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An Essay

On the Possibilities of Discovering ~~Some~~ Alloy
The Atoms of Which Can Be Agitated or Rearranged
By Gravity Tension to Throw off Heat

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The major advances in Physics, Chemistry and related sciences, during the last half century have to a great extent resulted from a systematic probing into the molecular and atomic nature of matter. These studies include not only the methods by which the atoms and molecules are fitted together to produce different substances with their characteristic properties, but also the way in which the atoms and molecules interact with one another and with radiant energy.

One of the most fruitful methods of investigating the properties of matter is to subject it to some kind of a field which will disturb its atoms and observe the effects which result. For example, the application of a magnetic or an electric field, to certain substances produces partial orientation of the atoms or molecules resulting in the well known Cotton-Mouton and Kerr electro-optical effects respectively. If the magnetic or electric fields vary with position, i.e., have a space gradient, in addition to the atomic or molecular alignment, a force is exerted in a direction parallel to the fields on the molecules or atoms provided they possess either induced or permanent magnetic or electric moments. Since in any conservative field the atoms or molecules seek a position of minimum potential, the alignment of the atoms or molecules results in the substance giving off heat if its temperature is to remain constant. When the field is removed the atoms or molecules are quickly knocked out of alignment by thermal agitation which in turn requires that heat energy be absorbed by the material. In other words, during the process of alignment of the atoms or mole-

cules by the application of a magnetic or an electric field heat is given off, while during the process of disalignment by thermal agitation after the fields are removed, heat is absorbed by the substance if its temperature is held constant. These effects are easily observable with magnetic and electric fields and as a matter of fact, some of the lowest temperatures ever produced were obtained by applying magnetic fields to certain paramagnetic substances which already were cooled within a degree or so of absolute zero.

In view of the above experimental findings and from an extension of the theory, an alignment of the atoms and molecules should take place when gravity tension or its space gradient is applied to a substance. If we confine our observations to the effects of the gravitational field or gravity tension of the earth, then the experiment could be carried out as follows: The molecular alignment first would be observed in a substance which is falling freely toward the earth and second in the same substance after it is brought to rest with respect to the earth. The measuring apparatus would of course, be in the same coordinate system with the substance. If the substance is falling it is approximately free of the influence of both the gravity tension and its space gradient so that when it is brought to rest, the gravitational field or gravity tension and its gradient increases from practically zero to full value. Consequently, in the process of bringing the substance to rest with respect to the earth it should give off heat due to the alignment of its atoms or molecules. Although such experiments usually show some heating because ^{of} the friction, distortions etc., of the substance, no heating produced by the application of gravity tension or its gradient has as yet been observed. This probably is due to the fact that the effect is smaller than the experimental error.

error.

A good estimate of the magnitude of the amount of heat given off by the application of the earth's gravitational field or gravity tension can be obtained from experiments carried out in centrifugal fields. It can be shown that as far as their effects on matter is concerned, a centrifugal field is equivalent to a gravitational field. Some years ago the writer looked for alignment of atoms and molecules in several substances in a centrifugal field of one hundred thousand times gravity and a centrifugal field gradient of one hundred thousand times gravity per centimeter, but the effect was too small to observe. Recently centrifugal fields of five hundred million times gravity and centrifugal field gradients of thirty billion times gravity per centimeter **have been produced** but a re-examination of the above phenomenon with this improved apparatus has not yet been made. In any case there seems to be little doubt that a substance such as an alloy gives off heat when subjected to the gravity tension of the earth and its space derivatives due to atomic and molecular orientation but that it is extremely small.

In addition to the partial alignment of the atoms of an alloy by the gravity tension, a separation of the different components of the alloy takes place. During the process of separation the substance also gives off heat if the alloy approximates an ideal solution. If the alloy is not ideal, heat either may be absorbed or given off depending upon various factors that are well known, but which are not germane to the present discussion.

The order of magnitude of the heat given off by an alloy as a result of the separation by gravity tension can be reliably estimated. Suppose we assume that an alloy of half tin and half lead completely fills a tube 5 meters long and 100 cm^2 cross section which is maintained accurately at a temperature

277° C. At this temperature the alloy is liquid. Suppose next that the tube is raised from a horizontal plane into a vertical position, i.e., to a position where its length is parallel to the direction of gravity. If then the alloy is free from convection as it would be if it is maintained at uniform temperature and if it is held in this position for several months, the percentage of tin at the bottom of the tube will decrease while the relative amount at the top will increase. A simple calculation shows that the concentration of tin at the top is about one tenth of one per cent greater than at the bottom and that approximately one calorie of heat is given off in the separation process. If after several months the tube is again placed so that its length is in a horizontal plane, the tin and lead will remix due to the thermal agitation of the atoms and heat is absorbed by the alloy.

Another interesting effect occurs when an electrolyte is subjected to gravity tension. Suppose a five meter glass tube is filled with a water solution of say, Barium chloride and the electrical potential between its ends is measured first when the length of the tube is parallel to the horizontal and second, when its length is vertical. The difference in potential between the two ends is practically zero when the tube is horizontal and approximately eighty five microvolts when it is vertical. This effect was discovered by Des Coudres in 1892. If a resistor is attached across the ends when the tube is vertical, heat of course is produced. If the tube is maintained at constant temperature the voltage decreases with time and eventually vanishes. The effect is believed to result from the fact that the positively charged barium ions settle faster than the lighter negatively charged chlorine ions as a result of gravity tension.

In conclusion we have seen that gravity tension effects an alloy in such a way that it gives off heat. This phenomenon results from the alignment of the atoms and from their separation by the gravitational field, the contribution of the latter being larger than that of the former. Also the gravity tension sets up a potential across the ends of a tube filled with an electrolyte and this potential when applied across an external circuit may produce heat or drive an electric motor to furnish power. Several other small thermal effects possibly may arise from gravity tension in addition to those discussed above but space is not available to consider them in this essay. Also studies of the effect of gravitational fields and their equivalent centrifugal fields upon matter will no doubt be of great value in the future.