ert a pressure on their own account which is sometimes very considerable and can be accurately measured. Another theory which has some supporters is that solutions are compounds of the dissolved substance with the solvent. It has been pointed out that when sulphuric acid is mixed with water heat is evolved, proving that a chemical compound is formed. No doubt this is true in this particular case and the probability is that the first theory is wholly, and the second partially, true. To understand the solution of a solid in a liquid it is necessary first to understand the state of solution of gases in gases. Gases mix in all proportions. Their molecules are free and able to move about in any direction. If two gases are brought together they continue to mix until a uniform mixture is obtained. If we take a flask full of heavy carbonic acid gas and invert a flask full of hydrogen over it, taking care that the openings of the flasks are fitted tightly to each other, in a few days carbonic gas will be found in the upper flask and hydrogen in the lower, although hydrogen, until a few years ago, was the lightest gas known to science. The molecules of gas are always in a state of rapid motion and therefore when two gases are brought together the molecules of one soon penetrate those of the other and in time complete mixture is the result.

Gases are generally soluble in liquids. Their solubility depends upon pressure and temperature. The greater the pressure on the gas, and the lower the temperature of the liquid, the more gas will be dissolved. In the liquid condition, however, the molecules are closer together than in the gaseous condition, and for this reason the solution of a gas in a liquid is not so complete as the solution of a gas in another gas, and the thicker the liquid the less gas it will absorb. Mercury for example, which is nearly solid absorbs very little of any gas, indeed so little that the quantity is difficult to measure.

Liquids, like gases, dissolve each other, but to not nearly the same extent. The molecules of a liquid are nearer each other than those of a gas, and not so free to move about. For this reason some liquids will not mix at all, or only to a very slight degree. Ether and water, for example, will not mix and neither will water and petroleum. Water and alcohol on the other hand mix completely.

Having considered the solution of gases, a case in which the molecules are widely separated, the solution of gases in liquids where the molecules of the gases are free, and in the liquids only partially so, and the solution of liquids in liquids, where the molecules are only partially free, we come finally to the solution of solids in liquids, a case in which the molecules of the one are partially free, and of the other tightly packed together. It is needless to remark that the solubility of solid substances in liquids is very limited. Metals, however, dissolve in some acids, and many organic substances dissolve in water and other neutral liquids. When a layer of water is placed over a soluble salt the salt begins to rise against gravity and to diffuse in it, the motion only ceasing when the substances is uniformly distributed throughout the whole mass of water. This motion may be arrested by bringing between the solution and the solvent a septum which will let the solvent through, but not the dissolved substance. A semipermeable wall of this kind can be prepared by saturating a porous earthenware cell with a solution of copper sulphate, and then filling it up with a solution of potassium ferrocyanide. A precipitate of copper ferrocyanide is formed on and within the earthen wall through which water, but not sugar solution, can be filtered. If we fill such a cell with sugar solution and connect it with a marometer to measure the pressure: and place it in pure water, we obtain an increase of pressure. A solution of sugar of one per cent. gives a pressure equal to 50 cms. of mercury. This pressure is called "osmotic pressure," and the laws governing it are the same as for gases, the pressure being proportional to the concentration of solid in the liquid. It has been found by calculations based upon the molecular weight of sugar, that the osmotic pressure of a sugar solution has the same value as the pressure that the sugar would exercise if it were contained as a gas in the same volume as is occupied by the solution. This is an important point and sheds a light upon the condition of solid substances in solution.

Solids, when dissolved in liquids, lower the freezing point proportionally, to their molecular weight. For example, if a substance called A has twice the molecular weight of another substance called B, an equal weight of A will lower the freezing point of a liquid twice as much as an equal weight of B. The vapour pressure of a liquid is also lowered according to the same rule when a solid substance is dissolved in it.

When a compound of a metal with an acid, as for example sodium chloride or zinc chloride, is dissolved in water, not only are the fine particles of the salt resolved into their molecules, but these molecules themselves are resolved into their primary elements. It has been found that the osmotic pressure and the lowering of the vapour pressure and freezing point of water when metallic salts are dissolved in it, are twice as great as expected from the molecular weights of the salts. From this it follows that there must be twice as many molecules, and therefore, instead of one molecule of zinc chloride there must be one molecule of zinc and one of chlorine. Another proof of this fact is that if we evaporate a solution containing sodium chloride and magnesium sulphate slowly, at ordinary temperatures, sodium sulphate and magnesium chloride separate out instead of the original salts. From this disassociation of metallic compounds into their elements in solution we get our galvanic battery. When a solution of copper sulphate is made the sulphur combined with oxygen, disassociates from the copper ; now when a piece of zinc is placed in the solution the zinc begins to combine with the sulphur oxygen, to form zinc sulphate copper precipitates, and when a circuit is made a galvanic current is evident.

We see, therefore, that the solution of a solid in a liquid is a continuous process of extremely fine division, the process being continued down to the molecules themselves, and in the case of metallic salts down even to their primary elements.

THE HOT SPRINGS OF SYDNEY INLET.

By T. R. Marshall, D. Sc ,
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SIDNEY INLET has a bad name. It has the unenviable notoriety of being one of the wettest places of a land of heavy and prolonged rains. But I am a firm believer in the law of compensation and here is a striking example, for Nature has consequently so arranged that the water-logged inhabitants of this region may be provided with a means of driving away the pains of rheumatism by enjoying a further soaking in the hot mineral springs which occur in the immediate neighbourhood. Having heard of the wonderful properties of these heated waters from prospectors who have received material benefit by a course of treatment in the springs, I resolved to pay them a visit in order to prove whether I, also, could obtain relief from recently