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MOLECULAR MOTION.

There are many who seem to find a difficulty in forming a conception of molecular motion, or how it can possibly have any relation to the form, color, or any of the physical characteristics of bodies. Such people examine a piece of glass, steel, or other hard substance, and mentally regard it as a continuous aggregation without pores and without mobility of parts, and therefore can make nothing of the simple doctrine that all masses are aggregations of molecules or little masses, placed at wide distances compared with the dimensions of the molecules themselves. So we find thattherestill remain those who deny that there is aught in nature to justify the doctrine of universal molecular motion, and who can see no connection whatever between the properties of aggregated matter and motions of the particles which make up the mass.

It is undoubtedly true that of the molecules themselves we know nothing except their deportment toward each other as manifested in chemical reactions. We know neither their form nor their color. We do not know the peculiar motions they undergo; yet to believe that matter as manifested to our senses, is not made up of insensible masses, but is continuous, or to believe that its parts do not at all times move among themselves, is to deny some of the plainest and most obvious indications.

As we write, the whole structure in which we sit is in a state of vibration. Wave after wave rolls through it. Some of the waves are sound waves, some are light waves, and some are heat waves; while there are tremors transmitted through earth, stone, bricks, mortar, and table, from the wheels of heavy trucks in the adjoining streets, plainly sensible to our hand. When we consider how extremely sensitive to motion are all the kinds of matter known to man; when we reflect how the most solid and inflexible substances obey the influence of the most delicate pulsations of—so far as man's sense of feeling is able to determine—perfectly still air, it appears to us a far more violent conception to regard matter as existing anywhere in a state of rest, than to conceive of its infinite and constant activity.

But let us attempt to conceive of the relation of motion to form, solidity, etc. If it were possible for us to rotate a rectangular piece of any solid material at the rate of a million times per second, there would be presented to our senses a cylinder with a uniform surface, hard and impenetrable, with color depending upon the nature of the material. Any one may convince himself of this by revolving a wheel with numerous spokes at high speed, and observing its appearance. The spokes no longer appear as spokes, but present the appearance of a continuous disk. If the speed be sufficient, it is impossible to thrust a rod through between the spokes, for the resistance of each spoke is so quickly followed by that of the succeeding one, that the aggregate resistance is apparently continuous. A ring rapidly revolved about its diameter generates a sphere in the same manner.

These are simple experiments which prove that motion has much to do with apparent form, and the apparent physical properties of matter

If we spin a large flat metallic disk on its edge, we may witness the gradual transition of mass motion into molecular motion. The mass, as it loses its rotary motion, gradually moves through smaller and smaller arcs of vibration; the rapidity of the vibrations gradually increasing until they pass into the limits of molecular motion.

This extreme sensitiveness of all matter to the effect of external motion, renders it probable that nowhere in the universe is matter in a state of absolute rest. So far as we can determine by observation, every particle of matter is whirling through space at a rate which is almost inconceivable. Everything upon the surface of the earth is rushing around its axis at a rate of more than a thousand miles an hour, and the entire mass is shooting through space, in its orbit about the sun, at a rate of nearly two millions of miles per day. The slightest change in the position of the center of gravity would produce immense results at this enormous velocity.

When we connect such stupendous mass motion with the known sensitiveness of matter to motion in its parts, or molecules, how is it possible to entertain the notion that matter is anywhere at rest?

POTASH FROM FELDSPAR.

A correspondent asks the following question: "By what method may potash be extracted from feldspar, and is there any means by which granite may be treated to make it possess an agricultural value on account of the potash it contains?"

The mineral feldspar is widely distributed over the globe, and since the supply of potash from wood has greatly diminished, more attention has been paid to the extraction of this alkali from the rocks, such as granite and feldspar, that contain it in considerable quantity. Ordinary flesh-colored feldspar contains 13 or 14 per cent of potash. The white variety, called albite, has a large admixture of soda, hence, for potash, the reddish feldspar is preferred. A cheap method for decomposing the mineral and obtaining the potash does not appear even yet to have been devised; but several of the plans that have been tried are worthy of mention, and may serve as models to any one who is disposed to pursue the subject.

Sprengel, as long ago as 1830, prepared alum by submitting feldspar to the action of sulphuric acid. The mineral was reduced to a fine powder, and mixed with concentrated sulphuric acid to a paste, and the two substances left in contact with each other for several months. Treated with water, the mixture furnished a solution of potash-alum, so pure that re-crystallization was not necessary. A great difficulty to be encountered in this process was to grind the feldspar to a powder. In order to do this it is first necessary to heat it red hot, then to cool it suddenly in water, by which operation it is rendered friable, and can be ground under a mill-stone to a fine powder. In all of the processes employed for extracting potash from feldspar the same difficulty of reducing the mineral to powder presents itself, and the method indicated above is the one usually followed.

Another way of making alum was suggested by Turner, who fused the finely divided mineral with neutral sulphate of potash, and thus obtained on the one hand soluble silicate of potash, and, on the other hand, an insoluble double silicate of aluminum and potassium, capable of yielding under the influence of sulphuric acid, alum and silica. The soluble silicate of potash was digested with lime, when insoluble silicate of lime was formed, leaving potash in solution.

Another way that has been successfully tried in the Laboratory of Columbia College, was to fuse two parts of feldspar, with one part of quicklime and one part of gypsum, and to extract the potash by water. Much of the sulphuric acid of the gypsum will go to the potash of the feldspar and render it soluble. Kuhlmann, in a similar way, decomposed the feldspar by fusing it with chloride of calcium, by which an interchange of elements was effected, and chloride of potassium formed.

It has also been proposed to treat an intimate mixture of powdered feldspar and fluor spar with sulphuric acid—in this way the silica is got rid of as fluoride of silicon, and the sulphuric acid, which at first combines with the lime, afterwards unites with the potash and alumina to form alum. This process is capable of being worked out on a large scale, if the fluoride of silicon were to be economized and converted into hydrofluosilicic acid, as that acid is destined to have extensive and important applications in the arts—one of which applications would be the separation and saving of the potash in the beet sugar manufactory.

Mr. Meyer fuses feldspar with lime in the proportions of 139 to 188 parts of lime to 100 parts of feldspar—and extracting the potash by means of water under pressure. This process involves lixiviating 288 tuns of calcined product, at from seven to eight atmospheres of pressure, in order to obtain nine to eleven tuns of potash—which must greatly interfere with its introduction on a large scale.

Ward in England calcines a mixture of pulverized fluor-spar, feldspar, chalk, and quick lime, and lixiviates the first with water, by which all of the potash is extracted. Professor Hofmann pronounces this to be the only method by which any of the experiments had succeded in obtaining all of the potash known to exist in the mineral; but although it had the sanction of his great name, it does not appear to have been conducted on a large scale by the inventor.

We have been led to speak of the various methods resorted to for the purpose of obtaining potash from feldspar, because we have frequent inquiries on the subject.

The operation cannot be carried on economically by any of the known methods, particularly since the discovery of the famous Stassfurt mines, where potash occurs in endless quantity, and can be manufactured cheaper than by any process hitherto known. The time is approaching when the greater portion of the potash of commerce will be obtained from the Stassfurt mines.

THE SCHOOL OF MINES, COLUMBIA COLLEGE.

This institution is under the direction of the trustees of Columbia College, and although of comparatively recent growth, has already advanced to the front rank of our American schools. It was originally founded, as its name indicates, to fit young men for the profession of mining, but in process of time it was found necessary to enlarge its scope so as to include engineering, technology, and natural history as well as mining. During the first year all pupils alike pursue mathematics, physics, chemistry, French, and German. This is looked upon as a preparatory year for what is to come. The second year makes some changes and opens the door to the selection of a certain class of optional studies for those who are to be mining engineers or civil engineers. The class still adhere closely to the study of chemistry, physics, mathematics, French, and German, and they commence their practical studies in the laboratory. The first year in the laboratory is devoted to instruction in manipulation, in qualitative analysis, in the determination of minerals, and certain glimpses of geology are obtained.

From the outset the students are taught drawing, and are urged to devote much attention to this important branch of education. The last two years of the course are full of instruction in geology, mineralogy, chemistry, assaying, and metallurgy, and by the time the student is prepared to graduate, he will have received a thorough instruction in all departments of natural science, in mathematics, in modern languages, and in everything that fits a man for the practical details of a profession.

The collections of the school are unusually rich in rare and valuable specimens. The mineralogical cabinet is said not to be excelled by more than one or two in the country, while the geological collection is believed to be the best in the United States. The library is well stocked with books of reference and the leading scientific periodicals of the day. The laboratories of the school are more extensive than any in this country, as they afford accommodations for one hundred working students. An important feature of the school is the fact that a thoroughly worthy student who can show that he cannot pay, is permitted to attend gratuitously. The trustees of Columbia College have sufficient income to carry on the institution without taking any fees from the students if at any time it were deemed expedient to do so. A goodly number of free students are constantly in attendance at the school, and no one is aware of the fact but the President and treasurers. The school will soon close for the year to be re-opened in October.

CONDUCTION AND CONVECTION OF HEAT.

The distinction between these terms is not popularly well understood. Thus it is common to hear people speak of water or air as conducting heat, while on the contrary talk about metals conveying heat is nearly as common and still more absurd.

The distinction between these terms is a very important one, and lies at the very foundation of a correct understanding of the laws of the transmission of heat. A short space may therefore be profitably occupied in the discussion of this subject.

Heat motion, or that "peculiar shivering motion of the ultimate particles of bodies" as Helmholtz so aptly defines it, is communicated in only three ways. These are called respectively *conduction*, *convection*, and *radiation*.

The conduction of heat is that form of transmission in which heat motion passes from particle to particle through a mass, the particles themselves sensibly maintaining their relative position. If a metallic bar has one end thrust in a fire, portions of the bar remote from the fire become hot. The bar meanwhile retains its form, save that its bulk is increased by the expansive force of the heat. There is no sensible evidence that the particles have changed their relations of position except that expansion of the bar indicates that they have separated somewhat. The motion is transmitted throughout the mass precisely as the vibration caused by the blow of a hammer would be, or the vibration caused by drawing a fiddle-bow over one end of the bar, with this exception, that the rapidity of the vibrations and the rates of transmission vary from causes not necessary to be here discussed.

Convection, or the carrying of heat, is quite a different process. In this case the particles change their positions in regard to each other. When those nearest the source of heat become heated, they expand, and becoming lighter in proportion to their bulk than the non-heated particles, they rise and colder particles take their place. Of course this cannot occur except in bodies the particles of which move freely among each other; and as fluid bodies are the only ones that answer this condition, it follows that they are the only conveyers of heat.

We see then that the best conducters of heat must be solids, and the worst liquids or gases, which are the best conveyers of heat; and that convection depends upon gravity which pulls down the specifically heavier particles and thereby pushes up the specifically lighter ones.

It does not follow that liquids or gases inclosing a space are therefore efficient in imprisoning heat within it, or preventing heat from entering. Such efficiency would depend upon collateral circumstances as well as the non-conducting power of the surrounding medium.

A non-conducting but a conveying medium, placed between two good conducting surfaces—these surfaces being kept at different temperatures—would be in constant motion, convey ing heat from the hotter to the colder surface; and the philosophy of filling such a space with some loose material as wool, is that it imprisons the conveying medium in its interstices and prevents in a very great degree its circulation.