

CONTRACTS have been let for the construction of the Service Memorial Institute which will be a unit in the group of buildings devoted to medical instruction at the University of Wisconsin. Some \$600,000 of the surplus from the Wisconsin's Soldiers' Rehabilitation fund are available, under legislative enactment, for building the structure. It will provide quarters for the research and clinical work of various departments of the medical school.

THE Chicago Lying-in Hospital has announced plans for its affiliation with the University of Chicago. A new \$1,000,000 building will be erected on the university campus.

DEAN CHARLES H. SNOW has announced the establishment of a course of study leading to the graduate degree of aeronautical engineer in the Daniel Guggenheim School of Aeronautics of New York University. The school was established in 1925.

AT Princeton University, Dr. William T. Thom, Jr., chief of the fuel section of the United States Geological Survey, has been appointed associate professor of geology, and Dr. Robert N. Pease, associate professor of chemistry at the University of Virginia, research associate in chemistry.

RECENT graduates of the University of Wisconsin with pharmacy as a major have received appointments as follows: L. E. Harris has returned to the University of Oklahoma, where he previously held the position of assistant professor in pharmacy; H. G. Hewitt has accepted a position in the College of Pharmacy, University of Buffalo; G. L. Jenkins has been reappointed as instructor in pharmacy at the University of Wisconsin; K. H. Rang has accepted a position in the University of Saskatchewan, department of pharmacy; Petrocinio Valenzuela has returned to the University of the Philippines, in the College of Pharmacy, in which he previously held a professorship.

H. MUNRO FOX, fellow of Gonville and Caius College, Cambridge, has been appointed to the Mason chair of zoology at the University of Birmingham, to succeed the late Professor F. W. Gamble.

#### DISCUSSION AND CORRESPONDENCE

##### KINETIC ACTIVITY, ORIENTED ADSORPTION AND MOLECULAR DEFORMATION AS FACTORS IN CATALYSIS

IF a swinging magnet passes near a fixed one, so that there is a close approach of like poles, the swinging magnet is deflected from its course or is even made to recoil. This simple device was used by Sir Ernest Rutherford to illustrate the influence of atomic nuclei on alpha particles shot out by radium.

If, in this experiment, the poles are of opposite polarity, they will attract each other; but the velocity of the moving magnet will determine whether or not the two will cohere. The most favorable condition for cohesion is naturally a direct head-on meeting at a relatively low velocity, whereas an off-center approach at relatively high velocity is unfavorable. Analogous conditions govern the fate of comets which approach the sun.

Atoms and molecules are no longer regarded as tiny little hard balls, for we now know them to be highly organized structures, most of which have, or may be made to have, some kind of polarity, which may result in their mutual cohesion. Chemical combination is a special case of such cohesion. From the fact that most atoms and molecules are able to build up, under proper conditions, into chains or three dimensional groups, it seems evident that they have a plurality of areas of charge or polarity. The tendency of these aggregations to crystallize, that is, to assume regular but various space lattices, having cleavage planes of unequal strength, further indicates that the fields of the particles (atoms or atomic groups) are of unequal strengths at different places, and are, in the course of group or crystal formation, in some way adjusted or fitted to each other. Possibly these particle fields are the net result of the motion of the constituent electronic units.

The more highly complicated the particles (atoms, molecules or molecular groups), the less the probability that they will present to each other their various polar areas in such fashion that true crystal-lattice or crystallographic union may take place, with the elimination of solvent or other adsorbed film, if such there be. To effect such union speedily, the meeting, besides being properly oriented, must be at an efficient velocity. However, since most particles have a plurality of areas of electric or magnetic fields, some kind of attachment less rigid or lasting than true chemical combination may occur. This seems to account for the tendency of more complicated molecules to form haphazard or random groups, or aggregations of such groups, from which, however, they *tend* to move toward their position of minimum potential—one big crystal. If for any reason (*e.g.*, adsorption of ions) groups acquire like charges of sufficient strength, the resulting repulsive forces will militate against union, and we have the time-lag characteristic of the colloidal state.

Transferring these ideas of optimum kinetic velocity and of oriented meeting to catalytic phenomena, the function of a catalyst may be pictured in three stages:

*First*, the catalyst binds or adsorbs a reacting constituent and holds it relatively immobile.

*Second*, the bound particles are held in oriented fashion (oriented adsorption), so that they present to the other reacting particles, fields most favorable to adherence to or combination with them.

*Third*, the electromagnetic or electrostatic fields of the reacting particles thus joined react on each other in such a way that the bond between the inner particle and the catalyst is broken, while that between the two reacting particles persists (synthesis).

This scheme demands a fitting together of the fields of the catalyst and those of one of the reactants, which may well serve as the basis of the "lock and key" comparison of Fischer, and the specificity of many biological, enzyme and catalytic reactions. It is also consonant with Professor Hugh S. Taylor's demonstration of selective points of activity, for it is not to be expected that all areas of the catalyst surface will be equally effective in holding particles arriving there with the criteria of successful fixation at an area of properly distributed charges—*i.e.*, proper presentation and proper velocity.

When a particle is fixed or adsorbed at an interface or effective catalyst area, the fields of the particle adjacent to the surface are largely balanced by the opposing surface fields. This neutralization should lead to a redistribution of the remaining charges of the particle, with the result that the exterior portion of the particle exposed to the solution then has a different electromagnetic or electrostatic configuration from what it had before fixation. It may now make attachments previously not possible.

If this new configuration is such that it permits the attachment of another kind of particle, there will be another readjustment of fields, with the following two possibilities: (1) If the bond between the two particles persists while that between the catalyzer surface and the now duplex particle breaks, we will have set free into the solution a new duplex particle which will undergo a readjustment of fields as soon as it breaks loose. The active catalyst area will then be free to begin the operation over again. (2) If the duplex particle sticks to the active area, activity there ceases. The same result follows if a non-reactive particle sticks to the active area (poisoning of catalyst), and it is conceivable that the fields of an active area may be so distorted as a result of conditions during use, that their activity diminishes and the catalyst becomes "worn out."

If the readjustment of fields following the fixation of a particle at an interface, or following the separation of composite particle from an interface, is such that the particle in question splits up, *decomposition* is catalyzed. The nature of the split determines the kind of products formed thereby. If a composite particle persists on liberation, we have a *synthesis*.

Consider now the effect of an increase in temperature upon a system of reactants, both in the absence of a catalyst and in the presence of a catalyst.

On the reactants the effect of heat is twofold: (1) the kinetic activity of the particles, as units, is increased; and (2) their internal activity is also increased, that is, their electrons rotate more rapidly and probably move to exterior quantum positions. Practically, the particles move more rapidly, and they swell. As a consequence, their fields may change both in strength and in location. Bonds heretofore potent may become weakened, and bonds previously impossible may be formed. The increased kinetic activity of the particle as a unit results in an increased probability of actual *number* of encounters, but beyond a certain temperature limit, which should vary in each case, the number of encounters *which are successful* will diminish. These considerations apply equally to the meeting of the fixed particle with the active catalyst area, and to the union of the particle so bound with the other reactant.

Catalysts are similarly affected by increase of temperature. Catalyst surfaces may develop effective areas not previously present, and, if finely dispersed, the catalyst will show increased kinetic or Brownian motion, which means increased probability of successful encounters. Too high a temperature may melt or cause surface flow and ruin the catalyst. Increased pressure would, in most cases, speed combination, because of increased concentration of molecules. Besides, pressure favors closer approach. When the effect of temperature on reactants and on catalyst weakens the fields, or increases velocity so that combination is no longer possible or sufficiently lasting, then the increase in number of encounters will cease to register an effect in producing increase in *successful* combination. That is, each system of reactants and catalysts will show a thermal optimum for combination.

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## MERCURY AND AMMONIA VAPOR AN EXPLOSION HAZARD

IN a small manufacturing process, strong aqueous ammonia was elevated through piping into a reaction tank, using the carboy containing the ammonia as a montejeus operated by compressed air from the shop lines. In order to guard against excessive pressures in the carboy a safety-valve consisting of mercury in a U-tube was used. This was connected with the carboy by about six feet of iron pipe. The U-tube was also of iron—standard 3/4" wrought iron pipe bent to the required form. Enough mercury was used to