Verständnis physikochemischer Organisationsprinzipien des Lebens.

Tatsächlich mag Bahadurs eigenes Vorgehen Gründe dafür liefern, warum *Jeewanu* in geteilten Ansichten vergessen wurde. Seine Arbeitsweise lag in mancher Hinsicht quer zu den Methoden der Zeit. Sie mag vielen Forschern als unkonventionell erschienen sein, und selbst guten Willens dürfte es sich als schwierig und mühsam erweisen, auf Grundlage der Publikationen eigene *Jeewanu* herzustellen. Lynn Margulis sprach mit Blick auf Forscher wie Bahadur von »gemishers«, Synthetikern, die aus dem Vollen des Labors schöpfen, die Mixturen von Stoffen zusammenrühren und darin nach Tagen, ja Wochen der Beleuchtung, des Erwärmens und Schüttelns nach neuartigen Substanzen und Strukturen suchen. Demgegenüber setzen Mikroanalytiker auf Kontrolle und Systematik der Stoffe und Bedingungen und streben ein schrittweises Verständnis der Prozesse an. Eine idiosynkratisch konzipierte und dokumentierte Herstellung der *Jeewanu* könnte also dazu beigetragen haben, dass sie einen Seitenweg der Forschung darstellen. Auch fasziniert Bahadur eher die materielle Präsenz der *Jeewanu*, die dynamische Struktur, welche sich dinghaft manifestiert, als dass er das Phänomen theoretisch zu durchdringen versucht. Kurz, Bahadur geht aufs Ganze, bringt es aber nicht auf den Begriff, und zitiert vielmehr Linus Pauling mit den Worten, manchmal sei es einfacher, einen Gegenstand zu studieren als ihn zu definieren.

Gemisch, Coacervat, Vesikel oder Protozelle – unser Wissen von *Jeewanu* ist begrenzt.

In einem Feld zwischen mikroskopischer Beobachtung und Strategien der Chemie stehen sie für Versuche, Leben als ein räumliches Ensemble stofflicher Veränderungen zu begreifen. Techniken der Analyse stellen Komponenten und Dynamiken lebender Körper dar, während Synthesen das Phänomen nachstellen oder zu erzeugen suchen. Dieser eigenartige Versuch, ein *explanandum* durch hergestellte Modelle zu begreifen, bringt Dinge hervor, deren Materialität ihren Begriff übersteigt, und die im Ungewissen lassen, ob eine solche Ablösung von biologischen Konzepten und deren Aufgehen in einem Handwerk der Materie Vergessen oder Erweiterung bedeuten. Ein opakes Modell einer Unbekannten – *Jeewanu* bleibt unklar.

Mathias Grote

→ *M.mycJCVI-syn1.0*

Cell

»All life is cellular life.« Or so proclaimed the little book *Die Zelle* confidently in 1919, penned (but not yet as lavishly illustrated as his later outputs) by the prolific science popularizer Fritz Kahn.[1] Hardly unusual at the time, it is a message that, in any case, would seem to have long lost its self-evidence. As we know, it was, if anything, rather smaller things – genes, molecules, enzymes – that have come define the essence of life. Yet in retrospect it is more curious still how promptly Kahn's cellular message became subverted in his own writings (or indeed, in almost any contemporary text pertaining to cellular life). Reading on, one cannot escape the impression that, in fact, even then there was no such life at all, but only things, more or less *life-like.* In the early decades of the 20th century, cellular surfaces thus routinely behave like emulsions of »cream,« »soap« or certain high-grade »motor fuels«; protoplasm is very much like bubbly »beer foam« or »champagne«; cellular activity best experimentalized by detouring through work with cellophane foil, ultrafilters, gelatine or collodion, notably, the especially »membranogenic« *Kollodium Schering-Kahlbaum DAB 6*.

Indeed in those days few things seemed particularly *natural* as regards the Natural History of cellular life. Instead, there were a great many *artificial* –

1 Fritz Kahn, *Die Zelle*, Stuttgart: Kosmos, 1919, on: p. 6.

and utterly modern – things traversing what was a truly unnatural history: plastics, textile fibers, emulsions, lubricants, soaps, and more. Historians of the life sciences, leaning, naturally, towards natural history, have rarely ventured into these terrains of artifice. They might as well – certainly the natural history of the cell, this so-called »unit of life,« barely resembled, say, the »biography« of an object (let alone an organic one); rather, it resembled a kaleidoscope of modern things. To be sure, outlines of the cellular life such as Kahn's above were no mere illustrative tricks of popular science; nor were they particularly metaphoric or the proprietary domain of only a handful mechanistic extremists. On the contrary, they reflected the kind of substantial, hands-on knowledge production that was typical of early 20th-century cellular knowing.

This, after all, was an age of ever more malleable and increasingly intricate things: the era of DuPont and I. G. Farben, of dreams (or nightmares) of national autarky; of viscose and celluloid, Bakelite, insecticides, margarine, and artificial silk; in short: of a chemically engineered, man-made world. No doubt that the »outstanding characteristic« of the times, as one entrepreneurial chemist noted in 1926, was the »recognition« of the less simple forms of matter as legitimate objects of scientific inquiry: »the industries based on vegetable and animal products and minerals used as such – textiles, paper making, rope and twine, leather, [...] paints and varnishes, glass, porcelain and earthenware, india rubber, military explosives, starch gum, gelatine and casein [...] coal and foodstuffs.«[2] Here, in this chemistry and physics of »everyday life«, was to be found a veritable science of complexity avant-la-lettre. And thus it is perhaps no wonder that one finds its somewhat unnatural – but omnipresent – objects constantly disturbing the apparently natural history of the cell. In fact, knowledge of cellular life could never be »direct«: »Because the dimensions are so small, the possibility of elucidating the structure of the plasma membrane, for the time being, doesn't exist; there remains the indirect method of investigation by way of comparison with membranes of known structure.«[3]

And of known structures there were plenty. Indeed, whether appropriated explicitly – as so-called »model experiments« – or epistemically productive along more subterranean paths, fabricated, and hence, known structures profoundly mediated what was known about cellular life. The essential logic was simple enough. As Ludwig Rhumbler's *Imitation of Life Processes through Physical Constellations* (1921) advised: by maximizing the »number of parallels« between imitation and original, a »suitably composed system of liquids,« for instance, thus persuasively served as »indirect evidence« that physical processes were »performed« in identical fashion in the protoplasmic substance of the cell. But over and above such deliberate, mimetic deployments, this veritable ontology of known things and structures exerted its influence subtly. Familiarity with the concepts of physical, surface and electro-chemistry was as mandatory as was knowing one's way around the practical tools of colloid science; more to the point even, insights into the »inner causes« of cellular behavior inhered in the diverted materials themselves.

Students of the cell, when touching, almost in passing, upon the mysteries of cellular behavior, thus preferably proceeded – most unromantically – by way of substitution: cells were replaced by things better understood, more accessible, or simply, more profitable: filtration membranes, foils, cellophane, latex, gelatine, frozen muscle, stored apples, liquids composed of cream, egg whites, or soaps. Mind you, there remained only »the indirect method of investigation.« Theories of the cell had it written in their names, be it the so-called »ultrafilter theory,« or its major competitor, the hugely influential »emulsion reversal« theory of the plasma membrane: in many ways, indeed, the life sciences of the cell were a matter of investigating – quite unliving – *Ersatz*. Or, to paraphrase Hans-Jörg Rheinberger, they were a matter of experimenting, tinkering and thinking with *ersatz-objects* – objects forever oscillating between »technical« and »epistemic

2 Charles Cross, »Chemistry Of Cellulose,« *The Times*, March 9, 1926, Supplement, p. viii.

3 Rudolf Mond, »Einige Untersuchungen über Struktur und Funktion der Zellgrenzschichten,« *Protoplasma* 9 (1930): 318–330, o:n p. 319.

objects.« Better yet: the experimental systems that gave definition to the 20th-century cell constitutively conflated and blurred those distinctions that might be drawn between technical and epistemic objects; they were epistemic only by virtue of being – literally – *technical*. By the same token, these cellular substitutions were not so much »local,« and locally confined to the academic laboratories, but belonged to experimental systems whose histories more properly were *mundane*: the natural history of the cell, for one, was intimately entangled with the material history of the world at large.

Max Stadler

→ Zelle

M. myc JCVI-syn1.0

Born of four bottles of chemicals, a powerful computer, a tremendous ego and an overabundance of digitized and sedimented metaphors, *M. myc JCVI-syn1.0* – a modified goat pathogen also known by the name *Mycoplasma laboratorium* – first emerged *in venter* into the public limelight on May 20, 2010 with reports in *Science* that something novel had emerged from a modern synthetic version of a hot dilute soup. The conception of the bacterium, however, was recorded at the U.S. Patent Office as early as October 12, 2006, and a glint in one man's eye toward fathering an engineered synthetic organism with a minimal genome dates back at least to 1995.

First isolated in the early 1960s from the urinary tract of a wayward sailor suffering from acute non-gonococcal urethritis, *Mycoplasma genitalium* proved instrumental in these efforts. Known to have »the smallest complement of genes of any known organism capable of independent growth in the laboratory,« *Mycoplasma genitalium* eventually proved to have over a hundred superfluous genes, each of which could be disposed of individually without influencing the full functioning of the organism. The testing and removal of these genes over a period of years led to further contractions of the genome until further work with a related species with a faster reproductive cycle, *Mycoplasma mycoides,* proved essential. The novel *Mycoplasma laboratorium* thus came about as the illegitimate offspring of chromosome transplantation between *Mycoplasma mycoides capri* (GM12) as the donor and *Mycoplasma capricolum capricolum* (CK) as the recipient.

Several earlier attempts had been made over the course of the 19th and 20th centuries to synthesize *M. laboratorium*'s predecessors. Wöhler's first attempts in 1828 succeeded only in producing some liquid excretory products (now preserved in dried crystal form at the Deutsches Museum in Munich), while later attempts to synthesize life artificially using radium at the Cavendish Laboratory in Cambridge in 1905 also failed – though not without fame and consternation from both scientific and religious quarters and an ultimate sink into ignominy of the would-be young inventor. Later efforts involving the artificial synthesis of DNA and various recombinant DNA techniques were each subsequently heralded as nearly bringing about the synthesis of life in the test tube. It remained for the infamous J. Craig Venter and his colleagues in suburban Maryland, U.S., however, to take the final steps toward a second genesis in the laboratory, documenting their steady progress toward this goal over more than a decade.

As contractions of the genome increased – a synthetic genome nearly 600,000 bases long was constructed from over 100 DNA cassettes – critical onlookers began to apply dilatory tactics to protest this purportedly immaculate conception of an organism having only »inventors« as parents. Yet such mangy arguments had little place within the stable of the J. Craig Venter Institute. From the tabloid *Star* read one morning on the Orient Express to the various trios of wise men and women appearing in public forums to pronounce on the significance of the