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*Miriam Allen deFord, for whom the day obviously contains more hours than for most mortals, has always carried on extensive and absorbing correspondences in addition to a full-time writing career. Last January she brought us the story of her epistolary friendship with Charles Fort, illustrated by hitherto unpublished Fortiana; and now she introduces us to a less widely known but fascinating denizen of the borderlands of science: Dr. Alfonso L. Herrera. Again she largely allows her subject to speak for himself, in excerpts from unpublished letters; and the result is a singular portrait of a man of intense imagination and enthusiasm whose scientific integrity managed to restrain him just barely this side of the crackpot Mad Scientist . . . but who could not resist an occasional wild surmise worthy of Stapledonian science fiction.*

## *Frustrated Frankenstein: Alfonso Herrera and his colpoids*

*by* MIRIAM ALLEN DEFORD

VICTOR FRANKENSTEIN, that pioneer protagonist of science fiction, formed from organic materials an adult man-monster, and by a sort of chemical sleight-of-hand vitalized the creature, to its and his undoing.

Dr. Alfonso L. Herrera of Mexico, being a non-fictional character and a responsible scientist, naturally never had any such gaudy performance to present. All he did was to experiment, with startling results, in the borderland between the inorganic and the organic — and possibly between the inanimate and the animate.

The purely chemical artifacts which he produced in his laboratory in Mexico City, and which he called colpoids, were not in any sense living cells. They were pseudo-cells, pre-organisms. Their apparent uncanny imitations of life-processes were the result of osmotic pressure. Herrera never claimed they were more — though just once he was almost ready to do so.

What he did claim was that he was seeking to demonstrate the conditions under which life originally arose on earth, and under which presumably it could arise again, given exactly the same conditions. "Life must have been the result of natural energies and forces in the primitive environ-

ment. . . . Life is not a special phenomenon, but a property which all matter possesses under the right conditions."

As Dr. Jerome Alexander said, Herrera's artifacts "illustrate not living beings, but rather many of the physico-chemical concomitants of life." Nevertheless, in 1932 some of Herrera's experimental results seemed to approach so near to life that he himself could not be sure whether or not the "cells" were imitating life — or had attained it. In the ten years remaining to him, he never came so near again. But he never doubted that he was on the right track — that "the production of such structures and their identity with the morphology of living protoplasm and living cells indicate that the physical basis underlying the two must have much in common. . . . I do not pretend to have proved the origin of life on earth, but to have given evidence. Life could have started as a reaction of water and atmosphere to constituents of the soil."

Herrera's "colpoids," compounds of simple chemicals, imitated independent motion, respiration, nutrition, pursuit, flight, combat, the extrusion of pseudopods, and reproduction by fission. Compare this with the criteria of life given by Maynard Shipley in *The Key to Evolution*:

"To be *alive*, in the strictly scientific or biological sense, a cell or organism must be endowed with (1) *irritability*, the power of responding to stimulus in the wide sense; (2) *nutrition*, or utilization of food — breaking down and building up nutrient materials from inorganic or organic sources; (3) *respiration*; (4) *excretion*; and (5) the capacity for *growth* and *reproduction*."

As Willy Ley has said, the colpoids "behaved in general like irritated and hungry animalcules."

Yet their constituents were only such simple things as olive oil, gasoline, washing soda, tannin, glycerin, oleic acid, lime water, albumen, nitric acid, collodion, and linseed oil, in various combinations, and in essence they were only saponified particles.

Anyone with a modicum of chemical knowledge and equipment can produce colpoids. Probably the easiest and simplest of the methods is to dissolve 50 parts of olive oil in 100 parts of gasoline, in a sterilized porcelain dish. Then dissolve 14 parts of soda lye in 100 parts of distilled water, adding a pinch of aniline black or rhodamine to color it. Now insert a small amount of the soda mixture beneath the surface of the olive oil and gasoline.

The resultant drops "sway, shake, breathe, skip, pursue and evade other drops, advance pseudopods, fight, eat, and reproduce."

They are colpoids. Three quarters of an hour later, they are only tiny bits of soap.

Add gum arabic in the proper proportion, and the movements persist

for an hour; add lactose, and the "arms" of some bifurcate colpoids turn cannibal, and suck and "eat" each other! "Colpoids are the best imitations of living infusoria, and . . . present a marvelous imitation of Brownian movement, each granule being activated by osmotic currents and not by the kinetic energy of the liquid."

In all, Dr. Herrera performed more than 10,000 such experiments, using various constituents. The principle was always the same — the introduction into a suitable medium of an appropriate chemical compound, whereupon "osmotic cells arose, showing internal currents and a great variety of macroscopic and microscopic structures and movements, chiefly determined by changes of surface tension and the propulsive action of osmotic currents." These might include "conjugation, palpitation, deformation, contractile vacuoles, pseudopodia, nuclei, direct division and multiplication, growth, increase of surface and volume."

Now, as Jerome Alexander said in his *Colloid Chemistry*, "the sources of life lie in the submicroscopic field, below the surface of these artifacts. . . . The law of probability is strongly against chance grouping of the enormous number of molecules needed to make up an amoeba or a bacterium, but much more in favor of the chance formation of a living molecule or molecular group." But if, as Henry Fairfield Osborn put it in *The Origin and Evolution of Life*, "Life arose from a recombination of forces pre-existing in the cosmos; [it] does not represent the entrance either of a new form of energy or of a new series of laws, but is simply another step in the general evolutionary process," then Herrera's colpoids demonstrate, if not the actual way in which life began, at least an approach toward the process by which it could have arisen in the past — or could conceivably arise today.

The Eighteenth Century chemist, Abbé Jean Nollet, the discoverer of osmosis, coined the name "plasmogeny" for the study of osmotic phenomena. This name, fallen into disuse, Alfonso Herrera revived, broadening its definition. In 1926 he published in Barcelona an illustrated book describing his experiments up to that time. Its title was *Plasmogeny (La Plasmogenia)* — a word which he defined as "a new science of the origin of life." This "new science" included "a study of the lifelike behavior of artifacts, as well as all researches and theories serving to throw light on the origin of protoplasm."

Plasmogeny developed until there was a "Sociedad Internacional de Plasmogenia," with affiliates in both Europe (chiefly France and Spain) and the Americas. Whether it survived its founder's death in 1942 I have not been able to ascertain. But certainly Herrera himself extended the implications of the "new science" far beyond its original modest research

objectives. In a smaller volume published in Valencia in 1932, and in *The Universal Biology*, published in Madrid in 1933, he defined life as "the physico-chemical activity of protoplasm," and added:

"There is no [dichotomy of] living matter and dead matter, because everything has life within the Universe; everything that exists can be reduced to the mass or quantity of matter which a body contains, and its life, which is motion." (This seems to come perilously close to animism.) From the molecule to "the constellations of the Zodiac," he could find "no sufficient distinction between the living and the inert." To him it followed that "all the beings of the Universe are brothers" in the most literal sense, since all derive ultimately from a parent nebula, by way of its suns and their planets. The microcosm is, in its origin and nature, only an "imitation" of the macrocosm whence in the last analysis it emanated, by "a chain of union and causality."

We are a far way by now from blobs of soda lye in olive oil and gasoline! But to Herrera, the road was straight and clear. From the fringe area of science, and the safe company of chemical experimenters, he passed inevitably into that still more dubious area, the fringes of philosophy. By temperament and conviction he was at once a materialist and an idealist. The cold pursuit of scientific fact with no regard for ethical consequences was abhorrent to his nature. Not all men alone, but all existing things, were brothers: and only recognition of this great truth could solve mankind's almost insuperable problems. He summarized his "laws of Plasmogeny" thus:

"All organic phenomena have been, are, and will be produced by known physico-chemical causes. There is no 'vital force'; it has not been proved nor can it ever be proved, in view of the achievements of Plasmogeny, which produces cells without the prior existence of life.

"When crystallization takes place slowly in the presence of colloids, . . . cells and pseudo-entities are formed capable of growing and reproducing themselves, even though in a limited way; and, as the technique becomes perfected, it is very probable that they may multiply indefinitely. . . .

"When the physico-chemical conditions of a cooling planet are favorable for the production of solutions of colloids and unstable nitrogenous crystalloids, . . . cells will evolve with all transitions between the crystal and the organic, eventually developing into beings as complex and sensitive as mankind."

Herrera's scientific imagination did not balk at growth beyond humanity as we know it. He was perfectly willing to posit future "supermen or other unknown beings." "It is possible that . . . humanity will be extinguished,

thus correcting an error of Nature. . . . Mankind cannot and should not consider itself the final and most perfect form."

To Alfonso Herrera, all compact of courage, enthusiasm, and sympathy, such a prospect brought no sense of doom. On the contrary, since to him all life was inseparably one, to be superseded by a higher form was achievement, not disaster, for humanity.

He had plenty of courage, in any case, this little man with the high domed forehead, the crest of white hair, and the big mustache. Until he was retired for age, he had been chief of the division of biology of the Mexican Department of Agriculture, and director of its biological investigations. But there had been an earlier period, under a less liberal government, when his outspoken freethinking and his unconventional approach to scientific problems had got him into very serious trouble indeed.

I have heard — though I am unable to verify it — that he had been professor of biology at the University of Mexico and director of the zoological garden; and that he was dismissed from these posts because it was discovered that he had sponsored, or was planning to sponsor, some experiments on the possibility of cross-breeding the anthropoid apes and man. As I say, this may be scandal and not history, or half-and-half.

I do know that at the time, about 1925, when my husband, Maynard Shipley, first heard of Herrera's colpoids, and initiated a correspondence that grew into a long-distance friendship lasting until my husband's death in 1934, Dr. Alfonso Herrera held no official position whatever, and was earning a bare living, with a wife and two young daughters to support, by doing urinalyses and similar routine laboratory jobs for doctors and hospitals.

And one thing I shall never forget: when, in the midst of the great depression, Herrera learned of my husband's illness, this old man we had never seen wrote to us, from his own poverty, that he wanted to send us all the books he could spare from his library, so that we might sell them and use the proceeds! Naturally, we refused firmly to accept the sacrifice; but it was characteristic of the man.

He had his brief moment of exaltation, when in 1932 he became almost convinced that improbable chance had reproduced in his laboratory the very conditions attendant on the creation of life. He was working with sulphocyanide of ammonia and formaldehyde. Twenty-four hours later, there appeared green cells with red nuclei, which seemed to exhibit all the characteristics of blue-green algae. Two weeks later, he observed "the mitosis of the green cells. . . . Magnificent!"

"The coloration," he conceded, "seems to be due to traces of iron and copper, existing as impurities in the formaldehyde, combining with the

sulphocyanide. But you know that these minerals exist in organisms. Copper is a stimulant to vegetation. New problems: chlorophyll has not been synthesized" — and "life seems to appear at the same time as chlorophyll."

"If this is life!" he wrote (his letters were always in French, since our Spanish resembled his English). "I find myself overcome with emotion!" And in a burst of excitement he exclaimed: "This seems to annihilate all doubts!"

Alas, we heard no more of the "blue-green algae." Herrera was a scientist before all: further experiment disappointed his high hopes; the lightning of chance had not struck him after all. He went back, undismayed, to his patient investigation.

I am sure he died still confident that, if not he, then another man of science would some day prove his theory of universal life and demonstrate its manifestation.

Or if not, then he had yet another daring hope for the far-off future:

"Perhaps some unexpected and unsuspectable discovery will rehabilitate all of mankind, or Plasmogeny may succeed in producing fertilized eggs — synthetic, artificial — from which may come highly perfected human beings, in a future which cannot be dated with certainty. . . . Philosophy will extend life and its problems to the Universe, and perhaps it and Science both will be perfected by artificial men — or by artificial brains."

Olaf Stapledon foresaw those eggs and those artificial brains, and incorporated them both in his cosmic fiction. He foresaw them in despair, Alfonso Herrera in enduring hope:

"Then," he cried, "physical and moral suffering will be extinguished forever — forever!"

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