tainly hybridism furnishes a satisfactory and sufficient explanation of mutation.

As regards the experimental production of species at the present time, we must choose between the practicality of the experimental production of new species by the action of radiations and by that of crossing. It seems scarcely possible to question the choice which should be made. A very weak point in connection with the production of species by radiations is the fact that there is no good reason to suppose that radiations of sufficient power have been active in this manner to any important extent in nature. Secondly, if such radiations were active, there is very grave doubt, on the basis of existing experimental work, whether they could produce viable species. If we take the other alternative, that of hybridization, we find an overwhelming amount of evidence for its occurrence in nature in all parts of the world and under all climatic conditions. Common sense would seem to indicate that the study of hybrids is much more likely to lead to permanently valuable results in experimental evolution than that of the effect of radiations.

The former generation attributed marvelous powers to electricity, which was then coming into the foreground in practical relation to human affairs. Almost every household attempted to cure itself of the various ills of humanity by the use of electrical appliances, from batteries to electrical belts. At the present time radiotherapy is as prevalent and as popular in the public mind as electrotherapy was a generation or two ago. An outstanding feature of our time is ray-mindedness. The popular exponents of biology have merely found this ray-mindedness an easy line of exploitation. There is no reason to believe, however, that radiations will, in the long run, occupy a higher position in biology, or even the popular understanding of that subject, than does electricity. We must apparently come back, as a consequence, to the sound Darwinian conclusion that environment may select variations but it can not in any important respect give rise to them. This dictum is apparently quite as true for special chemical and physical conditions as it is for the general non-living environment.

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ADSORPTION AND EMULSION FORMATION

IF oil and water be shaken vigorously together in a bottle or test-tube, an emulsion is formed which soon separates completely on standing. But if oil and mud be shaken together, the emulsion formed is a thick paste that not only does not disintegrate on standing but resists heating and chemical reagents to a remarkable degree. The oil used may be crude or refined, heavy oil, gasoline or even ether. The mud used may likewise be almost anything: sand, clay, road dirt, metal powder or fibrous dust mixed with water. The mud may be acid or alkaline. Gasoline and clay mud make a convenient pair to experiment with.

We get a clearer picture of what the soil, water and solid particles are doing if we take merely muddy water and shake it up with gasoline. The oil and water now separate clear quite quickly, leaving the solid particles in the form of a thin skin at the interface and on the glass wall. It is quite startling to see a clay suspension, that would not settle clear in months, changed to clear water in a few minutes by shaking with gasoline. The skin formed by the fine particles is quite tough and may be lifted out on a wire like a piece of wet rag. On drying it returns to a powder, indicating that no permanent chemical change has taken place. The solid particles can not spread (like a liquid) at an interface, and being themselves insoluble, can only adsorb the two liquids and mesh together.

Reinders[1] in 1913 made many observations with powdered metals and insoluble salts in water shaken with ether, kerosene, the alcohols, etc., and stated the theory very clearly—the interfacial tension between the two liquids must exceed the sum of the other two. Hofmann[2] about the same time made an extended series of similar observations. Wheeler P. Davey[3] in 1926 read a paper before the Fourth Colloid Symposium giving the theory of the formation of cup grease, which is a carefully prepared emulsion of water, soap and heavy oil. Davey's idea is that the long soap molecules (sodium stearate) in such an emulsion all have their small OH ends turned inward toward the water droplets and their larger CH_3 ends turned outward toward the oil. The meshing together of these bristling units (like hair brushes or chestnut burs) makes a stiff paste of the cup grease. Heating to 250° C. completes the dispersion and removes excess moisture.

The theory of adsorbed polar molecules is hardly sufficient to account for the formation of a tough layer of solid particles at an interface between two liquids. Each particle may be an aggregate of tens of thousands of molecules each but weakly polar in itself. Very clean dry sand easily floats on water, the grains gathering in patches. Here the lighter upper fluid (air) is adsorbed on all sides of the sand grains, causing them to float, and the air layers on adjacent grains tend to coalesce, bonding the grains together. However, in the clay-water-gasoline emulsion, the fine particles of silicates constituting the clay are them-

[1] Reinders, *Kolloid Zeitschrift*, 13: 235, 1913.
[2] Hofmann, *Zeit. Physik. Chemie*, 83: 385, 1913.
[3] Davey, Fourth Colloid Symposium Monograph, p. 38.

selves hydrophilic, hence the assumption of an oil film completely enclosing each grain is untenable.

If a mass of clay-water-oil paste be left floating on a soda (washing soda) solution for some time, the silicate particles gradually free themselves from the emulsion and sink. But each drags down with it a tiny droplet of oil, just easily visible with a 10× pocket magnifier, attached to its top. The soda has completely freed the surface of each grain from oil but has *not* destroyed the attraction of the solid particle for the oil droplet. Such behavior is not readily accounted for by either the mechanical or chemical theories of adsorption. An electrical theory would account for it if a particle of one dielectric partly immersed in another had an opposite charge induced on the remaining part. I find no reference to any such law in the literature, but it is plainly consistent with the current theory of dielectrics.

In the oil fields conditions are frequently ideal for emulsion formation. During drilling, oil and mud are intimately mixed by the drill bit. During flowing and pumping, flow through the fine capillaries of the oil sands will produce emulsions if free sand particles and water are present. Such emulsions in most cases represent a dead loss, for there is no efficient chemical method of separating the oil at a reasonable expense. The high voltage electrolytic method (Cottrell process) effectively separates the particles constituting the emulsion but requires expensive apparatus.

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EXCYSTATION OF COCCIDIAL OOCYSTS IN VIVO

WHILE excystation of coccidial oocysts has been observed and deliberately produced *in vivo* by various observers the phenomenon has not been put to the practical use of which it is capable. Segmentation of the oocysts is the usual method of determining the viability of coccidial oocysts, but the limitations of this method lie in the fact that only unsegmented oocysts may be thus tested. Excystation is a reliable criterion of viability that can be used to determine the length of life of oocysts after segmentation, the action of physical or chemical changes in the environment of segmented oocysts or of any other experimental procedure which can be tested by a conclusive manifestation of life within the matured oocyst.

The author has repeatedly carried out excystation *in vivo* using the following simple technique. Segmented oocysts from cats, dogs, guinea-pigs, pigs and prairie-dogs have been used with equal success; probably any species of coccidia from birds or mammals can be used. Young rats (75 to 100 grams) are deprived of food and water for twenty-four hours preceding the experiment. This has the double advantage of making the animal eager to eat and of thoroughly emptying the stomach and small intestine. The ripe oocysts are concentrated by centrifugation. If they have been exposed to any unpalatable chemical which may have been used to prevent putrefaction or for some experimental purpose, the chemical must be removed by dilution with water and centrifugation. The concentrated oocysts are suspended in four or five drops of sweet milk. The material is offered to the starved rat and will be immediately consumed. Sixty minutes after the ingestion of the oocysts, the rat is killed and the intestine is removed. At various points throughout its length it will be observed that the small intestine is distended with white contents. At these points the intestine should be opened and the contents observed microscopically. By examining various places in the intestine, all stages of excystation, if the ingested oocysts were normal, may be found, including motile sporozoites within and outside of the oocysts.

When using this method for experimental purposes, one or more control animals fed with untreated oocysts of the same lot from which the experimental were obtained should be included in the experiment.

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INVESTIGATIONS OF APPLICATIONS OF IODINE

FOR some time past, especially in Europe, considerable research attention has been accorded to the investigation of various proposed uses of iodine. This element, while less fortunate commercially, perhaps, than its congener bromine, which among other industrial applications has achieved importance in the manufacture of a widely used "anti-knock" motor fuel, is known to play a vital rôle in physiology, which fact may lead, it is thought, to the extension of its utility in food and medicine as well as in agriculture. Through the brilliant investigations of Kendall, Harington, McClendon and others, the intricate biochemistry of iodine has received much illumination. There remain, however, many unsolved questions regarding its physiological functions, especially in the lower animals.

These reasons led the Iodine Educational Bureau to establish on January 1, 1928, a multiple fellowship at Mellon Institute. This fellowship, having as its objects the investigation of possible technologic uses of iodine and also collaboration with other institutions interested in research on this element, is headed by