are not so dangerous to human life and consequently not so disastrous to the reputation of the manufacturer.

The very fact that in most instances the other kinds of material are purchased without any examination at all, gives an invitation to all kinds of fraudulent practices. There is an extensive trade in certain materials, which are used for adulteration alone.

In an investigation, made by the writer, of different brands of white lead, only two out of six samples were found to be worthy of the name of white lead; three being utterly worthless.

Upon one occasion, a shipment of lard oil received by the writer was found to contain a large portion of paraffine oil; it was returned, and a second shipment replacing it was also returned for the same cause. At last a shipment of oil was received which was satisfactory. When asked why they shipped such defective material, the reply was that they did not expect it to be so rigidly inspected.

That the rigid examination of materials, which are now received without inspection, is desirable, can scarcely be denied, but how far it should be carried, and to what extent it would be economical, is another and a more difficult question to solve. It is evident that it would be advisable, if practical, to have everything tested and inspected; but throwing aside this utopian idea, we can readily see that the systematic inspection of material can be extended far beyond its present limited sphere, with very beneficial results.

As an illustration of what can be done by such inspection, we can find no better example than the results obtained from the inspection of fertilizers. At one time fertilizers were sold entirely on the makers' guarantee or statement; now, in nearly all States some system of fertilizer control is in force, whereby all fertilizers sold in the State are subject to inspection and analysis, and in some States any citizen can send a sample of fertilizer to the State chemist, have it analyzed, and an estimate of its value, per ton, placed upon it.

The result of this system of fertilizer control has been not only a marked improvement in the value of the fertilizer actually sold, but, what is of far more importance, the introduction of a condition of affairs which renders the sale of worthless fertilizers practically impossible.

Similar benefits can unquestionably be obtained from an extension of this system to other materials, such as iron, steel, cast iron, oils, paints, and soaps. At present it is very difficult to get a paint which is worth anything, or a good lubricating oil at a reasonable price, and many of the soaps sold throughout the country are so injurious to clothes as to be worse than useless. Is this not, after all, a matter for governmental control? It may be claimed that this is too much like paternalism, but it is unquestionably the duty of the government to detect and punish fraud wherever found, and there is considerable room here for the exercise of this function. Have not all classes as much right for protection against fraud as the agricultural, if that class would not be the principal beneficiaries of government inspection?—Digest of Physical Tests.

* By L. S. Randolph, Professor of Mechanical Engineering, Virginia Agricultural and Mechanical College, Blacksburg, Va.

The Serpents of Java.

A correspondent of the Illustrated Family Newspaper relates the following regarding the venomous snakes in Java:

The Imho sugar estated in Java comprises over 12,000 acres, about one-third of which is in cane. This is one of the most densely wooded parts of Java, and the bush is like a wall, impervious even to many wild animals, but snakes flourish, and there are no less than ten varieties that are deadly poisonous. Eight of the coolies employed on this estate have died inside of four months from snake bites. The chain viper is most dreaded, as it will not get out of one's way, and when trodden on by the barefooted natives strikes fatally. Twelve miles away is the ruined city of Choru, a wilderness of temples built of stone, cut in designs as fine as lacework. On the north side of these buildings are long arched passages, and here wild animals resort to get out of the intolerable heat. Leading from these avenues are hundreds of small chambers having no windows. In these lurk more snakes than can be found anywhere else in the island.

It is not surprising that the eastern nations look upon Englishmen as lunatics, they do so many foolhardy things from no apparent motives save to risk their lives. Two years ago an English naval lieutenant was here visiting a neighboring planter, and his peculiar craze was making a collection of Javan reptiles. His only attendant was an English sailor lad about sixteen, and these two, against all warning, went roaming around the forests without a guide. In Choru, the ruined city, the lieutenant found a rich harvest, and killed a magnificent black jaguar, but an adventure with a snake ended his sport. One day he and the boy were under one of the long archways of the big temple, and, looking through the doorway of one of the dark chambers, saw something yellow in the far corner. Without a moment's thought he entered and gave the mass a punch with his cane. A tremendous hiss that fairly shook the walls was followed by an assault swift as the leap of a tiger, and the man found himself seized by a huge Dari snake, the most aggressive and dangerous of our constrictors. His left shoulder was crushed in the brute's teeth, and quick as a flash a coil was around his body, and he felt the steel-like compression.

But the grit of the boy saved his master's life. He had a heavy, sharp wood knife, and he struck the reptile two heavy blows just back of the head, the most vulnerable part of its body, because the thinnest. Its backbone was divided. The coil relaxed, but the powerful tail lashed out, breaking the boy's leg. It was two hours before they were found and brought up in a cart. The lieutenant's left shoulder was crushed beyond surgery, and the arm was useless. Both master and boy recovered after a spell of fever. I saw the snake, a hideous object, black and yellow, and fifteen feet long. Such a brute would crush a horse.

Gunning one day near the Wasli River in the interior of the island, I watched a number of wild hogs coming to the water to drink. Suddenly the head of a snake rose above the grass and a hog squealed. A python had seized a full grown one, easily three feet high at the shoulder, and thrown two coils around the body. Under the tremendous pressure the hog seemed to lengthen, and when the snake uncoiled I saw only a strip of meat, nothing distinguishable but the head. I shot the snake. It was twelve feet long and over seven inches through, and yet its coils had crushed the bones of its prey like chips. There is no doubt that hidden away in vast swamps of the interior are many anacondas of enormous size. Parties have been made up to hunt them, but the malarious climate drives them back. In the museum at Batavia is the skin of a serpent that must have been fifty feet long when living. Such a brute would kill a man as easily as it would a rabbit.