HALLIDIE'S WIRE ROPE WAY FOR TRANSPORTING ORES.

This invention is one of great importance, especially to the miners of the Pacific slope. Our illustration gives a general view of the whole apparatus in practical operation, conveying quartz from the top of a mountain in a rough mining region to the mill below. The *Scientific Press* thus describes it: "The wire rope passes over pulleys elevated upon posts of a suitable length, and, as shown in the engraving, the sacks of ore are suspended by the proper device to the rope. The sacks or cars are loaded on the dump at the mine on the mountain, and, the patent grip pulley being revolved by means of the engine, the sacks or cars pass down on one side, deliver their load, and pass up empty on the other side. Boxes may be used that are self-dumping, or operated by hand, as desired. By this means, the expense of road building, teams, drivers, etc., is done away with, and a safe and very convenient method adopted by which the ore is delivered to the mill. Either sacks or cars may be used for carrying, as desired. The patent grip pulley is a very ingenious device, and accomplishes its purpose admirably.

"The rope way may be run by the same engine that runs the stamps at the mill; and when the descent is sufficient and the load comes down, no extra power is needed, the gravity of the descending loads being sufficient to keep it in motion; it being desirable, however, in all cases to connect with the steam engine or water wheel, in order to regulate the speed of the rope, which is usually about 200 feet per minute. The posts, of course, are arranged high enough so that the cars may be clear of all obstructions from the ground, but the undulations of the ground can be followed. There being a pulley over the rope as well as under it, the rope is kept between the pulleys and enabled to pass over any mountain at any angle. A brake is sometimes used to regulate the rapidity. One very great advantage, possessed by this system of conveying ores, is that the weather will not affect it, for it can be worked during heavy storms and freshets, and the depth of snow is of no consequence; moreover it will run as well by night as by day, and with no more care.

"The advantages of this apparatus will be obvious at a single glance to any one familiar with the general rugged character of the Pacific slope.

"This apparatus should not be confounded with the ropeway of Hodgson's patent, which is now in operation at the Eberhardt and Aurora Company's mines in White Pine, as it is totally different in its construction."

PRECIPITATION OF ARSENIC BY HEAT IN MARSH'S TEST.

BY JOHN C. DRAPER, M.D., PROFESSOR OF CHEMISTRY, UNIVERSITY MEDICAL COLLEGE, NEW YORK.

Among the methods for the detection of arsenic, there is not one which promises better quantitative results, for the purposes of medico-legal investigators, than that by the action of heat on the arsenide of hydrogen. I have, therefore, endeavored so to improve the ordinary method, of precipitation of arsenic from its gaseous compound with hydrogen, as to render this method both satisfactory and reliable.

In the text books on medico-legal chemistry, it is recommended that the arsenide of hydrogen, developed by the action of zinc, dilute sulphuric acid, and the arsenical solution, should be conducted through a hard glass tube of narrow caliber which should be heated at some part by a spirit or Bunsen flame. The compound gas is, under these circumstances, separated into its constituents, and a metallic mirror of arsenic deposited a short distance beyond the flame. After the gas has been exposed to the action of heat, it is to be passed into a dilute solution of nitrate of silver, where any portions that have not been decomposed produce a dark brown precipitate.

From the above *resumé*, it will be seen that the arsenide of hydrogen is only partially decomposed by heat, since the silver solution is intended to arrest the portions that escape its action. I have, therefore, investigated the extent to which the precipitation by heat takes place, and for this purpose have passed the gas through a Marsh reduction tube, heated at five points by Bunsen flames, as shown in the adjoining figure, and which takes the place of the tube in the

apparatus represented on page 179 of the last number of the *SCIENTIFIC AMERICAN*.

In the first experiment, the arsenious acid solution, introduced into the decomposition flask, was moderately strong, and a stain soon appeared at 1. This was followed by another at 2, then at 3, 4, 5. The passage of the mixed arsenide of hydrogen and hydrogen was continued about half an hour, at the close of which time there was a thick deposit of arsenic about two inches long at 1, another about the same length but not so thick at 2, one still weaker at 3, while 4 and 5 were of about the same appearance.

In a second experiment, a very dilute solution of arsenic was introduced, and the rate of evolution of the gas was very slow; in this nearly the whole of the arsenic was arrested at 1, very faint and unsatisfactory stains appearing at the other heated spots.

In a third trial, a strong solution of arsenious acid was introduced with a result similar to that obtained in the first experiment. We may therefore conclude that, in the separation of arsenic by heat from arsenide of hydrogen, though the greater part of the metal may be removed by a single application of heat when the current of gas is very slow and it is largely diluted with hydrogen, if the flow is at all rapid or if the gas is rich in arsenic a very large proportion of the metal may escape reduction, even though the passing gas is frequently heated; and the last portions of arsenic are only separated in this manner with the greatest difficulty.

In an examination of the liver or other organ, in cases of arsenical poisoning, the solution generally obtained by the process of Fresenius and Babo is moderately strong when arsenic is present; it is therefore necessary to secure under these conditions the precipitation of the whole of the arsenic at the first heated spot, and obtain it in such a form that it may be weighed without loss, and then subjected to any other tests that may be desired. The possibility of accomplishing this problem in a satisfactory manner, we propose to discuss in a future paper.

DETERMINATION OF HIGH DEGREES OF HEAT BY THE MELTING OF ICE.

It was mentioned in our number for March 9 (page 168 of the present volume), that any substance, able to withstand the heat of a furnace, may be used to determine its temperature. We will now explain this method, which is one of the most interesting applications of our knowledge of the specific heat of bodies.

Suppose we take a lump of mica, asbestos, fire clay, or a large fire brick or a piece of graphite, and expose it so long to the heat of the furnace that we are satisfied that it has attained the same temperature; and then transfer the piece rapidly to the ice calorimeter of Lavoisier and Laplace, and notice how much ice it will melt.

As this most useful apparatus is not as universally known as it deserves to be, and as its description is totally omitted from most text books on natural philosophy, we will describe it here. Fig. 1 represents the exterior view, and Fig. 2, a

section of the same. It is made of three vessels of sheet tin, of similar shape, and fitting concentrically one into the other. In the smallest central vessel, M, we place the body of which we wish to determine the number of heat units; the space, A, between this vessel and the one surrounding it is filled with pounded ice; the vessel has a lid and this is also covered with ice. This ice is intended to be melted alone by the heat of the body, M. In order to secure this, and to prevent the melting of this ice by the exterior heat of the room where the experiment is performed, the space, B, between this second vessel and the third exterior one is also filled with ice. The latter will be melted only by this exterior heat, and the water proceeding from this melting runs off by the stop cock, E; while the water proceeding from the melting of the interior ice by the heat of the body, M, runs off by the stop cock, D, and is collected in a proper vessel (see Fig. 1), and carefully measured or, better, weighed.

As the substances used for this experiment may lose some of their weight by the intense heat to which they are exposed, it is unnecessary to weigh these before they are exposed to that heat; their weight is ascertained only after the practical portion of the experiment is finished, that is, after they have been exposed in the calorimeter, melted all the ice they could melt, and are cooled to the temperature of the melting ice, 32° Fab.

It is evident that precautions must be taken against loss of heat during the transfer, of the heated substance, from the furnace into the calorimeter; it is, of course, impossible to

prevent this loss altogether, and all we can do is to bring this loss to a minimum by care in our manipulations. It is unnecessary to make any corrections for the specific heat of the vessel itself, as we commenced with having it at 32° Fah.; and the heat the interior lining absorbs from the body, M, is finally all given off again to the ice to be melted. The heated body is best laid in the space, M, on a non-conducting cushion of mica and asbestos, as otherwise the heat would be too rapidly communicated, and serious disturbances caused.

Suppose now we have taken a piece of fire brick, heated it, and introduced the same in the calorimeter. We find that the weight of the water proceeding from the ice melted is 7.62 lbs., while the weight of the piece of brick after cooling is found to be 3 lbs.; 7.62 lbs. of melted ice is equivalent to 142×7.62 or 1,082.04 units of heat, and as this number was carried out of the furnace by 3 lbs. of fire brick, of a capacity of 0.19 specific heat per pound, we have 3×0.19 or 0.57 as the divisor of 1082.04 units, which gives for the temperature of the furnace 1,898° Fah.

If there is any doubt as to the correctness of the result, by reason of the uncertainty in the specific heat at the high temperature to which we exposed the sample of fire brick used, one single determination with a substance like platinum, of which the specific heat is exactly known, gives us the correct temperature of the furnace; and this may then be applied to correct the specific heat of the fire brick. Suppose, for instance, the method with platinum and water, explained on page 168, gave us, in the same furnace at the same time, a temperature of 1,790° we should then reason as follows: 7.62 lb. melted ice is equivalent to 7.62×142 or 1,082.04 units of heat; and as 3 lbs brick carried this amount, each lb. of brick carried one third of 1,082.04, or 394 units, that is, one lb. of brick, when it had absorbed 394 units of heat, showed a temperature of 1,790° sensible heat; its capacity for heat or specific heat must then be $394 \div 1,790$ or 0.22. As long, then, as we use this quality of fire brick and take its specific heat as equal to 0.22, we shall have more correct results than if we take it at 0.19, as it is found at ordinary temperatures and given in most of the tables of specific heat.

Correspondence.

The Editors are not responsible for the opinions expressed by their Correspondents.

Counterbalancing Saws and other Machinery.

To the Editor of the *Scientific American*:

E. F. J., writing in your issue of March 2, wishes to know how to counterbalance his gang saws so as to prevent vibration, and states that the saw gate weighs some 5,500 lbs. As the theory of counterbalancing seems to be but little understood among millers, I propose to occupy some of your space in explaining it in a practical way.

Let the circle, Fig. 1, represent a disk or wheel revolving upon a horizontal axis, S; it is evident to any mechanic that, if the disk be perfectly true and of uniform density, there will be no vibration; but if we attach the weight, A, to one side, throwing the disk out of balance, a vibrating action will be produced, which increases with the weight, distance from the center, S, and number of revolutions in a given time. To make our disk run smoothly, we apply an equal weight, B, equidistant from S, Fig. 2.

Before leaving Fig. 1, we must inquire what are the nature and directions of the vibrations produced by the weight, A. If we whirl a plummet in the air, we find a force developed called the centrifugal force, which keeps the string taut and draws the hand constantly towards the bob. So also with our disk; the centrifugal force of the unbalanced weight