

Jacksonville Illinois June 15. 1853.

Dear Mr. Cushing.

For your last letter you ask
 "What is solution" and give some notions
 about the matter, which I can accept with
 certain reservations. Solution has been a
 subject of much discussion among chemists ⁵⁷
 yet with unsatisfactory results. I have
 probably imbibed some peculiar notions in
 regard to it. These notions have come to me,
 for the most part through my experiments
 with ^{What I} ~~is~~ called surface attraction or that
 peculiar power which binds liquids or gasses
 to solids, as water to iron, Ammonia to gold..
 Soil &c. I should discuss the subject from
 this standpoint as furnishing a more

satisfactory explanation than can otherwise be had. If I take a clean Iron rod and plunge it into water and remove it it comes out wet. a film of water adheres to the iron. Why? It must be that the molecules of water have a greater attraction for the iron than they have for each other, otherwise the iron would come out as dry as when it went in, then we must regard our fact established. Now my notion is, that precisely the same attraction exists between certain different liquid substances. Therefore when two such liquids are mixed their molecules are quickly diffused and this attraction satisfied to each individual molecule as perfectly as the proportions of the mixture

will allow. There is no such attraction however between oil and water, Sulphuric Ether and water and various other fluids. These do not dissolve each other. Here we have our example of solution, the simplest form and this form may exist with varieties of force or intensity. We will illustrate. We take a dry Iron rod and dip it into oil. It comes out wet with oil, oiled over. Upon examining this in comparison with the rod wet with water we will find that the oil clings to the rod much the more firmly. Try again. Wet the rod with water and while wet dip it into the oil. Upon removal you will find the water has been displaced by the oil. This demonstrates that the

attraction between the iron and oil is greater than the attraction between the iron and water. Just as, we have solutions varying greatly in the attractions of the one body to the other some fluids cannot be permanently mixed will not dissolve in each other Others mix very freely. Others again with the greater facility and rapidity.

This expresses different degrees of the attractive power by which this solution is accomplished and maintained. This attraction is something entirely different from chemical affinity indeed has no relation to it whatever.

chemical affinity involves molecular decomposition and reorganization, Chemical attraction involves no molecular change.

No molecular union or disunion. a molecular association - not an atomic combination, an atomic association - not atomic combination. In a solution each atom or molecule is free to act ~~from~~ itself in the matter of chemical union. In chemical union such freedom does not exist. For instance in a solution of Iodide of Potassium the Iodine, does not act as Iodine. but if Iodine be dissolved in a solution of Iodide of Potassium it does act as free Iodine independently of either the water or iodide in which it is dissolved. The solution of one fluid in another ~~are~~ generally termed mixtures. The term solution being commonly confined to the same

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kind of an association of a solid with a fluid. through the Liquefaction of the solid. This liquefaction is accomplished by the power of this attraction. The Atoms or molecules as the case may be, are ^{separated} ~~separated~~ by, and to satisfy this attraction I see very many cases ~~the~~ this power exists but its ~~power~~ is to be able to separate the molecules of the solid. In this case solution may often be accomplished by melting or otherwise breaking up ~~this~~ attraction of the molecules of the solid for each other, and make a true solution.

Solution must not be confounded with suspension. Of this muddy water is a good example. The water of the Missouri River

may stand for weeks and will still be muddy. But a good filter will render it perfectly free from mud. Here the mud is suspended being broken up into very fine particles by mechanical means.

There is an attraction which causes the mud and water to cling together but this attraction does not cause a molecular separation. separation molecule from molecule, in the mud therefore it is not a solution. But a simple suspension. Now you say that in a solution of salt, the salt is broken up and equally distributed to the molecules of water. This is certainly true in a saturated solution of much less strength though some different form of grouping of the molecules.

or the relations they bear to each other.

I can readily conceive that these relations may be almost infinitely varied.

accommodating the distribution in an agreeable manner. But as we continue to reduce the amount of salt through decimal attenuations

the time must come when these molecules won't go round by any possible mode of grouping that I can conceive of. A time when we ought to take out a portion without getting a molecule of salt. It is true, however, that this would be rather a weak solution. I have said that this attraction which results in solution has no kinship with chemical affinity - is a different kind of force. As this is the reverse of ordinary

teaching perhaps I should fortify the point a little. One among the strongest examples of this attraction is that of water for salt.

Chloride of Sodium - not only is this salt liquidated to accommodate this attraction but, as you well know, the salt and water will both be melted down when the temperature is very far below the freezing point. There is, however no tendency whatever to chemical union between these bodies. The attraction of water for Iron is greater than that of oil for the same substance. There exists a tendency to chemical combination between the elements of water and soon a tendency to new chemical combinations. No such tendency exist

between the oil and Iron. If you will start your mind on a ramble among the different substances of your acquaintance I think you must become convinced that I am right. Now then I think this dig enough dose for one time. I think I have never submitted this line of thought to any one before except very imperfectly in a conversational way. and I shall be very glad to learn from you whether or not I have made myself clear. if you so what you think about it. Now dont write on a bit by four half sheet but get some paper and spill out your brain so that I can scratch around among it and see what there is in it. your truly W. V. Black