When, therefore, mere surface drying is all that is sought, there is a clear showing in favor of heated air on the score of economy when only theoretical principles are considered. But practically there are many sources of loss in the use of air for drying that cannot well be avoided even by the best applications of the principles we have endeavored to elucidate; so that a practical comparison, of the economy of this system with that of steam drying, would give very different figures. There is no doubt, however, that for mere surface drying, the greatest economy would be secured by hot air properly applied.

THE AMALGAMATION OF ORES OF THE PRECIOUS METALS.

It has frequently been our duty to call attention to the great loss arising from the imperfect methods, now in use, of extracting gold and silver from their ores; and the waste has been so extensive, amounting probably to thirty-five per cent of the whole of the gold and silver mined since the first discovery of these metals in California, and the inefficient processes are still so much used, that this important subject is always demanding our attention, as well as that of miners and other persons immediately interested. Much, indeed, remains to be written and done with regard to the extraction of these metals before a system, worthy of the present age of metallurgical chemistry, will be generally practiced. These considerations give interest to a new utensil and process which not only have the merits of apparent simplicity and adaptability to their purpose, but are recommended to the mining world by a practical man having experience and knowledge in this field, whose communications on this and cognate subjects are known to all readers of the SCIENTIFIC AMERICAN, namely, Mr. Percival Stockman, of 322 Grand street, Williamsburgh, N. Y.

The metal mercury still retains its preëminence as a means of obtaining gold and silver by amalgamation; and although the use of zinc is well known, it is chiefly employed in combination with or subsequently to the quicksilver treatment. Mr. Stockman employs mercury, using specially selected chemicals to expedite the amalgamation, and treats the metalliferous earth in an iron caldron, similar to those used for evaporating cane juice in sugar manufacture. This vessel is intended to be set in brickwork, and to be heated by a fire beneath it. The caldron has a socket, cast on the bottom inside, to receive the end of a perpendicular spindle or shaft. Attached to this shaft near the lower end, so as to agitate the contents of the caldron, are three or more fans similar to those of a propeller. Power for driving the shaft is applied by gearing on its upper part. The object of these fans is to keep the pulverized metallic ore in constant motion. The ore is placed in the caldron with sufficient water to make it of a muddy consistency, and the mixture is boiled for fifteen minutes; and then, the ore being diffused in the water by the heat and by the agitation of the fans, mercury is introduced. This metal is immediately, by the same means that divided the earthy particles of the ore, dispersed into millions of minute globules, and the heat gives these greater facility for attacking the gold concealed in the earth.

Mr. Stockman states that, in the case of ore containing pure metal, the amalgamation by the above described process can be completed in one hour without the use of chemicals. But the valuable metals are frequently found in combination with the sulphurets of antimony, arsenic, and mercury, and with the pyrites of iron, copper, and argentiferous galena; and it is especially with regard to these more obstinate combinations that a new and thoroughly effective process is desirable. Mr. Stockman treats these, in his newly devised apparatus, by the addition of chemical preparations, chiefly chloride of sodium, nitrate of potassa, lime, bisulphuret of carbon, and any of the fixed or volatile oils. The latter is especially needed when orpiment (the sesquisulphuret of arsenic) is present in combination with the pyrites; and with a view to rid such ores of the arsenic, the introduction of muriatic acid in connection with sulphuretted hydrogen is recommended. As in the case of the pure ore, the mixture is allowed to boil for fifteen minutes; the quicksilver is then introduced, and the mass is again boiled for two hours longer. At the expiration of this time, a stream of cold water is introduced to precipitate the amalgam; and the whole mixture is allowed to pass, from an outlet in the bottom of the caldron, to a sluice containing a separator in which the amalgam is gathered. This amalgam is then ready for separation of the gold or silver by evaporation of the mercury in a retort. As it is well known that hardly any two ores are chemically similar, it is obviously impossible to give fixed proportions of the ingredients above mentioned; these quantities must be determined by the character and percentages of foreign matters found in combination with the metals.

To the imperfection of the extracting processes now in use must be attributed the disappointment and failures of of many of those who go to seek their fortunes in gold and silver mines. Such searchers frequently base their calculations upon assays, perhaps scientifically made, of small specimens of the ores; and they have then been surprised to find that the ore did not yield, by the old methods, so much as the assay by ten, twenty, or fifty cent. This difference discourages the miner, and perhaps induces him to abandon his operation; whereas the fact is simply that the process of the assayer was more efficient than that of the miner.

The importance of this subject cannot be overrated, and any information that will add to the knowledge already possessed by our readers, many of whom are extensively engaged in the interesting and valuable industries of gold and silver mining, will always be received with pleasure by us, and communicated willingly to the public.

THE KNOWLEDGE OF SPECIFIC HEAT APPLIED TO THE DETERMINATION OF VERY HIGH TEMPERATURES.

Among the most important investigations, for finding methods to determine temperatures so high that no practical thermometer can give a uniform and reliable result, are those founded on our present knowledge of the specific heat of bodies. When, for instance, we know the specific heat of a body which can resist the effects of very high temperatures, say platinum, and we take a mass of this metal of known weight, place it in a blast furnace, and when the mass has acquired the temperature of the furnace, we transfer it quickly to a vessel surrounded with a known weight of water, we have only to observe the rise of temperature of this water, by means of an ordinary thermometer, to find how many units of heat were transferred from the furnace to the water by the intervention of the platinum; and from this it is easy to determine the degree of heat to which the latter was exposed. Pouillet was the first to examine the specific heat of platinum, and he found that it differs for different temperatures, which is, in fact, the case with most substances, even with water; and the saying that a unit of heat is the heat required to raise the temperature of one pound of water one degree is only approximately correct; in order to express ourselves with proper scientific accuracy we must say: The unit of heat is the amount of heat required to raise the temperature of water from 32° to 33° Fah. Régnault found that the specific heat of water increases, in consequence of its expansion, with the rise of temperature, and that if accepted at 1,000 for 32° Fah., it becomes 1,003 when the water becomes heated to 200°, or near its boilingpoint.

The specific heat of platinum is approximately equal to that of gold and mercury (see page 372, Vol. XXV.); but in order to use the metal for the purpose of measuring heat, a correct determination is required, and this was elaborated by Pouillet by means of air thermometers of peculiar construction. We here give:

POUILLET'S TABLE FOR THE MEAN SPECIFIC HEAT OF PLATINUM.

From	32°	"	212°	0·03350
"	32°	"	572°	0·03434
"	32°	"	933°	0·03516
"	32°	"	1,292°	0·03602
"	32°	"	1,832°	0·03728
"	32°	"	2,192°	0·03813
"	32°	to	2,732°	0·03938

The table shows that the specific heat of platinum, when taken at the common temperature, is nearly one thirtieth of that of water, while at some 2,700° it is about one twenty-fifth.

In order to make this more clear, we will state it in other words: At the common temperature, 30 pounds of platinum, losing one degree of heat, will produce one unit, and thus raise the temperature of one pound of water from 32° to 33°; while at the temperature of the blast furnace, say 2,700°, only 25 pounds of platinum, losing one degree of heat, will produce the same results.

We must, in passing, draw attention to a fact of much importance in regard to the theory of steam economy. The above table shows that the same quantity of heat will not raise the temperature of a mass of platinum equally for all parts of the thermometric scale; and for water, there is a still greater difference. So one unit of heat, being accepted as sufficient to raise the temperature of one pound of water of 32° one degree, will not suffice to do this to boiling water. If such water is heated in a closed vessel from 212° to 213°, it will require 1·013 units.

It is thus seen that in the case of water, it requires one seventy-seventh part more heat to raise the temperature of water from 212° to 213° than from 32° to 33°, and that, in the case of platinum, it requires only one ten thousandth part more heat to raise the temperature from 212° to 213° than from 32° to 33°, while, for the very high temperatures, it takes about one hundredth part more heat for one degree of thermometric ascension.

Applying the knowledge attained to the determination of the temperature of a blast furnace, we have only to observe by the thermometer the moderate amount of heat diffused in a large mass of water by means of a comparatively small mass of platinum, possessing a great amount of sensible heat or very high temperature at the moment that it is taken from the furnace. It is evident that precautions must be carefully taken against loss of heat by radiation, and against any other exterior disturbing influences, and the determination is then very easy, as we will illustrate by an example.

Suppose we have heated a mass of one pound of platinum in a blast furnace, and left it a sufficient time to be heated to the temperature of the flame. Outside we have say ten pounds of water, kept at 32°, surrounded by non conducting material, and enclosed between the double walls of a vessel, in the interior empty space of which the platinum is placed immediately after its withdrawal from the furnace. It is cooled without touching the water, and precautions are taken not to lose heat by evaporation of the water or radiation. Suppose now that, under the circumstances accepted, we find that, after a sufficient time has elapsed, the temperature of the ten pounds of water has increased from 32° to 43½°, or 11½°; this is, for ten pounds of water, equivalent to 115 units of heat, which, reduced to degrees in one pound of platinum of which the mean specific heat between 32° and 2,732° is equal to 0·03938 (see table), gives 115 divided by the latter number, or 2,920 for the degree of heat to which the platinum was exposed; so that the temperature of the blast furnace must have been 2,920° Fah. If the result of the calculation had given us a much lower temperature, say some 1,800, it would be necessary to renew the calculation with another coefficient of specific heat; in this case it would be 0·03728, which corresponds nearer to the specific heat of the temperature of about 1,800°, and would thus give a more nearly correct result.

This method gives at the same time the means of corroborating the specific heat of platinum in another way. If, namely, we make two experiments, in the same furnace and at the same temperature, with unequal quantities of platinum, we may obtain two equations of two unknown quantities, namely, one quantity the specific heat of the platinum, the other the temperature of the furnace. From these two equations, we may easily extract, first the specific heat in question, and secondly the desired temperature of the blast furnace. In this way, a few fragments of any substance able to withstand the heat of the furnace may be employed to determine its temperature. We reserve the further elucidation of this method to a future article.

SCIENTIFIC AND PRACTICAL INFORMATION.

VACCINE MATTER.

The terrible visitation of small pox, which has largely increased the death average in many of our cities, has created an unusual demand for vaccine lymph; and, moreover, it has drawn especial attention to the sources whence the virus is derived, and the need of obtaining it of the greatest possible purity. A Boston physician has recently found the applications for vaccine matter so numerous that he has devoted much time and attention to its propagation by vaccinating heifer calves. The animals chosen are between the ages of three and six months, and are selected with particular regard to their sound and healthy condition. As the disease affects the calf but for the short period of fourteen days, and as the pustules are ready for the lymph to be taken on the sixth or seventh day only, a considerable number, no less than three hundred, of calves are yearly required to supply the customers of this one collector.

The animal is thrown, and a portion of its abdomen is shaved clean; the virus is then inserted in small incisions about one inch apart. Vesicles are thus originated, and on the sixth or seventh day, the lymph can be removed by squeezing the spots with pliers. The exudation is carefully collected on ivory points. Hundreds of points can be prepared from one animal in this way. The crusts which afterwards form on the pustules are removed and fixed on gutta percha mounts, many surgeons preferring to communicate the vaccination by their use. In many localities, the vaccine disease has lost its vigor, and the operation is seldom followed by appearances of the cow pox; but the necessity of the latter as a prophylactic has called attention to the deficiency, and a supply fresh from the cow is valuable to ensure the taking of the vaccination.

A SUBSTITUTE FOR A RUDDER.

The screw steamer *India* of the Anchor line, plying between Glasgow and New York, put into Halifax, N. S., on February 23d. She had been twenty-seven days out from Glasgow, having lost her rudder on February 8th. Thirteen days afterwards, she fell in with the American fishing schooner *Joseph H. Chandler*, and lashed her to her stern, the schooner steering the strange vessel compounded of two craft dissimilar from each other in every respect.

EXPERIMENTAL SCIENCE AT CORNELL UNIVERSITY.

Professor Burt G. Wilder, referring to his request, published on page 49, current volume, encloses us some further suggestions for the guidance of such of our readers as may be able to forward him specimens:

"It sometimes occurs that the heads of rare and valuable animals come into the possession of individuals or associations, when only the skulls are to be preserved on account of the great expense of an alcoholic collection of brains. In such cases, for the sake of the brains, I shall be glad to open the skulls, by either vertical or horizontal section, as may be preferred, properly prepare them by maceration, etc., and return to the owners, free of expense."

The Professor desires also to mention that 500 copies of a circular nearly like this were distributed during the past month, and kindly copied by many scientific and agricultural papers; already specimens and letters of inquiry and information are arriving from all parts of the country and from all classes of people. In fact, the museums contain but a very small proportion of the valuable scientific material of a country; every village has its malformations, which are there regarded as mere curiosities and gladly put into the hands of scientific men when asked for; every hunter, butcher, and farmer has it in his power to furnish most interesting specimens every year, and according to Professor Burt's experience, is glad to do so, when assured of their scientific value.

COLEMAN, RAHM & Co., of Pittsburgh, Pa., have put into use Stearn's smoke burner improvement, in connection with some of their iron furnaces, and find that it heats the iron quicker, with a less quantity of coal, and prevents the smoke nuisance. The estimated total saving in time and fuel, by the use of the invention, is thirty-three per cent. There are about one thousand furnaces in operation at Pittsburgh. If the smoke nuisance could be abated, and money saved in the doing of it, Pittsburgh would become famous.

RECENT letters from Professor Agassiz report the safe arrival of his exploring ship at Pernambuco, Brazil. His explorations of the sea bottom are continued with undiminished zeal. He has made many discoveries of fossil and live animals, sponges, etc., the mere nomenclature whereof is enough to break the uninitiated jaw.