When the button is of proper size it is dropped into the bone ash cupel, thoroughly dried and heated to bright redness, where it melts, and as the hot air converts the lead by degrees into liquid litharge, and this latter is absorbed into the porous cupel, the button decreases in size until the last of the lead is slagged off and there remains in the bottom of the cupel only the fused bright button of gold or silver or any alloy of these. By too high a heat or overlong exposure in the crucible there is apt to be a loss of silver through volatilization. If too low a heat the litharge is imperfectly absorbed by the dish and the button solidifies ("freezes").*

Gold is nearly always found associated in ores with silver, and the button or bead obtained from an assay usually requires "parting;" that is, the separation of these metals. The button having been carefully weighed is treated with pure nitric acid diluted with half its volume of water, and heated to boiling in a test tube or small parting flask. If the proportion of silver is not less than three to one of gold all the silver dissolves in the hot acid, the gold remaining as a dark spongy mass. If less than this proportion of silver is present the gold protects it from the proper action of the acid, and the silver dissolves out slowly, or not at all. In this case—and a little experience enables the assayer to judge from the color of the button whether enough silver is present or not—silver must be added. Enough silver is cut from the silver foil, wrapped about the button, and this in turn placed in a small cornet of lead foil and placed in a clean hot cupel, where it melts and alloys; the lead soon slags out and the button is ready for the parting in acid as described.

The gold sponge or particles of gold powder obtained in parting is washed by decantation with hot water in a test tube. While the tube is filled with water a small annealing cup or porcelain crucible is placed with its mouth over the tube or flask, which is then quickly inverted, so that the fine gold falls to the bottom of the cup or crucible. By immersing this and the mouth of the flask the latter may be removed without disturbing the gold, which after decanting as much of the water as possible is dried at a gentle heat, then heated to redness to give it coherence, cooled and weighed.

The greatest care is necessary in weighing assay beads of gold and silver, as, owing to the value of the substances weighed, a very small error may make a great difference in the results.

The decimal or French system of weights are commonly employed in assaying. The *assay ton* is intended to simplify and facilitate the final calculations; the ratio which an A. T. bears to a milligramme is the same as that between a ton (2,000 lb. avoir.) and a troy ounce, so that if one A. T. sample of ore is assayed and found to contain one milligramme of gold or silver it is known at once that a ton of rocks contains just thirty ounces of the metal.

The weight of gold found as above deducted from the weight of the bead before parting (or adding silver) corresponds to the weight of silver.

One ounce of pure gold has a value of twenty dollars and sixty-seven cents. The ounce of silver is worth about one dollar and fifteen cents; it varies with the market.

As nearly all commercial samples of lead and litharge contain traces of silver, those intended for use in assay should be carefully sampled and assayed, due allowance being made for silver found in calculating results.

## SUSPENSION BY SUBDIVISION.

The fact that substances which are quick to obey the universal law of gravitation when in a mass, are apparently lighter when in a state of fine division, will doubtless strike most persons as singular when they consider that the relative amount of air displaced by each part of a substance must be the same whether the part be large or small; while to make a body really alter its weight compared to air, it is necessary that the relation between its weight and bulk should be changed. Its specific weight has clearly not altered. How then is the suspension of finely divided substances to be accounted for, if the same subdivisions be collected into a mass, they will rapidly fall; and also in view of the fact that the force of gravitation acts upon each particle without regard to its neighbors, and will exert its powers whether the particles are separate or aggregate?

It is easy to understand, for example, why a sphere of wood will fall more slowly than a sphere of lead of the same size, the wooden one presenting such a relatively greater resisting surface to the air compared with its weight than the one of lead.

Let us see, therefore, whether the mere act of dividing a substance can alter the relations of weight and resistance surface so as to permit an explanation of this phenomenon.

If two spheres of lead or other homogenous substance, having the respective diameters of one and ten, be weighed, it will be found that their weights are related to each other as the *cubes* of their diameters, or as one to one thousand, while the relation between the areas of their great circles or surfaces of resistance are as one to one hundred, or as the *squares* of their diameters, thus making the resistance of the air relatively greater in the case of the smaller body.

Now, although only liquids resolve themselves into spheres when divided, yet this reasoning may be regarded as approximately true of the irregular subdivisions of solid bodies, while the levity of fog and clouds will be more comprehensible. This principle is, of course, applicable to solids immersed in liquids, and also to the ascension of bodies of less specific weight than the fluids in which they are immersed. As the text books do not explain this common phenomenon, I thought that the above might prove interesting.

WM. B. COOPER.

*Large silver buttons must be removed with care from the muffle to avoid loss through spatting, occasioned by the escape of absorbed oxygen from the silver at the moment of solidification.

## THE ROMAN VILLA NEAR BRADING.

The work of exploring the Roman villa near Brading, in the Isle of Wight, is now proceeding with undiminished interest and spirit. The measures taken for protecting the remains from the severe frosts of last winter have been entirely and almost unexpectedly successful. No pains or expense were spared by the explorers (Mr. John E. Price, F.S.A., Mr. F. G. Hilton Price, F.S.A., and Mr. Brabrook, F.S.A.) in covering in effectually the buildings exposed to frost, and the result is that nothing whatever has been injured. With regard to the development of the ground plan of these extensive buildings, the following further discoveries have been made. The angle of wall erected a few feet to the east of the semi-circular structure between the principal room and the hypocaust has been determined to be an external wall of the building, as it is met by the undisturbed soil. The furnace in the wall of the hypocaust has been found in excellent preservation, being an arched passage formed of large tiles with layers of mortar. Several additional rooms, making now altogether 25 in number, have been traced, and the walls excavated. The central space has been determined to have been uncovered by buildings forming a garden of considerable extent. One of the new chambers excavated has at its south-west corner an apse of 6 ft. diameter, and at its north-eastern end a deep pit or well. This seems to have been formed without steining out of the hard sandstone, is about 4 ft. in diameter, and has been excavated to a depth of 25 ft. At a depth of 14 ft. the skeleton of a young person was discovered, which presented in several bones the appearance of severe injury during life. The bones have not yet been submitted to anthropological examination, but peculiarities in them, such as the size of the supraciliary prominence, seem to afford ground for interesting speculation. The teeth of one jaw were perfect, beautifully white and pearly, showing no sign of decay. And beneath an immense semi-circular stone, 5 ft. 6 in. by 3 ft. 9 in., had forced its way down the well, showing on the hard sandstone the path it had scooped out for itself. The raising of this stone was a matter of some difficulty on account of its great weight—over 5 cwt,—but it was successfully carried through by Jackson and the other highly intelligent workmen who are employed on the excavations. The same well or pit yielded a large number of tiles in perfectly unbroken condition of various sizes from 8 in. to 22 in. square. These had probably formed part of the flooring of the room. Many are marked with designs formed by drawing a comb along the surface of the tile when soft or by the fingers of the operators. One tile, 17 in. square, after having been elaborately ornamented by a comb along the sides and diagonally across, and then with a circle round the centre, was turned by the workman while still soft on to his right hand, and bears deeply impressed over the elaborate pattern a cast of that hand. Another, one of the 22 in. size, was walked over by the naked feet of one workman and the hobnailed sandals of others, and in like manner bears a cast of both feet from the ball of the great toe to that of the heel. Whether the practised anthropologists who are engaged on this work will be able (*ex peda Herculem*) to build up the whole mass from these slight indications remains to be seen; but it is sufficiently curious to find such living traces of a man who must have joined the majority 1,600 years ago. The series of coins from Severus (A.D. 222) to Constans (A.D. 350) has been rendered complete by the discovery of one of Magnentius (A.D. 250), who was the only missing emperor of the series. These conclusively fix the approximate dates of the erection and occupation of the buildings.