are the size and surface of the colloidal particle. This state is further characterized by the postulate of heterogeneity, which is a general, almost metaphysical hypothesis that the particle in the colloidal state is different from the medium in which it is dispersed.

Most formal definitions of colloids, or the colloidal state, are dependent on the concept of size of the particle. It has been pointed out that many reactions of colloids are not amenable to stoichiometric interpretations. The clear-cut proportionality between reactants usually prevalent in molecularly dispersed systems is almost entirely absent in colloids. Another difference between colloidal and crystalloidal systems is the ready reproducibility of the latter and the difficult reproducibility of the former when tested by the known indices.

The writer proposes a concept of the colloidal state based on a general probability hypothesis. A brief exposition is given below. An aqueous solution of sodium chloride is an example of a crystalloidal system. If one considers a hollow unit cube of 10 Å side length and moves this cube a distance of at least 10 Å, the probability is unity that the composition of this second cube is the same as that of the first cube. In fact, the composition of any cube of 10 Å side length is the same throughout the whole solution. So one may say that in an aqueous solution of sodium chloride one deals with a homogeneous system, homogeneous with respect to a unit cube of 10 Å side length. Theoretically, it is possible to choose a unit cube so small that moving it a distance equal to the length of a side of the cube gives a cube of different composition.

On the other hand, if one considers a colloidal system, such as a platinum hydrosol, the situation is different. It has long been known that the composition of platinum sols is complex. Pennycuick assigns them the general formula: $\chi Pt\ yPtO_2\ zPt(OH)_6H_2$. If one takes a unit cube of 10 Å dimension in a platinum sol and moves it a distance of 10 Å through the hydrosol, the probability of encountering a cube of similar composition is no longer unity, as was the case in crystalloidal sodium chloride solution. What the probability of finding a cube of similar composition is, is not known. It would be dependent on the history of the sol. The size of the unit cube chosen depends on the colloid under consideration.

A characteristic of colloidal systems which has been used to distinguish them from crystalloidal systems is the tendency of the former to change. The concept of probability can be applied in the following manner. Referring again to the system of aqueous sodium chloride, one sees that equilibrium is established almost instantaneously on dissolving the dry sodium chloride in water. Further, once equilibrium is established there is no tendency for the system to change in composition. In other words, the probability of change is practically zero. In contradistinction, a platinum sol is undergoing a slow, gradual change. Interpreted in the light of the above concept, a colloidal system is one in which the probability of change is greater than in a crystalloidal system. Changes due to the addition of electrolyte or those due to temperature and pressure are not considered. One deals with closed systems in which the tendency to change is a function of time. In equilibria of this nature probability can serve as a measure of this tendency to change.

The writer offers the above concept simply as a philosophical approach to colloids and not as an experimental index of distinguishing them from crystalloids.

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THE SMALL LINEAR UNITS

IN SCIENCE, Vol. 79, No. 2043, page 184, Dr. J. F. McClendon comments as follows:

> A more serious error is often made in the conception of the micro-meter, which is a millionth of a meter and not a thousandth of a millimeter. A micro-meter is abbreviated μ, and the micro-micro-meter $\mu\mu$. Many persons imagine that a micro-meter is a thousandth of a millimeter and suppose that a micro-micro-meter is a thousandth of a micro-meter, whereas it is a millionth of a micro-meter.

Dr. McClendon's argument seems to be based on the assumption that the prefix "micro" means millionth, whereas the Greek μικρός merely indicates small, little, trivial. It is true that science repeatedly uses the prefix to mean millionth, and in this specific case the argument is supported by many standard reference books. The "Handbook of Physics and Chemistry" (eighteenth edition, page 1630) gives, "Micromicron ($\mu\mu$) 1×10^{-12} meter." Other items in the same table show clearly the consistency of this notation.

On the other hand, Professor Manne Siegbahn, of the University of Uppsala, discussing "Spectroscopy" in the fourteenth edition of the Encyclopoedia Britannica (Vol. 21, page 183) mentions the "micron (μ), which is one-thousandth of a millimetre." In Webster's New International Dictionary (page 1337) under "measure" may be found "micron 0.001 mm" and "micromillimeter, micromil, 0.000001 mm." Again, on page 2548, under "Arbitrary Signs Used in Writing and Printing, VII, Miscellaneous," "μ micron, $\mu\mu$ thousandth of a micron." Many textbook writers have adopted this notation. See Grimsehl: "A Text-book of Physics," Vol. III, page 646;

Spinney, "A Text-book of Physics" fourth edition, page 611; Foley, "College Physics," page 666.

The final definition for such terms is determined by popular usage. These small units are rapidly entering the vocabulary of the public. Dr. McClendon's correction should be accepted. Delay will cause further confusion. It should be easy for every one to adopt the symbols, m – meter, mm – millimeter = 0.001 m = 10^{-3}m, μ – micron = 0.000001 m = 0.001 mm = 10^{-6}m, mμ – millimicron = 0.001 μ = 10^{-9}m, μμ – micromicron = 0.000001 μ = 10^{-12}m.

GLEN W. WARNER

THE RETURN OF MUSCULAR ACTIVITY AFTER PARALYSIS

SEVEN years ago I had a stroke of paralysis, affecting the right leg and arm and causing very slight confusion in enunciation. Among interesting features in recovery has been the effect of effort of will in the beginnings of muscular movement. These observations were made upon the earliest movements of the right hand, chiefly the thumb and fingers.

As indication of the location of the slight clot or leakage of blood in the brain, it might be well to say that the leg, at first completely dead to movement, returned to activity within a month sufficiently to allow walking, though it is not yet strong. Rapid repetition of the same consonant sounds was difficult and still is. The arm has recovered good use, except for some of the shoulder muscles which raise the arm. Raising the arm is still done partly by muscles which raise the shoulder and not, as is normal, by muscles of the arm proper, lying between shoulder and hand. In the hand the fourth and fifth fingers are weak, thumb, first and second fingers being in sharp contrast, showing nearly normal strength, though tiring with continued effort.

The point which seems of interest is the effect of volition in instigation of the beginnings of movement in the fingers, especially the thumb, and also rotary fore-arm movements. Lying upon the back, it was found within a couple of weeks that the fore-arm, when elevated at right angles to the bed and supported on the elbow, could be balanced by slight use of the arm and fore-arm muscles. Then experimentation began upon two points. Letting the fore-arm start to tip in any direction, it could be held from falling and made to tip in a different direction and held again. Successive tipping and stopping soon gave a jerky, rotating motion. Continuing in this way from day to day, it was but a week or so until pretty good rotary movement was possible. By that time the whole arm could be elevated at right angles to the bed with its weight chiefly on the shoulder, and it could be rotated.

But seemingly of more interest were the experiments upon thumb and finger motions and the part played by effort of the will. With fore-arm elevated, weight upon elbow, it was found that by *extreme* and prolonged effort of the will, an effort harder than any I had ever known before, an effort in which it seemed as if I were sweating blood but which didn't even moisten the forehead with perspiration, the thumb could be induced to bend perceptibly toward the fingers. At first it was only a bare trace of motion, and the exhaustion from the effort was so great that it could not be prolonged to produce more motion. After some minutes of recuperation a second violent effort of will succeeded in inducing another motion. In the experimentation it was seen that the initial periods of violent effort of will became shorter and shorter and the instigated motions gradually greater. This was true of the experiments on a single day and was also discernibly true in comparing results of successive days' experiments, though there was a slipping back between the last experiments one day and the first of the next day. The effort was as extreme as possible each time, but the duration of the extreme effort required to instigate motion grew less between the experiments of a single day, and on the next day the period of necessary initial effort was at first much longer than in the later experiments of the previous day, though perceptibly shorter than in the first experiments on that day.

It seemed that there was a threshold of resistance which had to be overcome and that this threshold lessened in needed duration in successive trials on any one day and, as experimentation went on, it lessened from day to day. During a few days the violence of the effort of will was extreme, but gradually the necessary violence diminished, and the effort needed in the later trials of one day became less than in the first one of that day. After some days both the violence and the length of time needed to instigate motion decreased until they became negligible.

After motion of the thumb was pretty well conquered, efforts to flex the fingers showed similar phenomena of necessary violent exercise of will and delay in its effectiveness, and gradual progress, as in the case of the thumb.

These phenomena seem to present something of interest and significance psychologically. I will not attempt to discuss them, except to say that the demonstration of the effect of the mental upon the physical seems to give reason for pause to some who are inclined to place all emphasis upon the physical and deny effectual action of the personal (spiritual) upon the physical.

I see no indication that ultimate recovery was at all hastened by any of this experimentation.

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