

IMMORTAL LIFE

HOW IT WILL BE ACHIEVED

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DEDICATION

This book is addressed to all earnest students of Life, and gratefully inscribed to the sweet singer who, in the midst of her triumphs in Opera, renounced a brilliant public career to aid in making these researches. Except for that generous aid this exposition of what we hold to be a scientific *renaissance* of Christianity, would hardly have appeared.

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IMMORTAL LIFE

HOW IT WILL BE ACHIEVED

INTRODUCTION

THE line of research indicated by the title of this work, was first undertaken in 1876, and the work, itself, as it at present stands, has been antedated by several minor volumes treating of the same subject, marking the progress of investigation, namely:—

Living Matter, published in 1888.

Pluricellular Man, 1893.

Long Life, 1896.

Natural Salvation (three editions), 1903.

Salvation by Science, 1913.

Forty years ago less clear ideas prevailed as to the nature and condition of matter than to-day. The electron had not then been discovered. Atoms and molecules were the *ultima Thule* of the physicist and chemist. The concept of a potency for sentience, impregnating matter universally, was, as yet, but vaguely entertained. Scientific opinion was moving in this direction, however, as the following citation from *Living Matter* will show.

“In the past, and largely as a necessity of theological tenets, matter has been depicted as the lifeless material of a manufactured universe. The physical science of to-day postulates matter, not as lifeless, but as primarily sentient; not the inert substance of a created world, but the living substance of a self-acting universe; that matter is itself *creative* of phenomena by virtue of that sentient attribute with which the ultimate atom is endowed and possessed. It portrays a universe, acting without interference. Impelled by a sentient attribute, matter moves and returns to itself

through the cycle of universal phenomena. Matter possesses the elements of conscious feeling. This it is which gives the semblance of subjective design in nature; the universe moving forward from the urge of a lowly self-consciousness. . . .

“That wondrous substance which — for lack of a better name — we still call matter, possesses the property of sentience from which all life is an organized development; that property which struggles upward from elemental feeling to intelligence; that primeval endowment out of which all that is noble, true and worthy in man, is born, and to the deep instinct of which all things base, false and vicious are but the dross that clogs its expression. Under the present conception there is no such thing as lifeless matter, and hence no such doctrine as ‘materialism.’

“In organized matter, we contemplate, not the miracle of an insentient force transforming itself into sentience and intelligence, but simply the raising-up of this primary sentience of matter to more full expression. . . .

“Here, on this eternal constant, the intimate life of matter, itself, founds the hope of a possible immortality for man. No vicissitude of earth has yet been observed to deteriorate its quality. Everlasting as the stars, it shines from the heart of each ultimate particle of matter, and illumines the wide deserts of space with the glow of light, of heat and of life. . . .

“Matter is everywhere potentially sentient; yet on the earth’s surface, matter can move in response to this endowment only when combined in a certain peculiar way, namely, in that complex association of molecules forming the semi-fluid substance which has been designated as ‘protoplasm’ in the cell-of-life, and only when acted on by sublimated matter, emanating from the sun. Such is the clutch of gravity, and the tension of the electric, dynamic and other modes of energy, that this ‘protoplasm’ is the only known terrestrial substance, loose, yet coherent enough to be able to move itself at the instigation of the initial sentience of matter. It is at once the material and the architect of organized life; in it stirs the sentience which animates every organism and constitutes man a living being. But for this mobile substance, the earth would lie a dusty *tundra*, with no tint of vernal green on its wide gray plains or mantling its rusty precipices. The continents would stretch out bare and solitary; on them the rain would beat, but no

living plant would grow. Save the lonely roar and wash of waves on desert coasts, the clangor of storms, or the harsh rumble of volcanic fires, the great convexed terraine would be a voiceless waste. In vain would spring suns caress it, or summer's passion burn, or autumn ask a harvest. Fruitless old earth, never crowned with life, would wheel onward through her era and epochs, a sphere of stone and water, dun, rugged, and mute."

It would be erroneous to assume that the concept of a sentient property in all matter is a wholly modern one. Anaxagoras, Zeno, Epicurus, Lucretius, in the classic era, divined it darkly; Gassendi erratically, in 1640; and Tyndall clearly, in 1870. Indeed, those who ponder these subjects longest, most deeply, almost invariably come to like conclusions touching matter and life. In 1891 we find Thomas Edison saying offhand: "It is my belief that every atom of matter is *intelligent*, deriving energy from the primordial germ. The intelligence of man is, I take it, the sum of the intelligence of the atoms of which he is composed. Every atom has an intelligent power of selection and is always striving to get into harmonious relation with other atoms. . . . All matter lives and everything that lives possesses intelligence. . . . The atom is conscious if man is conscious, is intelligent if man is intelligent, exercises will-power if man does.

"We are told by geologists that in the earliest periods no form of life could exist on the earth. How do they know that? A crystal is devoid of this principle, they say, and yet certain kinds of atoms invariably arrange themselves in a particular way to form a crystal. They did that in geological periods, antedating the appearance of any form of life, and have been doing it ever since, in precisely the same way. Some crystals form in branches like a fern. Why is there not life in the growth of a crystal? Was the vital principle specially created at some particular period of the earth's history, or did it exist and control every atom of matter when the earth was molten? I cannot avoid the conclusion that all matter is composed of intelligent atoms, and that life and mind are merely synonyms for the aggregation of atomic intelligence."

The above citations concerning "matter" and "protoplasm" are adduced here, rather to indicate scientific progress than pre-

sent existent ideas. The word matter is still retained, but our ideas of it have changed. A well-marked scientific progress has been made toward the identification of matter with energy, or rather, perhaps, in the reduction of matter to terms of energy.

No change, therefore, in rationale or hypothesis is necessitated, from viewing living matter as energy. It is merely that former theories of inert and lifeless atoms have been eliminated.

As to the intimate constitution of matter, meaning its ultimate constitution, two hypotheses find consideration in the world of science. The first holds that the cosmos, in all its phases, has its origin at some far depth of minuteness, from solid, vivific particles, or corpuscles, which give rise in their movements to all phenomena vital as well as physical.

The second hypothesis doubts the existence of such ultimate solid particles, and holds that a primeval, perhaps eternal, energy is the sole source of all phenomena, including the sense of substance, time and space; that the electron is but a dynamic eddy of the basic energy of the cosmos.

If Tyndall were living to-day, he would no doubt define matter as a form, mode or phase of energy, and treat of energy as living energy, possessing fundamentally the potency for life. As early as 1888, it had begun to be recognized that matter possessed a sentient attribute. None the less, terrestrial matter, meaning that at the earth's surface, would remain inert until acted on by the more sublimated matter which emanates from the sun.

The conception of the cosmos, and of matter in relation to energy, which now obtains assent, is, in effect, that the highly rarefied nebulae undergo "cooling," i. e. involution, to electrons and the atoms and molecules of the so-called elements; and at the same time part with an excess of the original, rarefied particles to outer space, a radiation, indeed, which causes the involution. The epochs and eras of orbited matter ensue: self-centered aggregations in which energy is locked up concentrically. Yet from the suns there still emanate streams, or tides, of the originally nebulous matter, which actuate life on the planetary surfaces. The universal energy is both subjective and objective. As related to the human mind, that individualized portion of it within the brain of a living being is subjective, with all the rest of the universe objective to it. The universal energy, then, has a self side, and is

capable of insulating a subjective self to which the rest of the universe is objective. This is what we see accomplished in the cell-of-life.

It is by no means incredible that personal beings exist on other globes in space, who far exceed man in knowledge and power. Nor is it impossible that they exert an influence on life here. Human prophets and seers have always claimed divine "inspiration" and "revelations" of truth. The evidence of anything of this sort is, in view of all the facts, very untrustworthy. So far as extraneous intervention, or aid, goes, we appear to be alone here.

That mysterious impulse which we now call energy, is at once the creator and destroyer of the universe as we at present behold it. Whence it has come and to what end it proceeds, no one can say. What it is in ultimate analysis, none can tell. When actuating machines, we name it power. When pressing, motionless, against obstructions, we call it force. When imparting movement to its eddies, we term it motion, of which heat, light and the rapid rush of electrons are observed modes. When it impels the so-called elements to compound or disrupt those compounds, we designate it as chemical affinity. In the protoplasmic substance, found in the contents of the cell-of-life — an unstable compound of five or six "elements" — we see it display automatism and that sentience from which our personal lives arise.

There is, indeed, but one logical explanation of the presence of life on the earth. It is inherent in the energy that falls on the earth's surface from the sun. Probably, too, it is locked up in all matter, tightly englobed in the atoms of the elements, which seem lifeless only because the sentient property within them cannot break free and display itself as life. The negative corpuscle still revolves within the atom, bearing its charge of electrical energy, and of potential sentience, which might be released and conditioned to exhibit life. That, indeed, is what occurs in the cell-of-life. In the protoplasmic substance of the cell, there appears to be an exchange and inter-play of freed electrons, instigating that pyrrhic circle, or bund, which underlies the self-consciousness of a cell. But the great source of freed electrons is, of course, the sun, without whose tides of aperiënt energy, earth would be a lifeless waste.

The solution, therefore, of the whilom riddle of evolution, lies not in further painstaking observation of every minute detail of anatomy, or histology, but in recognition of the great truth that the cause of life is a potentially sentient property, inherent in energy or matter, which feels its way consciously forward, and by means of experience and organization rises to higher and higher estates of intelligence. All these complicated mechanisms of life, adapted to locomotion, prehension of food, nutrition and reproduction, have come into existence under stress of pain or pleasure.

The cause of evolution goes deeper than organic details. It is a consciously directive factor. It is not to be found by pothering with organic details. Largely it comes here from afar — from the sun — was probably in the original nebula, and is competent to inaugurate an evolution of life here or elsewhere. As to its origin, it is vain to speculate.

The universe as we behold it is a revelation of energy. In vast panorama, it hangs athwart space, in the guise at once of substance and power. That conscious life is one of its potencies, can scarcely be doubted. Segregated in the cell, it displays subjectivity; a subjectivity to which everything outside the confines of that cell is objective. The energy which impels the universe, is capable of individualization and personality. Given sufficient organization in brain and body, it rises to mind and intellect.

That an elemental consciousness is the fundamental and final mode of energy is now increasingly probable, also that all other observed modes of energy connect down to it; and that not only the cell-of-life, as seen in unicellular life, but all multicellular forms of life, animals and plants, are *en rapport* with it. In short, a great truth of nature is beginning to dawn, namely, that all living creatures are within the cordon of the universal consciousness; that the, hitherto, mystic phenomena, which have so long puzzled the human mind, telepathy, clairvoyance, "spiritual intuition," are due to the relations of the cell-of-life with this sentient property of the universe. Here spiritism has its root and will have its explanation.

Energy, indeed, is now the one proper object of scientific study and experiment. All the great discoveries, that have made man what he is on the earth to-day, from fire and steam to the electron, have been discoveries in energy. At present, the swift, motile

electron marks our deepest gropings in the self-englobing of energy. But that the electron is the ultimate particle and building-block of the universe, is highly improbable, in view of what is already credible concerning the ether of space, its waves and the various rays which emanate from certain of the so-called "elements." But beneath it all, before it all, we conceive of a property primevally sentient, primarily self-conscious, potentially intelligent, actuating it all; in a word, the inherent property from which personal life upwells, and, through long ages of organism, is raised toward omniscience and omnipotence. Omniscience and omnipotence! Did the present orbited order of the universe originate from these grand heights of intelligence, to which human beings now aspire?

These are questions which transcend present knowledge to answer. But somewhere in the vast depths of the cosmic energy, *the potency to feel and live and grow wiser has its root.*

Living Matter (1888) concluded as follows:—

"There is a time in the young life of every fairly fortunate and normally healthy human being when existence is a joy, a well-nigh unalloyed sense of happiness; when earth seems wondrously fair and all nature a source of gladness to the eyes and laughter to the heart. That time, that season of joy, is when the living matter within our bodies is just reaching the adult condition, expanding and as yet unoppressed by the after-load of life's accidents and scars, the clearly apparent result of biogenetic health, and as yet undiminished fulness of the living element in all the tissues.

"Such an estate of life is attainable, then, an estate when life is indeed a joy and worth living, at least once in our lives, and hence is one of the possibilities of living matter on the earth. That we decline from that condition of health and joy is, as I have attempted to show, the result of (1) minute mechanical and chemical injuries within the tissues; (2) injuries from a continuous series of physical accidents which befall the organism, internally, from imperfect food and faulty assimilation; and (3) the mental, or vital recoil and reaction from all these injuries, exhibited in discouragement and world-weariness.

"These injuries may at times suddenly effect the death and dissolution of the organism, or, working slowly and in conjunction.

may occasion the gradual decline of the living matter in the tissues, and in time induce the condition known as 'old age.'

"It cannot fail to be apparent, however, that each and every one of these causes of death and old-aging *is of the nature of an ordinary physical cause fairly within human power to avoid or remedy, and many of which, in fact, we are every day avoiding and remedying.* It is the sum total of these causes which has heretofore rendered death a seemingly inevitable sequence to life. Yet not one of them but can singly be warded off by human science and foresight; and if one, why not all? It is a question of ways, means and skill with us, not that we die from any immutable law of nature as heretofore held and taught."

In *Pluricellular Man*, it was shown that so far from being an infrangible integer, the human intellect, or soul, is a confluent blend of a vast number of separate cell lives, each a center of self-consciousness; a confluence which may be diminished, quantitatively, and weakened in each separate cell until, as in extreme "old age," little of self-consciousness remains.

It was pointed out (1893) that the cell-of-life is the sole seat and source of feeling, consciousness and vital phenomena; not only in animal organisms, but for all forms of life on the earth's surface, it is in the cell alone, and only through and by means of the cell organism, that the potentially sentient property in energy, is raised up into self-conscious life and intelligence. No cell, no consciousness.

Since the days of Schleiden and Schwann, the "cell doctrine," as it is often called, has been alternately attacked and defended. For a time all organisms were regarded as cell communities, after the analogy of the citizen and the nation; the intelligence of the cell was much exaggerated. The intellect of a man was deemed to be an aggregate of the cell intellects resident in the brain.

The opposed contention, typified by biologists, like Richat, held that the animal organism manufactures and collocates its component cells, not the cells the organism. As late as 1916, we find a physiologist confidently discounting the importance of the cell in the human organism, his idea being, apparently, that cells are incident merely to animal life, and might even be dispensed with altogether, without greatly affecting that life!

That the general organism produces new cells, except by proliferation of existent cells, or extrusion of cell germs, from cells already *in situ*, is an assertion at which any competent histologist must smile. New cells come into existence only from existent tissue cells, the germs of which were transmitted in the embryo from parent organisms.

This fact alone, when properly comprehended, establishes the paramount importance of the cell to the organism. No embryonic cell, no organism; no means of replacement of the daily wear and tear of life; no means of transmitting offspring. The nucleus of the embryonic cell contains what, of late, is termed the heredity-germ of the entire organism. It is to the future organisms what the package of seeds is to the future garden.

It is true that the life of the organism, as a whole, constantly coerces the cell to act and to live its life for the good of the entire personality. It is true that certain groups of cells are specialized to various uses of the organism; muscular contraction to ensure locomotion, respiration and peristalsis; secretion, to produce chemical activity for the digestion of food; excretion, to eliminate waste products; deposits of earthy salts, to resist gravitation; and that, in many cases, these differentiated cells seem to be little more than chemical agents, under complete control of the totality of cell life which actuates the organism. None the less, these lowliest cells sometimes display individuality by breaking loose from that organized control, and running riot, causing the very worst of human diseases. The fact appears to be that in whatever tissue it is found, the cell never wholly loses its selfhood, and its ability to initiate independent action.

It is true that measured by the standard of intelligence displayed by man, the intelligence of one of the component cells of his organism is lowly and on a far inferior plane. Nevertheless, it is consciousness and intelligence.

Moreover, it is in the cell, and the cell only, that the property, or attribute, of energy which gives rise to life, finds means and opportunity to display those phenomena which we term vital, to wit — spontaneous movement; movement in response to feeling, sometimes termed irritability, though this latter designation fails to depict its significance. The cell, therefore, is, in reality, the only living thing on the earth's surface. Organisms, whether

plants or animals, live and are conscious only by virtue of the metabolism of their component cells.

The cell contents has long been the subject of curious observation and study. At first, and by biologists of Huxley's day, the cell contents was regarded as homogeneous, semi-fluid, of uniform consistency, composed of the six elements, oxygen, hydrogen, nitrogen, carbon, sulphur and phosphorus in a state of flux, which long bore the name of "protoplasm." Protoplasm, indeed, has figured large in the annals of biology. It was long believed to be that magic substance, that viscid, odorless, colorless, transparent chemical compound in which life first stirs.

It is hardly necessary to state here that cells are no longer supposed to be filled with, or composed of, minute drops of homogeneous, semi-fluid "protoplasm." On the contrary, the cell contents is now known to be very intricately, complexly, organized; and that, so far as known at present, life — meaning the conscious life of cells and organisms derived from cells — never otherwise manifests itself, except through this complex organization within the cell.

Apparently, too, this organization extends to a vast depth downward into the unfathomed minuteness of particulate substance. We are able at present to trace it no farther than organizations of electrons. That it extends far deeper, that the electron is, itself, an organization of bodies more minute, is wholly probable.

Shall we then, in our quest for the control of life, think little of the cell and regard its existence in the human organism as incidental and of minor importance? Scarcely. For on the surface of this earth the cell represents the mode and the vehicle by means of which the "potency of all life," the mere potency, has worked its way upward to self-conscious expression. No cells, indeed, no consciousness. If we were inclined to theorize, the potentially sentient attribute of energy might be regarded as energy in its initial and most esoteric mode or form, from which it would follow that the universe, as we know it, proceeds from a cause fundamentally sentient. This view need, by no means, lead us into pantheistic conceptions of nature, or beliefs in regnant anthropomorphic deities, since nature shows no sign of being controlled otherwise than by an impulse within itself. An omniscient Ruler, actively governing and directing nature from some point of van-

tage outside it, is, in view of the awful panorama of cruelty and injustice the world presents, the most immoral dogma ever imposed on the human mind.

Hence we must by no means lose sight of the cell, but rather keep our attention focused on it. For it is the cell which gives us the sense of feeling, the consciousness of self. It is the cell which proliferates and makes growth possible. It is through and by means of the cell that the organism repairs its injuries and maintains itself. It is the cell, too, which, in its nucleus, contains the germ of the race and makes its successive generations possible.

In *Long Life* (1896), the causes of old age — the progressive old-aging of the human organism — were enumerated and examined from the standpoint of histology, establishing the fact that the causes of organic death are essentially mechanical and chemical causes, to which may be added retroactive effects from fixed beliefs. Hence, that no fundamental law of nature underlies the death of our bodies, but that we cease to live from common causes, each and all of which can be alleviated and removed by efforts within the power of man to make.

In *Natural Salvation* (1903), and the three editions which followed, it was pointed out that apparently life on the earth existed, first, and for many ages, in the unicellular form, namely, as unicells, creatures consisting of a single cell-of-life. Second, that, beyond reasonable doubt, multicellular organisms, namely, plants and animals, were gradually developed from unicells, uniting by accident, perhaps, at first, to live together.

In brief, that living in the multicellular mode of life has proved a species of natural salvation for the unicells, as, for example, the cells of the human brain, the life-times of which are thereby increased many thousand-fold; thus establishing the fact that under nature, length of cell life depends on improved nutrition and protection, — a point of immense importance regarding the prolongation of human life.

In *Salvation by Science* (1913), the conclusions concerning human life, set forth in *Natural Salvation*, were summarized, the causes of old-aging restated, and lines of research indicated, looking to the control of life in the cell.

Inferential to this it was pointed out that happier, deathless life (idealized as Immortal Life), entered upon in some habitat more favorable than that in which we live at present (namely, Heaven), has been the most cherished ideal of mankind since earliest times; and, further, that the extraordinary development of the human intellect, and the remarkable physical progress of the race, give good hopes that this ideal will be realized; and that it is toward this sublime goal that the evolution of humanity proceeds, namely, the achievement of deathless life and the paradisation of the earth.

Salvation by Science has been harshly criticised as irreligious. Certain critics appear to hold that a biologist has no right to raise his eyes from the field of his microscope, or give expression to any of those grand, future possibilities which his science unfolds; that theology is something wholly apart, and above scientific consideration.

For criticism which is to the point, and therefore helpful, this author has the greatest respect, and has always solicited it. Instances of this, though not wholly pertinent to the purpose of this work, are yet very instructive as showing the obstacles which the idea of *Salvation by Science* has to encounter in the minds of many readers.

“You might as well ask us to discard Christianity altogether,” the editor of a denominational journal writes. “Your idea would supplant it, *in toto*, cast it to the four winds. Humanity without Christ! I wonder if you realize what that would mean. To me it would signify the loss of the one regenerative force which now preserves civilization.”

There is an entire misapprehension here. No such purpose to supplant Christianity exists. Would it avail — probably not — to point out to this critic that salvation by aid of applied science is quite in harmony with the scheme of immortal life, from morally renovated human life, set forth by Jesus? Or that the Christianity of to-day, as a creed, is little enough what Jesus taught, and differs from it so greatly, in fact, as to make the word Christianity largely a misnomer? Or, yet, that the now most important tenet of the

church, namely, that disembodied human lives are transported, when the body dies, to a supra-mundane heaven, or hell, was never held nor taught by Jesus, had no place in the Messianic scheme, nor yet was believed by the early Christians, for a space of at least two centuries after the crucifixion? Would the critic above cited, be greatly shocked, astonished, perhaps, if the present writer claimed to be the better Christian and could show that, both in spirit and in the letter, the present work conforms more closely to the doctrine which Jesus held and taught, than does modern Christianity — adding that the line of research for which the work stands, was undertaken to make those doctrines practical and practicable?

Another clerical critic, hailing from the great State of Missouri, has thought *Salvation by Science* worthy of a sermon in refutation — and has kindly sent a copy of it. After citing alchemist attempts to attain earthly immortality from elixirs and philosophers' stones, this critic has concentrated his main argument on the undoubted fact that all men who have lived in the past have died, and from this fact proceeded to draw the conclusion that all men who ever live in the future, will infallibly die. Yet could argument or conclusion have been more untrustworthy? Equally, a century ago, it would have been said, with the same aplomb, that no man would ever be able to converse in ordinary tones, between New York and San Francisco, or send the news along a wire across the Atlantic, or transmit wireless messages from France to America, or rise in the air, like a bird, and cover five hundred miles at a single flight. The prolongation of life is a physical problem, pure and simple, and the growth of knowledge is periodically enabling human beings to overcome physical obstacles hitherto deemed insurmountable.

With considerable certainty it may be predicated of the lower, unprogressive animal orders, that death for them is an inevitable sequence to life — unless rescued by man. Horses, dogs and oxen will, probably, go on dying. Man, however, has learned to set aside natural laws. To future educated mankind all things are possible. With prophetic, though choleric vision, Napoleon once exclaimed, "Impossible is the adjective of fools." With clearer vision, Tennyson wrote: —

“Of those who eye to eye shall look
On knowledge; under whose command
Is Earth and Earth's, and in their hand
Is nature, like an open book.”

The argument that men will always die, because they always have died in the past, controverts human progress, and needs hardly to be considered further.

A chemist at Buffalo, New York, takes *Salvation by Science* to task for treating so much of the origin of life on the earth, and so little of the chemical constitution of the blood which, in his opinion, is the one true avenue of approach to success in renovating the human organism. “What do these questionings concerning the origin of life have to do with a work devoted to prolonging it?” he asks. In a word, he would strictly specialize the effort.

But the very idea of achieving deathless life, looking to immortal life, involves the origin and end of life, and, also, every system of religion which has ever been formulated for human guidance. Immortal life embraces something more than mere continued existence. It implies a mental development which will render continued life enjoyable and of importance in the arena of the universe. It includes psychology as well as physiology, morals as well as ethics, religion as well as economics, theology as well as medicine, bio-physics and sociology. All are involved, yes, interlocked, with the idea of attaining greatly lengthened life. Not a single biological or ethical problem, affecting human life, can be named, which is not concerned with them all.

Moreover, it is a well-established fact that in earliest times, and as soon as man rose to the erected posture, looked abroad more widely and directed his thoughts above the mere gratification of his animal wants, his origin has vaguely puzzled him, and his destiny in the universe has given him concern. There is reason for this natural solicitude. By looking backward, he has gathered wisdom for his guidance; by looking ahead he has learned what to avoid and what to live for. All experience, all forecast, all human knowledge, indeed, is thus correlated and interdependent.

An Englishman, who appears to be a person of scholarly leisure, in the course of a letter which cavils genially with the idea that

deathless life can be attained from the growth of knowledge, remarks: "But what do we know of immortal life? We cannot really conceive of immortality. Like its co-relatives, eternity and infinity, it is beyond human comprehension; and that, to me, is evidence against the possibility of it, namely, that what man cannot conceive of he cannot attain, or would not be capable of, if attained."

It is probably a gratuitous assumption, that the future son-of-man may not comprehend ideas which are incomprehensible to man at present. It is not likely that the primitive Aryan from whom we are descended, could have comprehended wireless telegraphy. Waiving this point, we might, without much detriment to our argument, speak of deathless life as being for a period of ten millions of years, or the eon since man first walked as a vertebrate. That would measurably simplify the question of incomprehensibility, and, indeed, answer very well for present purposes! Perhaps, by that time, we would be able to comprehend immortal life better. Let me not be understood as casting ridicule on my English critic's stricture, which in a way is pertinent, but, merely, as repaying cavil with cavil.

A reader, who signs himself as Assistant Astronomer at one of our great observatories, comments in a superior vein — as becomes an astronomer — on the futility of all thought of attaining deathless life in the sidereal universe. "The solar system is, itself, ephemeral. It is running down, passing on to its dead stage. The nebula, from which it was evolved, ran down. In cosmic time, the widely separated dead orbs of this system — the dry clods of the universe — may rush together, generating sufficient heat, from collision, to again diffuse them in another nebula. But what personalized life could survive such a cataclysm?"

This comment was gratefully received, since it embodies an idea which has appealed strongly to many thoughtful minds, during the last half-century, namely, the mutable and transient nature of the cosmos. Our globe of earth is but a cosmic atom, still radiating its electrons and ions into space, contracting to its "dead-orb lunar age." The immense solar globe, itself, from the splendid radiation of which all terrestrial life has its source, will, ultimately, burn out and join the "innumerable caravan" of dark,

invisible orbs that wheel, ponderously, on their orbits in outer space.

“As heat departs and earth doth colder grow,
And the bright sun’s vast fires shall pale and smoulder low.”

In the colossal flux of the universe, all minor aggregations of matter wax and wane, perforce. “The stupendous whole” transmits its motion, its fate, to all lesser bodies — the human organism, for example. The stress of the universal inter-flux compels everything to begin and to end. Thus reasons the astronomer touching immortal life. A chimera, he says. The sick fancy of a dying child.

But let us put a hypothetical case. What if sentience — the sentient, conscious factor of energy — were the source of the cosmos? How, then, would it fare with these present conclusions of the astro-physicist and astronomer? If a primeval sentience were the cause of energy and motion, might it not develop to be the intelligent ruler of the cosmos? Might not a far-future son-of-man, arising from man-the-erected-animal, arising and growing in wisdom during the billion of years which some astronomers assign as the earth’s future life-time, might not such an all-knowing and all-powerful son-of-man become the director and ruler of solar systems, the arbiter of his own fate and fortunes in the cosmos?

If, at the center of the cell-of-life, there glows that which antedates energy, and is its cause, why should that superior, regnant principal become subordinate? Personalized in the future son-of-man, why might it not gain control of the cosmos?

Yet, do not these suggestions of limitation by the astronomer involve a rather disproportionately long look ahead? A billion of centuries — another astronomer’s estimate of the life-time of the solar system — is a great while. A good many things may happen in that time! Omnipotence, for example, might be attained by then, as well as deathless life.

An eminent scientist, whose name in this connection it may be more courteous to withhold, has written to question the fundamental propriety, or rather morality, of an effort to attain deathless life on the earth, or in the sidereal universe. He says: —

“I was once a confident believer in the plurality of worlds, meaning that other planetary bodies in outer space are inhabited

by beings of as great intelligence as mankind, or even much surpassing man, and that it may be possible to communicate with them.

“Later, wider views of the subject have led me to conclude, with Whewell and with Alfred Russel Wallace, that this is very improbable, either as in the case of Mars, or far more remote orbs; in short, that the chances are a thousand to one, that no organic beings like men exist at present in our solar system, or in others concerning which we have astronomical knowledge. In other words, I am now inclined to regard man as a biologic accident in nature: a creature the remarkable evolution of whose brain would not, even on the most favorably situated planet in space, be likely to occur once in a million times. When all things are considered, man is phenomenal in nature, and from many points of view, an anomaly.

“We have first to take into account the relation to each other of suns and planets in the matter of heat and light; also the lifetimes of planets like the earth, since there is but a comparatively brief epoch when life, and especially multicellular life, is possible.

“Consider further the fact that of all the million forms of life on the earth, even the thousands of vertebrates, not one, except man, has thus wonderfully developed brain and attained that intelligence which so contradistinguishes man from his congeners. Consider still further that the best evidence we can gain at present as to what started the human cerebrum on its career of evolution, all points to its being accidental, rather than something in the usual course of nature, since all other multicells — vertebrates — tend under natural conditions of environment and nutrition, to attain a restricted brain growth only, then pass into race stasis, and subsequently wane to type extinction. That appears to be the regular course of nature on globes of matter like the earth, an order of things which has occurred for fifty millions of years, in a thousand species of vertebrates.

“But suddenly, as if fortuitously, the brain cells of the human cerebrum began to do something extraordinary, unnatural, out of the established order of things, and attain an abnormal intelligence.

“Hence I am inclined to believe it is not probable that any species like man exists elsewhere in the universe about us, or even has existed, or is in the least likely to exist in future. To put it

in a different way, we are alone here, alone in a ruthless physical universe, and not only alone, but are an accident, a *lusus naturae*, a race of beings naturally ignorant, brutal and mortal, but accidentally come in possession of knowledge which is leading us on whither we know not — my own fear being that the more we learn and grow in intelligence the sadder to each of us, personally, will be our ultimate fate, the more poignant our final suffering of death.

“In moments of this fear and revulsion, I often feel it would have been better for us if we had never started on this extraordinary and supernatural evolution of brain. Better if man had remained in his ‘golden age’ of ignorance, procreation and natural old-aging, after twenty-five or thirty years of life, aging and passing away with no great reluctance at quitting life. Better if, according to the old Chaldee tradition, we had never partaken of the fruit of the forbidden tree of knowledge. Better to have remained in the ‘garden’ of primeval life, the only life Earth is fit to bear. Sometimes, even, I have thought it might be better for the children of men, to burn all libraries, close all schools, abandon all curricula of ‘education,’ of culture, of knowledge, and revert to that calm and happy golden age of our species, when there was neither aspiration, nor fear for our future.”

Without comment or argument as to the truth or falsity of this view (which has sometimes oppressed the author) my conviction is that it is too late to revert. I do not believe it possible to go back. Evolution of brain, attended by growth of knowledge, now appears to me to be inevitable. Whatever started it in the human cerebrum, I do not believe it could be arrested. Burning libraries would not avail. Even the fixed dogmas of the great religions have been unable to bring the progressive mentation of the human brain to a standstill. It will go on. What then? That is rather the question which we have now to answer. What then? The contention of this work is the present writer’s reply. Go on, make the best of it, and pull through to something better, if possible.

I think, too, that this scientist exaggerates the calm and happiness of the fabled golden age of mankind. If the truth were known the lot of humanity in early times was a miserable one. The glimpses we catch of human life in the bone caves, scarcely attract us to retrogression.

Still another, who styles himself an "Amateur Astronomer," comments in like vein: —

"Admit that you can 'achieve' immortal life," he writes. "Admit that you can make the human organism live on in spite of disease and all the other causes of death which now beset it. You would but put off the evil hour. This earth, this solar system, will come to an end. Life on the earth will terminate, either from extreme cold or in a burst of cosmic heat. What then? You would but have put off the inevitable, final catastrophe.

"I am no believer in disembodied spirits. Few astro-physicists are. The conclusion I have come to, after much thought on the subject, is that it will be better for the *genus homo* to remain one of the animal orders and, like its congeners, become extinct as painlessly as possible when the earth grows unfit to sustain life.

"Think of your race of deathless human beings struggling to preserve immortality on a theater of life which every day grows colder and colder, less and less habitable. To me that is an awful picture!

"After all, is not the parochial system of education and human control the best for humanity — the system that sterilizes thought and keeps man a procreative animal merely, dying off at three score years and ten, with a comforting promise of heaven after he has had his animal gratifications, and before death becomes very much of a hardship to him?"

Even if there were anything in so medieval a view, the answer to it would still be that parochialism has come to America too late to withstand the growth of knowledge. Nothing can withstand it. Man in America will as surely seek deathless life as the sun shines. What he will do with it remains to be seen by future intelligences more divining than this author or his critic.

"Materialism, pure and simple, I would catalogue this volume of yours. Materialism, leavened by skepticism, with atheism added, incidentally," is the comment of a popular preacher widely noted for the sensational character of his sermons. I am charitable enough to suppose that this clergyman read *Salvation by Science* no farther than the title and table of contents. Accusations of materialism are now quite obsolete. The modern scientist, adopting the new definition of matter, is rather a spiritist or a dynamist.

Matter, in the old sense of this time-worn charge, no longer exists. Sentient energy has superseded it.

“Skepticism?” All persons of average intelligence are now skeptics of much which was once believed. The charge indicates thought rather than demerit.

“Atheism?” Assuredly not in any proper sense of that word. No attempt has been made in *Salvation by Science* to account for the existence of the cosmos or the existence of energy, primarily. The universe may have been created. It may have existed from eternity. No one knows, least of all, evidently, those who profess to know so much. The assumption of such knowledge, under whatever venerable claims, is irreverent of the august mystery of the universe. Mortal man has no knowledge of the origin of energy, may never acquire such knowledge.

Energy appears to have a life side, to possess a sentient property; or rather, perhaps, what we know as energy is composite, made up of factors, one of which is the cause of consciousness.

It seems manifest, too, that this *conscious* factor, this sentient property of energy, is *good*, in the human sense, and makes for *good*, that an urge toward what is true and right pervades the cosmos, and that *evil*, in the human sense, results from the heterogeneous nature of the earth's substances, the chemical disharmony of atoms and molecules, collected from the four quarters of space.

Except for the urge of the sentient property of energy toward the evolution of what is true and good, there appears to be no interference with life on the earth's surface, from without. All things go on in accord with the original impulse as conditioned here. Nature is not directly regardful of man, nor benevolent toward him, nor yet providential. The trapped animal makes the long nights doleful with its anguished cries — in vain. The entombed miner prays and sobs to “God,” to “Heaven!” No help comes unless from his fellows. Sorrowfully we have come to learn that such faith in “Providence” is immoral, and but leads to confusion. We have felt “the cosmic chill” to which John Burroughs so fitly alludes. We have waked to the vast, mute impersonality of the cosmos. It neither lets nor hinders man. He may do what he can. There is liberty only. If he falls beneath its Titan stride he is trodden on and crushed. We are ever face to face with this mute, blank impersonality of the cosmos. It carries

the "elements of feeling" only; and the great lesson so plainly taught from it all is that we must push on, grow in knowledge, get control of it and save ourselves.

A teacher of English literature at a mid-western university, cites Bertrand Russell as an authority for her unbelief that human beings are, or ever will be improvable to the extent of greatly prolonged life. "I think that we may as well settle down to Bertrand Russell's views," she says. "He seems to me to have the right of it." Her letter has led me to read Mr. Russell's *Mysticism and Logic* with much interest. This author may be described as a soul whom modern science has disillusioned without rendering hopeful. He has brought himself to face the worst which nature and an impersonal cosmos can inflict upon us, and bear it with a lofty stoicism, tempered by a sad smile. If the evolution of the race had ceased, he would be unquestionably right. He depicts our real status in the universe with a strange accuracy which leaves one wondering how he can be so good a scientist and yet have no hope from science, no faith in it for the future. Beyond doubt, science disillusiones the race in respect to its childhood beliefs, but while doing so gives every normal scientist grand earnest of what the growth of knowledge will signify for future generations.

Still another teacher of literature, in the far west, inquires whether the idea that immortal life will come from the growth of knowledge was suggested by H. G. Wells in his book called *God the Invisible King*. Scarcely. The idea that greatly prolonged life can be attained by husbandry of the cell-of-life was first set forth in *Living Matter*, in 1888. Mr. Wells' book was first published in 1916. The idea, itself, has come down from the days of Prometheus and the Titans.

The present writer has read Mr. Wells' book with interest and, I may add, astonishment that mortal man, even Mr. Wells, knows so much about "God!" I suppose that in America the word king is not held in as high veneration as in England. To call the infinite energy, which actuates the cosmos, a "king" is, to us democratic beings, somewhat anthropomorphic and out of date. To many of us that infinite energy is the one unknown, undefined and indefinable mystery of the universe.

A city merchant, interested in sociology, writes briskly to ask whether the recognized lights of science lend countenance to the idea that deathless life may be attained by applied scientific discoveries. He specifies: "Has Professor H— of the University of C—, or Professor G— of Y—, or Professor S— of H—, (and eight other names of high repute), men to whom we look for our scientific opinions, endorsed this idea? I go to the constituted scientific authorities for my science. Till these authorities in biology speak, I decline to take stock in *Salvation by Science*."

If there is to be a "closed shop" of science in this country, a scientific guild or priesthood, like that of ancient Egypt, through which all scientific thought is to issue and be authorized, or else be proscribed, the present author can only say that he would deem such a state of things unfortunate. But I believe this critic to be in error. There is no such guild as he imagines. Certain professorial biologists may, probably do, entertain a high opinion of their own dicta; but the educated public of the country acquiesces in no such claim to rights of authorization, or proscription. How would Edison's discoveries have entered the world, or Marconi's, or Morse's, or Franklin's, or Bell's, or Maxim's or Nobel's, if they had awaited the solemn sanction of some clique of professorial scientists? No, this is still a free country. We can all cast our mites into the treasury.

What I find unpleasant, in this critic's attitude, is his air of being aggrieved. Is he not quite free to accept the contention of this work, or reject it? Apparently he rejects it with scorn because Professor So-and-So has not endorsed it. Very good.

At the end of a letter of emphatic dissent, one who signs himself "a believer in God," adds, "My chief objection to your irreverent project is that it makes no account of Inspiration and Revelation."

It is not wholly impossible that beings on other spheres in space, are able to act, per ether, upon the minds of certain individuals of our race on earth, and thus influence their conduct. The facts of wireless telegraphy render such a conjecture not wholly improbable. The medium through which such influences might come, undoubtably exists. One could easily imagine an inhabitant of Mars, e. g., making efforts to inspire great deeds, or reveal im-

portant truths to us on the earth, and this for our good, or conceivably from selfish motives.

“But” — one writes — “I want a faith that comforts and solaces me in sickness and in death. What is it to me that future generations may achieve immortal life under nature? I want a religion that will save me. You will find that nobody will want this scientific faith of yours. What people want and what they will adopt and pay for, is a religion which they can trust in, to save them, personally.”

The above is quoted from a letter, and others give expression to similar sentiments.

It reveals an attitude of mind which has supervened from centuries of indoctrination by supernaturalism, namely, that it is a religion *per se*, some religion, or any religion, which saves men, and confers on them the gift of immortal life, as a reward for believing in it.

It is an obsession which has come from that long-iterated doctrine, that men, or a certain number of men, will be “saved,” by divine favor or grace. Hence, naturally, such minds demand such a religion.

Scientific research does not undertake to furnish faiths-to-suit, or religions-to-please. Science points out the facts and brings truth to light. That is its great office, its service to the world. To the facts and truths of nature we have to adapt ourselves.

Because devotees and sectaries have been deluded in the past and their minds wonted to pleasing promises, does by no means constitute an obligation on scientific research to furnish further illusions, either for solace, or comfort.

Nature is not especially merciful to man, nor to any order of her fauna. We have to make our own way on the earth and do the best we can with conditions as we find them. Such is the cosmos. No human religion can alter it.

In this present, imperfect life of ours, there is but one grand, fascinating, ever-satisfying pursuit — the pursuit of truth. That pursuit and that alone ensures a progressive growth of mind and brain, with mental health and moral elevation. For truth is the soul of the cosmos. Even as we grope for it and dredge it up, bit by bit, from research with microscope and test-tube, it invig-

orates and renews the mind. It brings joy and hope. It clears the mental sky. It puts us in accord and in harmony with the steady beat and throb of the whole universe. Faith springs from the apprehension of truth. It is faith and hope which have pioneered all the great achievements of man in the past. To achieve immortal life we have need to grasp the facts, discover the truth and perceive that this grand promise of life-on-earth can be realized, that this great boon of life, free from disease and death, can really be won. Then will begin the world-wide effort of achievement. Then will be seen such a bending to the task of the energies of mankind as the earth has never before witnessed. Literally then, and in good truth, we shall be working for life's sake with new-born hope ahead.

And this leads naturally to a question, raised by a casuist critic, as to the real or relative nature of truth. In the course of a long letter of dissent, not unleavened by sarcasm, this other critic says, "To my mind it does not matter a rap whether your 'scientific salvation,' or Christianity, is 'true,' or 'false,' judged by any standard which you or I might set up. I do not believe there is any such thing as *truth* in that sense. Truth is what a person believes. What is truth to him one year may be false to him next year. So it is never worth while to introduce a new faith on the score of its being the truth. Go on with the faith that people have, I say. It is not worth while to start new ones. One thing is as true as another, if people only think so."

It would be just as well, then, for people to believe that the moon is a green cheese and the sun a huge smiling yellow pumpkin, or in obeh, or witchcraft, or any other erroneous doctrine, contrary to fact.

The difficulty with this critic is that he confounds what is truth to the individual, subjectively, with truth, objectively. Such subjective "truth" may or may not be delusion; but objective truth is absolute and eternal, the same yesterday, to-day, forever. The idealism of Berkeley was but a fantasy. Objective truth is the cosmic state of things in a real universe. A certain belief, or tenet, may be true, subjectively, to a believer, yet be utterly untrue *de facto*, that is to say objectively.

Unless what is true, subjectively, to the individual, corresponds

with truth, objectively, his belief may be in the highest degree injurious to him, putting him out of all harmony and peace with nature as a whole.

The problem in religion and everything else in life, is ever to make what seems true to us, personally, approximate real, objective truth; in other words, to bring our minds in harmony with all nature. That is what growth in knowledge signifies, namely, self-rectification.

“By what authority do you style *Salvation by Science* the creed of Science?” A professor of botany writes from a Western university, to ask the above question, censoriously; “I do not for a moment believe,” he continues, “that scientists endorse it. I am sure that I do not, nor do I know one who does, or would. Your claim that Science teaches it, or tacitly acquiesces in it, is preposterous and misleading. Science is fast coming to learn, through Psychical Research, that there is present everywhere an inner world of disembodied spirits, into which we enter at death. Our knowledge grows in this direction, and will soon displace any such vagary as your so-called ‘Promethean Faith,’ which is a hopeless, impossible faith, at best. The earth is not a fit place for prolonged human life; nor do I believe that it could ever be made such. Life soon comes to an end here. Chemical action tends to limit all animal organisms to comparatively brief life-times.”

Replying to the last of this botanist's strictures first, it may be said that there are well-authenticated instances in plant life, where trees (sequoias, baobabs) have lived for four thousand years; also where animal organisms — the elephant, the whale — have roamed either the land surface or the seas of the earth, for two and even three centuries. We know, too, that the human organism has survived, in fairly good health, for a century and a half.

As a botanist this critic should have known — before saying that prolonged life on earth is impossible — that under certain ideal conditions plant life on our planet is deathless, in the sense of surviving, potentially, as long as air and sunshine co-exist.

Furthermore, that the stable, well-nigh invariable formulas and ratios of chemical action, on the earth's surface, are among the best proofs we have that human organisms may be composed and maintained indefinitely. In fact, the terrestrial chemical basis for

prolonged life is almost perfect. As to this, consult any well-instructed chemist. The corpuscle of negative electricity (electron) and the atoms and molecules of nearly all the so-called "elements" of terrestrial matter have not, so far as known, varied during a hundred millions of years.

If the human organism under the imperfect conditions of environment and food which prevail at present, has survived in health for a hundred and fifty years, is it preposterous to suppose that under ideally better conditions it might survive double that length of time; or even indefinitely, under progressively improved conditions?

Undoubtedly this question touches down to deeper levels. This is merely a reply to the assertion of our botanist critic, on grounds which he himself takes.

Reverting to the first of his criticisms, it may be said, frankly, that no class of men differ more variously, or are less well organized, *inter se*, as regards their opinions than "scientists." Particularly is this true in the matter of their religious opinions.

Then, too, there are scientists and scientists, of all degrees of erudition and cultivation, scientists *soi-disant*, and those so called, in honor, by common consent of their fellow men; also thousands of very lovable, cheerful Christian Scientists who claim that Jesus, too, was a "scientist" and that Mrs. Mary B. G. Eddy was another and still better one. It is a matter for congratulation that so many of our fellow creatures are, or wish to be, scientists; it is a laudable ambition; and science is large enough, broad enough, wide enough, for us all to nestle fraternally together under its wing — if we can only think so.

There was no intention to assert in these pages that the view put forward here is the faith or creed of all who call themselves scientists, or of all college professors, physicists and chemists, or that it is the belief even of all those most renowned in scientific research. Science is still inchoate and unorganized as regards the views and opinions of its vast *personnel*, scattered over six continents and two hemispheres. One scientist often disputes what another asserts, and we are driven to discriminate.

"An opponent," thus styling himself, asks, with a flavor of derision, "Do you actually believe that the protozoa, the unicellu-

lar life on the ancient sea beaches, united of their own accord, as sentient creatures, to form the metazoa, and that the human organism, the human brain, has resulted from a plan or design on their part to better themselves and rise in the scale of existence, looking to cell immortality?"

The answer is, no; nor was any such position taken in *Salvation by Science*. We do not know how or why cells combined, whether by accidental cohering, or because they derived some immediate advantage of safety or food by keeping together. We have no more supposed that the combining unicells had a far-reaching design, or foresaw the results of their unions, than that the individual locusts of a swarm foresee the famine that may follow its flight; or that the individual *hoplite* under Xenophon, who marched with Cyrus the Younger, foresaw that this immortal expedition would open the way to the victories of Alexander and to the third great empire of antiquity.

We do not suppose that the unicell of the Silurian beach foresaw its apotheosis in the brain neuron of a Webster, a Washington, or a Lincoln. The cell but chose to do what *felt* best for itself; or it may even have been coerced to what it did by the merest accident of its environment.

With greater justice one of the associate editors of the *American Journal of Science* calls attention to the fact that the cells of polyzoa — *bristadella mucedo*, for example — are more fully organized than I have seemed to describe them.

This is a deserved criticism, and I am glad to record it here. At this late age of the earth's vital history, it is not easy to find illustrations of early metazoons. None the less, we would be slow to believe with the elder Agassiz, that all the present metazoons were "created" as we behold them. *Bristadella mucedo* was cited in this connection, not as being one of the early simple unions of unicellular life, but merely as resembling externally, perhaps, what these early unions might have been like.

The point really at issue here is whether the metazoons developed from unicells, or that the tissue cells of the animal organism form, multitudinously, in this same organism after it was otherwise created. The former position is the one held in *Salvation by Science*.

A reviewing editor writes to ask, "Is this 'natural salvation' idea of yours the same thing that Metchnikoff advocated, and Loeb has been working on?"

Professor Metchnikoff, of the Pasteur Institute, believed that "old age" is accelerated by the abnormal activity (phagocytosis) of the white corpuscles of the blood, which, after a manner, devour the cells of bone, muscle, brain, and other tissues.

Professor Loeb has held the theory that life can be initiated artificially by chemical agencies; he has claimed that fertilization of the ovum can be thus accomplished chemically in the case of the sea-urchin, without sexual union. If fully established, this fact will be of the highest importance.

The present writer does not know what were Professor Metchnikoff's views or beliefs, touching immortal life for human beings.

Another critic, a venerable teacher of theology, writes in pained surprise:—"Natural salvation! How can salvation be natural? Nature dies. Salvation is from God and His Son. Salvation is above nature. It is supernatural. Natural salvation is a contradiction in terms—a self-contradiction!"

What a picture do these words portray of the indoctrinated, dogmatized condition of this man's mind! Salvation a supernatural rescue at the hands of a supernatural being. Otherwise incomprehensible,

This, indeed, is the conventional, church attitude of mind, the attitude which regards the "soul" of man as a "spirit," detachable from the human body at death, or, indeed, in trance, or catalepsy; a spirit to be saved by Divine favor or grace, divested of the body, and un-incorporate.

It is this conception of life which the growth of scientific knowledge invalidates. Science wastes creeds as the warm spring torrents melt the ice of winter. There is no way of chaining humanity to a creed, except by arresting its mental growth. This latter is what a certain church in America has sought to accomplish. There is, indeed, no other way of perpetuating creed and its establishments, except by laying the spell of church authority on the brain, and effecting a semi-paralysis of this troublesome organ of progress. This is the long-existent condition in Mohammedan countries.

It is quite impossible to harmonize Mohammedanism, Catholicism, or Protestant sectarianism, with the growth of human knowledge and the progress of scientific discovery. The obstacle is something more than the mere fact that science invalidates certain dogmas of the church. It is rather that the mind of the scientific student outgrows the crudeness and the injustice of the creeds. Normally, naturally, the world grows away from them.

“Your contention is unique, to say the least of it,” another critic writes. “So far as I am able to follow your reasoning, you fail wholly to distinguish between physical and psychic powers. You treat them as if of common origin, as if there were no essential difference between them. This to me is chaotic and would subvert psychology. You confound sentience with the insentient forces of matter. You make neither distinction, nor difference, between them.”

There is no difference, that is to say, none as to their ultimate source or origin. There are no “insentient forces of matter.” Indeed, there is no such thing as matter, in the former sense in which the word was used. Matter, practically, for us is energy, and is sentient to us when it is embraced within the symbiotic cordon of our organic being, or self. It is then *us*, that is, personal to us. Outside that cordon, all energy appears to each one of us to be insentient. Sentience and insentience are merely other terms for subjectivity and objectivity, personality and impersonality.

A busy New York lawyer writes in a friendly spirit, to criticize what he deems a misuse of the terms *nature* and *natural*. His conception is still another instance of the hold which supernaturalism has even on the legal mind. “I do not regard science,” he says, “meaning astronomy, geology, biology, etc., as being properly natural or in the order of nature. I regard science as distinct from and extrinsic to nature. Hence natural salvation, to be attained from the progress of science, is to me a confusion of terms, a misnomer.”

In other words, the growth of human knowledge is not in the order of nature, but supernatural, or preternatural; not a part of the natural evolution of life on the earth, but something super-added to it, presumably from a supernatural source!

Another critic of more sectarian bias carries the same conception

to greater length. "But for Christianity," he says, "which is a supernatural revelation from God to man, associated with a divine effort to save mankind, there would be no science. It is the elevation and enlightenment of the minds of men that come to us through Jesus Christ, which makes modern science possible."

This writer appears not to remember that science and the sciences were well advanced in India, Egypt, and Greece many centuries before the era of Jesus.

Critics are of many types and tempers. Not a few condemn what their fellows approve.

"Who would want to live for centuries in a world like this!" writes "one who dissents." "Three score years and ten is quite enough of it. Too much. Think of the horrible monotony of a thousand years of human life. It is a frightful picture. The Lord deliver us from such as you! So far from encouraging an effort like yours, it should be summarily stopped, if not by an indignant public sentiment, then by government interference; that is, if there were the slightest danger of your bringing about such a calamity. I am happy to think there is not. Human life will never be much prolonged, for the very good reason that it ought not to be. It is not worth it; and nature will probably look out for that. So I do not fear you. Death is as much a part of the great scheme of things as Life. It is the other part of the great Plan. But lo and behold, a little dying mortal now thinks that he is going to change it all! It is enough to make the angels weep, and the devils laugh!"

We will allow this to stand, and pass to another of similar purport, but bearing the impress of a less passionate mind.

"I should fear such a gift as you seek to confer on human beings. It does not seem to me that earthly life could be made of sufficient interest to give us continual enjoyment for long periods of time. The Wandering Jew was but a fiction, yet I believe it embodies the truth concerning human life on the earth. It does not seem to me that the earth offers, or can ever offer, a proper theater or arena for immortal life. I am therefore inclined to consider death as a blessing instead of an evil, and that your proposed effort to 'achieve' immortal life on the earth by applied science is a mistaken one."

The above is a thoughtful statement of a widely prevalent view of human life. It deserves an equally thoughtful reply.

It is conceded at the outset that life, as the majority of our race now live, is not worth prolonging far beyond the pleasures of youth. Immortalizing such lives, subject to all their present ills, hardships, and discouragements, would be of the nature of a penalty, instead of a reward. If a greater experience which came from longer life did not enable them to attain a better mode of life, with fewer pains and ills, immortality on the earth would be inadvisable for them.

The earth is what we make it. The reason why the majority of mankind are miserable on the earth instead of happy, is to be found in them, in their ignorance and perverted minds, rather than that the earth does not afford an "arena" for happy life. Some are happy here, others not; the cause is largely subjective.

Considered physically, the terrestrial globe which we inhabit is not, under nature, a comfortable abode for man. But it has vast capabilities, enormous resources for improvement. It is capable of being made a paradise, a true Eden in the universe. Unlimited power falls on its surface from the solar sphere, power which can be bent to human uses. Its climate can be controlled and made whatever we desire it, its temperature regulated to the needs of life. It is not the earth in its present condition which we contemplate as the future abode of immortal man, but the earth improved and made "heaven." The paradisisation of the earth presents merely physical problems, many of which are already being undertaken successfully. The earth, made heaven, is one of the conditions which will come with the achievement of immortal life. The dawn of this grand future for the sons of men is already breaking on the horizon of science; and what we have now most need of is faith and courage to work for it; to cast aside our slavish fears of the supernatural, and work to save ourselves from the ills of life; to cease from idle prayers to be saved by supernatural agencies, and devote our energies to self-salvation.

Again, life on earth is not desirable for those on whom old age has set its insignia of infirmity and deformity with all the attendant daily pains and aches. A natural revulsion from life ensues from the senescent condition of the organism. Life grows less and less desirable until often the aged one longs for release from it.

This mental attitude touching life is purely the result of the decline of the associate cell life of which the human body is composed. It is to the regeneration of the component cell life of the organism that our present researches are directed. The object of them is to renovate the tissues, renew the cells, and maintain the human body in the adolescent condition: the muscles and digestive organs in a state of normal health and efficiency, the brain in a condition of mental power, hopefulness, and ambition.

It is not likely that such a person would desire to die, at least, not on an improved and beautified earth where the growth of knowledge and the rapid advances of scientific discovery gave opportunity for continuous mental growth.

But, reverting to our passionate critic, it may be said that *Salvation by Science* would by no means sentence a man to life. It merely enlarges his freedom to live or not. He does not have to live. In the phrase of firm old Marcus Aurelius, "the open door" is always there, under his hand, with liberty to issue forth to the unknown gods.

But there is always a palpable insincerity in these vehement assertions of those who declare that they do not want or care for longer life. Possibly not, after physical existence is overburdened by disease and pain. Yet the writer risks nothing in saying that if he could offer to the world twenty years, even ten, of added life in good health, at a reasonable figure in cash, he could easily become the greatest Croesus that ever trod the mundane sphere! Make no mistake, my friends. Life is the greatest prize which science will ever have to offer the world. But it will be life ennobled in mind as well as perfected in body.

One who terms herself "a believer in *Salvation by Science*," has written to ask, "How can these truths be disseminated? How can this new, better Faith be propagated?"

The capacity to receive truth comes from mental growth and the acquisition of knowledge. These truths will be apprehended and accepted as mental evolution in America proceeds. It is the growth of knowledge and the development of brain, which will prepare the way to accept *Salvation by Science*. Unformed, undeveloped mind is the stronghold of erroneous creeds. Further education is the only remedy.

"A Physiologist" from that great metropolis of much which is new and good, Chicago, writes to propound the following query, in dissent.

"With regard to an improved cell food and the lengthening of cell life from it, how is this to be inferred? We derive the vital energies of the human organism, mechanical and chemical, from something akin to combustion (katabolism) of the 'protoplasm' of the cell, which is thereby broken down, its stored-up energy liberated and waste products — carbon dioxide, urea — continuously produced.

"With any conceivable kind of cell food, however 'improved,' would not these waste products have to be produced, if organic life went on? What real alleviation of the 'duress' of cell life would be effected? Granting that cell 'protoplasm' has to be broken down in order to liberate energy for organic maintenance, how will the use of an improved cell food relieve the organism of the *onus* of getting rid of its waste products?"

In reply, it may be well to say again, that two parallel sets of phenomena go on, *pari passu*, in the cell-of-life whatever its situation, namely, the anabolic and katabolic, a building-up or reinforcement of the cell contents and a breaking-down of the same. Restricted to the cell, the building-up or reinforcement is all that is properly covered by the term nutrition. The breaking-down and consequent liberation of energy is quite another matter, required by the necessities of the environment. In other words, the cell has to work and use up its "protoplasm," in order to get on and live in the world.

But here a qualification must be made. We do not know yet what this apparent combustion of the cell "protoplasm" really is, nor to what extent it affects the cell contents. It is not like ordinary combustion; so much is known. That is to say, a certain part *en masse* of the cell "protoplasm" is not consumed, leaving a certain per cent. unconsumed. The protoplasm of the cell is found to be a highly organized fabric which shrinks throughout, when the cell works and suffers, much as a fat horse grows thin and poor when put to severe labors. There is combustion of protoplasm of the cell in no other sense.

Frankly, we do not know as yet just what takes place when intracellular shrinkage occurs from work and the liberation of

energy. The cell protoplasm cannot be compared properly with a quantity of coal, oil, or other combustible. It is highly organized, and tax it never so severely, that organization is preserved as long as the cell lives. It is deteriorated as a whole rather than expended in part; — and we venture to predict that this qualification will be found a very important one as our knowledge increases.

The same qualification must be made with regard to the building-up (anabolism) of the cell protoplasm by nutrition. It is not added to *en masse*, but improved and rounded out as to its entire interior organization. It is a case of fattening up the horse, grown poor from hard work and exposure, and not of pouring so much oil into a nearly empty oil can.

True, carbon dioxide and urea result from work and fatigue of the cell. A destructive metabolism appears to have taken place; but we do not yet know the intracellular *modus* of it.

Reverting now to the matter in question, namely, the amelioration likely to be brought about in the life of the physiological cell by a perfected cell food, the best estimate I am able to obtain at present is in effect that fully seventy per cent. of the entire organic energy, liberated by the average human organism, that is to say, seventy per cent. of its entire available energies from protoplasmic "combustion," is expended on our food stuffs, as at present ingested, in order to accomplish digestion, peptonization, admixture with bile, oxygenation, etc., etc., before the food is fit to enter the blood circulatory and go to the cells for their nutrition. Seventy per cent. of that entire combustion from which result waste products of carbon dioxide and urea.

If therefore this seventy per cent. of combustion and waste products could be rendered unnecessary in the organism by the introduction of a perfected cell food, the question asked by our "Physiologist" critic would seem to be answered in part.

Criticism which is denunciatory may be passed over. It would appear that one has but to doubt, in a published work, that death is an irremediable evil, to set a thousand devout minds aflame with animosity. The reason for this is, of course, that settled religious beliefs are disturbed. Death has long been made a cornerstone of religion.

Once, in a Mohammedan city, it became apparent to the writer that the mentation of the people was automatized by the Koran: Koranized beyond human power to change, alter or make progressive. A fixed creed not only prohibits thought in new channels, but actually arrests further brain growth and, as centuries pass, lowers the cranial arch. That is what has happened in the older animal orders, fixed modes and ways of thinking and acting have come to be "instinct," which degrade the brain to automatism.

The Koran is a mass of absurdities, but faintly leavened by a few wise adages and pious declarations concerning Allah: as a whole utterly unworthy of belief in the world of to-day. Yet the Mohammedan peoples would be exterminated rather than change their faith.

The Bible is a much better book than the Koran and presents a far better, more divine Christ than Mohammed. Nevertheless, it might be a misfortune to have the American brain enslaved to a fixed creed. If the evolution of life is a fact and human progress desirable, then there should be, and can be, no such thing as a fixed creed. Our beliefs should be subject to change from the growth of knowledge. It is because the American brain persists in making progress in spite of unchangeable dogmas that many heresy trials occur and a general metamorphosis of creed is now going on. And the end is not yet.

Whether the plan for a scientific renaissance of Christianity as presented in this work will find favor with the reader or not, depends largely or wholly on what that reader believes already touching life and mankind. If he has come to regard man as one of the mammalian orders of life on the earth and correlated to other orders; not differing in his origin and evolution; developed on the same multicellular plan; very like in skeleton, muscles and nervous system; on the same plane as regards nutrition, assimilation, metabolism and excretion of waste; giving birth to offspring by the same process of germ production in ova; old-aging in the same way and from the same causes; and, in short, differing from his animal congeners only in the respect of having greatly surpassed them, and being still progressive; — if such, I say, are his views of human life, this work will be found not only in line with them, but will suggest the logical outcome of human development, and help him, I believe, to form more practical and more humane

beliefs for his guidance in the future. One object of the present work, indeed, is to engender hope ahead, to present the great, sad tragedy of life on the earth, as enacted in the light of promise for the future and as having a grand end in view, —

“To which the whole creation moves.”

In view of the many criticisms, it may be advisable to define again what is meant in this work by Immortal Life. The common conception of it is what is meant: prolonged personal life, possessed of all its faculties, not limited by death.

The objection that it is not possible to conceive of immortal life, any more than to conceive of eternity or infinity, need not here be considered, or argued. What is meant by immortal life is life not limited by death, after a brief lifetime, namely, personal life at will and as long as desired; life not saddened as now by the constant fear and certainty of death; life with opportunity to live in the full enjoyment of every faculty and every joy of kindred, friends and mundane comfort; beatified life, not frustrated by disease and death at the threshold of its grand possibilities. The question of how many years or how many eons is immaterial, and better left to the future.

By a coincidence, two letters of inquiry were received on the same day, one from a prominent clergyman of the Unitarian creed, the other from an ecclesiastic of the Anglican church, both asking the same question, namely, “What, exactly, is meant by the term, ‘a scientific renaissance of Christianity,’ as you employ it in a recent work, entitled *Salvation by Science?*”

What was meant is, I wrote in reply, the realization of the actual teachings of Jesus by means of applied science; realization of the Messianic ideal of peace, good will and co-operation in great works for the improvement of the human lot; realization of the “Kingdom of God” on earth, with the attainment of immortal life, from research and scientific discoveries.

To comprehend what is meant by this, it is necessary to bear in mind that much of church Christianity, at present, is Christian only in name. The exalted Personage who lived nineteen hundred years ago, in Palestine, and from whom our era dates, conceived himself to be the Hebrew Messiah, and sought to found a divine

utopia, the denizens of which, he taught, would be immortal through purity of heart, meekness, mercy, unselfishness, brotherly love, righteousness, and right living generally. This is evident to all who read even the present gospel histories, with an unbiased mind. How sadly do those belittle him who teach that he was a God. He is infinitely greater and grander as a man — a great-hearted, pure-minded youth, inspired by a noble ambition to realize the national hope of Israel, the kingdom of God on earth, which the Hebrew prophets had long foretold, the coming of the son of David, the Prince of Peace.

Who will write the real biography of this great-hearted young Jew? Futile are the lucubrations of that legion of historical critics certain of whom even deny that such a person as Jesus ever lived! Truly, a historical critic easily goes astray. As well deny that Mohammed, or Siddartha, or Confucius has lived; or Cæsar, or Hannibal, or Augustus, or even Washington, or Lincoln! A great human personality is never obliterated from the life of the race, and never wholly manufactured by myth or tradition. Jesus lived in Judea, and lives on still in the communal life of Man.

For he was the great communal man, the founder of the true communal race-life, the prophet of the future meta-metazoon. Nor, despite all this present confusion of tenets and dogmas, are his ideas difficult to understand. He attempted to embody and realize the Hebrew Hope, the kingdom of heaven to come on the earth. He believed that his "kingdom of heaven," and with it immortal life for the sons of men, would come from moral purity, brotherly love to our fellow men, bearing one another's burdens, mercy, meekness and faithful service in all things, purging the heart of selfishness and pride; in a word, living for our fellow men, merging our lives, without reserve, in the larger life of our race.

Such was the life-scheme of young Joshua, or Jesus, of Nazareth, such the kingdom of heaven which he dreamed of founding in Judea, a province of Rome, nineteen centuries ago. Temporarily it failed, or seemed to fail, but has not failed, nor can it fail, though long in coming. It comes, none the less. What are nineteen centuries in the evolution of an idea like that when compared with the long life of our race! The full grandeur of the Idea has as yet scarcely dawned in the minds of men.

Supernaturalism, with its tenets of disembodied soul life, nether worlds and upper worlds, was grafted upon Jesus' simple, beautiful scheme of immortal life, by church synods and conferences, often for political purposes. That simple, beautiful scheme of deathless human life, taken by itself, stands forth as fine and true as ever; for it is natural truth. Did Jesus perceive intuitively what it has taken science so many centuries to learn? One might almost think so. In no respect, in no particular, not even in spirit, is the real Messianic scheme like Romish, Greek, or Protestant Christianity. When the church adopted Zend-Avestan supernaturalism, it lost Jesus by the waysides of Judea. Even so modern Buddhism has evolved itself clean away from its founder and is now practically an alien cult. Church Christianity to-day has but a vague claim on the believer in Jesus, and little right to the use of that name. Humanity will ere long turn again to the man of Galilee, and seek to find out what he really taught.

Who will write the real biography of this great-hearted young Galilean? It should not be a wholly impossible task, even now. Renan has come nearest it, yet Renan lacks reality and human atmosphere. Not unfrequently he confounds the two Jesuses, the actual young Judean, and the idealized, supernatural Jesus of the Church. For two there are, the one real, the other largely ideal, and to rightly comprehend Christianity, it is necessary to keep them distinct.

The first is the young Nazarene of the reign of Tiberius Cæsar, of unknown paternity and uncertain, though probably Jewish heredity. The youth of high thought, who read the law and the prophets, particularly Isaiah, and conceived the noble ambition to become the long-propheesied Prince of Peace, the Messiah of the Jews, the Redeemer of Israel, and to found "the kingdom of God" at Jerusalem.

Whoever wishes to understand the ideas of the real Jesus, and comprehend what he attempted to do, must read the books of Isaiah and of Daniel and Jeremiah, but especially the first. Isaiah was his fount of inspiration; fired by it, and conscious of unusual powers, he assayed the supreme effort of realizing in himself the long-delayed national Hope of the Hebrews. What the prophets had foretold, he resolved to be.

Such efforts are not imposture, but the birth of eras. The con-

sciousness of lofty powers sanctifies the self-exaltation. All the great cults of mankind have been initiated thus boldly, thus ambitiously, thus personally. It is on these lines that a Life of Jesus might be written which would possess actual interest in America to-day.

The other Jesus, the Jesus Christ of modern Christianity, is largely an abstraction, an apotheosis.

Such idealization and deification of the great characters of human history is not uncommon. Even within our own brief national history we have an idealized Washington, and an equally glorified Lincoln — almost laughably unlike the homely Illinoisan.

Thus Siddartha was idealized in the Buddha, Mohammed in the Prophet of Allah; and in the Classic era, Æsculapius, Prometheus and the entire Pagan Pantheon, every divinity of which had probably a personal beginning, even as Jesus, which later ages first idealized, then deified. This is the historic habit and tendency of humanity. Thus originated all mythology. The Gods were at first human beings, who came in time to be idealized and finally worshipped. This strong conviction of potential godhood appears to be an intuition of the human intellect.

In like manner Jesus became the concept of an adored Son of God incarnate, no longer human, but divine; the intercessor and pleader for man with the stern Hebrew Jehovah; the patient bearer of the sins of the world, bleeding, dying on the cross for sinful man.

In the larger light, it is a portraiture of the best instincts of the race, a high and noble conception of a human life, transformed and transfigured to a divine one: a loving, sorrowful, great-hearted divine man, worshipped and believed in as a potential saviour of all. A beautiful conception, slowly worked out through nineteen centuries of human life on the earth; a picture and portrait of what every human life ought to be, and of what it may become by living a better, holier life.

There is a moral grandeur in this slow, beauteous growth of a divine ideal of what human life should be and may become, something at once grand and sacred, the evolution of the best there is in us.

Gradually, as the race has developed, this idealized Jesus has grown up with it, purifying itself from the older, harsher ideals of

blood-guiltiness, ordeal, revenge, and merciless retribution, evolving the commune, sympathetic, loving Saviour of to-day, the true heart's brother of us all, divine only because he is first human, and what we may all become; the evolution of godhood within us.

And because it is a day set apart to this divine ideal in us, the Christian Sabbath is still a holy day, and should remain such, consecrated to the growth of this higher altruistic ideal, this spirit and sentiment to bear each other's burdens and to share-and-share-alike the hardships and vicissitudes of our hard terrestrial habitat. For there will never be any real peace on earth and good-will among men — probably ought not to be — till we all accept this ideal, till every man of us merges his selfishness and accepts equal opportunities with his fellows. Then — when we all stand together, shoulder to shoulder, heart to heart — then will begin that commune life of great works which will transform earth to Heaven, transfigure and spiritualize the human organism and win immortal life.

It is thus that the real Jesus lives on in the brain of the race, idealized, glorified. He embodied the Messianic idea of a loving brotherhood of pan-humanity on earth. Never will that personality die, nor cease. As centuries pass it but enters on new leases of life.

Twentieth-century science with its late new knowledge of matter, cell metabolism, human personality and the ether-of-space, but iterates, realizes and makes practical the *Idea* which inspired that lone, bright Genius of Palestine, in the days of the Cæsars. We are but giving form and dynamic potency to that Idea, clothing it with physical forces for actual, material realization. And let it be said again that this realization of the Idea is impossible only to those who cannot summon courage and hope to work for it.

It has been said often, and said as a reproach, that modern science, meaning the systematized growth of human knowledge for three centuries, has invalidated much of religious faith and left nothing in its place; that this self-same science controverts the creeds, particularly the Christian creed, and offers no satisfactory substitute; that its incessant advances sap popular belief in salvation by supernatural grace and yield no consolation at death. In brief, that it is of the nature of a destructive agency, an iconoclastic force,

which subverts the long-established cults of mankind, leaving nothing with which to replace them.

Hence the present attitude of conservative thought, the serious-minded thousands who have the common good at heart, who look to the past as well as the future, and who instinctively feel the world's needs.

All this great conservative class of minds, the class which holds humanity together in its larger evolution and steadies it in its onward progress in time, has long viewed this aspect of science, the creed-subverting aspect, with a certain distrust and apprehension, fearing that not alone religious doctrines will be discredited, but that common morality will slacken and an era of personal selfishness supervene in place of the higher spiritual mentality of our forefathers. In earnest of their apprehensions, conservatives point to the sordid self-seeking of the last half-century, its money-greed, church hypocrisy and practical atheism.

Yet year by year, science has gone on, sphinxlike, nullifying many beliefs of our fathers, until with this whole great class of conservative thinkers and well-wishers of their race, there has come a kind of consternation as to what can possibly result from so revolutionary a growth of human knowledge, or in what future faith it can eventuate.

And hitherto no answer to the question has been forthcoming. The effacement of creeds has gone on with no hint as to replacement. Science, like the Hun of history, has seemed to be leaving nothing behind save ashes and desolation; and from some quarters grave fears have found expression lest with the fading out of religious belief, our civilization should wither from its higher sources, and the genus *homo* revert to the lower order from which it sprang.

Hence the reproach. Hence the distrust of science.

In a sense the reproach has been merited. Scientific knowledge has grown slowly, impersonally, without responsibility, without plan and without regard to results. It is the mind and brain of the race which has been developing and garnering data for future use. The invalidation of old creeds has been incidental merely to this growth in knowledge, without design or animus. These centuries of incubation have been required, to pass forward and formulate a better creed, one nearer the truth.

But the time for it has come. The reproach can no longer be uttered. Science, the organized scientific knowledge of our era, has now its nobler creed to offer those who are willing to accept it.

But on what grounds does it rest? What esthetic grounds? What appeal does it make to our sense of the beautiful, the grand, the divine? What fuller development will it call forth of all that is best and noblest in the nature of man? Does it hold promise of immortal life? For it must do this, or fail. To what facts and truths does it refer its claim? An attempt at a general statement of these facts will be made in subsequent chapters of this volume.

Let it be said here, however, that there is no expectation of discovering "philosophers' stones," or "panaceas" on sale in bottles; nor is anything in the nature of a "wandering Jew" existence sought for.

Nor yet again, is voice given here to any of those mystic cults, or fads, in Parsee guise, or Hindû, which like parasitic plants take root suddenly in the fecund soil of America, but soon wither in the sunshine of our common sense. Salvation through science, indeed, is the fruit of that American common sense.

Salvation by science contemplates the prolongation of human life from a later, different view-point, namely, that such prolonged life is coming as a result of the increase of scientific knowledge in every field; coming from increased capacity to live, and enjoy life; coming naturally to us from the progressive development of mind and the growth of the human brain; coming as the grand complement of human evolution; coming indubitably, in time, but always with this proviso, that if any considerable number of our fellow men would join in the effort, earnestly, with faith in it, consecrating their inventive powers and wealth to the task, we might achieve this great boon and promise of life within a few years, by means of discoveries to be mentioned hereafter.

Greatly prolonged life signifies a greater life every way, a broader life, a loftier life, with larger interests, higher joys. In the natural order and sequence of things such a life would be longer of itself; happier life signifies longer life and *vice versa*.

The lower orders of animals, many of them, live brief lifetimes because their lives are circumscribed, their minds feeble, their brains small, their mental fruition confined to mere sensory pleasures. In physical terms the radius of such a life about the

axis of its self-consciousness is short, its self-determining energy weak. It does not reach out far into the world about it, and hence the world about it does not react strongly on it, to drive it forward for any great length of time.

Always it must be kept in view that this longer, happier life implies mental rectification and the elimination of evil propensities; in a word, the life of an immortal instead of the present life of man — man so lately erected and arisen from bestial orders.

Always to be kept in view, too, a full realization of the fact that to confer the gift of deathless life on the beast-man would be an endowment without meaning, a calamity. Such an endowment, however, could not be made. The beast life cannot, in the natural order of things, be thus endowed, since it is a lower order of life, around an axis of self-consciousness which lacks the power of self-maintenance and completes its cycle within a brief lifetime.

Life, indeed, as thousands of our fellow men live it, is not really worth living, they live so badly, so foolishly, so futilely, so without aim or ennobling purpose; the kind of life that naturally and properly ends in disgust with life, that brings death of itself.

Naturally enough, therefore, we constantly hear it said, that "life is not worth living." Millions of our fellow beings say that; and they are quite right; it is not — their kind of life. When told they may prolong their lives to a hundred years, by careful regimen and a change of habits, they scoff and exclaim that it isn't worth it; that they would not give up their habits of sensory gratification, to live twice a hundred years! that sixty years, indeed, is too much; and what they say is quite true — for them.

None the less, there is a different kind of life which is thoroughly enjoyable and worth living as long as possible. Of biological research and progress in discovery of the truths of nature, the writer can say in all sincerity, that these pursuits render life a constant joy, and it is a joy which is cumulative as years pass. As long as the universe holds new truth to discover, no one need or will normally tire of life; — and the universe is boundless and eternity is long.

The oft-raised question of excess of population, if death did not rid the earth of fifty millions of humanity per annum, is one

of the problems which solve themselves and need give us no concern. Procreation ceases naturally with the apotheosis of life; nor can there be the least doubt that in the economy of nature and of the universe, a wiser, diviner generation of human beings, living free from disease and death, is better than a succession of thirty-year generations of diseased, suffering, ignorant humanity as we at present know it.

Such a generation, indeed, can be fully trusted to take care of this and similar problems. That greater wisdom, which comes from longer life and the growth of scientific knowledge, can always be relied on, implicitly, to determine and regulate all such problems for the future. To raise them now as insuperable obstacles to the achievement of immortal life on earth, is as foolish and inconsequential as is worrying over the future coal supply, when the sun is continuously lavishing two hundred trillions of horse-powers on the earth's surface, which only wait being harnessed for human service! Imperfect solar engines, in fact, are already in use. Yet there is always the small philosopher to whose wits the problem of utilizing solar heat and light looks to be impossible, and who has his annual spasm of alarm over the coal supply.

With perfect confidence we may believe that the generation which follows us will know more than we do; for the greater communal life of man into which we are now entering implies steady growth and conservation of scientific knowledge.

IMMORTAL LIFE

HOW IT WILL BE ACHIEVED

PART I

IMMORTAL LIFE THE FONDEST ASPIRATION OF MANKIND

IMMORTAL life, life saved from disease, pain and death, has been the dream of the ages. Despite all anguish and hardship of the terrestrial habitat, in the past, this wonderful vision of deathless life somewhere ahead, has been the cheering ideal of dying man. None of the great religions of mankind has been without it as a corner-stone; none could exist or prevail without giving earnest to this aspiration, this inherent desire for longer, beatified life, usually associated with ideas of regeneration, resurrection of the organism, purification from sin, and salvation by ritual or sacrificial efforts.

The life of the race, the destinies of the world, indeed, have been largely shaped by this hope of immortality. The Hebrew lived and sought his promised land in the expectation of a Redeemer and a kingdom of God on earth, with immortal life and the resurrection of the patriarchs. Early Christianity prevailed throughout the Roman world wholly by reason of faith that through Jesus every believer would become immortal. Changed as the Christian religion afterwards became, there is now no longer a doubt as to the literal character of the original belief, the doctrine of Jesus, himself. Early Christianity was a rapt commune, buoyed by full faith in immortal life in restored bodies. It was in fact the *renaissance* of the Hebrew Hope. Similar of purpose was the religion of Mohammed.

In the light of twentieth-century knowledge, how do we stand toward this great hope of humanity? The religions of the past

have but aided and accentuated the aspiration. In America, with the greater intellectual growth of the race, the creeds which are our heritage from the Orient, are in process of flux, to separate truth from error, the gold from the dross, and build a better, grander faith.

What will that faith be?

Of one thing we may be sure. It will include immortal life. That fond hope will not be given up: that aspiration will be realized.

But by what means, or agencies?

We now answer, unhesitatingly, from the growth of knowledge, from the scientific regeneration of the human organism and from the improvement of the human theater of life. We are to save our "souls," and realize the long-cherished ideal of "heaven" on earth. Salvation — word dear to the human heart — will come from applied science, and the progressive amelioration of all the conditions of life.

But death, many still argue, is a part of the plan of nature. Death is intimately implied in an animal organism, foretold from its inception in the egg. All terrestrial organisms grow to type limits, fructify in seed or egg, shrink to a dry juicelessness and die. It is the best Life can do on a globe of matter like this earth. Such, at least, is a common view.

But we hope to put the matter in a different light. We expect to revise these conclusions, and show that greatly prolonged life is possible on the earth. Further, that it is nature's plan from the outset.

But within what lapse of time? Is it a far-off event? Can it be of interest to us, personally, of the present generation? How shall we make it our aim, our object of labor, our religion?

It is the purpose of this work to answer these questions and to point out what we have to do and do first.

This may be misunderstood. It may be objected that a scheme of immortal life as an achievement, is contrary to the religious doctrine of disembodied spirit life after the death of the organism; that it is subversive of it, and would appear as aiming to supplant it.

Be it said here, however, that the doctrine of disembodied spirit life is not considered or discussed in this work. Nor is it the purpose to treat of it, otherwise than incidentally or inferentially.

This effort confines itself to what can be accomplished with human life on the earth. That there are laws of life operative in the universe, of which we know little or nothing as yet, is conceded; but we do not believe the data now in our possession sufficient for a profitable discussion of so transcendent an inquiry.

This line of research therefore should not be deemed in designed hostility to, or intended conflict with the Christian creed, nor with the Hebrew faith, nor yet with that of spiritists; nor with the aims and purposes of societies for Psychical Research; since even the most confident spiritist must agree with me, I think, in confessing that from all which has thus far transpired as to the mental condition of disembodied spirits, no one would wish to become one as long as he could retain possession of a healthy physical body.

With the fundamental doctrines of the Christian Scientists, too, the effort to win deathless life must be largely in consonance. The author is led to make this statement at the outset, in the interest of harmony and cordial co-operation, that nothing may stand in the way of united action along what he believes to be so grand a line of human endeavor.

The great lesson from human history, the inference from the entire life of our race, is that we succeed best when we make earnest effort to help ourselves; that "faith" without "works" is inefficient and largely inoperative; that Nature helps those most signally who help themselves vigorously.

IMMORTAL LIFE ALREADY INITIATED IN MAN

To many, to most persons, the argument that we may attain salvation from disease, old age and death by the growth of knowledge, and win immortal life, will appear visionary, *in toto*, with, perchance, an added flavor of hardihood or impiety. So of the associate concept, that the earth may be made the home of deathless life, its climate ameliorated, its aerial envelope modified, its seismic phenomena regulated.

It may be a novel assertion, too, that we are already well advanced toward this great achievement for which the ages have labored, and the many Christs of men have lived and suffered.

Novel and visionary. Yet in the larger light, from the wider view-point, that is what, in reality, the remarkable progress of mankind signifies, since the dawn of history, and long before. There has been phenomenal development of mind, accompanied by equally phenomenal development of brain.

It matters not that the fast-passing generations of men have been little aware of this, or that, misled by erroneous cults, they have believed otherwise and cherished other hopes. This secular progress toward the winning of immortality has gone on, quite the same. In a sense it has been the religion of the cell-of-life.

Ever since the days of our rough, hirsute, and brutish ancestors, coarse in flesh and bone, savage in mind, a progress in physical refinement has been going on, the evolution of a finer type, which may not inappropriately be termed a spiritualization of the genus *homo*. It has come along the line of growing knowledge, reacting on the organism in a thousand ways: improved nutrition from better food, better housing, better care of the body, but most of all from larger thought and better mentation. Although still at the beginning of this progress toward spiritualization of the type, the human being of to-day is little like the bone cave man of twenty thousand years ago, and possesses an organism greatly ennobled every way, despite the diseases and weaknesses incidental to an as yet imperfect civilization.

That is to say, progress enough has been made to show us the trend, outlook and purpose of it. Nothing less, in fact, than a secular movement toward a transformation of the organism, the most notable feature of which is longer life.

Ever since what we term civilization first took root in the sodden mould of human savagery, ever since co-operation began, man with man, tribe with tribe, nation with nation, ever since knowledge tended to accumulate and be conserved in records, however rude, from one generation to another, there has been a progress, whether comprehended or not, toward this great end.

From co-operation and mutual effort to ensure safety, from the use of fire, from better food, from protective clothing, from clearer ideas, loftier ideals, higher ambitions and purer morals — all combining — the brief lifetime of our far-back ancestors, a lifetime not exceeding from seventeen to twenty years, has mounted steadily upward to eighty and a hundred.

What is it all but a progression toward deathless life? — What else, when we consider that energy is undying, and that the cell-of-life, of which every animal organism is an organized union, is already demonstrated to be a potentially deathless unit. A cell dies from obstruction and interference with its life, not from any self-limiting law of that life. Unobstructed, its life is continuous. It dies because it is thwarted, starved, poisoned, killed out by its environment in a befouled organism which is mortal as yet owing to imperfect modes of living.

What we still term matter, that embodiment of energy, offers no limit to immortal life in the cell. Its initial, sentient potence is indestructible. Immortal life means embodying it in an organism, chemically clean and pure, that is to say in sentient harmony, and in renewing that organism by an unvitiated influx from the eternal source without. Such improved nutrition of the cell we must attain. From times most ancient, indeed, there have been visions concerning ambrosia, bromia, nectar and elixirs vitae, i. e. immortality-producing foods and drinks, presaging magic changes which should lift the incubus of death and exalt mortals to the estate of the gods.

Science, the mission of which is to realize many of these long-descended ideals and aspirations of man, has now to produce actual ambrosias and nectars, cell foods which by direct nutrition of the protoplasmic molecule, will spiritualize the gross, mortal organisms of men, and aid us to pass from death unto life. It is the brain of man, the brain, par excellence, which has made this progress toward prolonged life, since the brain is the physical co-relative and record of the growth of knowledge. It is brain, indeed, which has ennobled the human organism.

BRAIN A STEADILY PROGRESSIVE ORGAN OF THE BODY

Whether a higher type of life would eventually develop from humanity, whether, indeed, the human organism is capable of being greatly improved, was one of those questions which early suggested themselves to biologists of the Darwin era.

The argument and the inference from evolution was, in a word,

that man as found on the earth is the long-descended heir of the developmental effort, — the effort of living matter in the cell mode of existence to improve its condition and rise to the highest possible degree of intelligence and happiness. On *a priori* grounds, there would seem to be no good reason to infer that a struggle extending through millions of years, and involving so much of individual effort and sacrifice, may not eventuate in a correspondingly grand future achievement. Evolution, in fact, naturally ushers in a moral and a creed concerning man's past and his future.

As to the further progress of the human organism, however, there were many indications which appeared to controvert the affirmative view. Not a few of those best equipped for forming an opinion on this subject, held negative views, to wit, that the human organism has long ago reached its type limits, limits which under the most favorable conditions it could not escape; in short, that the human type, anatomically and physiologically, is now "fixed;" that improved conditions will but cause it to vary within certain unsurpassable bounds; that man will remain a man henceforward, under whatever stress of evolution, continued even for many thousands of years, or forever.

When we examine the subject historically, there is much to confirm the above view. Apparently the human organism was as perfect four thousand years ago as at present, and differed in no external features or essentials. There seems to have been no change to indicate physical evolution within the historic period.

From a histological point of view, too, there is little to indicate even the most slowly-progressive development in most of the tissues of the body; for example, the osseous, muscular, connective, cartilaginous, and epithelial tissues. The cells of these tissues pass through a well-defined cycle of growth, and give rise to a series of growth products which vary, indeed, from youth to age, but show little visible change from generation to generation.

Moreover, the bone, muscle, cartilage, and other tissue cells of man resemble very closely those of the lower mammals, the types of which are even more clearly seen to be permanent and unprogressive.

Cataclysmic changes of the earth's surface, giving rise to new geologic, climatic, and atmospheric conditions, might, indeed,

if not too suddenly destructive, compel certain skeletal alterations and changes of form, both in man and other mammals, although there is the greater probability that such catastrophism would prove fatal to all well-established types of life; in brief, that the genus *homo*, or the genus *bos*, would perish off the earth sooner than develop into anything else.

There is little likelihood, however, that further evolution will be fostered by such means, the earth itself having reached an age and a permanence of planetary type, so to speak, when surface mutations of such revolutionary character are not to be looked for. The very permanence of his terrestrial habitat, in fact, is against the further evolution of the human organism, or the development of anything superior in the way of organic apparatus from such causes.

The widest view of this subject of organism and evolution which we can take, is so conclusive to this effect that the theory of a higher type of being than man, hereafter to come from terrestrial evolution, was practically abandoned, even although it is apparent and can be shown on good evidence that man in his mind, his intellect, is still progressive and manifestly capable of much future progress.

The general conclusion obtained that evolution in the ordinary sense has terminated in man, and that he is not only the latest but in all probability the last of the mammalia. A great deal in human creed, mythic, classic, and Christian, has originated here, namely, on the hopelessness of doing much better on the earth. The apparent cessation of evolution has long been felt to be disheartening; literature is burdened with it and aspiration concerning some other better state of existence has grown out of it.

But has evolution ceased? The question, which the anatomist and biologist have been not a little inclined to answer in the affirmative, is exceedingly important to the morale of humanity. Has the anatomist, the biologist or the physiologist overlooked any point, any particular, or any capacity by virtue of which man may still demonstrate himself progressive and take heart for himself and his race?

It is the purpose here to call attention to one important tissue of the human organism which can be shown to have been steadily progressive, and which gives no evidence of reaching, or of tend-

ing to reach, type limits. It will be shown that it is by virtue of the steady growth and development of this part of the body that man has so prodigiously surpassed all other species of mammals, made them subject to him, and overrun and dominated the whole earth. In the physical sense, the evolution of this tissue has been strangely overlooked by many, in fact by most, biologists, or, if touched upon, has not been held to determine the question of man's true position as a progressive mammal, compared with other species which are either unprogressive or retrogressive. For while all have abundantly recognized man's mental superiority to the lower animals, and connected it vaguely with his larger brain, this superiority of intellect has been attributed to a certain adventitious endowment of the nature of "soul," not a natural part of the organism, but an implantation from an extraneous source. Nor have biologists clearly pointed out as yet the relative truth of the matter in connection with man's rise from brute life to the estate of a world-dominant being.

The human organism, from the latest standpoint of science, is a compact, federal union of thirty or more differentiations of cell life. Every one of the thousands and millions of cells of which each tissue is composed, is a more or less independent creature, possessing to some considerable extent individuality and self-direction. They are banded together, however, indissolubly, and in certain situations are in protoplasmic contact by means of living filaments, so sentiently that all live and feel as one.

These orders of cell life, thus confederated, have, in the progress of organic development in the past, become mutually dependent and interdependent one upon another until one order cannot live long without the presence and functions of the others. Such are the bone cells, the muscle cells, the connective tissue cells, the hepatic, pulmonic, splenic, intestinal, spermatic, epithelial, capillary and glandular cells; an extensive congeries of diverse tissues, each containing millions of individuals and all mutually dependent on the general well-being and safety of the organism.

So far as can be judged by a comparison of man to-day with man in earliest historic times and man with the lower unprogressive mammals, all these above-mentioned cells, or differentiations of cells, do not of themselves tend to be progressive. For the good reason that there is nothing in the terrestrial environment which

now calls for a re-adaptation; nor has there been for thousands of years.

There is, however, a tissue of the organism, an order, or differentiation of cells, which we have not yet named, namely, the nerve and brain order. In brain and nerve we contemplate a colony, or order of cells, incorporated within the organism, living at the expense of the other orders, devoted to the acquisition of knowledge: a function diverse from all others, nobler than all others. In a sense, it is as if this brain order were a superior order which had entered the multicellular organism and lived on it, but repaid for its protected situation and its refined food by doing the thinking, planning, and caring for its host. So greatly has the function of acquiring knowledge ennobled the brain group of cells, raising it to such divine eminence over all others, that in man it has come to stand for the personality of the organism, the self, the ego, the soul of the human body.

Nerve and brain are not found in unicellular life; at least, not in the organic sense of these terms.

From as close a study as can be made of certain simple forms of multicellular creatures, which are doubtless quite similar to those from which the higher multicellular forms were originally developed, the first rudimentary attempt to establish a nervous system consisted of a living protoplasmic thread, thrust out from one cell to another. At first this would appear to have been a mere "feeler," but in time it came to remain constantly extended, no longer as a transient feeler, but as a permanent means of sensory intercommunication between cell and cell.

But, as multicellular creatures waxed larger, and differentiation of the component cell orders began, simple filaments of protoplasm, modified pseudopodia, were no longer sufficient for transmitting sensation from tract to tract; whole rows or lines of cells were involved in the strong currents of sensation that passed to and fro, and, in time, these cells became devoted wholly to the business of receiving, interpreting, and transmitting the aggregated sensations of all the millions of individual cells of which an animal organism is composed.

I need not here review the evidences and the argument by which it is now shown that sensory ganglia for perception and reflex perception grew up at the intersection of the primary nerve fila-

ments; how the special sense organs took form; how at length the cerebellum came to be lodged in the forward end of the multicellular animal, and how the ever-increasing need of greater capacity for the sensory business of a world-roaming organism led to that enormous super-addition to the cerebellum, known as the cerebrum.

What is designed here to point out is the fact that the nervous system of the human organism, particularly the cerebral portion of it, or, in other words, the tissue of mind and intellect, has always been in the past and is to-day a progressive tissue. It came into existence, as brain, in response to a necessity on the part of the organism for greater protoplasmic capacity, for the reception and utilization of intelligence. That necessity and that stimulus still exist and grow constantly more urgent.

Bone and muscle cells have developed to the extent of the necessity which led to their differentiation; the incentives to locomotion and organic support remain the same; hence, bone and muscle cells long ago reached the acme of their development. The same is true, or true in large part, of every other tissue of the body, save the encephalon. The brain is still forced to develop and grow larger in response to constantly changing conditions incident to the world's growth in knowledge. Certain tribes, races and peoples, it is true, adhere to habits and modes of life largely unprogressive, and, as a result, show little brain change from generation to generation. It is not so, however, with the westward-moving peoples of the dominant races,—the nations who think and invent. Science is the agent of brain growth. To think, in the true sense of the word, signifies brain development. New inventions stand for cerebral evolution. The changed sensory experiences, too, which result from new inventions, tend to alter the protoplasmic status of the brain, and add to its capacity for growth. In America, to-day, we see heads of varying sizes and shapes, not only the types emigrant from Europe, Asia, and Africa, but types and sizes unknown before in any country. There is actual brain growth among us. A new variety of intellect is being developed.

A comparison of the earliest human skulls, found in ancient caves, tombs, and mounds, with those of individuals of the present age, shows that on the whole there has been growth of brain as well as a perceptible alteration in shape, in favor of greater intellectuality. Brain has grown greatly in size and improved in form

during the last eight or ten thousand years;— a period of time relatively brief when considered in comparison with the developmental epoch of mammals.

Prehistoric skulls are smaller and less prominently developed, frontally, than those of our own people. The same general truth is exemplified when the skulls of existent savage tribes are compared with those of individuals from the highly civilized and progressive nations; there is less of that higher frontal development in savages, which we find associated with the growth of intellect, and this even in instances of large individuals, where the skull is very massive and capacious. Acquired knowledge and the sciences tend constantly, if slowly, to increase the bulk of the brain and modify its form; in a word, to render it a progressive tissue.

This proposition is still more grandly exemplified when the evolution of life on the earth is contemplated as a whole. In early metazoic life, brain was scarcely more than initiated. The lower vertebrates have small brains. But in the quadrumana the human brain is found to be outlined in type and form. From this order of mammals the progress of the human brain can be readily traced.

Nor can it be doubted, even although our microscopes fail to show the fact, that the brain tissue is receiving a *progressive internal development*, corresponding to the intellectual growth of humanity.

For the human brain to-day is the protoplasmic co-relative, the material counterpart of the entirety of human knowledge; and in future, as science increases its range and its acquisitions, there cannot fail to be greater and greater stimulus to brain growth and increased cerebral capacity.

It may not be wholly irrelevant here to allude to certain recent attempts in the province of surgery to open the sutures of the skull for the purpose of giving the brain greater room therein. These first rude efforts may be prophetic of measures which will be resorted to as time goes on to facilitate cerebral development, since it is already known to many specialists in brain disorders that congenital lack of room for the brain inside the skull is a serious incident in the lives of many persons, particularly where for several generations there has been a tendency to intellectual pursuits.

So surely as there are new things to learn in the great universe around us, just so surely will the brain of man go on growing and developing greater capacity for the reception of knowledge. It is in this respect and in this tissue that man has not reached the acme of his powers, and that evolution has not ceased.

And this aspect of his future brings us more clearly to a contemplation of his anomalous position on the earth to-day. From some reason — either a hint dropped in his earlier ear by beings from some outer orb of space, or, as is most probable, in the natural order of his terrestrial development — man left the rank of his brutal mammalian congeners and began to use his brain. As a result, his brain grew and has entered upon an era of development the limits of which no one can foresee. In consequence we find this tissue to be still progressive, but associated in the organism with other less progressive tissues which tend but to pass through a fixed cycle of growth and decline. It is this condition which affords the key-note and the explanation to his strange creeds, aspirations, superstitions, hopes, and fears; his optimisms and his pessimisms; his gods, his christs, and his satans.

And this is that riddle of the Sphinx, that fateful interrogation of the Ages which he has to answer: Will the progressive, still developing brain acquire such knowledge and obtain such mastery and such control over the forces of nature as to “redeem,” regenerate, and renew at will the other tissues with which brain is yoked in the organism, and which at present condemn it to a brief lifetime with them? Can the progressive tissue redeem and save the less progressive tissues? We have now good hopes that it can.

NATURAL SALVATION IN UNICELLULAR LIFE

The present development of life on the earth began in the Cambrian or pre-Cambrian ages; and the presence of graphite in the Laurentian, or “azoic” rocks has by some been considered evidence that there was a previous life development which was followed by a period of high temperature.

But to return to what is known, keeping it separate from conjecture, we find that low forms of unicellular life — individual life in one cell — were existing on the earth many millions of years

ago. Geology affords the evidence of this, though the exact number of millions of years is still debatable. That is not material to our purpose, however; it was a very long time ago. Fire, water, and unicellular life have wrought together to make the earth's surface what we find it to-day. But geologists are agreed that there was an azoic, or lifeless, age, followed by an epoch when protozoons — vegetable and animal cells of life, the monera, protamoebidæ, diatoms, algæ, myxopods, rhizopods, ciliata, flagellata, *et al.* — had appeared; unicellular creatures from one ten-thousandth to a hundredth of an inch in diameter.

For millions, perhaps hundreds of millions of years, certain of these protozoons were apparently the sole inhabitants of the earth which was fit for no higher form of life. Nothing more graphically illustrates the wealth of time at Nature's disposal, or the fact that the course of nature cannot be judged by human standards. Metazoons, creatures of higher, more complex organization, were to appear on the earth; yet through all these millions of years no sign or semblance of them was visible. Were these millions of years of unicellular life necessary to prepare the earth's surface for metazoons? The question is idle. Every measure of our estimation of nature breaks down on extended application. We have no code of morals for nature and can have none, for nature is eternal, and man a being of yesterdays and to-morrows.

Then occurred a new departure in terrestrial life, an innovation, but when, how early, or how late in that first long epoch of unicellular life we do not know. Some time during those millions of the earth's unhistoric revolutions, an innovation on unicellular life began. From accident of the environment, or even perchance from a malformation, two or more cells began to live united together, and to act in unison — the earliest metazoon! Or, as some biologists conjecture, an unusually tough cell wall, or membrane, may have restricted the ordinary course of multiplication of cells by fission. The offspring or increase of a certain protozoon may have been unable to separate from the parent cell, to lead an individual life apart, as formerly, and thus two or more protozoons may have come to live together, in sentient, protoplasmic contact as one life, and to act for a common interest.

It is not essential to our argument to show how metazoons be-

gan. As to this much is in dispute. The point made is that they came into existence and, beyond doubt, originated from the unicellular life which antedated them. In some way two or more cells contrived to merge their hitherto separate lives in one. Their separate sentiences were pooled, so to speak, in one consentient life.

This was accomplished by means of close protoplasmic contact. For it is possible for two cells to live as one and form a single life or self-conscious existence, if there is close protoplasmic connection between the two, that is to say, if they touch each other, or are joined together by one or more threads of the sentient living matter. When this occurs, the two cells may have one common life, in place of the two lives previous to the union. One common life may take the place of two; and yet the two cell substances do not become confluent or coalesce; they merely touch and remain separate seats, or fountains, of sentience; it is the two sentiences only which unite; as when two springs which issue at points near together, combine their waters in one rill. The two cell lives combine in one stream, but the cells themselves remain distinct, separate founts of life. The tremendous significance of this fact is little recognized or understood as yet. It demonstrates that the intellect of man, the human personality, is composite and dissoluble.

At the outset, however, certain hasty conclusions which have sometimes misled investigators should be avoided. The bodies of the higher animals are something more than confederations of unicellular life; that is to say, they have not come directly from a banding together of cells that once lived separately. The animal organism develops from a single cell in the egg. All the millions of cells in the various tissues issue forth, seriatim, from this one reproductive cell, which seems to contain representative particles, reproductive molecules, or "biophors," and "determinants," corresponding to every tissue cell of the parent organism. We have by no means sounded the depths of this latter problem, as yet. One conjecture is, that the entire animal organism, in co-relation with its generative tissue, fructifies in a species of sub-unicellular life; a germ life as far below the tissue cell life in size and bulk as the cell is smaller than the whole animal organism. The cell would thus appear to extrude a species of minute offspring which are assembled, as a colony, in the ovum.

Animals are grand communities of cells and something more, the result of long organization and new methods of cell life. But this distinction does not essentially detract from the importance which attaches to the phenomenon, disclosed to us when *two cells combine to live one life*. I have termed this a new departure, yet must not be understood to assert that it took place suddenly, as being the beginning or end of an epoch, or as indicating a creative act.

Here, too, it will be well to enlarge the common conception of a cell. We are apt to think of unicellular life as being very low and simple. Whereas the truth appears to be that the "cell" is a relatively huge and vastly complex organism; and that the unicellular life of the globe is an evolution of a most hoary antiquity; herewith also this other fact should be associated and kept in mind, namely, that in the bodies of metazoons, in plants and trees, the unicellular type of life, this ancient life of the Silurian ages, still persists. In fact, it will hardly be too much to say that the unicellular is the only real, distinct type of life which exists, or has ever existed on the earth's surface, or probably ever will exist. Since all the metazoons are but more or less well-organized and well-perfected confraternities of cell life, where the individual lives of millions of cells are unified in a single, larger personality.

Many of the polyzoa are suggestive of the manner in which multicellular organisms started. In *paludicella* we find cells joined together, as joints or sections of the branches of a minute tree-like growth, attached to stones in streams. It is a tree in miniature; the cells grow forth, one beyond another, offspring above parent cell, but otherwise have little connection one with another. It is simply an arboriform colony, or zoarium. Other polyzoa, like *mucronella*, form mat-like disks on stones in water, the cells lying in contact merely.

In certain of the zoaria of polyzoa, however, a considerable degree of individualization is exhibited with division of labor among the cells. In *bristatella mucedo* the cells not only adhere, but the whole colony crawls with considerable facility from one water weed to another. *Kinetoskias* is another zoarium where the colony has arrived at the point of differentiation of function. *Adeona* presents an equally interesting example of a simple colony of unicells.

Among the hydrozoa, *siphonophora* affords an example where a floating colony of unicells has taken definite form and organized its individual cells to work for the common good. In *siphonophora*, as, indeed, in hundreds of other instances, the beginnings of multicellular mind are apparent. That is to say, there is present not only the cell intelligence — that which pertains to all cells — but that larger intelligence which comes into existence from the consentience of the entire colony — the pooling of the separate cell sentiences in one larger intelligence.

This habit among protozoons of colonizing — however it originated — may have opened the way to metazoons. Often the colony grows up around one mother cell, whose offspring instead of dispersing remain loosely attached together. Of such agglomerations *anthrophysa vegetans* is a good instance.

In other instances the envelope, or cuticle, of the mother cell expands and enlarges, forming a sac which contains the entire colony for a considerable time, till the reproductive power of the parent cell is exhausted by imperfect nutrition. Eventually the sac bursts and the group disperses. Many of the flagellates exhibit this phenomenon, the parent organism continuing to move about after becoming a colony instead of a single cell.

In *gonium pectorale*, a volvocine of stagnant fresh waters, a colony of sixteen offspring cells adhere laterally to each other, in the form of a minute, rectangular plaque of a light green color. *Pandorina*, on the other hand, gives birth to either sixteen or thirty-two offspring, which live for a time in a species of globular colony, inside a thin envelope, through which each cell thrusts out two flagella. While living as a colony, these sixteen or thirty-two cells act together, as if actuated by a common impulse, moving their flagella in unison to propel the colony. It changes direction, tacks suddenly, and otherwise affords evidence that all the cells are acting together as one. Either there is a sentient contact which serves to enable the sixteen separate cells to act as one, or else a temporary species of nervous system, consisting of filamentous processes thrust forth from cell to cell.

In the oft-cited instance of *volvox globator*, the colony is of more complicated structure and forms a large green ball, to the surface of which the individual cells adhere in great numbers, as many as twelve thousands to a ball having been counted. In

this case they appear to touch each other and are each provided with two flagella which project through the membrane. Here each cell appears to be a free agent within its own envelope, but projects protoplasmic threads or filaments, like telephonic wires, into its neighbors, by means of which a network of consentient communication is established. At an internal signal all the thousands of flagella swing in harmony like oars, and the ball moves from point to point. It is clear that something analogous to a nervous system is here present, even though of an ephemeral nature, consisting of filaments which can be thrust out and withdrawn at will.

In the dioecian *volvox* the male colony remains apart from the female cellules, except at time of fecundation, when both colonies break up, scatter, and presently conjugate in pairs and groups.

Colonies of protozoons which come from a single parent cell present some analogy with a multicellular animal organism, which also develops from a single egg-cell. The way, however, from a colony of *protista* to the organism of a vertebrate animal is long and, in its ætiology, but little understood.

The first metazoons were clearly makeshifts, owing to stress of accidental conditions. It is likely, indeed, that they had often occurred for millions of years, occurred thousands of times, but had died out, or progressed no further than the polyzoa we see at present time, owing to unvarying conditions, flood and drought, heat and cold. But at some time one or more of these unions of cells chanced to survive longer and took more permanent form, sufficient permanence to carry it on and set up a new mode of life by organization — that organization and differentiation of cell function which was to play so grand a part in the future.

Space and a desire to make the argument continuous prevent more extended enumeration of such primitive unions of unicellular life. But one has only to look abroad on the face of nature to see conclusive proof of the position here taken. In every tree, shrub, and plant, in every animal that walks, every bird and insect that flies, we behold an agglomerated organized mass, or congeries, of cells, each filling its place and doing its appropriate part in a cell commonwealth. There may be thousands of cells in

the plant or insect, or there may be millions in the tree or the animal. The proof, we say, is on all sides. Tree, animal, insect, alike, are examples of this principle of *e pluribus unum*, for the common good of all.

We wish here merely to show the manner in which the meta-zoons started, and the significance of the act when two or more protozoons unite to live one life and become one larger self.

No claim is set up here, that we know at present, from what colonies or unions of primitive unicells the vertebrata were developed. Nature, indeed, appears to have performed many strange experiments in multicellular organisms, long-extended and horrible experiments, which go far to convince us that we must not deify or even personify nature. For nature is elemental and impersonal. The unicells first organized in uncouth and savage forms,

“Dragons of the prime that tare each other in their slime.”

Dinosaur, megatherium, and mastodon roared and battled through ages that to man are incomprehensible.

“A monstrous eft was at one time lord and master of earth,
For him the bright sun shone and his river billowing ran.”

Man's hundred thousand years are but as a span to the era of vertebrate monsters and monstrosities, while earth's young uni-cells were making their first tremendous efforts at organization.

But when two or more cells unite to live together as one, each has first to surrender, temporarily at least and in part, its own self-conscious personality; and then as a merger of all these surrendered personalities there ensues a larger, grander self about a new axis of self-consciousness.

The most perfect example of this self-surrender and resultant, grand consentience is exhibited in the brain of man. Here temporarily during the day some sixty millions or more of cells, actually operative, extend filamentous processes and, all taking hold of hands, so to speak, surrender each its self-consciousness and autonomy to form the human intellect. From this grand surrender, and at the instant it is made, there flashes forth the consentient human personality, the “soul of man.” It is done as if by electric contact. This intellect or “soul” is the union of these sixty millions of brain cell lives; they surrender self to live as one.

But in the brain this is but a temporary self-surrender. Owing probably to the severe vital draught which the consentience makes on the individual cell, the human intellect cannot remain constant or continuous. There must be respite and recuperation for the constituent cells. Accordingly we find that after ten or fifteen hours the consentient strain is relieved; the union is disrupted. Sleep ensues. Suddenly, as suddenly as it began, the brain cells let go hands. The filaments are retracted. Contact is broken. Each cell resumes its individual life, becomes itself again, self-conscious, and attends to its own personal affairs — nutrition, elimination of waste products, rest, growth.

But the instant the cells resume self-life, the human intellect has ceased, as when electric contact is broken, unconsciousness supervenes.

Why, it may be asked, why and how did the first two or more protozoons come to unite their self-lives in one larger self? From what seems accident of the environment, perhaps, on the *objective* side; and for greater comfort, ease, and safety, on the *subjective* side; or rather, when accident, or "the law of chance," had initiated the innovation, the subjective comfort which resulted from it led to a voluntary and wilful continuance of the new mode of living.

For by thus uniting, a division of the hard labor of living was possible; the single cell was no longer compelled to face the world alone and perform all the various kinds of labor which the act of living necessitated. After combining, one cell could do one kind of work and confine itself to that, and another, another kind. One cell, or group of cells, could attend to locomotion, as in *volvox*, another to securing food, and still another to digestion and assimilation of the food.

Soon, indeed, one cell, or group of cells, in the union, took upon itself the office of spying out food, or sighting danger and notifying the motive group to move forward swiftly, or to beat a hasty retreat. This spy cell, or group of cells, soon assumed the leadership. In time, complete differentiation of labor-function was effected. The locomotive or muscle group not only performed no other kind of labor, but became unable to perform other. Its internal organization conformed to this want of the union. So of

the group which seized, or digested food, and pre-eminently so of the spy cell group which ere long devoted itself exclusively to discernment, intelligent decisions and a general directorate and protectorate of the other groups.

This apparent development of metazoons from protozoons, of so great significance in the terrestrial scheme of life, was set forth by this author some years since a little more in detail.

“Very soon after creatures composed of many cells (metazoons) were developed from groups of unicellular life, the necessities of locomotion in the struggle for food led to the differentiation of certain tracts of cells as bone and muscle, and finally to the development of the entire apparatus for mechanical movements.

“Simultaneously, too, another peculiar species of differentiation began to be necessary, namely, a special tissue, whose office should be that of intercommunication between the different associated cells and tracts of cells which were thus assuming more and more diverse offices, and becoming somewhat different in character, one from another. It was thus and for this reason that a nervous system began to be needed and hence to develop; for the plastic, living substance has always shown a faculty of adapting itself to widely variant functions and modes of living.

“Certain cells began to take up the business of receiving sensory influences from outlying cells which were hard pressed or in want of food, and of transmitting such sensory influences to contiguous cells. In short, certain lines of internal cells began to take upon themselves the task of conveying the sensations of others from one tract of the cellular mass to another tract, and of interpreting the sensation received from one tract to the comprehension of the sentience of another tract, so that action, within its sphere of action, would ensue in the second tract. In addition to their own sentient economy, these lines of cells in the incipient nervous system took up the function of common carriers of *sense*, and also the office of interpreters of the sensory language of one order of cells — if I may borrow the figure — to the different language of another order.

“Thus, humbly, as we conclude from observation of low forms of life, did the nervous system, or tissue of intelligence, begin to develop. Primarily there was but one or two simple thread-like lines of cells attempting the office of transmitting feeling, and

succeeding indifferently at first; but as animals increased in size, the business of telegraphing sensation grew, and a network of lines was developed. Sensation was going both ways, and soon the necessity of a common center to which sensory influences could be brought, and thence distributed to their proper destination, was forced upon the nascent, sense-conveying cells, and a ganglion, or little brain, came into existence. The confusion, too, resulting from counter-currents of feeling soon led to the formation of double lines, one for transmitting sensation inward, the other for transmission outward; and thus the divisions of sensory and motor nerves were inaugurated to and from the little brain center, which presently assumed the function of deciding upon the merits of transmitted sensations, and responding to them by a message from its own sensibility.

“Nerve ganglia multiplied as animals increased in bulk and attempted larger movements; and in time, to avoid confusion and get the organic business done, one ganglion was obliged to take the lead and keep order among the other ganglia, to decide between them when they got at variance, and generally to take the office of head ganglion.

“Thus, in time, a larger and capitally important ganglion was raised up into prominence to perform the function of oyer and terminer, a cerebellum, and finally a cerebrum, — a mass of highly organized cells which have from long use and inherited development the capacity for intelligent perception and thought.”

Without any attempt to present a consecutive line of examples to illustrate the progressive development of the cerebro-spinal system, the above outline indicates the principle upon which this group of cells has come forward to occupy its present grand prominence as exponents of intelligence.

In treating of the cells of the brain as individual, living creatures, it may be well to set forth more explicitly what their *status* of intelligence probably is, and explain how far they may be regarded as sentient. It is not claimed for any unicellular creature that it possesses rational powers to such extent as is evinced by an organized tract of cells like that of the human brain. For in the human brain we find a great number of cells of four or more varieties, devoted some to memory, some to reason or the com-

parison of experiences, some to vision, some to hearing, and some to the estimation of odors and flavors; and it is the sentience and experience of them all which are combined in the human intellect. Yet from observations of unicellular life we find, as in the case of ciliates, that it is quite possible for a single cell, no larger than many of the brain cells, to possess not only sentience, but to acquire the data of memory, and to act from its previous experience. Many forms of unicellular life, indeed, behave *rational-ly*; nor is there reason to suppose that the cells of the brain are less capable of perception and of memory. In the brain, however, cells of different tracts are concerned with experiences of particular kinds, some recording the data of vision, others the data of hearing, and still others collating and comparing such data. It is probable that a cell of the tract or group in the area of vision, for example, is largely occupied with depiction of visual imagery, and becomes a kind of living, sentient specialist, or expert in colors and scenery.

None the less it is a sentient creature, with its own internal economy of nutrition and growth. In a word, it is a sentient self. It perceives, lives and acts from its own personal point of view, for its own behoof and welfare. This much is quite certain. It is a sentient creature and within its limited sphere has acquired a kind of wisdom of its own. More we cannot predicate of the individual cell. It is a pygmy of a limited degree of intelligence.

Nor does our argument claim that the protozoons first banded together from intelligent foresight as to the results of union. The beginnings of metazoic life were probably accidental *per se*. But the results of union and division of labor followed quite the same, and it is from these actual results that our conclusions are drawn. By union of their hitherto separate sentiences the cells evolved a higher kind of sentience, a *nous*, a soul, developed to a higher degree of intelligence, from the exercise of which each cell of the organic union was grandly benefited in the matter of food and protection, and is enabled to become a participator and beneficiary of mind.

The passage from the unicellular to organized multicellular forms of life, from protozoons to metazoons, was, we conclude, primarily effected by simple combinations of cells and varying of

their functions. It was thus that the organized life originated. The question of importance next to be asked is, What was gained by it? Of what use was it? What advantage accrued from it to the cells themselves which, from the strict biological point of view, are not only the first, but the only type of life that has ever appeared on the earth? since all terrestrial life, organic as well as unicellular, goes on by virtue and instrumentality of the cell mode.

What advantage therefore has accrued to the cell, and how far has it by this means advanced toward that natural salvation which is the goal of all life?

A survey of the whole field shows clearly that the single cell made a great personal gain by uniting its life with its fellows. This is apparent even in the primitive colony of ciliates, more evident still in *volvox*, and grandly demonstrated in the animal organism. The cell in the colony lived longer and more comfortably than when struggling for life, alone; and at the acme of organization, in the vertebrate organism, we find cells which have attained to what is, for a cell, immortality. In unorganized unicellular life, the average lifetime of a cell may have been less than two days, not much longer. In organized metazoic life, we find the neurons of the cerebral cortex of an elephant, or a whale, for example, living two centuries. By combining with their fellows, these cells, or their descendants, have increased their span of life thirty thousand times!

In man these brain cells often survive for a century. Human beings, with lifetimes correspondingly prolonged, would live to the age of eighteen thousand years.

It is apparent, moreover, that these groups of brain cells would live longer (for they give little evidence of having exhausted their capacity for living on) but for the fact that they are dragged down to death by the fate of the organism, i. e., the failure of co-ordination among the other tissue groups of cells.

This is profoundly interesting as showing what cell life, under favorable conditions, may accomplish in the way of a vast longevity, from successful combinations, and organization generally. There appear to be cells of the brain *which would live on for many centuries were it not for accidents to other parts of the organism.*

Generally speaking, longevity is the proof of correct living.

That cell, or union of cells, lives long that is well nourished and well protected. No animal organism is as yet perfect, even approximately so. All the groups of tissue cells have not been equally advantaged by organic union, but taken together a great gain has resulted, chiefly in the matter of food and protection. The brain and muscle cells of the animal organism, for example, have their food specially prepared for them along the intestinal tract and brought to them in the arterial conduits, and they are housed and shielded from the mordant action of oxygen and the attacks of hostile bacteria by the integument and bony walls.

But how do we know this? it has been asked. How do we know that the cell neurons of the human brain are the same in aged subjects as in adolescence? How do we know that the cells of the human brain do not progressively die, and are replaced by new cells?

From the structure of the cerebral tissue and the interlaced processes of the cells, in relation to the mnemonic economy of mentation, anatomists and physiologists had all along inferred that the neurons seen in aged subjects were identical with those found there when the brain first developed.

Incidentally the present writer obtained confirmation of this conclusion, while examining, under high amplification, the brain cells of young and old dogs at New York City, as long ago as the winters of 1890-91-92. The material examined consisted of the brains of twenty-six dogs, old and young contrasted. The object sought at that time was, primarily, to demonstrate the condition of the cell processes and the state of the arborizations in adolescence and young adult-life, as compared with the same in old age.

It was at this time that the discovery was made — announced in *Salvation by Science*, in 1913 — that the causes of old age in animal organisms, are intracellular; that the component cells of the body, themselves, grow old individually, or in other words, that the causes of old-aging are to be sought within the cells rather than in the organism as a whole.

These examinations of the brain cells of dogs of different ages — repeated many times, allowing for the necessary difficulties and the usual errata of the staining process — presented altogether, in their entirety, so good a picture of progressive cell aging as to

leave no doubt that these were, indeed, the same cells existing *in situ* throughout the lifetime of the dog from the age of six months to that of fifteen and sixteen years, which is canine old age. There was no indication of proliferation of the cells, no new cell growths, but uniform evidences of cell aging, greater at ten years than at six, and still greater at fifteen or sixteen than at ten. The brain cells of very old dogs were quite uniformly smaller, shrunken, more bound in by formed matter and had the processes shorter and less distinct. The only exception to this condition of old brain tissue, was infrequently a single cell — one in a thousand, perhaps — which was less decrepit, so to speak, than its fellows, from having been favorably situated near two or more capillaries, where it had been better nourished from the blood plasma.

As a whole, the picture presented, was that of uniformly aging cells, not otherwise than if they were the same cells remaining *in situ* from youth to advanced age.

All the physiological cells are alike benefited in that prime requisite, food; and this fact must be kept in view when the higher social organization of the metazoons is considered. Food specially prepared and refined by groups of cells which have made this office their business, has largely conduced to the longevity of the physiological cell and made brain possible. Without a specially prepared food the organic cell could not survive for a day. Improved food, protection from enemies and, subjectively, that greater guiding intelligence that comes from organic life, are the factors which have so improved the cell (the protozoon developed to a neuron) that it lives for a century in man, and in the whale, the carp and the elephant for two centuries.

In plant life as we now view it, banding together has not been as advantageous for the saprophytic cell. We have trees two thousand years old; but so far as we at present understand the arboreal economy, the vegetable cellulose are not long-lived. This would follow, *a priori*, from the far less perfect organization of plants, the more crude food supplied to the cells, imperfect protection and the apparently inferior sentience of the cells themselves. The contrast but emphasizes the deduction made for the physiological cell, namely, that it has attained its pre-eminence

by perfecting the organic union of which it is a unit. And the inference has sometimes been drawn that could the metazoon as seen in the animal organism, be given a more perfect development, the component cells would reach that acme of natural salvation for which they have striven for two millions of centuries and would become, in very truth, deathless cells-of-life.

There is no more wonderful and grandly instructive spectacle in nature than this widespread and long-extended effort of the globe's unicellular life to save and preserve itself from hardship, accident, disease and death. Nor has the effort been "instinctive" in any other sense than all sentience is instinctive. From the subjective side of life, the primitive unicells of the ancient earth began to live together in mutual comfort, aid, and protection, and continued these unions till by division of labor and differentiation of function the simple colony developed into the vertebrate animal organism, with its thirty specialized genera of cells, all acting together for the common weal.

Man must still turn to the unicells for grand examples of social organization and progress by means of organization. Vastly and grandly more than is yet exhibited in human civilizations have the protozoons united and combined for mutual betterment. In this maple, towering in leafy beauty, we may find two billions of arbo-real cells, organized, apportioned for diverse labors, trained to special work, devoted and *artisaned* to the production of fiber, bark, sugar, and chlorophyl, and all in an orderly sequence of effects and a consecration of each cell self to its appointed task, with an apparent content and faith in the outcome, when each does his share, such as the human world has never yet seen nor understood.

In that horse dashing along the track we behold several billions of cells, each a living creature, an individual life, banded, united, and organized in such multicellular complexity that it is the glory of anatomy and histology even to have demonstrated and described it. And in the matter of locomotion — since speed is the criterion on the horse — we may behold this entire body of cells moving at a speed a million times greater than that at which it would be possible for these cells to move if living isolated and solitary, as did the ancestral protozoon on the beach of the Cambrian ocean.

We should not here be understood as denying or leaving out of the account the influence which the metazoic mind exerts for longevity. It is by reason of this superior intelligence, obtained by banding the small wits of the cells together, that those better conditions were gained which make cell longevity possible. Nor yet would we appear to assert that the animal organism lives for the benefit, or at the behoof of the component cells. In the animal brain the cells live to themselves only during the eight or ten hours of sleep daily. During waking hours the lives of all these cells are consentient, banded and blended together to form the self-conscious mind of the animal, which devotes its energies to supplying the animal wants. Without this consentient union for mentation, locomotion, and general muscular activity, the animal could not have developed. The component cells improved, each its individual condition, by forming a consentient partnership.

This point might readily be given fuller illustration, and a thousand examples of metazoic life cited in evidence of the principle, rationale, and intent of the passage from unicellular to multicellular life; but the idea has been conveyed; and this is enough for our present purpose. The genuineness of the deduction can hardly be controverted. By banding together and by organization, with division of labor for the common good of the union, the cell-of-life, as first seen in the protozoon, has come to live two centuries, instead of two days, with a legitimate inference that it is practically deathless under improved organic conditions. That is to say, there is nothing in the constitution of the cell, no biogenetic law, that prevents it from living indefinitely. Revolutionary as this deduction may appear to those who teach and believe that death is a final law of nature, the reverse of that doctrine can now be confidently maintained. It need scarcely be added that this conclusion is of the greatest significance, as affecting our beliefs concerning human life and the future of life on the earth.

And after metazoons, what? After cell unions and cell organization in the animal organism, what next? After an organized development which has resulted in the advancement of the cell, the brain cell, to a high degree of intelligence and a grand longevity, what next in the line of its progress?

Bearing in mind that the cell is the original and, strictly speak-

ing, the only type or mode of life which has thus far appeared on the earth, what means will be adopted to still further improve and better its lot? Will it, of its own initiative, inaugurate anything better or greater than the animal organism as we see it about the cerebro-spinal axis in vertebrates?

The answer would seem to be no, as regards the individual cell, and yes, as regards the consentient union of cells as displayed in the brain and mind of animals and man. And if yes, what has already been accomplished in this larger corporate capacity? Union and organization are manifestly the order and method of all life on the earth. Since the cell banded in the metazoons and made a grand gain for itself in so doing, we might naturally look for unions of metazoons for mutual benefit and progress. But here, as against such actual unions by contact, the physical laws of the globe on which we live, interpose obstacles. We cannot have sixty millions of men, or monkeys, or elephants living in a ball, like *volvox*. Contact-union for mutual aid, defense, protection, comfort, and improved food is limited. If we attempted to unite or blend a nation of people as a metazoon, or even make it resemble one in the matter of consentience, as, for example, the five score or more millions in the United States, every person, or citizen, would need to be represented as seated, as if at a desk or table, in one place, where food and the material for his work were brought to him in ducts and tubes. Still further, it would be necessary to conceive of them all as built in and encased by the substances which they manufacture. Further still, and most essential of all to the truth and pertinence of the simile, we should need to depict every citizen as connected with his neighbors and through them with every other citizen, by cables, bands, or cords of sentient living matter continuous with his own living substance. We must picture, too, the more prominent class of citizens as having thrust forth immensely long tentacles, forming nets of this same sentient matter, extending long distances from their bodies, and lying in close contact with similar tentacles belonging to hundreds of their fellows, in order that they may feel and literally *sense* all that these others do or think.

If this condition of things existed throughout the nation, we would undoubtedly find the individual citizens living as one enormous National Person. In place of a hundred millions of

individual men and women, we would see them unified in a self-conscious national life. Such a nation would act and conduct itself among other nations as a Personal Being.

Upon a lower plane of inorganic relationship of atom to atom, and orb to orb, it is possible that such a unified personality possesses the universe, answering to the indefinite conception of deity. Gravitation has been held to be the lowly organized personality of cosmos, expressing itself in natural phenomena. Von Hartmann, in his "Philosophy of the Unconscious," appears to have grasped some such conception, which, however, he immediately perverted to the exigencies of an immoral philosophy.

Since meta-metazoons, as of vertebrates, are physical impossibilities, the advantages which come from union and organization have to be secured in a different way, by other methods of obtaining the necessary consentience.

In hymenoptera (insect metazoons) the bees and ants offer suggestive examples of social and economic unions. In the swarm and apiary we find that differentiation of function and division of labor have proceeded far, and taken their place in heredity; and in the case of the queen bee the social organization has operated to greatly prolong her life. Swarm life also serves to afford general protection from enemies, equalize the food supply, and defend the union against the rigors of climate.

In the termite ants we find not only all these advantages gained from swarm organization, but others that come from war-like operations which organized union renders possible.

In bird life, crows, pigeons, geese, penguins, and many other species have attained advantages from rude organization; and in mammalian life there are many humble examples of flocking, herding and banding together for mutual benefit, to gain protection from enemies and to secure food. The wild horse, bison and caribou herd for protection; wolves form packs, to pull down larger animals for food; baboons, monkeys and savage humans band, tribe and horde for protection, better food and companionship.

The lower vertebrate orders and primitive man have thus set us examples, so to speak, pioneered the way and initiated that larger organization by virtue of which civilization has arisen. The early and wild mutations of men furnish complicated yet fairly

clear studies of the development of the nation from the tribe and the clan. No different principle is involved than that seen to be operative in the flock and herd, and also in the ant-hill and hive. It is the instinctive effort and push of the cell-of-life to obtain better conditions.

It is not the intention here to enter upon the political history of mankind, the rise of nations and empires, or the causes of their decline. Nor yet to trace the beginnings of commerce, or the rise of the arts and sciences; or recount the history of war and the constant world-wide struggle for freedom from oppression. It is all a part of that process of union and organization of humanity, to secure higher advantages. Something analogous to it has taken place among the tissue cells in the development of the animal organism: the natural clash of conflicting interests, the fight of self against self-surrender for the common good, that self-surrender which comes so hard, yet always redounds subsequently to the individual good and ennoblement.

For fifty thousand years the effort at human organization has ebbed and flowed, operating blindly, misled by a thousand false ideals. Religion has fought against religion, cult against cult, and "god" against "god." For the true law of human progress was not yet perceived. The ideal of human confraternity was not yet recognized; that ideal which the convexed surface of the globe so strongly suggests, and which the greater history of cell life so convincingly teaches. For it is the inestimable privilege of our science to narrate the rise of the cell-of-life and demonstrate the method and law of its progress; to found natural salvation and uphold a new ideal; to confirm the doctrine of human brotherhood as taught by the Founder of the Christian religion and, incidentally, to show why that sublime doctrine has for nineteen centuries appealed so strongly to the human heart — because it is a law of terrestrial life and a necessity to further human progress.

The advisability of peace and good-will among men had been taught before the Christian era, and the advantages of harmonious action set forth by others; but the Personage who appears in history as Joshua, or Jesus, was the first who profoundly *felt* and *lived* it, and gave his life for it. In his mind glowed that divine ideal of a "kingdom of God" arising from brotherly love and that mutual co-operation and union of all humanity which

alone can ensure salvation under nature. Biology endorses with a cordial reverence the tremendous efficacy of that ideal and shows it to be in line with the whole progress of life on the earth. Science now labors for the realization of that ideal. Other doctrines of the present Christian faith will fall, its eschatology fade away. That alone will remain; for it is, indeed, millions of years old; it has been operative for two millions of centuries. Thousands of years before our era, unhistoric Christs had announced it in horde and conclave and died for it; but Jesus put it in the form of a world-faith for this latter epoch; and his service of love must ever command our reverent affection. He identified himself with that universal law of life by virtue of which corpuscle and primeval particle surrender their self-lives to form the cell life, the cell the human intellect; and by virtue of which, still, the human life will hereafter live in the grander life of a deathless humanity.

For the atom is not self-lost in the cell, nor the cell in the organism, but from its self-surrender lives a better and longer life; and in the future grand sodality of human life the individuals will become immortal, even as the cell has prolonged its life in the brain. The vital unit is not lost in the union. What it gives of self to the organization returns to it again with compensations; and he who casts his life into the consentient human effort, takes it again, ennobled by self-sacrifice; it returns to him, christened and imbued by the larger life of which for a time it has formed a part. The brain cell could never have attained its present estate but for the greater personal life of the organism in which, for a part of the time, it blends itself.

For the point to be kept steadily in view is, that cell life, perfect enough not to die, but live on continuously, is a question and merely a question of excellent food, protection from injury, loftier joys and germinal renewal, and not that death is a final law of nature, as a false eschatology has hitherto taught mankind.

Two millions of centuries have struggled forward in pain and travail to make the human brain capable of the human intellect. It is a priceless heritage, the great ancestral estate of humanity. It is not destined forever, nor much longer, to be lost in death; we shall carry it through to a greater destiny. The true scope and intent of life is now just dawning in the minds of men. We are waking, — after idle dreams, — waking to what we can do

and be, waking to the great possibilities of science, waking to live, instead of resigning ourselves to death.

Parent and child, through a hundred generations, constitute in reality but one human personality, pressing forward, in time, to become something better, wiser, more powerful and happier. The parent dies and the child succeeds, but at a vast loss of knowledge and of time, not because death and birth are the ideal or ultimate laws of life, but merely because we have not yet acquired sufficient knowledge and power to escape death. The human personality, incarnate, living on from century to century, conserving science, able to renew itself and resist all the vulgar agencies of decay and death, is the ideal human being, not a chain of parents and children.

But life, as we now live, is one long contention with accidents, bacteria, improper food, duress of climate and hostile fellow creatures. First the cell was driven to a mode of reproduction, to escape extinction; multicellular creatures developed from cells and may be said to have inherited the reproductive mode of life. Humanity has arisen from its lower ancestry to its present estate, by virtue of the reproductive, alternate mode of life. Hence, to die appears to many persons to be as natural a fate as to be born; yet when more closely examined, death is seen to be an unnatural event, a result of hardship and distress, a fate repugnant to life everywhere and a catastrophe to be escaped.

THE CELL-OF-LIFE

In view of the amazing complexity of the animal organism, as inherited by human beings, and the involved, interactive processes, and complexes of energy, upon which organic life depends, the attainment of deathless life, or even greatly prolonged life, always appears, *prima facie*, as chimerical. Regarded merely as a complicated machine — the one and only view-point of many critics — it is, indeed, wonderful how a human life can go on for a week or even a single day. Yet constantly we see it going on in health and vigor for four score years and even for a century. How is this marvel accomplished in organisms so frail, so involved?

The answer to the question, when correctly apprehended, sets the whole matter of life in a clearer light, and incidentally reveals the grounds on which rests the newer, later faith in immortal life from the sciences.

It rests on the cell-of-life.

It founds on the fact that animal organisms are produced by minute units, each a living creature and each possessing the power of growth and self-repair. It is in this respect that the human body differs fundamentally from a machine, a mere mechanical contrivance. For though it is an apparatus involving mechanics, that apparatus is upheld continuously by the labors and contributions of millions of tiny artisans, each self-sustaining and self-renewing. Under conditions of an ideal scientific nutrition and protection, the cell-of-life is capable of living and performing its vital functions indefinitely.

And what of this cell-of-life?

It is very small; but *small* and *large* are relative terms merely; and though to the unaided eye usually less than the 1-1000 of an inch in diameter, the cell as we see it and inherit it in our tissues, is, in another sense, a large organism — the standard embodiment of terrestrial life. Compared with those low attenuations of matter which science now recognizes, the cell-of-life indeed is almost colossally large and complex. By virtue of its delicate, involved organization, we see the inherent, sentient property, which all matter possesses, raised up to a degree of intelligence, capable of self-direction and able to inaugurate self-motion, in a word, able to *live* and move about. For if there is such a thing as free will anywhere in the universe, it is within this little cellule of living matter.

Amplified by our highest microscopic powers, a cell may be made to look as large as an acorn. The cytoplasm, of which the body of it is composed, now appears as a delicate net-work or lace-work, evidently organized for vital functions. Within it is another little mass, also organized and more vivific, called the nucleus. At times, too, we are able to see other bodies within the net-work, a centrosome, chromosomes, granules and passive plastids, also vacuoles.

Manifestly the nucleus is the inner seat of the cell life. When stained, the nuclear net-work reveals itself more vividly than the

cytoplasm of the cell body, in the so-called chromatin and linin network. When the cell divides in reproduction, the nucleus also divides, after undergoing profound changes.

We have whole volumes and courses of lectures, treating of the changes seen to occur within this cell-of-life; but as to what actually takes place in the substance or texture of the net-work of living matter, when the cell takes in food and assimilates it, in order to live and grow and divide in offspring, we know very little, as yet, and have great need to know more. A sentient impulse, as yet unseen, unclassified, guides these processes.

Months and years of patient observation have been devoted to a study of these cell changes, as indicated to us by the microscope and the methods of staining which have been devised to render them visible. Nucleus and centrosome have long been objects of closest scrutiny — why they divide, why the “spindle” and “pole-bodies” form to usher in fission and prelude the birth of a new cell. For when properly nourished, the cell, if no other labor is imposed on it, tends to multiply itself and give birth to offspring. What is of great interest to us, however, in this inquiry, is the fact that if the wants of the entire organism of which it is a loyal unit demand of it the function of a muscle cell, we shall see the cell turn its energies in obedience to this demand and produce not offspring, but a contractile substance which makes locomotion possible.

Or if a brain cell, we may see it devote its capabilities not to reproducing itself, but to the generation of what seem to be currents of sublimated matter for use throughout the whole organism. But the intimate nature of these processes, the key to it all, remains to be demonstrated.

It is as if, hovering like an aviator above some busy factory, we were looking down on the looms, the flying shuttles and whirling spindles, with no clear notion of what the motive power was, or what was being woven.

At such a disadvantage, indeed, is the observer, with his present microscopic powers, that we have come to think further visual scrutiny of the cell-of-life of little avail, and that we shall do better to attack the problem by experimentation otherwise. Deep down in the cell we are dealing not with physics, but with a sentience which is the raw material of psychic phenomena.

Conflicting views have often found expression as to the real character of the cell-of-life and its relation to the animal organism. It has often been held, and is so still, that it is the life of the organism as a whole which not only holds the component cells in function, but which calls them into existence as cells.

While the first limb of this hypothesis is true in some degree of the physiological cell, at present, it is yet difficult to understand how the biologist who has comprehensively studied the development of living forms on the earth's surface from early ages to present times, can endorse the second claim, namely, that the life of the organism calls its cells into existence, to suit its needs. To the present writer such a claim reverses the first principles of terrestrial evolution.

This is said in full view and recognition of the sway, direction and dominancy of the organic life, as a whole, over the individual cell; — even as the State governs but does not create or beget the individual man.

It has been held, too, that the fact that cells in certain tissues of the organism, and in plants, are found to be connected by living fibrils of the nature of protoplasmic bands, continuous from cell to cell, is evidence that the cell is not a separate center of life, but a confluent portion of the protoplasm of the body as a whole, with nothing resembling autonomy of its own.

The truth of this matter, from the histological standpoint, is that ninety-nine per cent. of all the cells of the animal body are clearly disjunct, connected with each other only by fibrils and processes *that touch each other*, or communicate cell with cell only by means of rather elaborate end organs which strongly suggest sentient contact, or even communication of an electrical nature.

Only a relatively very small number of cells in the animal organism are siamesed by protoplasmic bands, continuous from the cytoplasm of one cell to that of another. It is the rare exception, not the rule, and appears to the present writer to show merely that the exigency for united action in such instances is so imperative that these avenues have been set up the more certainly to ensure unified activity, and by no means to disprove that the cells are individualized centers or units of the organic life.

Every cell of the organism gives forth an emanation, both particulate and dynamic — sublimated matter in motion — in response to the stress on its life from without. Blended together, millions of them, the cell emanations form the great neuro-electronic *aura* of the body which, acting reflexly, rules, controls and holds each cell to its task. That portion or tide of it which is directed by the mind we term the will power, and sometimes speak of it as “nervous energy.”

That the cell-of-life is a relatively large organization of smaller vivific bodies (“physiological units;” “biophors”) has been and remains the mature conviction of the most eminent exponents of biology. Everything in nature points to the truth of such a conviction; and we may add that it is the view here endorsed.

The cell-of-life is selected here as the basis for work in the effort to control organic life and prolong it at will, because this little mass of living matter is the one which displays phenomena which have all along been regarded as vital phenomena. For that reason it is the logical starting-point for an effort of research which has to deal with bio-chemistry.

Let it be repeated, however, that the cell-of-life is by no means treated of here as the lowest living unit in the universe of matter. An electron, indeed, may be as “personal” as a cell. Yet for the reasons cited above, the cell is the logical starting-point of an effort to control terrestrial life.

Nor does the fact that the cell is an organized sodality of smaller living bodies — electrons, for example — in the least rob it of its individual life, or personalized character, since in the cell the component electrons are clearly organized about a personal axis, and for the time being pool their smaller lives in the greater personal life of the cell.

From the center of these small spherules, life is exhibited. In consistency, the living substance is semi-fluid; it is so nearly transparent as to be deemed colorless; and it does not give off odorous particles. As above remarked, it is ordinary matter, oxygen, hydrogen, nitrogen, carbon, etc., and the cause of its peculiar behavior, in the living condition, is in all probability the manner in which the particles are combined, and their arrangement and relations one with another.

More profoundly, when we seek to know why living matter always assumes the form of and exists always in the small spherical integers, termed "cells," we are brought to contemplate a new law of matter which apparently acts counter to gravitation, or, as is more likely, prevails upon an interior plane of matter within that on which gravitation acts. It is the sway and prevalence of gravitation over ordinary matter which causes the world of matter, as we see it, to appear lifeless and inert. But in living matter, or protoplasm, we behold a law of matter find expression, subversive of gravity, prevalent over it, and transfiguring ordinary matter in spite of gravity. This may seem a bold statement. Life, indeed, has been held by many biologists to be a co-relative of gravitation, a cognate and derivative mode of the universal energy of matter. Cognate, indeed, it no doubt is; derivative also in the loose sense of being aided and facilitated by it in all the larger forms of terrestrial life; for it is assuredly not the intention here to convey the idea that the ordinary functions of animals are carried on contrary to gravity or chemism. The writer ventures, however, to set forth the conception that within a normal cell of living matter there is an expression of energy not derived from gravitation, but superior to it; as if emanating from an inner seat of energy. Such an opinion by no means conflicts with the monistic conception of energy. It is meant merely to set forth that life is not the immediate derivative of gravitation, or chemism, which many physical philosophers have been inclined to consider it, but rather a static property which antedates gravity, and, in the intimate composition of matter, outranks it.

Indeed, the truer view of this great question is, probably, that life finds but an irregular, erratic expression in the superficies of the terrestrial globe, where gravity and the grosser modes of universal energy prevail as a rule. Yet the conception will be found to grow in the mind of the student of living matter, that this wonderful static property is a very universal property; in a word, that all matter is *sentient* at bottom; and that its apparent *insentience*, or lifelessness and inertia, as seen on the earth, is less a natural than an unnatural and fortuitous condition into which it has fallen from the involution, incident to planetary formation.

This view need not incline the student to entertain pantheistic conceptions of matter, or drift away to extreme opinions as to

a universal mind inherent in nature: an ocean of omniscient intellect, from which our "souls" are stray dribbles. On the contrary, the entire trend and drift of biological science are to the effect that the primary static property of matter is sentience only in the sense that the raw flax is damask, that the crude ore is a steel warship, and that in the great tracts of universal matter there is nothing more intelligent than the *elements of intelligence*; even as in "protoplasm" of lowly grade there is little save the capacity to feel. Be it remembered, too, that there is now, probably, no "protoplasm" existent on the earth's surface of such lowly grade, such archaic simplicity upon the scale of intelligence, as that which first stirred, on the early shores of the azoic oceans.

As the student examines those wonderful little integers, the "cells," day by day, the inquiry constantly presents itself, Why does the living matter adopt this form? Why does it live in these little globules of uniform size?—for although the size of cells differs considerably, relatively to each other, in different tissues and situations, the difference is mainly within certain definite limits; and the general type and form are unmistakable and apparently unchangeable.

Why does protoplasm exist in such small measures of substance, each scarcely more than a pin's point? Why do its "cells" fail, since they are constantly growing, to attain larger size, an inch or more in diameter? Why do they not coalesce in the tissues into one sentient working mass? And why, on the contrary, do they constantly divide, when these small dimensions are reached, and become dormant, die even, rather than transgress them? These are inquiries which the student will find often recurring as he observes cell life. The idea conveyed from the totality of such questionings is one of a certain ever-present barrier to protoplasmic life, or a constantly restricting law which makes life on the earth possible only in this small form, or type. Some stress of terrestrial matter appears to confine life to this minute expression. This little cell is the only way in which life up-wells from the profound depths of matter. For it is apparent that the cell is but the *form*, through which some very esoteric or final property of matter flickers up.

So great confusion of thought has often been exhibited on this

subject of cell consentience that it is important to set the matter in a clear light. In the cell-of-life we have presented the spectacle of a thousandth of a grain of matter which has set itself to *live*, set up for itself as against the rest of the universe, stepped out from its former relationship and allegiance to other matter, and started a new little world of its own. For that is what a living cell really is: a minute portion of universal matter which has set up autonomy. The laws of matter no longer control this thousandth of a grain of matter as formerly.

In every animal and in every cell there is always matter, a large per cent. of its bulk, which is not living, and hence inert; but the really living portion of the cell carries itself in defiance of gravitation. True, it is borne on by the earth on its orbit and revolves with it; none the less it is able to direct chemical action for its own behoof and combine forces to overcome gravity when it wishes to climb hills or trees. In a word, it fights gravitation to do as it pleases, and succeeds. So long as it lives and is not crushed out, it is to a degree independent and self-directive.

As to the origin of life on the earth, we have no certain knowledge as yet, whether it came here from some other world in space, or originated here from a capacity to live inherent in matter. The former supposition puts the question of origin one step farther away; the latter is the one to which all intermediary theories must ultimately lead.

It is not difficult to believe that there are other planetary globes where life develops more easily and with less travail and duress than on our earth. It is not incredible that the first cell, spore, or perhaps still more rudimentary germ of life, arrived here from some other world. It has been held that the "molecule of protoplasm," so called, could not have originated on the earth. Cell life, it is maintained, does not now originate spontaneously; and the inference is therefore easy that the first unicellular life of the globe was from an implantation.

This conjecture once admitted, the next surmise might be that the earth was life-seeded by design, or from personal motives, on the part of intelligent beings inhabiting a more life-fertile globe in space. And it is more reassuring to think that such vital implantation was from beneficent design and to conceive of it as Divine.

It is a moral contradiction that beings more intelligent than man should be malevolent. On this earth, at least, normal intellectual development does not tend to, or eventuate in, malevolence and cruelty, but rather in a desire to give happiness. By human standards, an omniscient mind could not be a "Satan"; yet we do not know what exists afar. There is not much in the present life struggle on the earth that indicates mercy, kindness, or beneficence.

There is no biological evidence, pro or con. The attitude of the universe toward life on the earth seems to be impersonal and neutral. Animal and vegetable life grows, bears seed and dies, unwatered, uncherished, unharvested. And while at first, owing to long indoctrination, this thought of uncherished neglect pains many minds, it must on reflection come to be regarded as a glorious heritage of liberty — the liberty of the universe.

As nearly as can be estimated there is on the surface of the earth, at present, "protoplasm" (meaning matter temporarily in that condition of reciprocal activity which we term "living matter") to the amount of 5,500,460,500,000 tons; the sum total of cells.

Temporarily in the living condition, we say. For a significant, almost startling phase of it is, that this vast quantity of matter is constantly passing out of the living into the non-living condition. As often as once in six hours, probably, once in twelve certainly on an average, the entire five or six trillions of tons of protoplasmic matter falls out of the living into the non-living condition; and *pari passu* an equally vast weight of non-living matter is transformed to the living condition. It is believed that all, or the most part, of the matter which makes up the outer strata of the earth to the depth of many miles, has at some time or other been in the living state, and not once or twice only, but many times.

We may, indeed, go much farther and not exceed what is probable in supposing that in the great past history of the universe — a history of successive series of solar and planetary formations — matter has lived in an indefinite number of forms and types of life from eternity, intermittently and alternately.

For here it is significant to note the reversion of scientific opinion from the extremes of the dynamic hypothesis of *pure*

force, toward the Newtonian idea. Light and also heat and electricity are not only dynamic, but material. Force, so far as we know it, is always associated with an efflux of matter.

The method by which this continuous passage of non-living into living matter is effected, is association and contact with previously existing living matter. The non-living must be infused into the living matter ere the non-living can be re-vitalized.

The intimate impulse which accomplishes this vast transfiguration seems to be a *subjective* one, resident in the "protoplasm" itself, or, in other words, in the matter which is, for the passing hour, in the living condition, and which sinks down from that living condition, while in the act of raising up non-living matter to its own level. The impulse, or working energy, is apparently a transgression of subjective sentience into matter-moving power or motion, effected at a great depth of atomicity, on that low plane where particles are able to move in response to a primarily sentient property which they universally possess.

It is from this low plane, or condition of tenuity, that "protoplasm" is built up, and sets forth in its wonderful career. On the earth as we now inhabit it, life struggles upward from this deep-lying, sentient plane of matter in the teeth of a gigantic resistance. The energy impounded in "protoplasm" is largely expended in overcoming this resistance; the bulk of our living substance has necessarily been impressed into mechanical service, — bone, teeth, hair, cuticle, muscle, tendon, in order to make way and obtain food. This, in fact, is life on earth, as man has thus far led it; but it is possible to improve the earth as a theater of life, and by the control and regulation of its natural forces, to lessen the resistance.

Growth is a law of living matter; and on the earth's surface "protoplasm" is capable, under ordinarily favorable circumstances, of increasing its bulk much more rapidly than it wastes, or dies.

It is able to conserve energy. A cell is capable of raising up a greater amount of non-living matter into the living condition than it loses by the act of so doing.

The only limit to such growth is the capacity of the earth as a field for life; it tends to sustain as much matter in the living condition as it has room for. The various genera and species of living things, moreover, mutually limit and restrict each other.

But for animals, plants would probably overrun the earth to the full extent of its standing room; but for some species of animals, others would increase inordinately. Bacteria, in a favorable medium, propagate at a rate of which no conception can be given in figures.

The point of interest concerning this is that, given favorable conditions, with no checks to its growth, the tiniest dot of protoplasm might convert all the available matter of the universe into "protoplasm!" or, in other words, when once a *modicum* of matter, ever so small, has entered the living condition, it has the power to draw an infinite quantity of contiguous matter into the same life-expressing combination, and continue the process indefinitely. It is as if the universe of matter were combustible and the dot of "protoplasm," introduced into it, were a spark of fire, — with this important difference, however, that growth of living matter implies the raising up of matter to higher degrees of complexity, or the storing up of potential energy in matter, the reverse of igneous combustion. While we cannot affirm that growth of "protoplasm" is creative of energy, it is certainly conservative of energy in a manner elsewhere and otherwise unknown. In this so-called protoplasm, a higher or more primary attribute of matter, to wit, *sentience*, appears to make heat, light, and kindred modes of energy its servants and to successfully stem the ordinary effects of katabolism.

In past ages of the world, noticeably the carboniferous, a far greater quantity of matter has been in the living condition at one and the same time than at present; the indications are that there have been periods when the continents sustained twenty times more vegetable protoplasm, year by year, than during the present era. From age to age the quantity has varied in accord with the terrestrial conditions.

As yet we know no method of transmuting non-living into living matter apart from the agency of previously existent living matter. But no more can we at present make feldspar, or mica, or gold, or silver, or lead. It is as likely that we shall discover a method of producing living matter, as that we shall learn to produce any of these substances. The task waits a deeper knowledge of matter, but is impossible only for the present.

One reason for believing that new protoplasm and new protozoa no longer come into existence spontaneously is that many or all of the micro-organisms which we study under the microscope are new only in the sense of being newly discovered by us. Many of the disease-bacteria were at least operative and produced the same poisons three thousand years ago. The diatomaceæ of to-day exhibit the same characteristics and the same silicious envelope as those taken from fossiliferous strata laid down in the seas of the tertiary epoch. In fact, many of the genera of micro-organisms are the most venerable and changeless of anything upon the earth. Nor can we wholly agree with those who regard these minute creatures as the most rudimentary of living forms. It by no means follows that because a living creature is small, it is therefore exceedingly simple and recent in the sense of ancestry and heredity.

FORMS, APPENDAGES AND FUNCTIONS OF CELLS IN MULTICELLULAR ORGANISMS

It is of interest to study the forms and functions assumed by cells in the multicellular organisms, the human body for example, not alone as showing the wonderful plasticity of the cell-of-life, but as an augury of what can be done with it in the future.

The lowest, simplest forms of cells are globular; but when aggregated in multicellular organisms, subject to mechanical influences, cells are of many forms and sizes.

Both in unicellular and multicellular life, too, cells are found to put forth numerous appendages, to accomplish nutrition and locomotion, communicate with their fellows and unite with other cells for communal labors.

In a general way cells may be said to have an outer skin, or membranous envelope, formerly much referred to as the cell wall; but this is not always present, nor actually essential. Often it appears to be that outer stratum of the cytoplasm which has become lifeless, owing to destructive external influences, but having become so, assumes, incidentally, the rôle of a protective covering. The delicate, sentient metabolism would, indeed, appear to need protection as well as insulation from the external world, electrical

insulation, perhaps; for always it must be borne in mind that cell life is a process, insulated, apart and by itself; that the cell in order to be a living self must be thus separate. Otherwise it would not be a self; nor could the animal and human self otherwise result from an organized federation of cells.

Sketched with a pen, as we write, are six typical forms of cells from the brain and nervous system of a human subject, magnified about 350 diameters. The first is what may be termed an undeveloped cell from one of the second deep layers of the cerebrum, frontal convolution. It has the appearance of being a cell not, or not as yet, very actively engaged in functions pertaining to the personal life; and hence certain observers have been inclined to rank this layer as a reserve layer, from embryonic life, which may, possibly, be drawn upon for more active service later in life. The suggestion is a fanciful one, with a grain of truth in it, perhaps. The way to verify it will be to examine this layer from a young subject in comparison with that from an aged subject, after an arduous lifetime, to ascertain by count, through the thickness of the layer, whether the number of cells in the latter is markedly less.

The second cell is a bipolar cell, such as is found in great numbers in the first deep layer below the dendrites or multipolar cells of the cerebral cortex. These cells put forth two axial processes, one at each pole.

The third cell is a typical multipolar, or many-branched cell, very numerous in the spinal cord and in various parts of the brain, and in nerve ganglia. These cells put forth from four to fifty processes, or branches, which are believed to be largely for association, by sentient contact, with other cells, and also to facilitate nutrition. At least one process, or branch, usually makes directly off to a relatively great distance, and in the end, after numerous offshoots, is enclosed with others in a sheathed nerve trunk. This latter branch is the one generally termed the neuraxone, axone, or axis cylinder process.

The fourth is the typical dendrite, or tree cell, often termed the large pyramidal cell, from the shape of the cell body. It sends up a plant-like apical stalk to a relatively great height, branching to finer and finer fibrils in mazy arborizations; minor sprouts and fibrils also issue from other portions of the cell body. From the

base of each cell, too, as with cells of the third class, there descends an axone which at length enters a nerve trunk and extends to distant portions of the organism.

The fifth is similar to the dendrite, yet differing in certain minor

Fig 1.

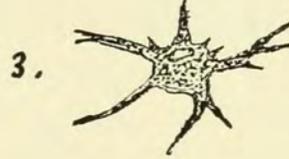
1. Simple, undeveloped cell, from the deeper layers of the brain and spinal cord.



2. Bipolar, or spindle cell from the cerebrum.



3. Large multipolar cell, from spinal cord, brain and nerve ganglia.



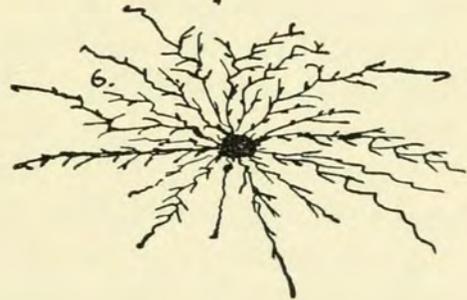
4. Dendrite, or tree cell, from the cortex cerebri, with neuraxone severed.



5. Omdritic (Purkinje) cell from the cerebellum.



6. Adjuvant cell, found in the brain and spinal cord, called also basket cell and spider cell.



characteristics, and found for the most part in the cerebellum and not in the *cortex cerebri*. This cell is usually called the Purkinjè cell, from its discoverer. Like the dendrite, it sends down a neuraxone, but smaller, and its functions are believed to be similar.

The sixth is often termed the basket cell, and sometimes the

spider cell, from its shape and branched processes. Strictly speaking it is not a nerve cell, but one of a group of connective tissue cells, distributed throughout the brain and spinal cord for the purpose of supporting and sustaining the nobler multipolar cells in position. We come upon it constantly when examining cells of the brain and cord. Its function is clearly adjuvant; and to this entire group the general name of neuroglia has been given.

As a rather striking illustration of the truth that a cell is a cell, throughout nature, whatever its function may be, whether associated with millions of others in the highly organized multicell, or living an independent life as a free-roaming unicell, it is of interest to compare an amoeba (*amoeba radiosa*), generally held to be one of the simplest, most primitive forms of cell life, with a large multipolar cell from the anterior horn of the spinal cord of man. In form, at least, the two cells resemble each other so closely as to suggest a common origin at the outset of life on the earth, and also a common metabolism, internally, as regards biochemical activities.

The more the cell-of-life is studied the stronger grows the conviction that what at first seem veritable miracles can be wrought with it. Mark what it has done in the brain of the bee, or the ant. In that tiny dot of living matter, not as large as a pin head, there is a development of knowledge, a repository and a continuum of heredity which embraces the entire science of aviation, architecture, engineering, economics, offensive and defensive warfare and a highly developed sociology.

Throughout unicellular life, too, as well as in the multicells, we find the same remarkable evidences of capacity for adaptation and transformation, the fresh water rhizopods, for example.

Primordially, the cell-of-life appears to have nourished itself, that is to say, obtained its food, by the absorptive, or saprophytic method, drawing in food particles from without, through its outer skin, or cell wall. The tissue cells of multicellular organisms — animals and plants — still obtain their food in that way, from the blood and the sap.

Unorganized, when living a free, roving life, amoeboid unicells, originally saprophytic, have developed various ways of seizing and ingesting larger food particles, also smaller unicells, as prey. From

their substance they thrust forth a great variety of processes (pseudopodia) both for locomotion and for grasping elusive food. They spread nets, or webs, spun by impulse of will from the super-

Amoeba radiosa, showing
protoplasmic rays, put forth
to capture food and as pseudo-
-podia for locomotion

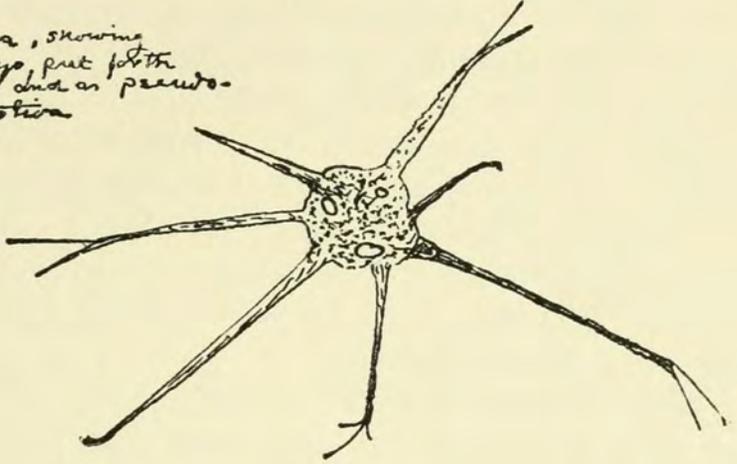
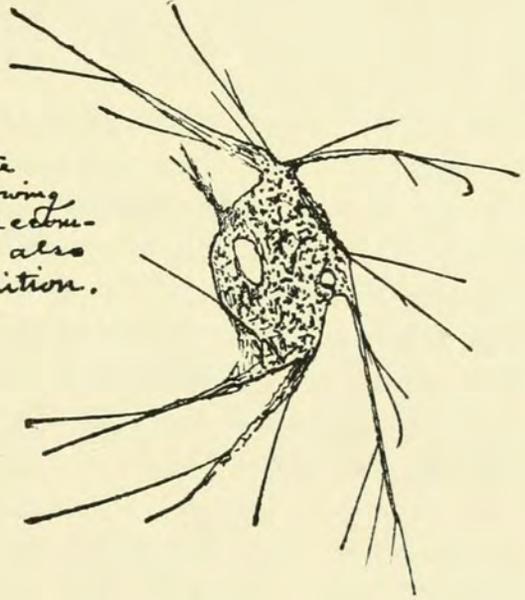


Fig 2.

Large multipolar cell
from the anterior horn of the
spinal cord of man, showing
filamentous processes to accom-
-plish co-ordination, and also
it may be, in aid of nutrition.



ficial substance of their cell bodies, to catch and enmesh smaller unicells.

Others of this class of predatory unicells — like the light-armed peltastæ of ancient armies — have equipped themselves with javelins, needle-like darts, which they eject from their substance, and hurl to considerable distances to transfix and paralyze their prey

or their enemies. It is hardly too much to say that they overwhelm their prey or their enemies with flights of envenomed arrows, since often the one thus attacked is seen to sink inert, as if paralyzed.

In response to hunger and will power there has developed in these originally simple amoeboid cells, chemico-sentient apparatus not only for transforming alloyed protoplasm into pointed, detachable darts, but apparatus for casting these with relatively great force; — as seen in individuals of raphidiophrys and heterophrys.

Figure 3, as sketched, gives some idea of the way in which the pseudopodia of the simpler amoebæ have, in heterophrys, developed to long lance-like cils, projectable, and even detachable for casting to greater distances.

Along the larger trunks of these processes flow transformed currents of the cell cytoplasm which give rise to needle-like cils more minute than threads of finest spun glass. Under stress of hunger, fear, or hate, this unicell transforms sentient matter to lances and forked darts. When we learn how this is done, we shall be far on our way to control and guide the cells of our own tissues.

The point to which attention is particularly called in connection with these different forms and types of the cell-of-life, is its intrinsic capacity, as here displayed, to transform its own substance (cytoplasm) and adapt it to various uses; and this as bearing on the analogous capacity of the cells in the animal organism for change under stress of the *will* of the whole organism. In a word, it shows what the cell-of-life can do, and how facile a substance for transformation is this marvelous living substance which we sometimes call "protoplasm."

No longer a free, roving unicell, seizing its food in the turbid puddle, but associated with myriads of its fellows in the animal organism, our physiological cell-of-life takes its nourishment from the conduits of the blood stream, beside the capillaries of which it is located and does its life work. A million other cells labor conjointly to make this blood plasma the highly refined nutriment it is: — the last word, under nature, in the line of cell food. It is therefore on the circulatory apparatus of arteries, arterioles and capillaries, with their associated veins, veinlets and lymphatics, and

on this refined blood plasma flowing swiftly through them, that we must fix our attention as the one and only instrumentality for reaching, modifying and renewing the living substance of the cell.

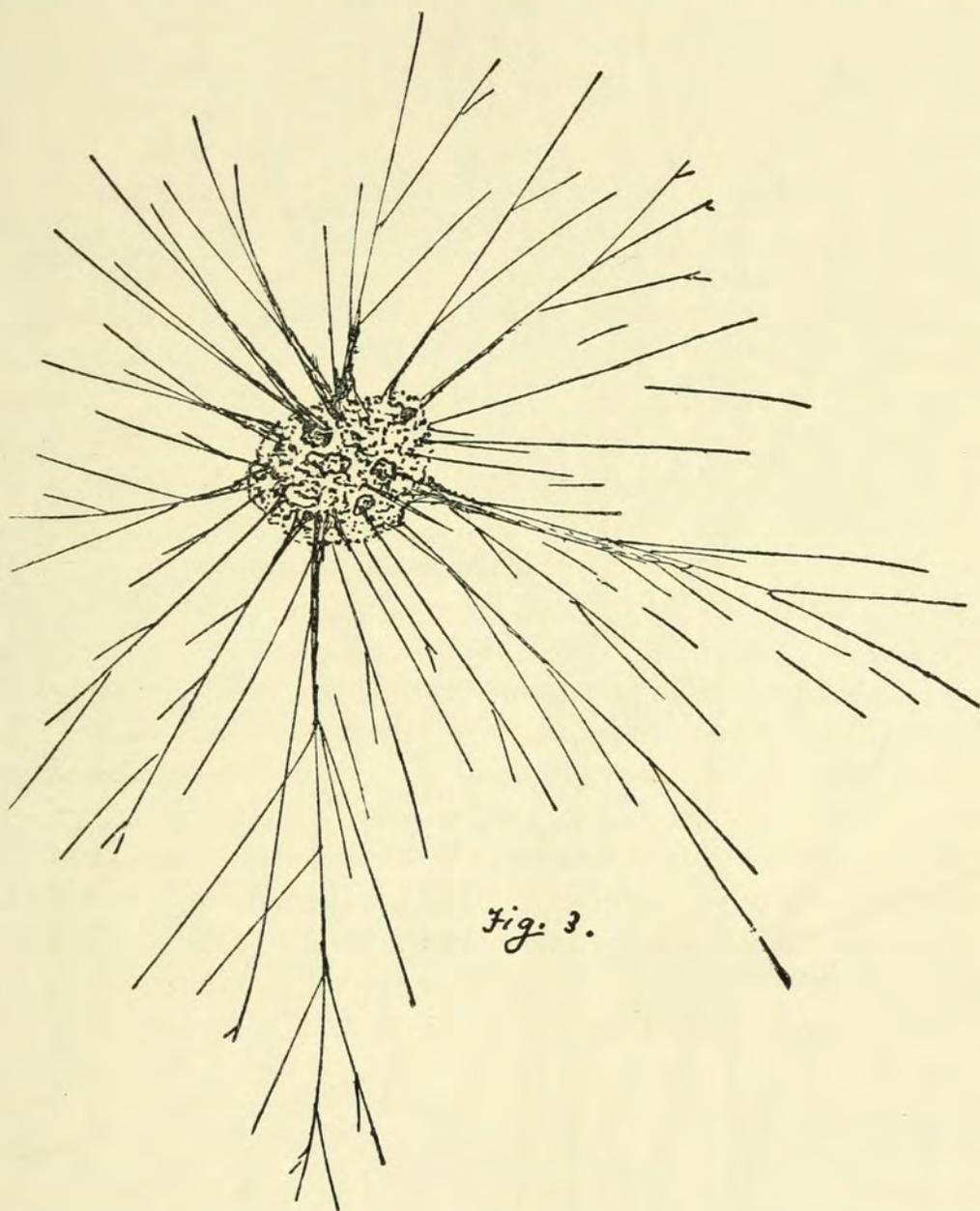
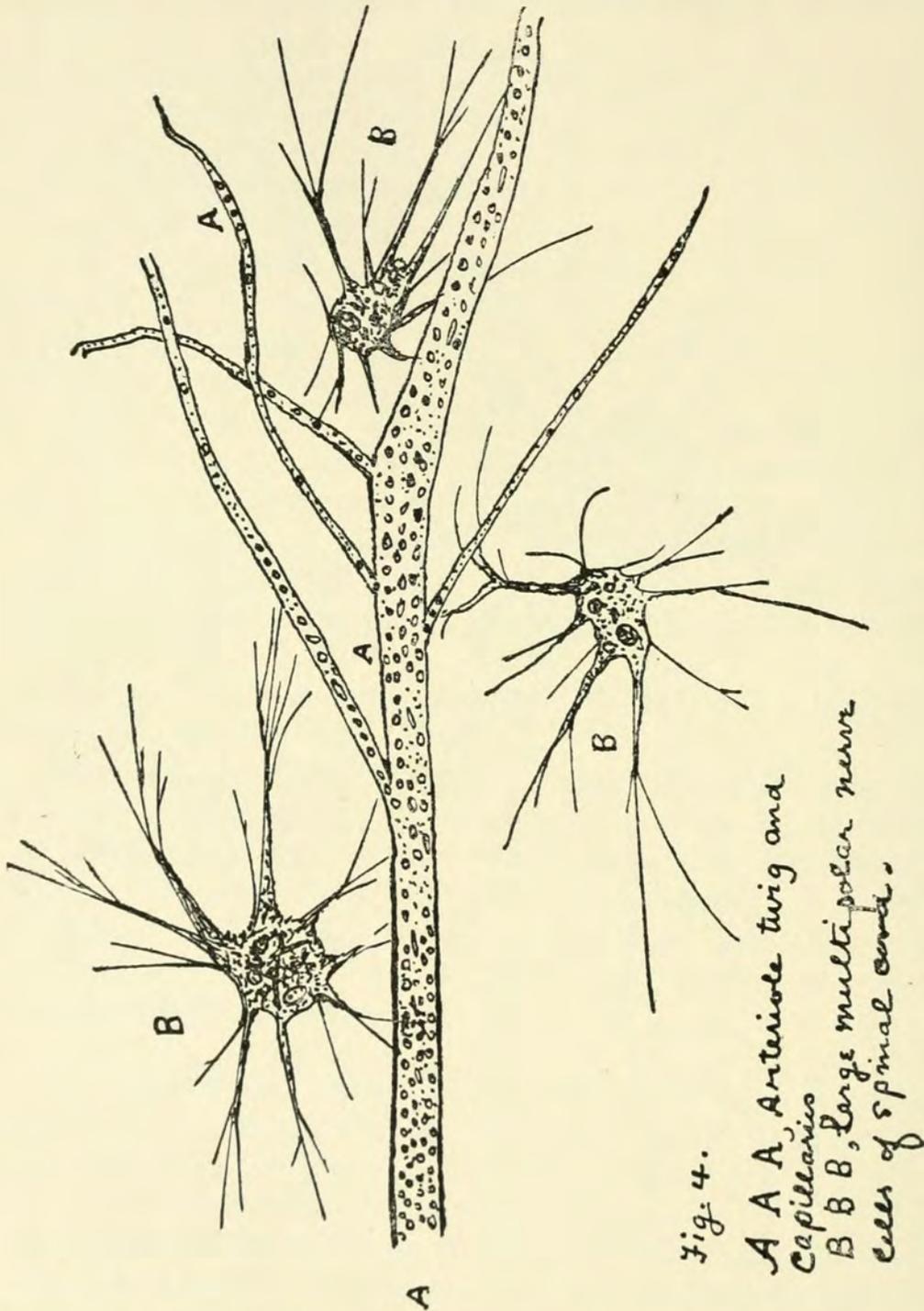


Fig. 3.

The blood stream, foul, or pure and renovating, is our sole means and vehicle of cell nutrition. On nerve fibrils we depend for incitation and stimulation by will power as directed by the brain; but the blood plasma and circulatory apparatus are our sole means of renewal of substance.

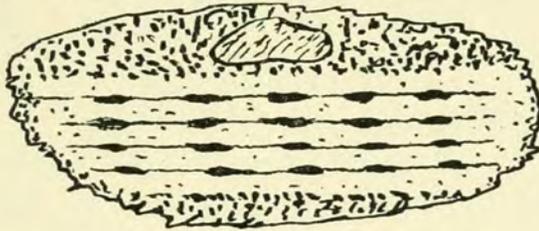
Figure 4 represents, in diagram, the position and relation, as regards nutrition, of the large multipolar cells of the spinal cord



to an arteriole twig and capillaries. Through the arterioles and capillaries flows the blood stream, bearing with it the red and

white blood corpuscles, and the plasma which alone the cells attract to themselves and absorb. It has been held that the plasma seeps through the walls of the capillaries, also that these walls contain minute stomata through which the cells have the power to suck the plasma. Certain fibrils from the cells appear to touch — perhaps tap — the capillary walls. Take the case of a muscle cell,

I *A muscle cell.*
When contraction begins.
Knotting up of the contracting filaments.



II *The same at maximum of impulse.*
When the knots of the contractile filaments
appear to coalesce in one larger knot,
or bulb, at the center.

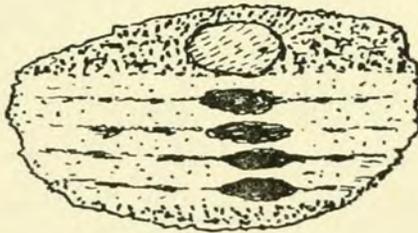


Fig. 5.

the function of which is alternately to contract and elongate, thereby producing mechanical movements. The muscle cell is nourished not differently from those of brain or cuticle; but at the call and behest of the whole organism for contraction and elongation, we find the living substance responding after a manner, sketched in Figure 5, which represents a muscle cell at two stages of contraction, a first, or initial stage, and a maximum stage; the relaxation, or elongation stage being the same, conversely, accompanied by an acid chemical reaction.

A portion of every such muscle cell, one side of it, consists of undifferentiated, granular protoplasm (cytoplasm) containing the nucleus; that is to say, the living matter of this part of the cell still retains the original character of all cells not specialized by the needs of the whole organism and devoted to particular uses and functions. This is the part to which self-life, growth, etc., is now restricted.

In the other part, on the other side of it, or midway through the cell, we find an altered specialized tract of protoplasm, where the living substance is arranged in filaments, lying parallel to each other. These filaments are capable of contraction, at an impulse from the other part of the cell. To this specialized part of the cell protoplasm the name of myoplasm has been given.

After embryonic life this cell devotes its powers not to multiplying itself by fission and division, as is the wont of unicells, but to the production of dynamic energy for the common good of the confraternity of cells in the whole organism. It is a fine and very suggestive example of what the cell-of-life has shown itself able to do under stimulus of a certain definite sort.

In like manner a brain cell devotes itself to the process of thought, or a gland cell to the production of saliva, or of pepsin ferments. At the call of the common good, too, this brain cell or this muscle cell stands steady in its place and prolongs its individual cell life from the few days, or hours, of the original, rapidly-multiplying unicell, to fifty, eighty, or a hundred years. Wonderful data for thought and hope lie in these facts of cell life. First, we have need to study and analyze the stimuli which impel the cell to these grand feats of adaptation, and second, to produce and use them at will.

The muscle cell is in truth a grand example of what a cell may come to do in response to the demand made upon it by the whole organism of which it is a loyal subject. What we here behold is electrons, innumerable, organized and bending their efforts, we may even say their wills, harmoniously and in unison, to accomplish one great purpose. Even so the star-suns of the galaxies of space bend their united efforts to turn the wheel of the sidereal universe, at the call and behest of the cosmic common good. It all moves from the sentient side, in the cell; or in the Milky Way.

It is in the differentiations of cell life, however, in special organs and functions of animal and plant life that the capacity of the cell for change and perfection is most strikingly displayed. The eye, for example. Here is an intricate illustration of what each cell, or group of cells, can do and make, when stress or incitation is given it to modify its life and its cell products to certain uses. Within this globe of the eye we have cells which make glass, both transparent, colored and semi-opaque; cells which secrete clear liquids and also jellies, cells which make black pigment sheets, and also the toughest of fiber, and which put forth and maintain highly sensitized fibrils, cells which stand together co-operatively to produce a matchless mechanism of muscle fibers, cells which transform their substance to cilia and to hair for protection of the more delicate surfaces, and cells which constantly secrete soothing fluids for laving and moistening the entire apparatus. All this has been done by the cell-of-life in response to the call of the whole organism for light. And the point of interest here is the transformation which the cell has shown itself capable of.

In short, we come to learn that the cell is in very truth the proteus of our world of life. As regards longevity it may live a day, a week, as in unicellular life; or in the muscle, or brain, of multicellular life, it may — if the need of the organized life of which it is a unit demands it — live fifty years, or even for two centuries. A cell lifetime, indeed, may be long or short as the cell itself wills, or the will of the organism of which it is a part, stimulates it. It may be ephemeral or practically deathless.

As another marvelous instance of what the cell-of-life may be impelled to do, at the continued behest of the whole organism, take the case of a gland cell, lodged in *trabecula* at the root of a fang in the jaw of the rattlesnake, or the cobra. Here we have cells differing little in appearance from the cells of the parotid, submaxillary, or other glands, and like them drawing nourishment from the same blood plasma, yet this one manufactures and excretes through the gland duct, when suddenly pressed, a poison so deadly that half a minim of it will destroy a million cell lives. Yet in some manner at present unknown to us, this gland cell contrives to make and keep separate from its nucleus and the remainder of its cytoplasm this potent weapon of death.

Analogous to this are many plant cells which manufacture acids, acrid juices and gums; analogous, too, are the hepatic cells of the animal organism which make and excrete gall.

Not only is the cell-of-life able to assume wholly diverse functions, but even in as extreme a case as that of cells removed from the animal organism in which they have been developed during a thousand generations of ancestral life, these cells when thus removed, and if nourished in favoring media, adequately protected from outside infection and extremes of temperature, live on for weeks, or months, and probably would do so indefinitely. It is solely a question of *nutrition* and *protection*.

For example, a bit of heart muscle, containing the specialized, peculiar muscle cells of that organ, has been kept alive and pulsating for three months. This is exactly what experiments here had led us to infer, to wit, that the cell-of-life lives by virtue of a sentient impulse and vital processes inside itself, and will go on doing so as long as it is nourished adequately and protected from "death" by the outside world. Death comes to it, in the animal organism, because in an aging organism it is no longer nourished sufficiently and protected from septic attacks, i. e., microbes and poisons. In an aging, shrunken organism, as that of man at eighty, adequate nourishment no longer reaches the cells through the blocked and contracted capillaries, and unremoved waste products, breeding bacteria, subject them to a constantly growing handicap to survival.

Another point of great interest and significance in these experiments with heart muscle cells, above referred to, is the fact that when removed from the organism and placed in media suitable for nutrition, these cells proliferate, i. e., increase in number by growth and division, thereby resuming a more primitive function of the cell-of-life, one which they would never again have exhibited, had they remained *in situ*, within the heart organ whence they were taken for the experiment. This fact, incidentally observed, is of an importance which will loom largely in the future.

Yet another fact or principle which ought not to be lost sight of, is the tenacity with which these cells from the heart muscle hold to their function of pulsation. Removed from their place in the beating heart, and placed in fluid media inside a glass jar,

there would appear to be no longer organic stress, or reason why they should go on pulsating, yet they do so for months, thereby affording most reassuring evidence of cell fidelity to an assumed function, a loyalty of allegiance to the animal organism from which it has been transplanted.

Incidentally, however, it was observed that cells of this bit of transplanted heart tissue, cells which lay on the outside of it and most exposed to demoralizing influences, so to speak, changed to, or rather in proliferating gave birth to a species of amoeboid non-pulsating cells, as if, under stress of hard, untoward conditions, the heart-muscle cell were displaying a tendency to revert to that simple primordial cell from which all multicellular life has in time developed.

Here it may be well to state definitely, that, in all that follows, we are dealing with the lives, the psychic side, of unicells and multicells, rather than with the forms of life; and hence that we are not entering upon discussions of natural selection, descent, variation or adaptation, in either the Lamarckian or the Darwinian sense; nor yet of the opposed theories of species formation, like the *mutationstheorie* of De Vries and others. The general theory of the evolution of life on the earth is accepted as a matter of course; but it is rather with the psychic side of such evolution that we are now concerned.

It was an evolution, covering millions of years, but it went on after nature's purblind fashion, until all the varied flora and fauna of the earth's multicellular life have come out of it.

Signal advantages, we say, resulted from such united life. To unicellular life, therefore, multicellular organization has proved a species of natural salvation. It has been the unicell's upward way to a kind of unicellular immortality, and as such is of profound practical significance to the biologist and the student of social science as pointing the way to prolonged life for man, from communal effort.

The microscope proved that the human organism was a vast, highly organized, consentient confederation of cells; that it lives only in its cell life; that it has no other life than comes from the harmonious confluence of the cell lives; and that the far ancestry of these component cells was the unicellular life of the ancient

earth. Yet the embryology of man shows us that all the tissue cells of the organism issue forth and develop from a single ovum, composed of as few, possibly, as two cells emanating from the bodies of the parents. How and by what physiological process the *semina* of millions of tissue cells in an animal organism are embodied, or garnered, in these few embryonic cells is still a matter of research. However accomplished, it is distinctly a process, or achievement, of multicellular life, one which developed after the unicellular colony took on permanent form and perfected its organization. The details of it remain to be demonstrated.

Does each cell of the animal organism fructify and secrete exceedingly minute *semina* which are attracted to and garnered in the cells of the reproductive organs and afterwards develop in the embryo; or does the personal aura—the soul—of the plant, animal or man so impress itself on the reproductive cells that by virtue of their mnemonic faculty they remember, imitate and reproduce the parents in the child?

Many months have been spent studying the lives of plants and animals, considered as organized unions of cell life; or in other words, the phytopsyche (plant soul) and histopsyche (tissue soul) as so many consentient unions of the cytopsyche (cell soul). It became evident that by means of sentient contact, cell with cell, two or more cells—a hundred, a million—may coalesce, sentimentally, and form one larger communal life about a common axis of self-consciousness; in fact, that the lives of all the multicells are such organized unions of the lesser lives of their component cells. This composite origin of the human soul was, indeed, a novel discovery as in contrast with former conceptions.

THE NEURO-ELECTRONIC CIRCULATION

When we speak of the organic circulation, what is generally meant is the circulation of the blood and lymph, with its arterial, venous and lymphatic apparatus. No other circulation is recognized, either in anatomy or physiology.

There is another, however, the most important of all, the one most essential to animal life and personality, since by no other

agency can a multicellular organism be actuated and its many millions of separate cell lives unified in the one greater self-conscious life. By means of this circulation alone is the multitudinous cell *psyche* united, consolidated, held together, and incited as the animal self or soul.

So little is this latter circulation known, or recognized, that it has as yet received no name, no descriptive designation. Provisionally, until a better designation is found, it may be called the electronic circulation, or better, perhaps, the neuro-electronic circulation, since electrons enter into the composition of the substance which circulates.

And here it would be well if the reader could glance at two anatomical charts, one of the blood vessels, the arteries, the veins and blood circulatory apparatus generally, the other of the nervous system, meaning the cerebro-spinal system of afferent and efferent nerves, and nerve filaments, as minute as shown by charts. Even a casual glance at the two sets of bodily apparatus will convey an idea as to the analogy of the two circulations — the one so well known, the other of which so little is known, as yet.

But, as in the case of the blood circulatory apparatus, no illustration as a whole can depict, either the capillaries, or the far more minute terminal nerve fibrils which reach the cells and hold cell to cell in sentient communication; since this is below the ken of the human eye, and a matter of microscopic demonstration.

Whereas the blood and lymph currents circulate in tubes and tubules, the neuro-electronic circulation is maintained through insulated cables which divide into smaller and smaller lines, apparently solid, composed of an organic substance which it is the function of certain cells to secrete and keep in continuity. To the neuro-electronic fluid — if fluid it may be called — the nerve trunks and nerve fibrils are as pervious as telegraph wires to electric currents. Instead of being of copper or iron, however, the nerve cylinders are of complex chemical composition, of greater but slower conductivity. The neuro-electronic current appears, indeed, to enter and actuate first one group of chemical molecules in the nerve trunk, then another, and to be accompanied by sentient as well as physical activities of the transmitting substance, a substance which cannot better be described than as being a kind of alloyed protoplasm, not so greatly alloyed, or "fixed," as not to be

still semi-sentient. Like striped muscle fiber it is an alloy of cell cytoplasm.

Two phases of the neuro-electronic circulation are incidentally exhibited in an animal organism, namely, a sensory phase, and a motor phase, the one setting inward to the center of self-consciousness, the other setting outward under incitation of will power, to direct and incite the mechanical apparatus of the body.

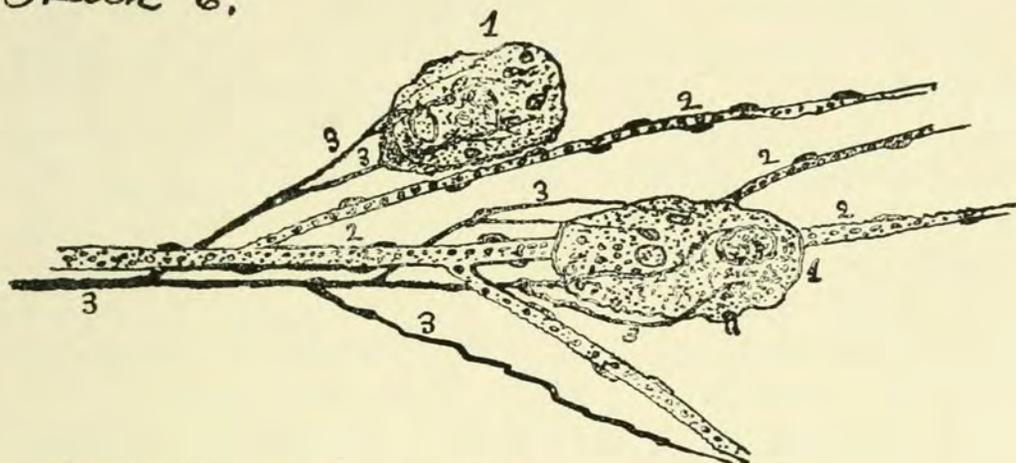
For the most part, however, the neuro-electronic circulation — like that of the blood — goes on subconsciously and constantly, both during sleep and waking hours. It is largely a function of the cell life, below the ken of the cerebral self-consciousness, and is as yet an unentered field of investigation — one of grand possibilities.

So far as our present knowledge of the neuro-electronic circulation goes, the substance which circulates consists of emanations from the cells of the entire organism, and passes to and fro along the inner thread of the nerves, inciting first one group of molecules, then another. Each group, in turn, incites that next it, and thus the impulse goes forward to the muscle, gland, or epithelial surface, to be influenced.

Apparently, each molecule, or group of molecules, in the core of the nerve, gives up, as the impulse travels, certain of its free electrons, thus forming something analogous to an ordinary electric current. We know, at least, that electricity is present, and appears to be generated as the impulse moves along the nerve. Yet the phenomena are not a little complicated; — somewhat as if a line of a thousand persons, stationed half a mile apart, connected by telephone, were passing a message from one to another for a distance of five hundred miles, to still another person, who, on receiving it, would be incited to wield an ax or turn a lever. For this reason, probably, nerve messages are transmitted slowly, compared with electric messages through wire. Something more than a current of electrons is set up. An emanation from the cells accompanies it, an emanation which has sometimes been termed *vim*, *virtus* and, more loosely, vital energy and vital power. No recognized term has been given it, because its nature, character and functions have as yet been scarcely recognized. In the substance which circulates, the electron would seem to be what the red and white blood-corpuses are in the plasma of the blood-stream.

Figure 6 attempts to illustrate the two circulations, conjointly, in glandular tissue like that of the pancreas, the parotid, or the thyroid gland. An arterial twig with its capillaries bears nourishment to the cells whose function it is to secrete certain "juices," necessary to digestion, or the organic well-being. With the arteriole, or often so, enters a small efferent nerve trunk, branching into nerve fibrils which ramify among the gland cells. By virtue of

Sketch 6.



1. Salivary gland cells.
2. Capillaries from which they draw nourishment
3. Nerve filaments of the neuro-electronic circulation, which stimulate and regulate the cell activities. These filaments often envelope and sometimes bore into the cell bodies.

the current, maintained in the nerve and its fibrils, the cells are held in function through life and stimulated to activity as required. Deprived of this constant neuro-electronic current — if the nerve were cut — the cells soon relapse from their proper organic duty, degenerate and become desuete, or even run riot in new growths. It is the neuro-electronic circulation alone which holds all the many groups of somatic cells in function and renders animal life possible.

No effort has been made in this pen sketch to represent either the venous capillaries, or the afferent nerves. These latter are the reverse phase of the neuro-electronic circulation.

Through the neuro-electronic circulation which reaches it along the nerve fibril, there comes this mandate so masterful that the life of the cell bends to it constantly, as the worker-bee labors in the hive, the skilled artisan in the factory. It is the voice — the sentient aura — of the whole organism, the whole organized civilization of the nation and the race. That voice, that sentient aura, “circulates” by means of the nerve filaments.

In yet another particular the neuro-electronic circulation differs from the sanguineous. The substance, current, or medium, which circulates, is an emanation from the cells, especially the cells of the brain and nervous system; its origin is intracellular; and its efferent and afferent nerve fibrils — which correspond to the arterial and venous capillaries of the sanguineous circulation — are cell processes, namely, fibrils put forth by the cells themselves. These in the case of the brain dendrites and multipolar cells of the spinal cord, consist of associated arborizations, and the so-called axis-cylinder processes, which, issuing from the base of each cell, unite with others and pass into the larger nerve trunks.

The neuro-electronic current is thus a combination between cell and cell, or in other words, the circulating medium of the associated cells. While the circulation of the blood plasma may be termed intercellular, the neuro-electronic is intracellular, and thus connected with the sentio-chemism of life itself.

The idea to be conveyed may be assisted, perhaps, by a few pen-strokes — Figure 7 — illustrating the relations of four pyramidal, or dendritic cells of the human cerebrum, and of the multipolar cells of the brain and spinal cord, generally. The cells and cell processes are sketched black, somewhat as they look when stained by Golgi's corrosive sublimate method, with no attempt to represent the neuroglia, or the capillaries of the blood circulatory system.

The neuro-electronic circulation, as will be seen in the case of these four dendrites, is through the cells, and from them outward, by means of the axis-cylinder process, or neuraxone, to the muscles of the mechanical apparatus of the organism.

With no little propriety, therefore, the neuro-electronic circulation might be termed the sentient or subjective circulation. It comes from the life-side of matter.

Permit the repetition here of the cardinal fact touching the neuro-electronic circulation. It is through the cell-of-life, not around it; and the motive power which causes it to circulate is the will power of the cell: that will power which emanates directly

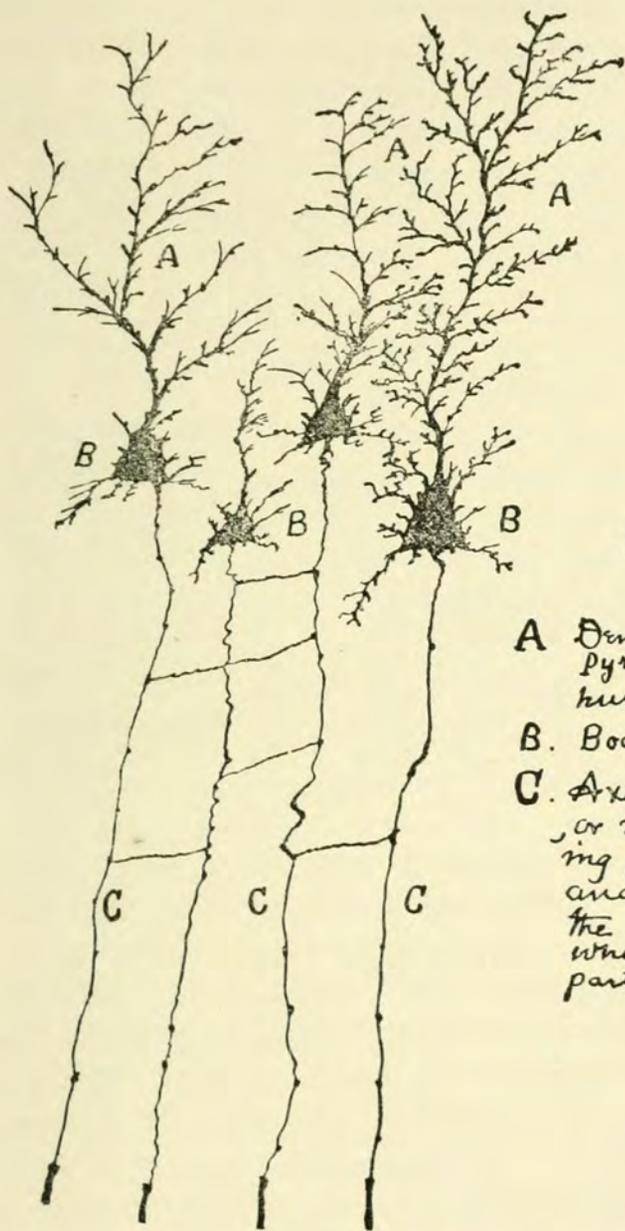


Fig 7.

- A. Dense arborizations of pyramidal cells in the human cerebrum.
- B. Bodies of the cells.
- C. Axis cylinder processes or neuraxones, descending from base of cells and finally uniting in the sheathed nerves which extend to distant parts of the body.

from the sentient life of the cell. The vehicle of it appears to be currents of electrons. The idea now held at this laboratory is that the essential element of it is an emanation from the life-side of the cell, superadded to the electron, modifying, or otherwise affecting, its frequency, rhythm, or even its internal character.

It is not likely that our present methods of staining and examination bring out the finer fibrils of the arborizations of the cells, but only the relatively coarser, grosser portions. The cortex cerebri of man and the higher animals is a veritable maze of these fibrils, developed apparently for association and affiliation, cell with cell, that each may *sense* what goes on in the others. Whether the fibrils of different cells touch, join and anastomose, one to another, is a matter of dispute and discussion. In some situations cells appear actually thus to coalesce with other cells, but certainly not as a rule. Each appears to preserve and maintain its own individuality intact. What strengthens this latter view is the presence of numerous "buds," so called, or nodules of living matter, in the arborizations, which are conjectured to serve as tiny accumulators in the sentient circulation.

In any sketch of this kind it is quite impossible to depict the length of the axis-cylinder processes, or neuraxones, which descend to relatively enormous distances, through layer after layer of fusiform, or nuclear cells. Often they are seen to communicate with each other by means of lateral offshoots, thus maintaining complete sentient and, perhaps, electronic tension. Ultimately they join other axones and are combined in the sheathed nerves which extend to the most distant parts of the organism. Altogether, it is the most wonderful mechanism in creation.

HUMAN PERSONALITY

ITS COMPOSITE AND DISSOLUBLE NATURE

BIOLOGICAL science places the long-debated problem of human personality under new lights.

It will not be necessary here to enter upon an exposition of the "cell doctrine," or point out that the human body is an organized union of physiological cells, nor iterate the evidences of the evolution of life. We begin, therefore, with the general statement, that the human body, as we inherit it from our ancestors, is a vastly organized association of cell life, each cell a small organism, guided by a lowly intelligence which stands to it as mind. The present functions of the tissue cell of the animal body, as we observe them, do not imply a notable individual exercise or display of cell intelligence; such exercise of intelligence, however, is potential in every cell, was once displayed by the ancestry of that cell, and might probably again be called into use, if the conditions of its environment were altered and demanded it.

In brief, the tissue cell is like an artisan who has so learned his trade and has worked so long in the same factory, making the same kind of goods, that he now works with little mental effort, because it is not required; yet the capacity for other lines of work and thought still survives in him in some degree, although he would very likely starve, or perish, if cast suddenly forth into the wilderness. If the transition from his factory and his habitual food and labor were made gradual, he would adapt himself to the changed conditions.

We are speaking now of muscle, bone, or gland cells, in short, of any and all of the thirty orders of tissue cells, save one. The intelligence of that one has not been as much restricted by its appointed task. We refer, of course, to that order, or genus of cells which appear as brain and spinal cord, or the nervous system as a whole.

It is with this wonderful group of cells, the neurons, that we have to deal in the vexed question of human personality (personal identity, self-consciousness, "soul"), and incidentally to inquire whether this human personality is detachable from the organism or not.

We are not here understood as affirming that the cells of the nervous system are the only cells of the organism concerned in human personality, not even when this group is extended to include the sympathetic system. Every group of cells in the animal body is faintly and in some minor degree apparent in the sub-conscious human intelligence. All enter into and contribute to that great sea of *feeling* which we term the sub-conscious mind. Physiologists have described a sixth sense which they term the muscular sense — the indistinct sensory representation of the vast group of muscle cells in the personality. A glance at the organic mechanism is sufficient to show that these cells and groups of cells can have but a secondary, or reflex representation; a faint twice-reflected sense, like earth-shine on the unlighted segment of the moon. For muscle and gland cells form groups by themselves, not interlaced with the neurons and having no interlacing processes, being only reported, if we may use that word in this sense, to the neuron group by means of immensely long filaments which the latter have sent forth. In fact, all those vast groups of cells in muscle, bone, and gland are, as far as the human personality is concerned, but so many outlying, alien provinces of an empire, controlled and stimulated to action from the central capital, but only reflexly and faintly symbiotic with it.

The manner in which personality — intellect and mind — fell to the lot and became the task of the neuron group, is now apparent and can be demonstrated. A trace of it appears even in the zoaria of polyzoa. Something like an incipient nervous system exists in *bristatella mucedo* and in *kinetoskias* where a colony of unicells is seen to act as an individual, by transmission of impulses from cell to cell to ensure simultaneous action to a certain end on the part of all the cells. The same is observed in the volvocine colonies.

At this early stage of differentiation of function, any cell of the colony may act as a brain or nerve cell. The capacity was inherent in all cells at the outset of multicellular life. One cell, living

alone, may do all that any multicellular organism can do, on a small scale. But in a colony of unicells, particularly in a large colony, certain cells, on account of their outer or inner location in the colony, come habitually to do certain things and assume certain functions. Those on the outside unite to propel the colony onward toward food; those on the inside deal with the food after it is seized and ingested; and there come to be those which take it upon themselves to spy food, or to scent it at a distance, in a word, to act as eyes, ears, and nose for the colony. But to convey what these cells saw, or scented, for the benefit of the colony, to other cells, those for example which propel the colony, it was necessary that certain intermediate cells, or lines of cells, should act as carriers of this intelligence and pass it on from cell to cell, and here we have the origin of a nerve — a line of cells passing intelligence to the other cells. In this necessity of the many-celled colony we find the beginning of the function of nerve and, ultimately, of brain. For very soon the need of a common center to which the conveyed intelligence from without could be brought, would make itself felt. Certain cells would be impelled by the common want to take up the function of estimating these conveyed impulses, whether faint, or intense and imperative, of estimating and responding to them. Thus somewhere along the incipient nerve line a nerve ganglion would be developed from cells which, under other circumstances of the colony's needs, might have become locomotive cells or gland cells. For it is the many common wants of the cell union which have forced the assumption of different functions upon different tracts of cells. We observe, first, a condition in which a cell is compelled to *feel* the *feeling* of another cell. The medium or agency of transmitting feeling in this case is probably an actual current of corpuscles. Excited to action by this received sensation, the intermediate cell transmits the sensation to another contiguous cell; this latter in turn transmits it to a third, and so on. But sensation thus conveyed onward, from cell to cell, requires referendum somewhere. Moreover, different lines of cells thus acting as incipient nerves would cross each other, as such lines multiplied, and cause distraction and confusion.

Hence a new necessity arose, the necessity that certain cells along an embryo nerve line, or at the crossings of such lines,

should assume a higher function of intelligence, the function of determining the relative strength and value of the conveyed impulses which pass through them, and of acting for the common good by judging of them, neutralizing some of the least important, or intensifying others, and, in general, regulating and administering for all. And in these cells at the crossings, or midway the incipient nerve, we find a nerve ganglion developed, that is to say, a little brain for that tract of cells and nerve lines. These cells of ganglia have the magisterial office thrust upon them by the importunity of their fellow cells in the multicellular union. They find themselves the recipients of confided *feeling* from the others, on all sides; they are stimulated by it and led to respond as judges of such feeling. From their situation and the necessity incident to it, the faculty of discrimination and of judgment as to the nature, character and motive of these incoming currents of sensation is in time developed.

The cell neurons of the brain have thus been made the repositories and agents for the estimation of a thousand simultaneous currents of these partly-interpreted sensations, transmitted to them from all portions of the organism, and particularly from the organs of special sense, the eye, the ear, the olfactory and the gustatory tracts.

Thus impressed into the service of the organism, the neurons have developed in numbers adequate to that service. Instead of a tiny ganglion for the receipt of simple sensation, we have in the human brain a grand mass of cells capable of receiving and estimating the perceptions of a hundred inferior ganglia, of comparing these perceptions with other previously recorded perceptions from the same organs of the body and with those from other organs; of deciding as to the relative importance of all these and of responding through the motor system of nerves, in accordance with conclusions which are arrived at after a final estimate of the grand total of perception, reflex perception, and the thousandfold perception of perceptions which make up the complicated process which we commonly call *thinking*.

It is of interest to examine the minute anatomy of the neurons, and study the physiological mechanism by means of which they join themselves together and unite their lives to form the human intellect. Of interest, because this mechanism is the most wonder-

ful thing in the world. Throughout the length and breadth of our earth there is nothing to compare with this sentient combine of brain cells and the marvelous networks of living matter which they put forth to sustain self-consciousness.

The means by which the neurons are united in the brain has long been known to minute anatomists; and during the last fifteen years numerous investigators have described the amazing networks which they form in the cortex of the cerebrum. Whether or not the microscopic fibrils coalesce end by end and become continuous from cell to cell, has been a subject of controversy, backed by what has seemed evidence on both sides. The contention that the neurons are directly united by their filaments, has not been demonstrated beyond question, the facts going to show that these extended, delicate processes of the cells very closely approach each other and, during the elate, erectile condition of diurnal wakefulness, actually *touch*; and that in sleep this contact is broken, a condition of non-contiguity, brought about in part by the shrinking away of the blood capillary system in the cortex during somnolence.

Until recently, however, no observer appears to have fully comprehended the profound psychic significance of this extraordinary web of living fibrils.

Gehuchten, Obersteiner and His called attention to the extraordinary length of the protoplasmic branches of brain cells, and to the extended and intricate networks which they form. Conjecture was attracted to them; but it was not until the growth of our knowledge had embraced other discoveries that these marvelous networks of sentient, protoplasmic threads were identified not only as a means of association of cell with cell, but as the sentient web of living matter by means of which self-consciousness and personal identity exist and are possible. In a word, that it is by means of this vast network of interactive fibers, fibrils and filaments that the many millions of cells of the brain are able to live as one self-conscious entity and give rise to a personal intellect.

Histologically, as the abode of the genus of intellectual cells, the human brain must be conceived of as a vast skein or congeries of nerve fibers, on the outer surface of which, carefully roofed over by the cranium and tough membranes, lie the most important groups of cells.

It is of these cell groups of the convoluted, outer surface or cortex of the brain that we shall here speak almost exclusively, scarcely more than referring to the great nether group or groups, commonly described as the nuclear and fusiform cells; for it is in the cortex that the ramifications of the cell processes which we are now to study, are best exemplified.

These cell groups of the cortex, of the cerebrum, and of the superficial gray matter of the cerebellum, are wonderfully well situated for nutrition, supported at ease, so to speak, by the fibrils of servant cells of inferior grade (neuroglia), lodged in fluid beds, and guarded by protective or repair cells. Great advantages are theirs, and great things in the line of intelligence are accomplished by them. Not even our best methods of preparation and staining have yet enabled us to trace all the delicate branches, fibrils and processes which they thrust forth and maintain extended, in order to touch and to lie in sentient contact with those of other cells, thus enabling hundreds of them to live in close apperception and sentient communion one with another.

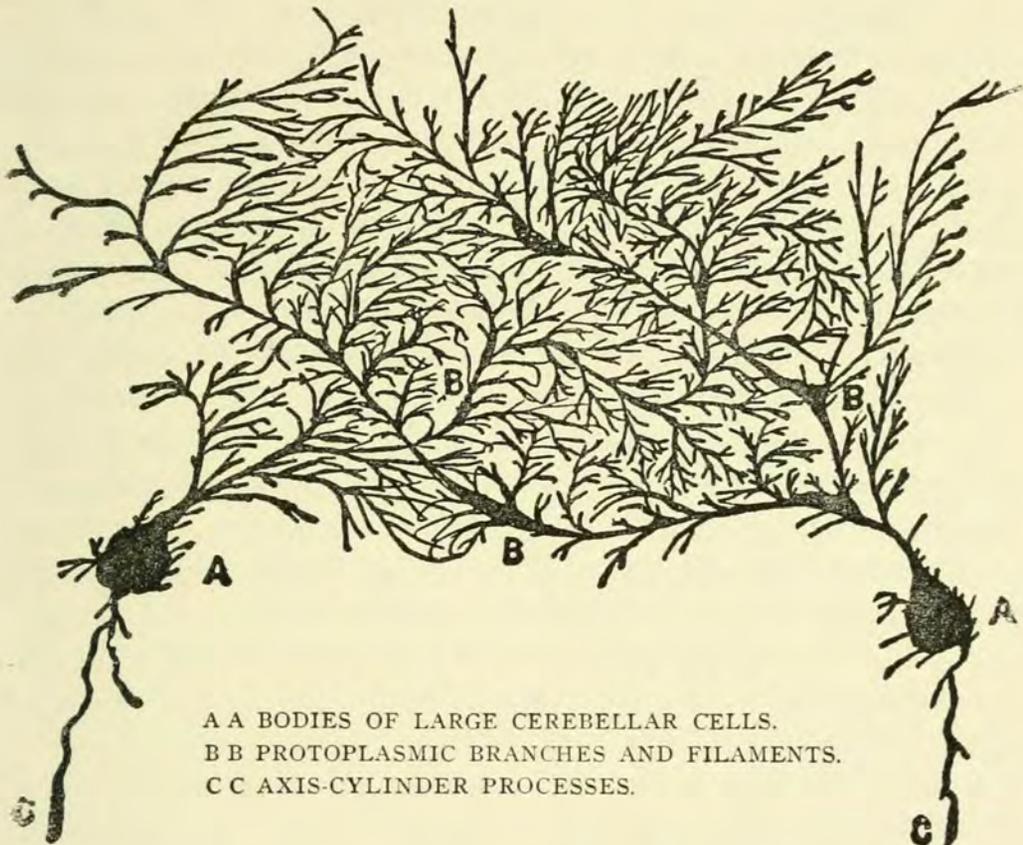
The cells of this class, or species, from the human cerebellum, or lesser brain, differ considerably in size and general appearance from those of the cerebrum, and also from those of the spinal cord; but from their position and connections, their psychic rôle is believed to be similar, since they are held to preside over and inaugurate the passage of subjective sentience into molecular motion.

The protoplasmic processes of the large Purkinjè cells from the folia of the human cerebellum interlace somewhat as sketched with a pen in the accompanying drawing. But neither in this sketch, nor the merely diagrammatic one of pyramidal cells from the cortex cerebri, which follows it, can the amazing networks which the branches and filaments form, be fully depicted, since as seen on "slides," after microtome section, the filaments are often broken, or cut asunder.

The Purkinjè cells, so called, are from .03 to .04 of a millimeter in length; but the branched processes and fibers which emanate from them are of far greater extent.

These cells are collocated in a layer at a depth of less than a millimeter in the outer stratum of the foliated cerebellar surface, and are nourished from a rich capillary plexus. They are sup-

ported, that is to say, held up otherwise than by their own consistency and firmness, by a system of adjuvant cells called neuroglia and formerly known as "spider cells," or "basket cells," which some observers have been inclined to classify as semi-nerve cells. In some tracts of the brain these spider or basket cells have been discerned as forming a net of supporting fibers about the body of the larger nerve cell.



A A BODIES OF LARGE CEREBELLAR CELLS.
 B B PROTOPLASMIC BRANCHES AND FILAMENTS.
 C C AXIS-CYLINDER PROCESSES.

From what may be designated as the base of the nerve cell, there emerges a process, or protoplasmic branch, termed the "axis-cylinder process," which dips downward into a layer of smaller nuclear cells and enters the great skein of nerve fibers which forms the central parts of the brain. How far this axis-cylinder process or fiber proceeds has never yet been fully demonstrated, but it is believed to proceed to, or become continuous with a fiber which does proceed to, other tracts of the opposite hemisphere of the brain, and even to pass down the spinal cord and extend to distant tissues of the body.

Reverting again to the body of the cell, we find issuing from the other side, the side opposite the base and hence the part directed toward the outer surface, one and frequently two large branching processes, which often extend a relatively great distance toward the extreme outer surface of the cortex and branch, like a tree top, into smaller and smaller processes and fibrils, till the best methods of preparation fail to trace them farther.

In this outer layer of the cortex of the cerebellum (which has been inappropriately termed the *molecular* layer) the extended, constantly branching processes of many cells lie side by side, contiguous and in contact; and as these processes and fibrils are protoplasmic and sentient, we can scarcely doubt that they *perceive* each other from such contact, and communicate one with another. In a word, there is the strongest probability, short of certainty, that the business of *willing* movement outward to the muscles is dependent upon the concerted action of these cells.

Besides the fibrils of the large Purkinjè cells there are also in this outer "molecular" layer, minute fibrillar processes from great numbers of smaller cells which lie embedded in it; also nervous fibrils which, so far as discovered, are not processes of cells, but seem to be of the nature of separate growths, analogous in some degree to the fibers of muscular tissue, which are not pure protoplasm but of the nature of protoplasmic alloys.

These latter minute fibers also lie in contact with the diffused fibrils of the Purkinjè cells, and apparently bear sentient impulses from them downward into the vast hank of central fibers,

Beneath this layer of large-branched cells, there is another class or variety of smaller nuclear cells, the bodies of which have scarcely one-fourth the diameter of their superior neighbors. Many of these have small fibrillar processes, one of which is sometimes seen to rise toward the "molecular" layer while the other dips downward amidst the white *fasces* of fibers. The function of these smaller nuclear cells is not easily divined.

In the medulla oblongata and in the gray columns of the spinal cord are also found large cells with branched protoplasmic processes, somewhat resembling those of the cerebellum, with small nuclear cells and fusiform or spindle-shaped cells, in connection with the same mazy hanks and bundles of communicating fibers. And in the great hemispheres of the cerebrum, or grander brain,

is found an arrangement of superior cells and inferior cells, with enormous hanks of fibers similar to that observed in the cerebellum, but on a vaster scale.

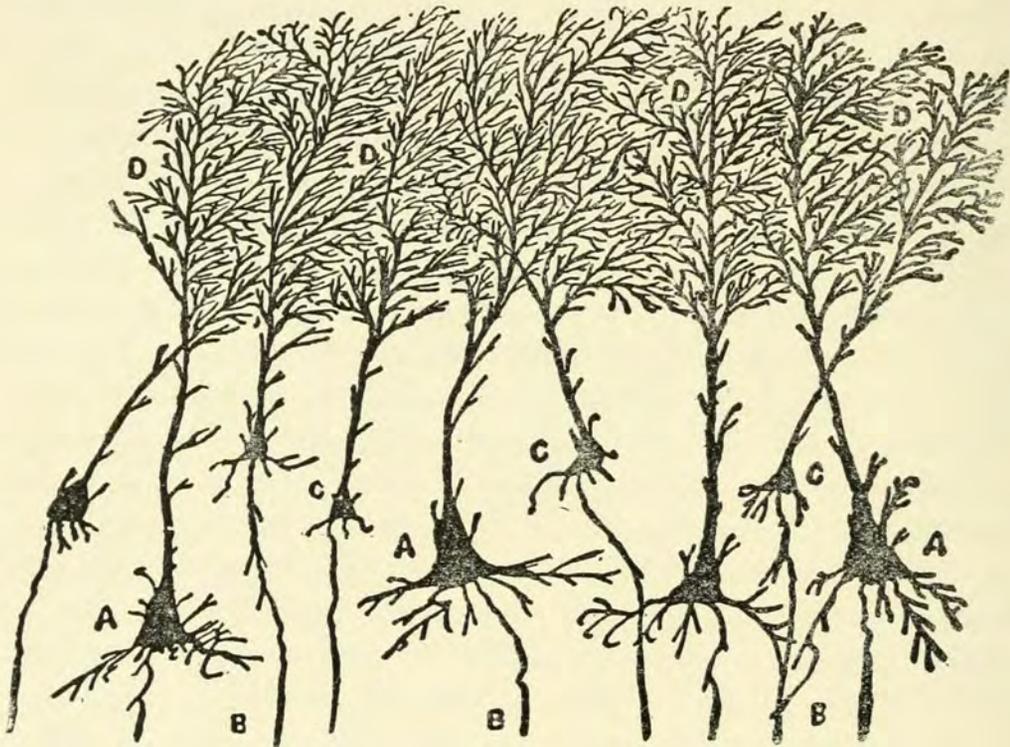
The superior and larger cells of the cerebral cortex differ in form from the Purkinjè cells, and from their triangular outline have received the name of pyramidal cells. They are found in great numbers and at varying depths in the "molecular" gray cortex of the cerebrum. The body of a large pyramidal cell averages about .04 mm. in length by .02 mm. in width. It occupies a free space, is surrounded by blood capillaries which supply it with nutriment, and rests easily in lymph fluid, with a number of protective cells and repair cells in close attendance upon it. It is further supported by the nets of "basket" cells (neuroglia), and altogether is placed in a position of ease, as if for intellectual labor. The large cell body contains granular protoplasm; and within it are to be seen the essential cell nucleus, occasional vacuoles, and very frequently a few grains of pigment. The base of a pyramidal cell is directed toward the axis of the brain convolution, i. e., toward the mass of white medulated nerve fibers of the interior. At the base, the protoplasmic cell-substance is prolonged downward in a number of branched filamentous processes; and ordinarily, about midway, one of these assumes the character of an axis-cylinder process, which, entering the mass of sheathed fibers, becomes one of them, extending eventually to some distant quarter of the brain or of the body. The other processes from the base, especially those from the outer corners, branch out in finer fibrils, which intermingle with those of other cells and with the minute fibers which certain cells appear to produce and cast forth from their cell bodies.

A still more remarkable process, however, rises from the apex or top of the cell. This apical process is directed upward or outward into the cortex, branching at intervals and extending to a comparatively great height into the "molecular" or outer layer of the cortex, where its fibrils lie in contact with those of numerous other cells.

In certain situations, noticeably at the summit of the convolutions, some of the pyramidal cells attain great size, comparatively, and are found to have bodies .12 mm. in length by .05 mm. in width; but, in far greater numbers, there is associated with them

a class of small pyramidal cells, much like those described above as regards form and processes, but smaller, having bodies no more than .01 mm. in length by .005 mm. in width. It is not impossible that these small pyramidal cells are a reserve in slow process of development to the larger class, or would so develop under stimulus.

Beneath the layer of pyramidal cells there is also found in the cerebral cortex a "nuclear" layer of small rounded cells, some



A A A LARGE PYRAMIDAL CELLS OF THE CORTEX CEREBRI.
 C C C SMALL PYRAMIDAL CELLS.
 B B B AXIS-CYLINDER PROCESSES.
 D D D APICAL PROCESSES AND PROTOPLASMIC BRANCHINGS.

of which have protoplasmic processes as seen in the cerebellum; and there is also a fusiform group.

We find that the entire surface of the cortex cerebri is composed mainly of these marvelous networks, associated with the plexuses of blood capillaries and the adjuvant neuroglia required for their physical support and maintenance. The superficies of the cortex, indeed, is by far the most remarkable structure of

which minute anatomy has knowledge. The extent and intricacy of the fibrillar threads, loops and twigs, formed by the mutual interlacing and interlooping of the thousands of tree-like branches which the cells send upward into it, are quite incomparable. In this respect the cortex of the brain is a hundred times more dense and more involved than are the tops of the trees in a dense forest. The branches, in their amazing ramifications, not unfrequently extend to a distance of twenty times the length of the cell body. It is as if each tree of a thick forest sent forth vines for branches, which climbed to a distance of several hundred yards, dividing as they proceeded into a thousand vinelets and tendrils, which enwrapped and entwined everything in their course. Such a jungle, growing to a height of several hundred feet, would no more than illustrate this astonishing lacework of the protoplasmic fibrils of the cortical cells.

Histologists were early led to inquire with wonder as to the significance and use of this mazy output of living filaments. It cannot be wholly or largely for the purpose of accomplishing cell nutrition, for these cells are nourished by the saprophytic or absorptive method, and not by the prehension of food particles.

It is not to accomplish locomotion, for these cells rest nearly stationary in fluid beds, sustained by the nets of neuroglia.

The conclusion is reached, of necessity, that these far-branching processes are thrust forth for the purpose of mutual perception and communication, cell with cell. The sentient, protoplasmic fibrils touch, or so nearly touch that what one cell feels and knows is known and felt by its neighbor cell. It would follow that an impulse or a sensation which comes to one through its afferent fiber from the outer world is felt and known by all its mates throughout that entire convolution or tract of cells, and not only in that one convolution, but — so complete is the protoplasmic connection — throughout the whole brain, which is thus made to take cognizance of sensation as a unit, as a personal, self-conscious individual.

For all this mazy web is demonstrated by the reactive agents of our staining fluids to be pure protoplasm; sentient, living matter, capable of feeling, and able to convey sensation. When, therefore, a sensation, received either through the eye, the ear, the organs of taste and smell, or through the thousand sensory nerves

extending to the surfaces of the body, is transmitted along a sheathed nerve fiber and reaches one or more of these large cells of the cortex, intelligence of such a sensation is at once distributed by means of the sentient network to a hundred neighbor cells, and from them is diffused over the entire brain, which thus receives tidings as if it were a single huge cell, instead of an aggregation of two hundred millions of cells, each a distinct living creature.

By means of this sentient bond of cell to cell, afforded by the protoplasmic networks, many millions of cell lives are blended in one common life, having one common sense. By means of this bond, too, a higher life of greater compass than that of the single cell is rendered possible. For by it thought, which is the business of comparing what one cell or tract of cells knows with what another cell knows, begins, and both cells are thereby made wiser in experience. Reason is set up; imagination is made possible; and, in the end, the human intellect is developed from what was at first the primary sentience of individual cells.

For it is not here intended to advance the doctrine that the human intellect is of no higher character than the sentience of a brain cell. By means of this extended organization of cells, too, something more than a quantitative and cumulative result is attained. Human intelligence differs, not only in quantity but in degree, from cell intelligence. By specialization and organization, a higher plane of intelligence is reached. Biological synthesis would lead us to infer that by means of organization, higher and higher planes of sentience and intelligence have been successively attained — a long series of such ascending steps — since first the simple elements of life began to seek expression in terrestrial matter. Extended organization and the specialization of parts to distinct uses have led to those more complicated actions and reactions in the plastic, protoplasmic substance, the entirety of which issues in a higher kind of intelligence; higher because vastly more of form and of experience is included in the brain as a whole than in the cell.

Briefly, we wish to convey the idea that, according to the present biological conception, the human intellect is something more than the associated sentiences of the two hundred millions, or more, of cells contained in the brain; that it is an extended development of those sentiences to a higher grade of intelligence,

rendered possible by the interaction and intercommunication of the cells.

This association and this organization have been largely due to the wealth of protoplasmic branches and fibrils which the brain cells have thrown out, in order to come into touch and sentient contact with each other. Once touching, by whatever agency contact is brought about, something of the nature of "current" from cell to cell throughout the whole brain appears to be set up and maintained at a considerable tension during self-consciousness, i. e., during wakefulness. To generate current for maintaining the consentience of the brain as a whole, an increased blood supply is requisite; work is done and energy absorbed. The condition, moreover, gives rise to waste products and leads to exhaustion of the cell, rendering a period of recuperation and rest necessary. The sentient circuit must needs be broken. In sleep, the brain cell ceases to live in its corporate or social capacity and reverts to its old-time, unicellular mode of life. Independent again, it nourishes itself and gains strength and substance afresh.

Wonderful as are the protoplasmic processes which the neurons put forth, to secure consentience throughout the brain, they are not without their analogue in unicellular life. *Amæba radiosa* projects long linear rays, as it floats, to enable it to perceive and draw in food particles. *Gromia terricola* projects a net of filamentous rays and snares. *Raphidiophrys elegans* emits long, lance-like rays, or darts, of exceeding tenuity, more minute than the finest fiber of silk. In the case of unicells these filaments are temporary, befitting the wants and necessities of single cell life. In the case of the neurons the necessity is for filaments more continuously extended.

By means of this elate, retractile mechanism, this vast network of *feelers*, each cell of the brain is able to *pool* its self-life in the grand merger of brain life, but resumes that self-life again when, by shrinkage or retraction of the network of filaments, sentient contact with other cells is broken. From such sentient contact, thus induced and brought about, the larger personality ensues. Yet we merely see here on a large scale with millions of cells, what occurs when two, or three, or a hundred unicells join and set up a communal life. By sentient contact with each other a new, larger personality comes into existence, as if around a new

axis of consciousness. Several cell lives are thrown into one. The cell relationship, or reciprocity, suddenly, instantaneously changes. A new sentient polarity is struck.

Personality is not resident in any one prominent neuron, or monarch cell, but in all the cells, consentient together. There is no "king cell" ruling the others, in which personal identity centers, no sovereign "monad." This view had its day and has been wholly discredited. No more is the human intellect located at any one portion or particular tract of the brain, as for example, the *corpus striatum*; this notion, too, had its day and passed to the limbo of similar contentions, made before the consentience of the neurons was understood. Personality is a coherent blend of the lives of all the neurons, dissoluble and terminable in sleep, or from shock, or at death of the organism.

This faculty or ability of the cell to unite its life with other cells, surrendering that life to become, for the time, part of a life greater than its own, has never received much recognition, as yet. None the less, it is the keynote of human personality; and no adequate conception of that personality, or soul, can be formed until it is comprehended.

In truth, it is time to cease speaking of the human intellect as a psychic integer, an indissoluble unit of intelligence; and a society for psychical research which bases its investigations on the assumption of a detachable *psyche*, goes wrong at the outset, and from the very nature of things will wander in darkness and meet with little success in its quest. Human personality can now be resolved into its separate cell sentiences. We are able to show how the cells (neurons) unite, by what means the greater personality is brought into being and maintained from moment to moment and from year to year, and also what physical steps and events are associated with either the temporary, or the final cessation of that personality.

So ephemeral a thing is this self-conscious personality. And at best it is intermittent, with the alternate lighting and darkening of the terrestrial hemispheres. Once in twelve hours it must stop in order that the neurons may rest from the stress caused by their unification as mind. The self-conscious personality is as much lost in sound sleep, as in organic death, only in the one case sentient contact is resumed, in the other not.

Moreover, this personality varies in degree according as the brain cells come fully into sentient relationship, or but partially. In certain degrees of somnolence, a part of the brain cells appear to join contact, giving rise to dreams. A dream implies a minor degree of self-consciousness; a part of the neurons are in contact; but the more complete personality of waking hours is not established. To be fully self-conscious, all the lobes, convolutions, and tracts of cells must be involved. This is best accomplished after the cells have rested, after sleep, when each cell has for a time been withdrawn from the consentient *bund* and has had time to attend to its personal wants, nutrition and the expulsion of waste products which accumulate while the cells are consecrating their energies and merging their self-lives in the greater life of the organism. The sentient contact is less perfect toward the end of the day, when the neurons are fatigued. The personality is then much affected. We grow heedless and do work badly; the *morale* runs down to lower degrees; we are less hopeful, less ambitious, and yield more readily to temptation to evil courses; and this because the personality is weakened.

If the brain of the criminal classes could be inspected and examined with this end in view, it would be found below normal in these particulars of the formation and maintenance of the personality.

When one hemisphere of the brain is damaged, or paralyzed by pressure of clots from ruptured blood vessels, so that cerebration is limited mainly to the other hemisphere, we have the phenomena of a diminished personality, an intellect abated in volume and power. The axis of self-consciousness appears to have shifted. Personal identity continues; yet the patient remarks *that he is a little strange to himself*, and has the feeling that he is not quite the same. To his friends it is evident that he is not what he was before the seizure.

In extreme old age, when the progressive enfeeblement of the neurons has become marked, at ninety or a hundred years, the personality dwindles to so feeble a flicker as scarcely to enable the person to be self-recognizant, or perform the most habitual acts. It can hardly be termed personality, since there are constantly recurrent lapses to self-forgetfulness. *Pari passu* with the cell exhaustion, personality slackens and deliquesces to the vanishing

point, giving that surest of physiological evidence that intellect has its source in the cells, shines forth from them, and disappears as these founts of life grow senescent.

It is the cell-neurons which need rejuvenation; personality would then up-brighten as when oil is renewed in a burned-out lamp.

The cell-neurons of the great, highly-developed brain-colony will continue to shrink in senescence and lose the power to maintain personality, until such time as we discover how to regenerate them *in situ* — probably by bio-chemical reagents, similar to the “ferments” now obtained from the endocrine glands. It is not too much to say that greatly prolonged life, deathless life it may be, now awaits clearly indicated new discoveries in bio-chemistry.

THE HUMAN PERSONALITY IN RELATION TO THE ETHER OF SPACE

A PROBABLE SOLUTION OF SPIRITISM

IN the course of efforts to analyze the currents of nervous energy which emanate from the cells of the brain, the writer has found it interesting to observe the effect of these currents, or emanations, on free-roving micro-organisms (under the microscope). As a criterion, or means of comparison, a "control" current of electricity from a small static machine has been employed, of high frequency and similar intensity, as indicated by the electro-scope, the working hypothesis being that the emanant current is a current of electricity (corpuscles) plus x, that is to say, plus something issuing from the brain cell, this latter being, of course, the unknown quantity concerning which knowledge was sought.

The sensitivity of these minute organisms is exceedingly delicate, so much so that it may yet be found advantageous to use them as instruments of nice determination of values, particularly where the ether is in question as environment and medium of the cell-of-life. Their behavior, when subjected to emanant influence from other cell life, is very interesting and suggestive. They are truly psychic.

In fact, these observations, *in toto*, have led me to lay down, as a law of cell life, that every cell, whether a free unicell or a tissue cell, organized in multicellular organisms, is a "psychic," importing the word, as quoted, from the vocabulary of our friends of the *Psychical Research Societies*, when applied to automatists, or "mediums;" persons who appear to lapse voluntarily into an abnormal condition where self-consciousness is in abeyance, and thereby have certain latent powers of the brain heightened.

In dealing with this word "psychic," too, and in attempting to adapt it to the results of my observations of the behavior of micro-organisms under the conditions above mentioned, I have found

myself obliged to define the word more fully and definitely than I have before seen it defined, in fact to re-define it. I think, however, that psychologists generally will commend this later definition. It is offered merely for what it is worth.

I therefore define a "psychic" as a person who is able, temporarily, to drop ordinary perception by the five senses, and pass into a *state of perceiving through and by means of the ether*, instead of by the air and the combined methods of air, ether, gravity, touch and chemical action, as seen in ordinary perception by the five senses of daily life.

A little more succinctly, every cell-of-life is naturally a psychic. But in the brain, which is an organized assemblage of cells, the necessities of the terrestrial life in air, water, etc., have led the united assemblage to depend on five organized senses: ear, eye, smell, taste, touch. Ordinarily it does thus depend. None the less, under certain conditions which we term abnormal, it is able to revert suddenly to the vastly swifter, more far-reaching perception through the ether, where neither ear, eye, nor touch are requisite. The cell of a simple micro-organism is all eye, all ear, because it is in practically instantaneous etheric communication with its environment. The marvelously delicate protoplasmic web of the cell organization vibrates to the ether thrill.

A psychic or "trance medium" then is a person who from some not yet fixed habit or *metier* of sensory perception — either from disease or defective inheritance — is able to revert, like Swedenborg, to perception through and by means of the ether, the five senses of ordinary daily life passing for the time being, either wholly or partially, into a state of abeyance, so far as in some instances to be wholly inoperative, the psychic becoming insensible to sound, heat, cold, etc.

To see, hear and feel by means of the ether is what it is to be clairvoyant, clairaudient and "telepathic." A human brain communicating by means of the ether with the brain of another person is naturally and from purely physical causes a "mind reader." The ether puts every brain *en rapport* with every other the world over. Every brain, animal or human, probably possesses this faculty of etheric perception, potential, in greater or lesser degree. But it fades out as the brain ages and grows rigidly organized, that is to say habituated to perception only by means of

the five organized senses. Animals appear to possess etheric perception; cats and young pigs, for example; and it is often apparent in young children before the axis of self-consciousness locates its poles permanently and determines rigidly the personality of the existent life.

Instinct has always been a dark, inscrutable word, both in biology and theology. Biology has affected to scorn it of late years, but has never been able fully to cope with it, as in the case of homing cats, and of little pigs finding their way back to the parental sty, after being carried off in closed baskets for many miles, by roundabout roads.

I wish here to call attention to the clear manner in which etheric perception by the brain solves the whilom mystery, and to the light it sheds on much of the phenomena formerly termed "instinctive."

In the human brain, which is a well united (by protoplasmic filaments) association of millions of cells, there occurs, in the case of "psychics" and "mediums," a sudden reversion to perception by the brain *en masse* through the ether. The whole organized assemblage of brain cells drops into what is termed the trance state, seeing and hearing through the ether instead of the air. It reverts to etheric perception. A sudden, wide enhancement of the perceptive powers of the brain ensues instantly, such as all the celebrated "mediums" profess to experience. It is a different, more exhaustive *metier* of perception. The whole brain *smokes* with emanations, that is to say the emanation becomes visible, sometimes phosphorescent. It is an effort of the entire brain as if it were one cell in unicellular life. We then have clairvoyance, clairaudience, telepathy and clear perception of the whole commune life of the earth; cognition also of the past and even of the future; — for clear cognition of the past is, in the last analysis, the equivalent of precognition, premonition, or divination of the future.

WHAT IS THE ETHER?

But what is this ether of cosmic space wherein perception by the cell-of-life is so far-reaching, and to which the perceptions (clairvoyance, telepathy) of a person, in the "psychic" or trance state, revert as a vehicle of communication?

What do we know of it? What and where is it?

It is everywhere. It is the basis and matrix of the universe. It is that primeval element, "without form and void," from which the cosmos has emerged. It pervades the interstices of all matter. It is the fundamental thing, the background on which the universe is built up and from which it has been evolved.

We know of matter as attenuate as the electron; and we may define the ether as everything below, or smaller. That is the best we can do at present in the way of a definition. It is the residuum of the cosmos.

Certain physicists and chemists believe this world-ether to be a homogeneous substance, or element, not particulate; a condition which they attempt to describe as "jelly-like." This view, however, would appear rather like a limitation of the human mind than what the analogy of the universe teaches. I deem it safer, more likely, in the light of that analogy, to define the ether as being *all matter that is below the electron*.

Below the electron, for aught we know to the contrary, there stretches away, abysmally downward, a realm of matter as yet unentered by the researches of man. That, indeed, is what now appears most probable. How far downward it goes, to what profound depths of things parvicular, no one knows.

None the less it is with that realm of fine, yet very likely discrete, particles within particles — each with its titanic endowment of energy — that life, the life of the unicell and of the organized multicell, is involved and has its intimate environment; the real environment through which it acts and interacts with all other life. It is a realm exceedingly sensitive to the action of cell life and in its reactions with that life displays subtle properties.

Mathematical calculations of the ether, made by the late Lord Kelvin, Sir Oliver Lodge and others, give well-nigh incredible figures as to the density of the ether, its weight and content of energy: for example, weight, if it were iron or stone, of a thousand tons per cubic millimeter, with a content of energy of 10^{20} ergs, or 3×10^{11} kilowatt centuries; otherwise equivalent to the output of a power-house of a million horse-powers, working continuously for forty millions of years. Figures wholly fantastic, conveying little meaning as to the real nature of the ether which other sources of information, however, teach us is a medium more

elastic and easily vibrant, more sensitive to impressions and more continent of such impressions than anything of which we have thus far gained knowledge. We know that light-waves from the fixed stars, or suns of space, press steadily forward in it for six thousand years from the date of their emission; that it is the vehicle not only of the marvelously delicate thrill, transformed in the telephone and in "wireless" messages, but also of the enormous weights of gravitation, seen in the revolution of the planets. Not only is the ether the vehicle and medium of light, heat and magneto-electric phenomena, but of still more subtle effects, rays and emanations of cell life, which unceasingly pervade it, modify it and hold it in a certain attitude, phase or rhythm; vibrating or *echoing* all life on a certain note, vibrating to the totality of all life. So far from being fancies, as many might think, these are but deductions which the accumulation of facts already necessitates. In brief, the ether is now the great new world of discovery.

CELL METABOLISM IN RELATION TO THE ETHER

As illustrative of the effect of cell life on a medium so elastic, so sensitive as the ether, we have to realize that there is on the surface of the earth, approximately, six trillions of tons of matter, minutely organized as living matter ("protoplasm") in the cell-of-life; or approximately, if spread out, more than ten thousand cells to every square yard of surface over land and sea.

We have still further to realize that every cell-of-life is a small, but powerful bio-chemical engine, associated with the passage of sentience into kinetic energy — matter-moving energy — by the intermediate step, or steps, of will-power. What we see in the cell is a complicated, delicate organization of the molecules and atoms of more elementary matter, having for its object the raising-up of the inherent sentient property of these molecules and atoms to a higher estate of intelligence; — for that is the evident object of cell life in all its organizations. It is a complicated, conjoint process, sentient in origin, attended by radiant activity, liberation of energy and emanations of corpuscular matter and even of atoms. Every cell as a result of its metabolism — its life — surrounds itself with an *aura*, or atmosphere of emanation, com-

parable to that about a magnet. The same in greater volume is true of the multicell. Nor is this *aura* of emanation and radiation confined to the immediate vicinity of the cell. It goes forth to great distances.

We have presented then the picture of this all-pervading, sensitive ether and thousands of cells, if averaged, to every square yard of the earth's surface, each giving forth radiant energy and emanations. It could hardly be but that a medium so sensitive to impression would be impregnated and profoundly impressed by so potent an agency, and as a matter of evidence, otherwise, we find it so.

The question then arises, what form or mode does this influence of cell life on the ether take? And here comes in for estimation all that great class of phenomena, facts, traditions and recorded marvels, which from time immemorial has been classed as mysterious and which science has usually ignored, wisely, perhaps, since the data for explanation were not yet in hand. But now, in our growing knowledge of the ether and of matter, we see the cause. That cause is life. A vast composite thrill, or sphere of influence, throughout the ether is set up, which appears never to cease, at least not for thousands of years. It is this which we are now attempting to examine and study: the voice of all terrestrial life, speaking into the ether from every cell, uniting in one great mandate of direction and guidance.

This strange *echoing* of life and the forms of life by the ether is what has long baffled us to understand and to explain. I use the word, *echoing*, because at present it partially defines what is meant, not that it adequately or comprehensively defines it. For it is more than an echo; it is an echo, a mirror-reflection and a memory combined, an echo-memory, continuously repeated, carrying, too, formative influences.

THE PROBABLE EXPLANATION OF MIRAGE, FROST-FLOWERS AND GHOSTS

Often when matter, like water vapor, is in the nascent, formative or transition state, this echo-memory in the ether appears to take form and become "fixed," as in the frost-flower on the win-

dow pane in winter; those wonderful fronds and fern leaves which form with such startling suddenness, even as one watches them.

In quest of symbols of comparison, this ether "echo" resembles photography rather than echoes; there issue into the ether, continuously, what is equivalent to *pictures* of the forms of life and — what is far more difficult of comprehension — *impressions of traits and qualities* as well as of form, shape and pattern. The evidences of this are many. An etheric "echo" of character as well as a picture of form and lineaments is cast and reverberates unceasingly. These echoes, or pictures, "psychics" often appear to perceive, and vaguely, ignorantly, attempt to interpret to us.

By what mode of radiation, or emanation, this is accomplished, we do not yet know, whether by rays purely dynamic, or a projection of corpuscular matter from the cell katabolism. Certain facts indicate that both modes occur in combination. Thus far it can only be said that the sum total of all the phenomena shows that something of the nature of this echoing of imagery exists in the ether, and reacts on the cell-of-life. The ether is the repository of the "soul" of life on the earth, the garner and the continuum of that soul.

The difficulty of conceiving these phenomena lies in forming concepts of the wonderfully tenuous and elastic nature of the medium in which they occur. Thus far science has dealt with no substance like it. Anomalous and absurd it appears to think of a substance which will mirror the morals of a living creature, a cell or a man! Yet science is face to face with this anomaly.

Often this imagery takes fantastic forms, as revealed in the mirage over desert lands, where for a moment or an hour, owing to a nascent state of the aerial vapor as the day advances, it is "fixed" visibly in the atmosphere, as groves, streams and fountains; or in the vast semblance of populous cities, with structures like those of the great World's Fairs, perhaps the ether echo-memory of them.

The strange truth appears to be, that every life, every personality, which has ever lived, whether unicell, animal or man, is thus "echoed," and be-pictured. Its *imago*, form, traits and morals even are "echoed," preserved and carried on into the future. In this ethereal realm it joins and blends with "the innumerable caravan" of those who have lived self-consciously in protoplasmic

life. It is not the self-conscious personality; that self-consciousness pertains to the living matter of the cell-of-life, but the *image* of that personality, the shade, the ghost.

From this it follows that when a "psychic" passes into the condition of etheric perception, in place of ordinary perception, these images, shades, or "spirits" of the dead, or even of the living, throng upon her suddenly heightened sense; a semblance of "control," "personation," or of "possession" occurs, and then her physical tongue, or pencil, gives utterance to the etheric echo, picture or vision. We who are normal, or think we are, who live according to the evidence of our five senses, perceive nothing of all this etheric imagery. To attain it, direct protoplasmic contact must be established with the ether.

Knowing what we now know of the ether, it is by no means incredible that what the "psychic" perceives, is but the "shade," the etheric image, of the personality that was once embodied and hence self-conscious; the etheric "echo" of what that personality once was.

"Psychics," too, are of all degrees of excellence, as such, and alas, of all degrees of rectitude. Some possess etheric perception much clearer than others. None perceive perfectly; and all interpret what they perceive vaguely and erratically, tinged and colored by their own ideas and beliefs.

PSYCHICAL RESEARCH; A HARSH CRITICISM

A former member of the *American Society for Psychical Research* in a very harsh criticism of *Salvation by Science* remarked, "This book would never have been put forth if the author had been conversant with the scholarly work of Frederick W. H. Myers, entitled *Human Personality*, and the *Reports and Proceedings* of the English and American Societies of Psychical Research. His ignorance is his only excuse, if excuse it can be called."

This is frankness of the gauntest, tempered by charity the coldest; and unfortunately I have not even the poor excuse which my critic concedes. I have read Myers' *Human Personality* very carefully, also the later papers and works on the same subject by

Professor Crookes, Sir Oliver Lodge, Mr. Stead, Dr. Hyslop, Rider, Podmore, Carrington, Camille Flammarion, Dr. Lombroso, Professor William James and others, some living, many deceased.

Nor am I unfamiliar with the "psychic" phenomena, induced by many "mediums." My sin therefore is one against much "light" (as my critic sees it), all the light there is, indeed;— and I certainly wish there were more. I desire earnestly the privilege of saying that my attitude toward all and everything in the line of *bona fide* psychical research is that of a pupil and learner. I believe that the *Psychical Research Societies* and the authors cited above have done good work to advance the truth, even when—like Sir Oliver Lodge—they manifestly fail to discern it.

"Our records *prove* the persistence of the discarnate spirit's life," wrote Frederick Myers, and died strong in that belief.

Is it all so certainly proved then?

The writer is not a partisan pro or con. A new view, what I believe to be a solution of spiritism, is presented here wholly from the standpoint of my own researches; a view associated with a new definition of human personality and of psychic phenomena generally. It is presented in the hope that it will be tested experimentally by others.

The Records and Proceedings of the Psychical Research Societies jumble together instances of clairvoyance, clairaudience, telepathy, hypnotism, "double personality," levitation of tables and "materializations," with alleged communications from "discarnate" spirits: a bizarre accumulation of phenomena, often having no proper relativity to the matter in question. All so mixed, so confounded one thing with another, that it is difficult to isolate or locate the facts that go properly together for a logical explanation of anything connected with it. One turns wearily from the perusal of it, with the strong conviction that the key to it all is missing, and that the right route has not been followed.

So much so that the present writer has found it better to revert largely to the inductive method of investigation, in the light of our new knowledge of matter. For example, these alleged levitations of tables and flower pots, clairvoyance and telepathy, when not tricks, may very possibly be connected with etheric phenomena. But what are these "materialized spirits," "spirit hands," ghosts and apparitions? Much of it is imposture, but possibly not all.

It would be by no means surprising if the ether were a factor or agency here. "Materializations" may take place in it, naturally. But how?

For answer to this let us return to the analysis of those currents and emanations which constantly issue from the human brain and the human organism as a whole. Of these currents we can now say positively that they are like and probably identical with electrical currents, plus a flux of minute particles, corpuscular, or molecular, it may be. There is such an outward flux from the brain, although we cannot yet say just what kind of matter it is, nor yet that it is always the same. Very likely it varies and changes, with the mood, temper, or physiological condition of the brain from which it issues.

Experimentally, the evidence of the existence of this emanation is as good as any evidence can be. It exists and forms an *aura*, or atmosphere, pervading and surrounding the organism, overflowing it, too, on all sides. The evidence from a great number of observations is also to the effect that in case of a "psychic" in trance, passing into the state of etheric perception, the quantity or volume of emanation from the brain cells is increased, or intensified. Either from a secret, conscious effort of the will, or from subconscious will-power on the part of the "psychic," this volume of emanant matter is then greater and not very unfrequently takes visible form. In the case of Dr. Lombroso's observations of Eusapia Paladino, a "cool wind" was felt to issue from her head. By night this emanation is phosphorescent.

The emanation or radiation from her organism may have been of sufficient volume, as Dr. Lombroso believed, to enable her muscular strength to be transferred by it.

As analogous phenomena, from a wholly different source, the writer once saw large dim globes of luminous matter roll slowly along the rails of a railroad, on a hot summer night, hopping from rail to rail where the rail-ends joined, and finally exploding with a considerable report and dissolving from view, as they reached the wheels of a locomotive standing on the track;—a case of natural "materialization," not associated with life, or living organisms. These luminous bodies—a foot in diameter, perhaps—were probably electrons, englobed and associated with other matter, either fluid or gaseous.

The emanation from the brain of a "psychic" is apparently composite and quite complex. It would be interesting and instructive if Dr. Lombroso, or Dr. Foà, could have devised some method of testing it, electrically and chemically. In this brain cell emanation and the power of the "psychic" to project it, either consciously or subconsciously, resides undoubtedly the explanation of table-turning, table-lifting, spirit-rappings, spirit hands, spirit faces and "materializations" generally. (I am speaking here, of course, of that small per cent. of all of these "manifestations" which is not fraudulent.)

The fire-fly and gymnote originate and cast forth emanations from the cell metabolism of their bodies. In unicellular life we even see the emanation take the form of tiny improvised javelins. Unicells also levitate objects, hypnotize their victims, and paralyze their foes — all by will-power.

These emanations are mysterious only in the sense of being not yet fully understood; they are "spiritual" only in the sense of being physically very tenuous and fluidic. The "mediums" themselves are commonly ignorant persons, some honest, some tricky. Often they are as credulous concerning "spirits" as the venerable Alfred Russel Wallace himself. Yet not a few of the "best mediums" frankly declare themselves skeptical; two whom I know personally are unbelievers as to the existence of disembodied intelligences. "Somehow, yet how I don't know, I do all these things, myself," one of them said to me.

I record here a very interesting observation by Dr. Lombroso, namely, that when Eusapia Paladino was seen to "levitate" a table, her own weight, when sitting on a scale, was found to be increased exactly by the weight of the table lifted. To the physicist this fact of itself is very significant; and altogether the physical problem thus presented, is a very pretty one. That it has any connection whatever with disembodied intelligences is so highly improbable, that to find such phenomena included among the "evidences" of the existence of such intelligences is a curious illustration of the hold certain old superstitions still retain even on the minds of savants!

It is an interesting question how far, to what distance, the material part of the emanation can be projected by the "psychic" — one of those problems which will ere long become a matter

of experiment, to wit, the raising of ghosts and visible apparitions.

The writer, however, is far from holding that all apparitions are thus subjectively projected. Ghosts, phantoms and phantasms are apparently of many kinds. There is a well-evidenced phantom which seems to be purely etheric, akin to the mirage, the appearance of which is freakish and dependent on properties of the ether not yet understood. These, like *Fata Morgana*, have apparently no direct connection with the human brain and might appear anywhere, far from the haunts of men: what our Theosophist friends would probably term "elementals" or "nature spirits." There is also the *poltergeist*, the crime-ghost, the haunted-house ghost, and finally the venerable graveyard ghost, of the existence of all of which there is fairly good evidence, but by no means evidence that they are disembodied personalities still intelligently alive. The plea made here and made very earnestly is that science shall not weakly falsify itself by turning "spiritist," until we have investigated the properties of the ether-of-space a little farther.

The ability of certain psychics, when in trance, to externalize or project what De Rochas calls a "fluidic double," or "astral double," to a considerable distance outward from their bodies, also rests on good evidence. Beyond reasonable doubt it is to this projectable "fluidic double" (in conjunction with an emanation from the brain cells of the medium) that many of these phenomena might be attributed.

It is safe to predict that these phenomena, *in toto*, will be demonstrated to be etheric in connection with cell emanation.

The "control spirit" of the medium in many of these cases is, I believe, one of the many latent personalities of which the human brain is the habitat, or repository, and which in trance rise into temporary possession of the medium's faculties. But of this more will be said in connection with the subject of human personality.

For this has brought us to the crux of the matter — human personality.

AN ERRONEOUS DEFINITION

It is easy to see that a false definition of human personality is the rock on which *Psychical Research* has thus far split. Here,

too, the truth-seeking Myers went astray at the outset of his painstaking quest. He assumed — they all assume — that the human *psyche*, the personality, is an infrangible unit, detachable at death from the human organism, with self-consciousness intact; they assume this, or at least make use of it as their working hypothesis. That was the definition of Butler, of Hamilton and of all the mental philosophers of the past century whose works were formerly used as our college text books. Myers was a follower of Reid and these former lights of Mental Philosophy. He attempted, however, to expand the conception of a detachable *psyche* in accord with certain facts of scientific research and his copious records of “spiritist” phenomena. From these latter, largely, he deduced the idea of a subliminal, or subconscious personality, and also of a supra-liminal, or self-conscious personality, but held that these sometimes interact. It is, he believed, some essential part or principle of the subliminal personality, or of the two combined, which causes apparitions and spirit phenomena generally. This esoteric principle, he held, was the part of human personality which survives, self-consciously, the death of the body.

The idea of a subliminal, or subconscious mind was purely hypothetical with Myers. He had little conception of the part the ether plays in psychic phenomena and knew nothing, experimentally, of those emanations from the brain which cause all, or nearly all the “evidences” on which spiritists rest their contention. It must therefore be reckoned as a good guess on his part, or would have been, if he had classed it as physical and natural, instead of “spiritual.” From lack of this later knowledge and from his erroneous theory of human personality, Myers went astray and groped in darkness. The now well-indicated facts of biology and histology prove beyond question or peradventure that the human personality is no such indivisible integer or entity, but an organized union of cell lives, separable and dissoluble; that even during the organic lifetime it can be increased or diminished. It is not an infrangible integer which cannot be dissolved, but an aggregation of lesser lives which can separate, as when a thousand people gather in one assembly, and afterwards depart.

NO CELLS, NO CONSCIOUSNESS

The "cell doctrine" of life is as old as Schleiden, Schwann and Virchow; yet it seems never to be fully understood, never comprehended as to its real significance. Every living organism is composed of either a single cell or an assemblage of cells. The cell is the only source and seat of life on the earth, the only means of sensation, consciousness and self-consciousness; for consciousness enters only by the door of sensation.

The evidence is overwhelming that nowhere on the earth's surface is there anything resembling consciousness except in and by means of this same cell-of-life. The cell, as we find it everywhere, is a little *self*, a small, yet delicate organism in which the elements of sentience, elements existing in all matter, are raised up by the steps of organization to self-hood and self-direction, that cell self-hood which in the multicell rises by further organization to self-consciousness and personality.

In the human brain we have tract on tract of cells, specialized and differentiated for varied functions of memory, comparison, imagination, reason; all grouped, united and organized about the axis of a larger life; in short, a complicated, extended organization of the smaller, simpler cell lives; a structured organization and a *form*. None the less all sensation there, all consciousness, is in the cell, nowhere else. No cells, no consciousness.

How then shall we define human personality? What can it be, but the sensation and consciousness of the cells, filling, flooding, playing through this *form*, this structured organization of brain? It is the confluent tide of cell lives which fills the organized form, charges it with emanation and sets up the axis of the greater self-consciousness.

THE BIOLOGICAL DEFINITION OF HUMAN
PERSONALITY

Instead of being an indissoluble entity then, a living human personality, a self-conscious intellect as we know it, has to be described as consisting of two factors, *first*, a structured organi-

zation of brain and of the cell protoplasm, and *second*, a confluent tide of cell life, filling the structure with sensation and consciousness. Devoid of the confluent cell life and apart from it, there remains but an unconscious structure. When the cells die and their metabolism stops, sensation ceases and the factor for self-consciousness is no longer supplied. Both factors are essential to personality — the structured organization of brain and of brain cell protoplasm, which has come down to us through a thousand generations, and the confluent tide of cell life and sensation which fills and animates the structure. Without the cell factor we have no sensation, no sense of self, without the structured form, no intelligence and experience, in a word, no human intellect. Yet, what constitutes intellect and personality in any sense worth preserving, may lie empty of self-sensation, void of self-consciousness, as in sound sleep, or insensibility from a sudden blow on the head. The structured form is there in the brain, but the tide of cell life no longer fills it in the manner requisite to self-consciousness.

In reality, however, this structured form is the most important part of human personality. Simple sensation to animate it might come from any cell-of-life; but that structured organization which comes from ancestry, is another matter. The veriest brute possesses sensation and self-consciousness; but the virtues of a Lincoln or a Washington come only through a vast past life of the race. That form of brain, that structured protoplasm, is what lives on from generation to generation. Not even the worst freaks of atavism obliterate it. Even after dark ages of abeyance, it reappears. Probably no virtue, no fine trait of character is ever wholly lost from the brain of the race. The animal brain, particularly the human brain, is wonderfully continent of these old ancestral forms, or patterns of personality. From parent to child they are transmitted *in ovo*, sometimes well-nigh unchanged. We know as yet all too few facts relative to multicellular reproduction, that esoteric process of involution by which an adult animal fructifies in the regenerative tissues and — rather than die — projects itself forward from the aging organism *per angustias vias*, to re-develop later as a new life. There have been many theories of gemmules, plastidules and the germplasm, theories still *sub judice*, or in controversy. A part of the process only is visible. But we know that it occurs. What is of interest about it here, the new

life, thus projected forward to develop a new organism, takes with it from the old one apparently all the traits and characteristics of the latter, even when they do not reappear or figure largely in this next new life. We have learned that they are there quite the same and may rise into prominence in the second, third, fourth, or far-future generation. It is like a composite photograph of a numerous class, or family group, which adds a new individual to the group with every fresh generation. Another face enters to join the pictured company and with each new face comes a new personality in the brain. They blend in one picture, yet none the less they can be resolved into those separate faces again. So of the long series of ancestral human personalities; they, too, are all there in the brain strata, and under certain circumstances can be segregated individually.

But it seems to be a law of human personality that but one at a time can rise to be the ego of the organism, and take control of it. In other words there can be but one ego in the animal organism at a time. When one of the older, dormant personalities of the past rises from its racial sleep in the brain to assume control, the present incumbent must temporarily abdicate. This appears to be what sometimes happens in the case of "mediums," passing into the trance state. Some one of the dormant personalities "rises from the dead" and assumes control. In hypnosis it is a living personality that steps in from without; for this, too, may happen; and it is in this that hypnotism differs from "spirit" control. A dormant personality of the brain may wake to the control, or a living personality may enter to do so from without; or as is not impossible, some freakish, composite guise or "echo" of personality from out the mirrored ether.

When this wonderfully structured brain which our ancestors have transmitted to us—the labor of a thousand centuries—is studied in the light of the accumulated facts of heredity and protoplasmic inheritance, the true dawn breaks on this hitherto dark subject of human personality and human life, past and future. Of the vast subconscious life of the brain we know almost nothing as yet; for we who are now quick, but live on the surface of it.

It is this ancestral brain, co-related, lobed and convoluted, with its deep strata of nuclear cells, granule cells, spindle cells and polymorphous cells, which contains "the innumerable caravan" of

human personalities from the past, meaning always this essential second part and factor of our definition. Like those other deep strata of the geologic earth, long eras of life have laid them down, and the fossils of that life are still there. The more we cleave it apart, and delve into it with the microscope, the more it suggests an olden past life of which these cell strata are the repository, the book-stacks and the storehouse.

It is like some vast old crypt, but not of dry bones or decay; the ancestral life, stored away here, is still sweet and clean and unresolved. It is only sleeping, quietly sleeping there, and merely a hard physical jolt will sometimes wake up one of these former personalities, to rise, resume cell sensation and cell consciousness, take command of the present multicellular organism with its warm metabolism, and re-enter the realm of light; — and then we have a case of “double consciousness.” For they are all down there in those nuclear strata, asleep with their fathers before them.

EXEGI MONUMENTUM

Horace's “*Exegi monumentum ære perennius*” embalms the sentiment, desire and hope of the individual man in all historic time, and the better the man, the stronger his desire to leave behind him some deathless, rustless monument of his personal life. Oftenest, marble, hard granite and perennial bronze have been impressed to this service to perpetuate the passing, personal life and carry it forward to future time.

In vain. The marble moulds, the granite crumbles, the bronze rusts away. Chronos' iron tooth prevails. In all the world, in all this seething welter of restless electrons, no combination of them preserves its stasis. No monumental substance stands the wear and tear of this oft-smelted universe's vast life.

None, even approximately, none save one. One substance there is which for a hundred millions of years, at least, has endured, while the metals fade and rust, and archaic rocks crumble and vanish, leaving neither sign nor trace behind.

That one unique and wonderful substance is the living matter in the brain cells of our race, transmitted to us from out those far depths of antiquity, when the protozoon — whence-ever he came

— first stirred on the shores of the primeval sea. This is the substance which has endured and will no doubt endure through the equally long epochs and eons of future time: the substance which grows, not wastes, nor rusts, as centuries pass, grows and incorporates in itself the record of all the past.

Surely, this were that grand, enduring “brass” of which to fashion and chisel the longed-for, rustless tombstone of man, the *as perennius* of the ages, compared with which Cheops’ name on his pyramidal syenite is as Keats’ despairing “writ on water.” Here is the desiderated monument stuff, fit to meet and satisfy the aspirations of our race. It is here and herein that we may labor to set up each his mausoleum which shall live to all human time, though the world stand to remotest ages. If latest researches in psychometry teach anything whatever, it is that no impress of a human life is ever lost here. It goes on in the great formed and formative *aura* of the race life; it survives in each individual life; it helps shape and mould, for better or worse, each new life that is born of us, every future generation that succeeds us.

What awful yet divine glimpses of our personal responsibility shine forth through these slowly opening portals of our later knowledge of living matter. We make our monument here — have always made it — whether we realize it or not. Every day we are rearing that monument for all time. Why summon the granite block? Why supplicate the bronze tablet? Infinitely more enduring, more commemorative, is this daily work of our lives in forming the future brain of the race and sustaining the *aura* of its mind. A realization of this is indeed the “one thing needful” to our future ideals and ambitions. Not a stone in a graveyard, to lean and fall, but an inscription in deathless living text on the Brain of the Race. There we each live on, whether we wish it, in our blindness, or not. There we daily graven the merit or demerit of our personal lives.

WHERE IS SPIRIT-LAND?

Ever since man first pondered the question, he has believed vaguely that the dead, though dead, are not wholly dead, but somewhere, somehow, are resurrectable and returnable to life.

They are gone from conscious life, he knows, yet he has always felt that they are but deeply asleep somewhere and may sometime wake, or be waked.

And that is the true instinct, the etheric sense of the truth. Somewhere they sleep. But where? Where is their place of rest? Where is spirit-land?

The Jews said in *sheol*, the Greeks in the subterranean caverns of the nether world, the Egyptians in dim Amenthe, the Hindûs in Nirvana, the Christians in Heaven — or Hell, the Mohammedans in Paradise — or Gehenna. Many modern spiritists, with glimpses of the truth, have held that the spirits of the dead are everywhere present about us. When they have learned a little more of the ether, they will people it with spirits which they will fondly and erroneously believe to be still self-conscious lives.

There have been philosophers who have theorized of a fourth and even a fifth dimension of space, and even of a second dimension of time, where dwell the spirits of the dead; astronomers, too, who have quite as fondly located spirit-land on other planets of the solar system.

The whole world, indeed, has constantly asked the question, Where is spirit-land? The search for it has been long. They have looked the universe over for it — and never found it.

And yet it was so near them all the time!

They were carrying it around with them, inside their own skulls!

For this strata-ed, structured human brain-of-man is our *sheol*. Here is that spirit-land to which we shall be gathered, garnered we may say, where ere long we shall all sleep with our fathers.

Nor is it so very small a nirvana. Collectively, as a race, we are carrying around two millions tons weight of it on our shoulders; — and Dr. William Hanna Thompson has assured us that a dot of protoplasmic matter, no larger than a pin-head, will embody for all time the destinies, past and future, of a whole genus of earth's fauna.

We who live in what we term self-conscious life, are but temporary denizens of the outer, dendritic cell layer of the brain. We perceive little, remember little, of the great past life of that brain. It is mostly subconscious to us. None the less it is all there, the whole past history of the genus *homo*. There are good evidences

that no experience, nor memory of it all, is ever lost. It has been laid down in successive schemes, experience-schemes, memory-schemes, each representing a generation, that is to say, one personality. Each is like some web of lace-work, once woven and now laid away in the delicate cell protoplasm of those granular and nuclear layers.

Yet given the requisite cue, and the whole fabric of that personal life, with all its traits and memories, may be brought forth again and find expression. It is not a little like those song-records, used in the graphophones and pianolas. The song may be heard again, if sound is admitted to it. So of these dormant personalities of the brain; they may live and speak again, if the brain cell life can again be made to play through them, restoring sensation, self-hood and self-consciousness. Apparently it needs sometimes but a slight shift of the axis of personal self-consciousness, to bring about a re-admission to the dormant scheme of the warm tide of existent cell life. A former personality of the ancestral brain is thus revived, waked up and connected with the metabolic apparatus of cell life. It is here that a "psychic" in trance "connects" with "control spirits." Every human brain is a reservoir of such latent personalities; and a good psychic, an honest "medium," is one of those very rare, interesting instances, abnormal though it may be, where one or more of these long "dead" personalities rise into habitual control of the existent organism, take possession of it for the time being, and talk or write much as this same olden personality might have done in the past, perhaps a thousand years in the past. For this ancient brain of ours carries in it, potential and recoverable, the lore of all the ages of man, the forgotten tongues of the Aryan, the astronomical figures of the Chaldee. We but live on the outer surface of it. To most of us the doors to its deep archives are closed. "Psychics" sometimes descend to them, ignorantly, a little way, but are usually obsessed and misled by erroneous beliefs which render their revelations well-nigh valueless.

TO WHAT EXTENT CAN A PAST PERSONALITY BE
RAISED FROM THE DEAD?

An interesting speculation is ushered in by this revivification of long dead personalities, dormant in the brain of their descendants, in connection with the Hebraic doctrine of the resurrection. Could the personality of an Abraham be waked from this his traditional "sleep of the dead" in the brain of a lineal son of the Patriarch, and re-animated to self-consciousness by the conscious cell-life of that living descendant, be made to speak, to feel and to behave generally as Abraham once spoke and felt?

And if so, would it be actually the Abraham who once lived on the Plain of Shinar? Is the doctrine of the resurrection of the dead to be thus verified in the growth of human knowledge? How is the Pythagorean faith in the transmigration of souls affected by such scientific possibilities of re-incarnation? The dormant personality is re-clothed by cell sensation and brought back to self-consciousness. Practically this is re-incarnation.

It is a strangely realistic interpretation of the Hebrew woman's prayer, "Give me children, or I die," and a biological truth which the daughters of the white race in America have great need to take to heart.

What a solemn sense of personal responsibility to one's family and one's race is thus unfolded to the conscience. To us who live in conscious, cellular life — each generation in turn — is entrusted the custody, the welfare, the very life of our ancestors, equally with that of our children and our race for the far future. No moral doctrine of the century equals it. If such recall from the dead be possible, it carries a power for good, unequaled in the tenets of religious creeds. Its appeal is irresistible even with the most hardened, the most depraved. It embodies the quintessence of conscience. He who comprehends it and debases himself, thus betraying his great trust, must indeed, like Orestes of old, fear pursuit by the Furies.

SUMMARY OF CONCLUSIONS AS REGARDS HUMAN
PERSONALITY AND THE ETHER OF SPACE

These conclusions concerning the ether, etheric perception and human personality were reached incidental to other researches. They have been sketched in so desultory a manner that it may be well to restate them briefly:

In the light of our growing knowledge of the ether, the words "psychic" and "spiritual" as employed by spiritists, must be re-defined, or replaced altogether, by the word *etheric*, since the phenomena with which these words have hitherto been associated in a spiritist sense, pertain wholly to the ether in its intimate relations with the cell-of-life. The same is largely true of the word *instinct*; it stands for a partial reversion to etheric perception, in place of perception by the specialized sense-organs of multicellular life.

The cell-of-life is naturally and primarily "psychic," that is etheric, in its mode of perception. The multicell has developed specialized sense-organs on which it comes ordinarily to depend, but under abnormal conditions it may revert to that more instantaneous, far-seeing mode of perception by means of the ether. This reversion of the brain of a psychic to ether-perception is what is seen in clairvoyance, clairaudience, mind-reading, premonition, etc., etc. An ancient and purely physical mode of perception, reverted to under abnormal conditions. The lower animals, indeed, are more frequently "psychic" than human beings.

In the light of this our increasing knowledge of the ether, too, we learn that it is constantly and profoundly affected by the cell-of-life which is not only the organized mechanism through which sentience and consciousness are raised up from "the elements of feeling" that exist in unorganized matter, but also a chemical engine with a considerable output of kinetic energy. We have come to believe that the ether is the agency by means of which memory and mnemonic impressions generally are transmitted to the sentient protoplasm of the cell. We find, too, that memory is not confined to cell protoplasm, but that a kind of memory, "echo," or mirror-picture of all phenomena is constantly present in the ether everywhere, and that it may be caught and imitated

by matter when in the nascent, or receptive state, caught and "fixed" there, as seen in the frost flowers on the window pane in winter, in crystallization, in Fata-morgana apparitions and in the mirages that play over desert lands.

We have learned also that protoplasmic matter, especially embryonic protoplasm, is ever in the nascent state, and we have been led to form the working hypothesis that it is the ether "echo" or ether "memory," in connection with the inherited plan *in ovo*, which constitutes that formative, guiding power that underlies natural selection.

Further studies of the cell-of-life have shown that it gives forth an emanation, forming an *aura*, or atmosphere, about itself; and that when cells are organized in great numbers in the brain of man, this cell emanation, collectively, can be estimated, measured and to some extent analyzed. We have evidence that it consists in part at least of electrons, that the ether is involved with it as a vehicle, and that there is carried along with it molecular matter from the metabolism of the cell, matter which is sometimes visible and phosphorescent.

We have learned also that under certain abnormal conditions of the brain, as seen in "mediums" when in trance, this emanation is enormously increased in volume and may become an agency for the transmission of kinetic energy to accomplish levitation of tables and other objects; also that it may be projected outside the brain of the medium by will power and made to assume the form of human hands, human faces, etc., in a word, "materializations." It is probable, indeed, that this entire class of "spiritist" phenomena can be thus interpreted; and it is wholly improbable that self-conscious, disembodied intelligences have any connection whatever with such manifestations.

This conclusion is more certainly established from the fact that our increasing knowledge of the cell-of-life in the brain has compelled a new definition of human personality, one that controverts *in toto* the former conception of spiritists, namely, that such personality is an infrangible entity, detachable from the animal organism at death, with self-consciousness intact.

The definition of human personality which our present knowledge of the brain necessitates is, in effect, that instead of being a permanent entity, it consists of two factors, first, a confluent tide

of conscious cell life from the cell metabolism, and second, an organized plan, form, or structure of the brain and of the protoplasm of the brain cells. It is the former which furnishes the factor of sensation, self-hood and self-consciousness. But it is the organized structure, descending from ancestry, that furnishes the factor of mind, intellect and all which makes personality intelligent, worth possessing, or preserving.

Sensation and consciousness pertain to the cell and cell metabolism. Without the confluent tide of cell life in the brain, there could be no self-consciousness; without the structured plan, no extended thought, no human mind. The two factors go hand in hand. Both are requisite to an adequate definition of human personality.

At the death and dissolution of the animal body, this organized structure which comes through ancestry, is obliterated, and the sensation, raised up to self-consciousness in the cell, sinks back to the lowly "elements of feeling."

What remains then of that personality?

First, the offspring, the child, to which the ancestral personality has gone forward through those *angustias vias* of multicellular reproduction. Not only is the child, in and of itself, a partial reduplication of the parents, but it has latent in its brain apparently all the traits and tastes, virtues and vices, of those parents; so many dormant, potential personalities which under certain conditions may be displayed; or if not displayed in this first generation, they yet give evidence that they are really preserved and transmitted by not unfrequently appearing many generations in the future. Indeed, they appear never to be lost from this amazingly receptive web of the brain cell protoplasm. The child is thus, for a generation, the possessor and custodian of the now unconscious personalities of the parents.

Second, the past personality remains and continues objectively, that is to say unconsciously, in an "ether echo," or mirrored as an "ether memory" which inheres and continues indefinitely. We know not how long. These strange "memories" appear to "loom" in the ether and sometimes to stand in a species of stasis, caught occasionally and "fixed" in the air, as apparitions and phantasms.

Our knowledge of the ether is not yet sufficient to exhibit these

phenomena experimentally, much less trace out what secondary effects result from them. Such phenomena, however, are what we would be led to predict from even our present scanty knowledge of a medium possessing properties so bewildering. At present the ether with its possibilities is one of the most fascinating objects of study. The writer is led to believe that all phenomena now deemed occult (including spiritism) will here find a purely physical and rational explanation. Everywhere the memory of past life appears to inhere and be reflected back. We cannot yet say how; etheric phenomena transcend the known laws of corpuscular and atomic matter, as light transcends sound.

We have to realize, too, that the ether permeates and flows freely through all solid matter, and that these strange "memories" are there, too, inhering and probably operative in the very warp and woof of all substance, in air, in water, in iron, in stone. Hence etheric images pass freely through house walls and all material obstructions.

Not only is personality transferred to offspring. Every human life, as it lives, imparts its image, as etheric memories, to all those of its own generation who live about it. It is pictured in the brain of all its contemporaries, and lives on there, objectively, influencing their lives for good or evil; and thence, in effect, it is flung far forward to future generations. It also lives on by means of the symbols of speech and written language, as tradition, as books, and in literature generally.

But it is with the effects of the cell-of-life on the ether, its "echo" there, and with the transfer of the structured protoplasmic form of personality from parent to child, from brain to brain, down the generations of the race, that we are here most directly interested. For it is largely and mainly in the germ-plasm of the race that we survive personal death, enter into the life of future generations and thus enjoy a species of dormant immortality — as if asleep in the house of our children.

It is here that we are gathered to our fathers and here that we shall dwell with our children of the far future. Here is our spiritland, our nirvana of rest. We are not banished to the nether caverns of the earth, nor to far realms of cosmic space. We live on in the house with our family and our race, and may even perhaps, on momentous occasions, be called to life to give them advice

or counsel, as She of Endor recalled Samuel. We are still with them and of them, and if we have done well when in life and accomplished much for our race, we shall be exalted. Though dead and now personally unconscious, we shall be still helping on. We are not put away, nor left eternally behind in the tomb. We go forward with our kind, bearing our share in the greater life of kin and country.

Better than this we who die, cannot hope. In this still imperfect life of ours we grow tired in time and sleep with our fathers, yet we sleep not in the grave, but in the brain of the race, and as science grows, may possibly know a species of resurrection, if our descendants shall desire to call us up, or can tolerate our old-time speech.

More than this we cannot yet hope. Perhaps it is enough for us who are still so imperfect. Enough, till the grander day comes when our children, transfigured and perfected in their organisms by the growth of knowledge, shall cease to die. But even in that grander day we shall be with them. We shall be there.

CONCLUSIONS WHICH HAVE COME AS A RELIEF

This definition of human personality and these intimations as to its fate and destiny in the universe will not, as I know, prove pleasing to many spiritists. The whole world, indeed, sighs for a blissful personal immortality, still, alas, unearned, unachieved. The hope of a beatified future life, when disembodied from the organism by death, has been long fostered, cruelly fostered in view of the inevitable awakening in the light of greater knowledge. Perhaps it was necessary thus to tide the race over a long, hard era of human evolution, otherwise too hopeless. None the less cruel when we wake from the dream.

The sacerdotal promise that the "good" who pay tithes, will be gloriously rewarded when they die, goes not far beyond church doors. The student of life, nature and the greater world has ever seen little enough to reassure him in the thought that his personality may possibly survive death and live on, conscious or semi-conscious, adrift and a wanderer "upon this hurrying, heaving sea of matter illimitable," with its vast catastrophes of cosmic

heat and cold. Little enough for hope or faith in the magnificent yet awful fires of far-blazing suns, or in the *rigor mortis* of those dark, invisible, dead orbs which, eon after eon, swing ponderously on their joyless orbits through the outer reaches of space. The earth, we are told, will one day join this dark procession of dead orbs. One could picture it, still wheeling onward, bearing on its lifeless bosom the wretched, self-conscious "souls" of the race that once lived here in the flesh.

"From dawn to dawn we drifted on and on,
Not knowing whither, nor to what dark end."

— *Thomas Bailey Aldrich.*

To the present writer therefore the above conclusions, touching human personality and its fate in the universe, have come as a relief from many apprehensions, earlier in life.

"Survival is a hypothesis which people who do not stop to reflect, accept complacently. But the philosopher is a little more reserved.

"Life is painful enough not to give us any brilliant idea of what is to follow, and it is with something akin to terror that I figure the possibilities that I, my ego, my consciousness, can have no end and will live eternally. Who knows in that case what is reserved for me? We are all, all such deplorable cowards, so ridiculously feeble in the face of the immensity of the universe, that we have everything to fear from the colossal forces, perhaps unjust, perhaps absurd, which will have the power, perhaps eternally, to submit us to tortures and to misery.

"Happily this survival is improbable." — *Charles Richet.*

THE INTIMATE CAUSES OF OLD AGE AND ORGANIC DEATH

IN this first half of the twentieth century we are waking to the greatest, the gravest problem which has ever engaged the attention of men, the problem of controlling life and prolonging it at will. As the first step to this, we seek to learn the intimate causes of old-aging and organic death.

Strictly speaking, medicine, all medical practice, is an effort to prolong life, or postpone the immediate dissolution of the human body. From the thirteenth to the fourteenth centuries, too, while chemistry was still nascent, there were mystic alchemists and alleged Rosicrucians who sought to grasp a sporadic immortality by elixirs and strange decoctions. But not until this last quarter of a century has the grander idea been grasped, that prolonged life, looking toward immortal life, will be the natural outcome of the evolution of life on the earth.

It was an idea that could hardly have found place until the *Origin of Species* and the *Descent of Man* were written, since it is the logical complement and sequence of these doctrines of nature. It could hardly have come before, save, perhaps, as visional in the brain of a philosopher. But following the epoch of Darwin, Huxley and Tyndall in England; of Humboldt, Goethe, Helmholtz, Hæckel, Weissmann in Germany, and their biological contemporaries in France, America and other lands, the achievement of immortal life follows as the keystone of the arch, the climax, the perfected fruit and flower of the evolution of life. Follows from the natural growth of knowledge, presenting itself in the light of a great achievement. For, with the dawn of this new century, we have wakened to the hard fact that whatever we have here on the earth we must achieve for ourselves.

More life, longer, happier, personal life, idealized as immortal life, has been the desire of man from earliest ages. It is the voice

of nature — nature that everywhere contends that to live is better than to die; and that life even under hard conditions is worth preserving. This is the “instinct” of the cell-of-life, both as a protozoon and when united and organized in the metazoon; it is the voice of the cell, heard crying up from its lowly depths in the tissues of the organism. It is the faith of the subconscious life in us.

Ever since neolithic days there are evidences that human beings have regarded death with repugnance and fear, and have made rude efforts, looking to salvation. The primitive religious cults all breathed this grief at death, this desire for more life.

But for the last ten thousand years human beings, generally, have despaired of escape from death by self-effort, and made their appeal to supernatural powers. In their ignorance of nature and the causes of natural phenomena, belief in spirit life took form: the shade, the *psyche*, the *umbra*, the *manes*, the wraith, the ghost.

Full of doubt and of fear as the belief was, it yet proved a species of solace. For the hope of more life has never been given up, never will be given up; but as death appeared inevitable, our far human ancestors comforted themselves with a vague faith in the supernatural. The comfort was hazy; the faith was ever infirm; yet the sick and dying found a nebulous solace in it; death was a little easier.

Sacerdos entered, put on his robe and took charge of the vagrant belief. What had been merely a fitful hope was exploited in a creed, with doctrines. Rite and ritual were prescribed, sacrifices enjoined, and tithes collected. Reason and conscience were borne down by the voice of sacerdotal authority, nether worlds for torture were portrayed, and blind faith exacted under ban and penalty. Fane, shrine, temple, mosque, and cathedral were reared, and vast guilds of priesthood organized.

That was the price, the penalty, which humanity paid for longing after more life, for believing that somehow there would be immortal life somewhere. We should fix our attention, not on the errata of creed and religion, but on the nature of this great Hope of the human heart, the Hope that inspired it all.

For, if human beings had all along been persuaded with certainty that this earthly life of three score and ten years was all

to which they could attain, there would have been no religion, no priest. It was the longing for more life which made religion possible in human history.

Sacerdos proved the greatest of hypnotists. Humanity passed into the sleep of the creeds, with its phantasmagoria of gods and devils, nether worlds and upper worlds, limboes, purgatories, torture-hells, and gaudy-golden heavens!

A long, wild, troubled night of the human brain.

It is from this spell of indoctrination, this trance of dogmatism, that we are now waking, waking in the clearer light of our growing knowledge of nature.

Classic fable records the catastrophe of the Earth-born who, rashly importunate, strove to scale Heaven; and Hindû sages have taught that the Lords of Life and Death have jealously defined their realms and shut the doors, lest mortals pass the forbidden thresholds; that in the present orbited order of matter and the cosmos, death must follow fast on life, till the order ends; till orbital motion unlooses its swift arcs and the bright, huge-grown orbs rarefy in the fire-dust of another universal nebula. Not till then may the Lords of Life and Death loose the bonds of death.

Yet even in most ancient days there lived a Prometheus, an Æsculapius, an Epicurus.

“Him neither fear of the gods, nor thunderbolts, intimidated, nor portents of the skies, but rather roused the innate courage of his soul, that he should be the first to break down the jealously guarded portals.”

What man has dared, man will dare again and more. “The bold breed of Iapetus presses on, unabashed, with face set to the dangers of an unknown future.” Across the gulf of more than two millenniums, the hardy courage, the bold initiative, of these great-hearted ones of old, lends inspiration. The breed survives, the breed that brought down fire from the skies, that raised the dead. That is ever the scientific spirit, the spirit that came from partaking of the Tree of Knowledge, the spirit that will accept nothing less than an untrammelled liberty to seek knowledge and use it.

THE METCHNIKOFF THEORY OF OLD AGE

Passing over the theories and beliefs as to old age and death in the past — beliefs connected with the religions — it will be worth while first to make a résumé of existent knowledge and views on the subject.

So few persons actually die of "old age," it has often been denied that such cause of death really exists. More than seventy per cent. of all deaths is from acute or chronic invasions of the disease-producing bacteria, either sudden, sharp attacks, or prolonged sieges. From birth to advanced age, the human organism is continuously invaded, assaulted and preyed upon by noxious unicellular life.

In time, these multiplied assaults, and the damage resultant from them, inaugurate very complex, far-reaching complications, difficult to trace and estimate. For an organ, or tissue, enfeebled by microbic attacks, gives forth an altered, inferior product which in turn embarrasses and lowers the vital tone of other organs and tissues. Thus the entire organism is progressively impaired and depressed from normal function. In this condition it is less resistant to the never-ceasing attack from without; for a high vital tonicity is the organism's natural defense. As years pass it becomes impossible to calculate from cause to effect the damage done by bacteria.

It has been held, too, that the roaming white cells or corpuscles of the blood sometimes assume the rôle of intra-organic assailants; — and this brings us to consider the Metchnikoff theory of old-ageing, namely, that after middle age, these leucocytes, now known as phagocytes, begin to prey on the more highly differentiated cells of the stable tissues, bone, muscle, skin, etc., and even on the neurons of the brain and cord, to the extent that a gradual wasting away ensues, with the consequent phenomena of old age.

Professor Metchnikoff distinguished two classes of phagocytes, the macrophages and microphages, the latter smaller than the former, having extensible nuclei which permit them to pass freely through all the tissues. It is to the more voracious macrophages, however, which are essentially minute animals, that the damage to the organic tissues in advanced life is chiefly due: they turn

cannibals, so to speak, and devour the cells of the associated tissues; and the cause of this unnatural perversion of appetite, or morale, is attributed to poisons of the nature of ptomaines, produced by several orders of putrefactive bacteria which, as life advances, find lodgment all along the alimentary tract, becoming "naturalized" there in immense numbers.

Professor Metchnikoff saw reason to hope that these invasions of putrefactive bacteria may be combated by ingestion of the *kefir* microbe, found in specially soured milk. He also believed that the cells of all the tissues may be reinforced by substances of the nature of *serums*, obtained by the now familiar methods of inoculation of the horse and other animals.

As a result of all his studies and discoveries, Professor Metchnikoff announced his belief that the present span of human life may be prolonged sixty years; that the healthy working period of middle age may extend considerably past a century, thus placing himself in harmony with Buffon, who believed that the natural lifetime of man was not less than one hundred and twenty years.

OLD AGE FROM ORGANIC DISHARMONY

But aside from these alleged ravages of phagocytes, there are functional causes of organic decline which come from lack of co-ordination and co-operation in the *ensemble* of organs and apparatuses of the body.

To make this quite plain we must conceive of the organism as made up of thirty or more groups or differentiations of cells: bone cells, muscle cells, liver cells, lung cells, renal cells, epithelial cells, blood cells, nerve and brain cells; in a word, all the diversely specialized tracts and groups of tissue cells which together form the animal body and are necessary to that grand co-operative effort, exhibited in a human life.

There must be a stomach, a liver, a pancreas, etc., for digestion; lungs for oxygenation; kidneys for elimination; and blood for the further transformation and transportation of the food to all the various groups of cells. All must be fed every second. Each organ and apparatus produces a different product; and all must blend and labor together in a kind of organic rhythm, balance, and

counterbalance. And this rhythm and counterbalance are very nicely and delicately adjusted, so much so, that the least aberration or dereliction from duty and function disorders the organism. So much so, that it is the highest art of physiology to watch over the organic entity and preserve the balance of organic interaction.

But as years pass, one organ, or another, or many, tend, from the wear and tear of life as we lead it, to become impaired and disabled. There are deposits of "formed matter," diminution of the number of cells from inflammations and poisonous ingestions. One organ or another thus fails to do its part, the balance is lost, vicarious action begins; what we term the "constitution" is broken up and discordant action ensues. Most persons die of this organic discord.

OLD AGE FROM INVISIBLE DIRT PARTICLES

A number of years ago, the startling statement was put forward, that organic decline, ending in death, comes from a progressive asphyxiation of the tissue cells; that after adult life, we slowly suffocate, from a thickening and hardening of the membranes of the alveolar sacs of the lungs, oxygen no longer passing freely in, nor carbon dioxide out. The hardening of the alveolar membrane is aggravated from impregnation by minute dirt particles in respired air; it being a well-established fact that the lungs are progressively discolored from infancy to old age; and that the lungs of certain craftsmen, stone-workers, dry grinders, and others, are very palpably thus impregnated.

As a proximate cause of organic decline, there must be something in this hypothesis, which will have to be reckoned with in future efforts to alleviate the causes of old age. But it can scarcely be said to go to the root of the matter, and we are still left to inquire why otherwise than by impregnation with particles of dirt, the alveoli become hardened, lifeless sacs, impervious to gases, instead of the living, pervious membrane of childhood. And this leads to casual mention of a theory of old-ageing, suggested from this laboratory in 1896, namely, the theory that the cells of all the tissues are slowly impregnated, embarrassed, and killed out by invisible dirt particles which are in-

gested with our food, enter the blood plasma, and finally reach the cell by absorption.

Dirt, which has been well defined as "matter in the wrong place," is commonly supposed to be a molar condition of terrestrial matter which does not prevail nor exist in the molecular realm. Hence, by virtue of this molecular exclusion and the elective power of living matter to choose and select such particles as it pleases for its nutrition, the protoplasmic cell has been presumed to be in the "chemically pure" state. There is reason to fear, however, that such an assumption may not be strictly accurate.

Only a microscopist knows the full bitterness of the life struggle with dirt. It is doubtful whether even a gas can be, or at least has been, generated chemically pure, so omnipresent is dirt. Dirt is Nature's heterodoxy.

The animal organism is a great destroyer of dirt; that is to say, the various ferments and "juices," which it is the life work of many groups of the somatic cells to secrete, act chemically on dirt as well as on true food, on innutritious as well as nutritious substances, to break them down to the elemental condition. Having passed the digestive tract, too, and entered the blood plasma, still further reduction and elimination take place, before the highly rectified particles go to the cells of the nobler tissues and organs.

In an adolescent organism, normal, healthy, and strong, this eliminative process is practically adequate. Adventitious substances are expelled or broken down and resolved chemically.

But in older organisms, during periods of weakened action, the process of resolution is less complete; microscopic dirt may accumulate in enfeebled cells. If not dirt, what is that darker-tinted residuum in old protoplasm?

Is there dirt in the blood? Or rather, to how great an extent is the blood a dirty liquid? In other words, is dirt taken up, associated with nutritious particles, by the absorbents and lacteals?

We know that the fine particles of inorganic substances, administered as medicines and poisons, pass readily into the blood, and speedily enter the protoplasm of brain and muscle cells. In the examination of old amœbæ, which are nourished in dirty water, we see a great deal of this. Under high power the same

is discernible in a culture of bacteria, which can be killed out by an admixture of dirt in the fluid.

It is not of the chemical action of inorganic particles in the protoplasm of the cells that we are here treating, however, but of their merely negative behavior, or presence as dirt. A particle of arsenic, antimony, or iron may excite protoplasmic action which may speedily result in its expulsion, resolution, or encystment, where a merely reactionless particle of silica, or lime, might remain as an obstruction.

The question here raised, as regards dirt, is whether minute particles of inorganic matter, or obdurate organic matter, entering the plasma of the blood, find ultimate lodgment in the cells, and remaining there undissolved, chemically unassimilated, or unexpelled, give rise to those aspects which distinguish aged from young cells. Are accumulations of microscopic dirt in the cells one characteristic of cell old age? Is all organic life from infancy to old age and death a struggle with dirt?

But while the dirt hypothesis of old age contains a scintilla of truth, it must, like the foregoing, be ranked with proximate rather than with primary causes of old-aging.

DR. EVANS' EARTHY SALTS THEORY OF OLD AGE

Dr. De Lacy Evans also believed that old-aging resulted from accumulations of "earthy salts," largely phosphate of calcium and silica, in the tissues, and also the unregulated wasting of the cell protoplasm by oxygen. This opinion has gone the rounds of both medical and popular journals, with variations. We now know that such earthy salts, to some extent and in some tissues, at certain stages of life, do accumulate in a way to embarrass the cell life and to weaken the tissue. But this condition is far from being constant, or continuous, or secularly progressive. It is incidental and often associated with microbic invasions. As to the undue wasting of the cellular protoplasm by oxygen, that is largely a myth; a far greater difficulty in old organisms is to get oxygen to the cells at all; they smother for want of it.

OLD AGE FROM BLURRING OF THE BRAIN

An hypothesis of the old-aging of the nervous system and cerebral tissue of man has also been advanced from the progressive effects of continuous or oft-repeated mnemonic and sensory impressions in the protoplasmic substances of the brain and minor nerve centers.

Memory, experience, and the growth of the intellect depend on impressions from the external world which come to the brain through the organs of special sense and the general sensibility, and remain there as pictures. Such impressions, or pictures, are believed to be physically inwrought in the sentient substance by something akin to dynamic action, and, as is well known, will remain there, mentally recognizable, for many decades. From such portraiture of the external world, physically impressed in the material substance of the brain, we have what is commonly termed, experience. This experience, however, is something more than an accumulation of impressions or pictures; for it is accompanied by the formation of opinions and intellectual growth. There is assimilation of the collected data as well as mere accumulation; growth of the garner itself into an organic sentient whole, its substance being arranged, moulded, or impressed in such a degree, that one writer has not hesitated to define the "soul" as "the form of the organism."

It is a well-known fact, moreover, that the frequent repetition of the same impressions, as of sensory experiences, scenes, and sounds, has a marked tendency to dull our sensibility to them. Equally well observed, too, is the loss and confusion of memory in advancing life.

Hence, the inference that the constant repetition of impressions and the continuous be picturing of the brain substance with mnemonic imagery has its natural, physical limits which cannot be long outrun without utter confusion and blurring of the material medium, as when one picture is printed upon and over another. And the conclusion derived, touching long life, has been that a lifetime greatly exceeding seventy-five years must, of necessity, result in mental dullness and confusion of thought.

Thomas Parr, however, at the age of one hundred and fifty-

two, is alleged to have been "bright" and normal as to "all his faculties." Henry Jenkins, of Yorkshire, England, "distinctly remembered" the battle of Flodden Field, fought one hundred and fifty-seven years previously. Robert Evans, of Spitalfields, "clearly recollected" the execution of Charles I., one hundred and thirty-two years before.

What is known as to this subject goes to show that if the data of experience are normally assimilated with one's existent knowledge and incorporated as such knowledge in the mind, no confusion will result from their progressive accumulation.

In the aged, too, recollections of youthful years often appear to be revived and to grow vivid, although it is a matter of common experience that our memory of past events fades with the lapse of time.

OLD AGE FROM LACK OF INCENTIVE TO LIVE

Closely associated with the above theory of old-aging is the psychic theory, namely, that we age and die because after the purely animal or sensory cycle of brain development is accomplished in mating and procreation, there follows a period or condition of non-development. A new, higher cycle of mind growth is not initiated, and does not begin, with its new interests, new ambitions and fresh incentives to live and act. The brain neurons do not take a fresh start to live, and hence the stasis of advanced age ensues, with its common conviction that life has been lived, and that naught remains but to exist for a few years more and die.

According to this view, if it were the fixed belief of human beings, the current faith, that after the age of forty-five, a new cycle of life was to begin, a new, later course of study and preparation for another life effort would be inaugurated; and if the world and the social system offered a field for this (as in future it will do), then the stasis of advanced life would not set in; human beings at fifty would be seen brightening up for a higher, stronger life, with better, loftier ideals.

The chief obstacle to this at present is not that these new cycles of brain development cannot be initiated, but that the world*

and society offer no field for it; the hostile presence of the younger generation pushes the adult generation off the stage of life. What is needed for prolonged life of the individual is field for him to live and develop; in a word, incentive to and opportunity for a greater life.

We have abundant evidence in numerous observed instances, that at the age of fifty, sixty, or eighty, the human brain may enter on a new curriculum of study, growth and achievement; and that, *pari passu* with this new effort, the cell life of the whole organism has been notably quickened and strengthened. For it is ever the brain life which quickens, sustains and maintains the life of the other organs and apparatuses of the animal organism.

A provisional importance must therefore be attributed to the argument for the psychic cause of old age. To the writer it is at least apparent that the first step toward the achievement of deathless life will be from the psychic side.

The assumption that the brain, progressively, is dulled by multiplex mnemonic impressions, founds on the idea that the brain is like a photographic plate or film. Whereas, what we know of the brain neurons leads us to conclude that there is little or no analogy of this kind; that the building up of a personal intellect bears little resemblance to photography. A human intellect, with memory, implies a co-related, co-operative effort on the part of many millions of cells, acting together, pooling their cell lives about a personal axis. Each cell is thus stimulated to live in a certain way, rather than stamped by a photographic picture from without. The cell contents, or sentient substance of each cell, is in a state of constant flux and mutation, replaced every second by fresh particles, not "fixed" as in a photograph. An intellect is, therefore, a certain manner or mode of cell life relatively to the other cells of the entire brain, not a series of photographic plates, packed away in the brain. The instances of double personality, double consciousness, and recurrent personality, indicate that when, from any cause, the first or former personality ceases, a second personality may begin, as if about a new personal axis, and go on to develop another intellect of the brain cells, quite as if the first had never existed.

It is, therefore, fair to infer that if, at the age of fifty or sixty, it was the custom of human beings to enter on a new cycle of

brain life, and there were opportunity and social field for it, a new axis of personality would slowly take the place of the old, and that the cell life of the brain would arrange itself about it, quite as readily as if no former development had taken place. The problem of such prolonged brain life would lie in giving the brain cells a pure, normal food, through an uninjured blood circulatory, and preserving them from the ills that come from association with other impaired cell groups of the organism.

The brain appears to be a colony of cells destined to live long and capable of doing so, but for the weakness, diseases, and frailties of the organism in which it has developed. On the one hand, it is the organism by means of which it has come forward and arisen to its present high estate of intellectual puissance; and, on the other hand, it is this same organism which now drags it down to death.

THE VEGETABLE THEORY OF OLD AGE

The "cometh up like a flower" theory of old age has long been a popular one.

When we regard the growth, blooming, and death of a summer flower, the shooting upward of the flower stalk of a poppy, for example, with its blossom, its seeding, and its suddenly ensuing juicelessness and dead rigidity, we contemplate phenomena not wholly unlike what takes place in the human organism, when regarded in the large, passing from infancy to maturity and old age.

What has taken place in the poppy stalk?

One class of plant cells has developed, multiplied, and from the products which have issued from them, has produced the stalk proper and leaves. Immediately another class has, in like manner, given rise first to the bud, then to the gorgeous blossom with its stamens and pistils. Fertilization follows in its timed order; and later another class of cells matures as seed.

It has been held that these latter cells in some manner sap and eviscerate, so to speak, the cells of every other tissue of the plant, and thus sapping them of their life elements, or germs, condense these latter in the seed, where it may long lie dormant, yet is

capable of producing another plant; and that the parent plant, thus sapped and eviscerated, dies naturally, its life being virtually taken away and carried forward to the seed for another year.

The observed fact that the stalk and lower leaves of the poppy remain green until late in the season, if the flower stalk is nipped, has been regarded as evidence of this view, namely, that the phenomena of its growth, maturity and dry death stand for a development, successively, of one class of cells after another, from the seed around to the seed again; that the plant dies when the germs of life have left the stalk and leaf and passed upward to their final lodgment in the seed.

It is an easy theory, easily derived, easily argued, and falls in superficially well with certain aspects of the cell doctrine. But it carries a great and vicious untruth; vicious in that it would indicate that the primary and ultimate object of all plant life is to bear seed; of all animal life, to bring forth offspring.

Per contra, we believe that the object of all life, vegetable and animal, is to live and feel the joys of living; and that seed and offspring are produced because, under the hard conditions of the earthly habitat, we are unable to live on continuously. That is to say, if the earth had always been an easy habitat for life, *there would have been no seed, no offspring, no death*. Offspring and seed result originally from hardships and prospective death to the parent cell, and are not the object of living, but rather an evasion of death.

It seems very desirable to have these premises right at the outset as contrasted with the contrary view, and to set off free from a radically wrong theory of life.

To return now to our observation of the poppy stalk, whatever of fate, of final tendency to go to seed, there is in it, will be found due to heredity, established by long conformity to climate and other conditions; a habit of living which leads the different classes of cells to develop and produce tissue at a certain time, relatively to each other; and in the manner in which these different tissue growths of the stalk and flower limit and restrict each other.

Why does the poppy live? It lives to express its life, its personal life, and to take its personal satisfaction from living. It is an organized effort at fruition. Seed is its mode of escaping death.

But granting the general truth of the doctrine that seed and death result primarily from the hard conditions of terrestrial life, which make it impossible for metazoons to live on continuously and deathlessly, it has been argued that all existent forms of life have fallen irretrievably into this mode of living and dying. Not only do the same conditions of hardship and limitation still prevail which first induced seed and death, but every plant and animal lives by virtue of, and in accord with, a plan or an arrangement of the germinal matter in the seed, which compels it to unfold as did the parent, and inevitably produce seed and die.

That is to say, the arrangement of the protoplasmic molecules in the germ, seed, or ovum, is such that the successive growths of tissue must, if the plant or animal is to live at all, succeed each other according to the order of their arrangement or garnering in the germ.

In the main, this view must be conceded to be upheld by the facts. Heredity does thus hold all forms of life within its iron clutch. Plants and the lower orders of animal life tend not to change, and for the most part would perish if suddenly altered conditions compelled great changes; and it is but to a single tissue, even in the human organism — the cerebral tissue — that we can look with any confidence for a successful contest with the restrictive dominion of heredity. That one tissue is still progressive and capable of self-direction and self-elevation, capable, too, of revolutionizing the organism.

THE HYPNOTIC THEORY OF OLD AGE

There is also what may be termed the hypnotic hypothesis of old age, the idea that old age ensues from a fixed belief, or mental expectation, that it will occur at a certain age. That from earliest ages this expectation has taken the form of creed or an instinct and acts, after middle life, as a species of inveterate hypnosis, compelling the person to behave after a senescent fashion, and feel the sensations and even experience the pains of senility.

In a word, that we grow "old" because we believe that we shall grow old. It is, therefore, an attitude of mind that causes old age; and the inference is, that if a fixed belief that man is

deathless and will never grow old, could be substituted for this, his present belief, greatly prolonged life would follow.

In support of this theory, the well-known physiological effects of innervation are cited. Muscle cells severed from their connection with nerve and brain soon atrophy and die. The same is true of other tissues. Stimulation from the brain and spinal cord is necessary to the life and function of all the associate tracts of cells. These live only from their connection with the brain and are dependent on it for *motif* to live and work. It is this pre-eminent brain colony of cells which not only controls and dominates, but continuously furnishes the stimulus—the tide of corpuscles—that impels the servile tracts of cells to activity in their appointed ways. Severed from the brain, they turn idle, run riot, or lapse into desuetude.

Moreover, there is the vast array of observed phenomena where fixed beliefs and the mental state, known as expectation, are seen to have profoundly affected the operations of the human body, even to producing the semblance of virulent diseases and death itself; of scar, stigmata, and all the strange phenomena that ensue from religious exaltation. In fact, the evidence is complete as to the brain's occasional dominancy over the organism.

Of the hypnotic theory, however, it must be observed that it fails to account for the old-aging of animals, insects, and plant life—unless they, too, are hypnotized!

OLD AGE FROM HARDENED ARTERIES

A celebrated physician was accustomed to say, that “a man is as old as his arteries;” and from this dictum, which has its grain of truth, has come what may be termed the blood-circulatory theory of old age. Succinctly, that excluding what may be classed as accidental deaths from bursting arteries or veins and from arterio-capillary sclerosis, there is in aging organisms a slow chemico-mechanical contraction and diminution of the caliber of the capillaries, which results in starvation of the tissue cells, from exclusion of the blood corpuscles and even of the blood plasma. Oxygen and nutrient particles are from this cause slowly excluded from the cell which starves like a captive shut up in a

dungeon. The progressive shrinkage and diminution of the capillary tubes has been ascribed to chemical changes in the "formed matter" of which they are composed. In foetal life capillaries grow forward from a terminal cell-bud and are hollowed into channels behind the cell as it advances. It has been argued that, after a certain lapse of time, this formed tube deteriorates from chemical instability, irrespective of the personal life and without reference to it.

THE DISCOVERY OF CELL OLD AGE

In the winter of 1892, while conducting a microscopical examination of the brain neurons in dogs, the writer was led to observe the differences between the cells of young and old canine brains. These observations were afterwards extended to other canine tissues. Later still, the same results were verified in the genus *sus*, and finally in human tissues; the result of the entire series of observations being to establish conclusively that the cell-of-life in animal organisms has its period of adolescence, maturity and "old age;" that old age as we know it in man comes from an antecedent old age of the cells. These little founts and seats of life, themselves, become smaller and senescent. Our human old age is a resultant condition, reflected outward, from this old-aging of the tissue cells.

The work referred to was done in part at New York City, and the "material" examined was the brain and spinal cord of dogs (twenty-six dogs) large and small, old and young, from the dog pound of that metropolis. In these canine subjects the cells of old individuals were found to differ visibly from the younger, in that they were less delicate, the filaments less extensive and, as a rule, the whole cell smaller; that is to say, the living portions of the cell which could be stained, were less in quantity in the old than in the young. Not only were the nuclei smaller, but the cytoplasm was equally diminished. It was apparent that these old brain and cord cells had deteriorated and were declining by a process of involution. Yet here and there on the slides appeared a well-nourished cell which looked to be holding its own with those of the "control."

Observation of these variations was carried through five pairs of old and young dogs — each pair with a “control” — of about the same breed and of the same size as nearly as could be obtained, although the latter particular is of no especial importance; a small dog may have as large cells as a large dog.

In passing, it may be noted here that nearly all these old New York dogs had lesions of the spinal cord, most frequently in the posterior columns and the column of Türcck.

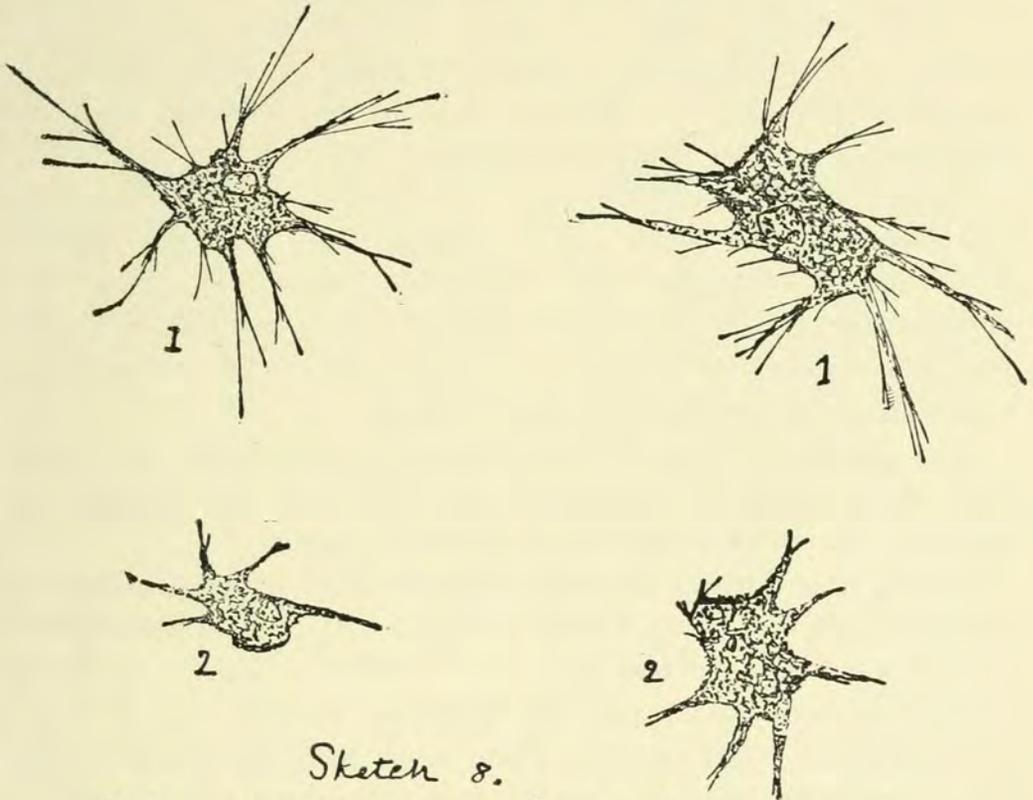
Later, the brain cells of pigs were compared in like manner with those of old hogs, with the same general result; though it should be remarked that in the genus *sus* not a single lesion of the cord happened to be encountered; but this may have been largely due to chance.

Next year, as far as possible (not an easy matter without suspicion of a pathological vitiating of the results) the same comparative studies were paralleled in human subjects, with substantially the same revelations as to the progressive change in the aspects and appearances of the cells from youth to advanced age.

Still later, the cells of other tissues of the human organism — cuticle, bone, muscle, liver, heart — were in like manner contrasted, under high microscopic power, the general result of all these observations being to establish the fact that the cells of the mammalian tissues, man as well as the lower animals, shrink in size and change their appearance as the subject ages, tending to fall into a condition which cannot be better nor otherwise described than as “cell old age.” The cells themselves become senescent; and it is cell old age which underlies organic or bodily old age in animals and man. In other words it is the old-aging of the cell which has so long been that mysterious cause or agency which induces and is associated with constitutional and functional old age in man. There are intimate or primary causes of cell old age, incident and peculiar to the inner, personal life of the cell itself, and proximate or secondary causes due to the metazoic or associated life of many cells, living in a co-operative union.

The causes of cell old age are manifold; the pre-determining bias from ancestry; faulty nutrition of the cell from impurities in food, that is to say the general impurities of food; decline of the body heat, in advancing years; starvation of the cell from the shrinkage of the capillaries, causing restricted circulation of the

blood plasma; diminution of nervous energy from the brain and cord to the tissues; i. e. slackening of the subconscious life; slow poisoning of the cell from unremoved waste products of the whole body; microscopic "dirt;" what may be described as the gradual "binding out" of the cell from the chemical hardening of its environment of formed matter; the (possible) drain of germinal



Sketch 8.

- 1.1. Multipolar cells from anterior horn of the spinal cord of an adolescent dog
- 2.2. Similar cells from cord of an old dog.

elements to the reproductive cells; slow, chronic suffocation from lessened oxygenation, due to the fouling and thickening of the alveolar membranes in the lungs.

Sketch 8 will give some idea of the changed appearance of multipolar cells from the anterior horn of the spinal cord of dogs, in old age as compared with adolescence, viz. eighteen months as against fourteen years. The cells appear smaller; the nuclei are noticeably smaller; and the arborizations now for the most part

fail to be revealed by the stains. Old tissues are, it should be remembered, less easily stained than adolescent tissues. In the cases cited, the fibrils had either largely disappeared or become so attenuated that the stains failed to render them visible on the slides. The cell bodies, too, are less distinctly stained and have assumed a perceptibly shrunken appearance, not unlike the cells of animals suffering from extreme fatigue, or when long famished.

In the pituitary body or gland — exceedingly interesting on account of its influence, when stimulated, or diseased, on the growth of the entire organism — the contrast between adolescent and aged cells was most remarkable. The cells examined were from the posterior lobe, the anterior containing none of this class. As stained by the nitrate silver process, these cells appear to be dendrites or pyramidal cells, somewhat resembling the cerebral pyramidals, but less regular and typical. Each has one, sometimes two neuraxones, or axis-cylinder processes, which however, are not as easily traceable as in the cerebrum.

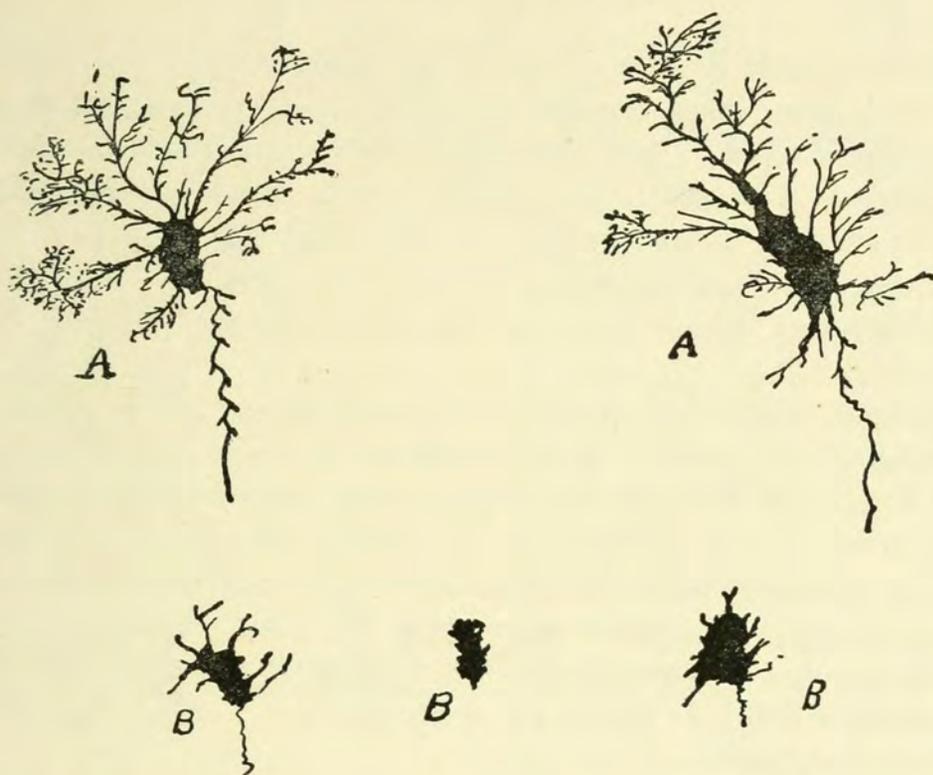
The pituitaries from but two dogs were examined, one apparently about eighteen months old, the other very old, certainly not less than eleven or twelve years, probably more.

Sketch 9 gives the generalized result of what the microscope revealed. In the young animal the cells, cell branches and arborizations are displayed clearly even in feathery detail. In the old animal the presence of the cells is shown for the most part as a mere irregular patch of black stain, much as if the branched processes were dead and only an encysted cytoplasm and nucleus remained of the cell. Even this cell body was smaller and less distinctly stained, as if shrunken or impregnated by non-living matter.

Curiously enough, however, on one slide, out of seven or eight of this old tissue, there appeared a single cell in good condition, as large or larger than any of those on the slides of young tissue, having all the characteristic arborization, with the neuraxone traceable to a considerable distance.

Apparently this was a cell that had continued to be well nourished while its fellows had starved — how, or why, it would be interesting to know. Perhaps because located contiguous to a capillary channel which had remained fully open and pervious to the blood-stream. Similar rare isolated instances of well-preserved

cells were observed among the cerebral dendrites, and also among hepatic cells: rare individuals, surviving in health and strength, in the midst of a shrunken, dying generation of their fellows. This is a point of far greater interest than was at first appreciated. Briefly it is one of the best evidences of the main contention of



A A Dendritic cells from the pituitary body of an adolescent dog.
 B B B Similar cells from a very old dog.

Fig. 9.

this volume, namely, that the cell-of-life under favoring conditions of nutrition and stimulation, is a potentially deathless unit; that the cells of the animal organism decline, in senescence, owing to unfavorable conditions of their environment; i. e. lack of nutrition, contamination and overdraught on their powers, to support the wants of the organism as a whole.

Allowing for all *errata* of the staining processes, either the nitrate silver method or the dyes, the facts in regard to cell old age appear to be about as I have endeavored to sketch them.

THE CAPILLARIES IN OLD TISSUES

Many practical difficulties attend the preparation of the capillaries for examination, chiefest of which is an injection fluid that will penetrate them. The fluid, moreover, has to be forced into the artery at a considerable pressure, and in aged subjects, and often in adolescents, the vessels give way before the capillaries can be filled. Gases, too, sometimes act to make "pockets," especially in old subjects, where many of the capillaries are plugged, or desuete.

So many, indeed, are these practical difficulties, and so greatly do subjects vary, that it would be unsafe to draw deductions or form an opinion as to the difference between old and young capillaries, from a single comparison. A considerable number of comparisons should be made, and all the conditions carefully estimated, as, for example, the greater elasticity of the young capillary.

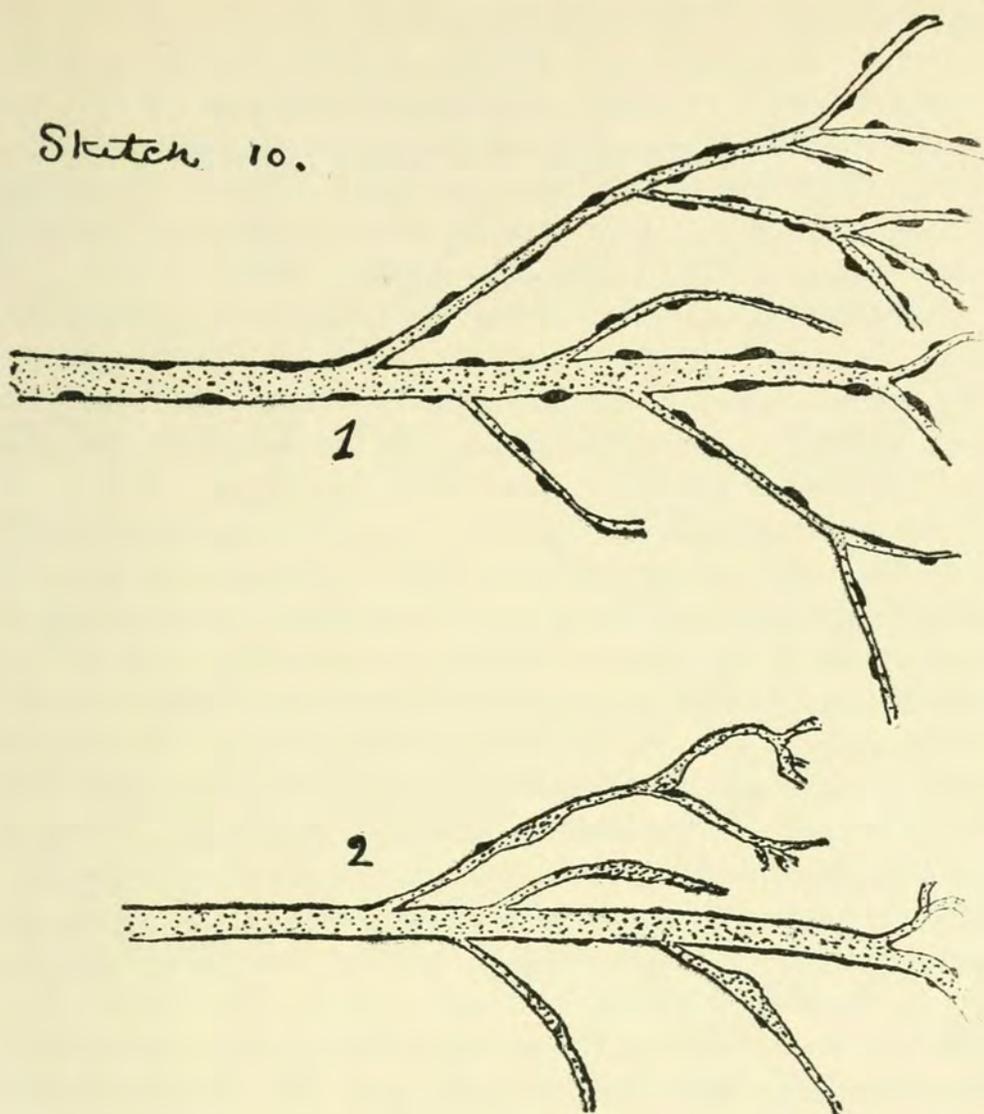
The accompanying pen sketch was made after a week's work in such comparisons. It stands for a general result rather than for any one instance.

Of old capillaries, compared with young, it may be said, first, that they are shorter as a natural result of tissues thinning in aged subjects. This is especially noticeable in the epidermis and cutis; yet in forming an opinion it is necessary to do so guardedly, on account of the greater pressure required to inject the old tissue.

There are pouches in old capillaries, and often they appear to end abruptly in cul-de-sacs, although here again it is well to bear in mind that this latter appearance may be due to failure of the injection fluid to penetrate further. Allowance for this, indeed, must be made constantly in all cases, old or young.

There can be no doubt whatever, that as a rule, applying to at least ninety per cent. of two capillary systems, adolescent as compared with aged, the calibers of the old capillaries will be found of notably less diameter. For instance, where young capillaries have an average caliber of 1-2500 of an inch, the corre-

Sketch 10.



1. Arteriole twig showing capillaries in young tissue, just below the capillary meshes. The nuclei of the formative epithelial cells, still alive, are here numerous in the capillary walls, stained black by nitrate silver.
2. Similar arteriole twig from old tissue, relatively shorter, with occasional pinched enlargements, and few nuclei visible. Such old capillaries can hardly be termed living tubes.

sponding old capillaries will be as small as 1-3200; and in the brain, or cord, where the young are 1-4000, the old might be less than 1-4600. It will be understood, of course, that I am not here speak-

ing of dilated capillaries, or of pathologic cases, but of what may be termed the normal aged condition; nor yet of the sometimes pouched, sometimes stenotic condition of a capillary.

In old capillaries scarcely a nucleus of the formative epithelial cell can be distinguished in the walls of the tubule. *Per contra*, in young capillaries, where a successful attempt is made to stain them with silver nitrate, the nuclei are numerous.

Old capillaries as a rule evince the tendency above noted, to show "pouches," "pockets" and plugged loops. In the old, too, considerable tracts are not unfrequently found obliterated, the loops apparently plugged with unremoved waste, or stenosed beyond the point where the blood-stream can penetrate them.

The arterial capillaries are, of course, the channels through which the blood reaches the tissue cells and passes over into the corresponding channels on the venous side of the circulation, to be pumped back by the heart to the lungs for re-oxygenation. Not only the blood plasma is oxygenated, but separate charges of oxygen are taken up by the red blood disks and borne by them to every part of the organism, to maintain the body heat at 98° Fah.

It is not difficult, therefore, to perceive what happens when the arterial capillaries become so narrowed, stiffened, plugged and generally impaired that the plasma fails to reach the cells, and the blood disks cannot readily pass over to the venous side, but stick by the way, or become pocketed.

This is manifestly one reason why lean, elderly persons, with shrunken tissues, suffer so constantly from cold feet, cold hands and from low temperatures generally. This is one of the large factors of old age. Incidentally, greater stress is put on the heart muscle to force the blood through to the veins. The accumulation of venous blood which we often see in the veins, however, is quite another matter, due to abnormalities of the valves in the veins and to enfeebled heart action.

Micro-photography is of less avail here than in almost any other situation. Allowing for the greater difficulty of injecting old tissue, there yet appears in the latter, as compared with young, a condition somewhat as sketched above.

Rarely, or never, do we succeed in so perfectly injecting the capillaries, that the finer, ultimate channels, loops and meshwork — where the arterial capillaries pass over and are differentiated as

the venous capillaries — can be examined; the latter, indeed, in most instances, remain filled, or partially filled, with blood at the death of the subject examined.

The first capillaries, from the arteriole, in young tissue are longer and of greater caliber as a rule. Evidently their elasticity and dilatability are greater. The strong heart of youth sends the blood disks, charged with oxygen, through them rapidly, without obstruction, or squeezing, generating that heat so necessary to health and vital well-being.

In age the reverse condition prevails, with lack of heat, and sluggishness, not only of the plasma-flow to the cells, but of the neuro-electronic circulation through the nerve trunks and fibrils.

I have attempted to show the pouched appearance in this size or grade of capillaries, where apparently the red disks of the blood pause too long in their obstructed flow. Some of these pouches look to be greater than I have drawn them; but when all the difficulties attending examination are borne in mind, that question is a delicate one, at best.

In this connection, it may be remarked that in 1896, a prize of \$400 was offered from this laboratory for the best exhibit of microscopic slides, comparing aged and adolescent capillaries from human or canine subjects, with a view to increasing our knowledge on this subject of capillary shrinkage and the resulting cell starvation.

The offer and the motive for it were made as plain as possible; but very little came of it, many microscopists professing themselves unable to comprehend what was wanted.

SENSATION AND CELL OLD AGE

In a work, entitled *Age, Growth and Death*, the late Professor Charles S. Minot of the Harvard Medical School went into the matter of the progressive senescence of the physiological cell far more deeply and comprehensively than any of the foreign histologists. He recognized a structural change in the protoplasm and nucleus of the tissue cell, from youth to age. Incidentally, Professor Minot held that the protoplasm of the cell is increased, while the nucleus is diminished — a deduction which the present

writer's observations fail to confirm as regards the former. With few apparent exceptions, I have found that the entire cell "ages" and is diminished in size, "protoplasm" and nucleus alike.

As to an intimate structural change in the living matter of the cell, from infancy to age, that is of course beyond our present powers of observation to demonstrate, although it appears likely.

Touching the causes of this change, Professor Minot was silent, as if regarding it as something final in the order of the universe.

But certain of the primary and the proximate causes of this progressive structural change in the protoplasm and nucleus of the cell from youth to age, have already been suggested above.

To these causes, already enumerated, must be added another, from the psychic side of the cell life, to wit, *sensation*, that is to say, the sensory life of the cell from moment to moment and day to day. Painful sensation undoubtedly impairs the sentient protoplasmic structure, impairs or deadens it; while on the other hand, pleasant sensation vivifies it. But in organic life as we now live it, painful sensation in time overbalances pleasurable, in the cell life, leading to a secular deterioration in structure — the structure requisite to maintain life. The philosophic and practical inference from this is easy, the moral plain.

Granting the existence of a structural change in the somatic cell, evinced from foetal life onward to old age and death, we are of course constrained to seek the causes. Why does the change occur? To leave it there, in the hands of Fate, does not help us to grow in knowledge. At present the primary causes seem to be errata in cell nutrition, bias from cell ancestry and a possible fructification of the cell in a species of corpuscular germ elements which set up a drain of depletion on it; although this latter hypothesis is contrary to the present germ-plasm doctrines.

The cell in its self-conscious life, whatever its situation — whether a protozoon or a metazoic tissue cell of brain, or muscle — is subject to that continuous reaction from its environment which we ordinarily term sensation. This reaction is iterated from moment to moment, hour to hour, and day to day, during the entire cell lifetime.

Now we know from common observation that the repetition of identical or similar sensations dulls, that is to say lessens, the sensory capacity of brain cells.

Does sensation then cause that structural change in the nucleus and the protoplasm of the cell, which we associate with senescence? Data are lacking for answer to this question.

THE INFERENCE FROM MAUPAS' OBSERVATIONS

More than half a century ago, in France, E. Maupas, and afterwards Balbiani, demonstrated that a colony of unicells, living on by fission, from parent to child, became senescent, enfeebled and tended to extinction, unless sexual conjugation took place at intervals of forty or fifty generations. Rejuvenescence was thereby effected; otherwise the colony died out. Later, in this country Professor G. N. Calkins has, as I understand, verified Maupas' conclusions from actual observations. My own work in mammalian tissues, old and young, as mentioned above, tends to establish the same general fact for the metazoic cell, since the various organized groups of tissue cells in metazoons are analogous to the cell colonies of unicellular life. The fact, too, that metazoons can only be renewed, that is to say rejuvenated, by the sexual method, goes still farther to show that the same law of life prevails alike in the unicell colony and the orders of tissue cells.

During the last quarter of the nineteenth century, when research was younger, many of us fondly believed that we held the key to the vital situation in a discovery — then believed authentic — that unicellular life was naturally immortal; that certain infusoria, bacteria, protozoa, meaning the first simple forms of life, lived and multiplied by fission and division, without dying; that there was really no such calamity as death in this primary form of terrestrial life.

This, if true, was perceived to be of tremendous significance. It opened vistas of great hopes. For it was already recognized that unicellular life was the basis of multicellular organisms. If, therefore, these structural units of our bodies were deathless under nature, the whole question of immortal life for man resolved itself into one of proper care and husbandry, protection and nutrition, of the physiological cell. The hope was logical, the deduction legitimate, if these premises concerning the natural deathlessness of the unicells were true.

Professor August Weissmann — whose theories of life and death are now common property throughout the world — made the natural immortality of unicellular life one of the foundation stones of his famous hypothesis of the germ-plasm; other German histologists concurred, as also several noted English biologists; and for ten years we really seemed to be at the bottom of the great problem of life on the earth. It was then more logical to argue that the attacks of disease bacteria, acute and chronic, might be the ultimate cause of old-aging. For we contemplated the human organism — the *soma* — as composed of cells, not essentially unlike unicells, and if these component cells were deathless unless crushed by violence, starved, suffocated, or otherwise killed, the problem of prolonging human life indefinitely would be solved when we could ward off cell dangers in our bodies. With the somatic cell potentially immortal, death was due to organic errata. Our lives rested on a fixed and sure basis of immortality which was in plain view; the neurons of the brain were so many units of eternal life, if only we could guard and protect them.

True, Professor Weissmann took the ground that mankind continued to die, periodically, because prolonged human life was not useful to the human species; in a word, that the individual existed solely for the good of the species; that we die after we produce offspring because there is no longer any reason for us to live; and that this must be accepted as the law of human life.

It required but a normal exercise of common sense, however, to discern a palpable fallacy in this corollary of the Weissmann theory. Hence, those who hoped for greatly prolonged life, from the growth of knowledge, were not disheartened; for they recognized the fact that the highest interests of the species will be conserved far better by a race of perfected individual organisms which were deathless, than by constant generations of mortals. It was perceived that the only possible reason for thus exalting the species and sacrificing the individual on its altars, must lie in the expectation that ultimately there would be developed from the species a race of more perfect individuals.

The germ-plasm of Weissmann is the human reproductive tissue, a cell colony which lives on, deathless, from generation to generation; the *soma* alone dies; the germ-plasm has survived from the time unicellular life was the only form of life on the

earth. Rejecting the theory of Darwin and others, that gemmules from every cell of the organic tissues are garnered in the reproductive tissue, to be extruded as embryonic cells, Weissmann taught that the reproductive cells, by permutations and combinations of the germinal substances, are equal to the task of originating new generations of mankind, unaided, and that the *soma* has nothing to do with reproduction save the servile task of bearing the germ-plasm forward in the world and supplying it with food.

Here, again, common sense could not help thinking that as between these rival theories of reproduction, the truth may lie midway; that the despised *soma*, while not transferring organized "gemmules" to the reproductive cell colony, may yet by virtue of "nervous currents," which pass to and fro, so influence, mould, and *individualize* the germ-plasm as practically to impress the ancestor on the offspring, and virtually reproduce the parent in the child. This view, at least, had the merit of reconciling opposed theories; and — saving clause — it is not clearly known as yet in what nervous currents which reciprocate between the reproductive organs and the rest of the body, consist, or how fully representative of every organ and tissue of the body they may be. A nervous current is a great mystery and involves many unknown quantities and qualities of matter; it is a fruitful field for investigation. When we are able to analyze a nervous current, we will know a great deal more about human life than at present. It would not surprise the writer, if a nervous current were found to be capable of transferring the image and character of one cell to another. It may prove a stream of an almost infinitely more minute form or type of "gemmules" than Darwin dreamed of, or Weissmann repudiated.

Then in 1885-86, and for a time, this sense of certitude, this feeling of mastery of the great problem, was given a rude shock, by deductions drawn from the observations of Maupas, confirmed by contemporary biologists. Primitive unicellular life was not deathless in any sense, after all. The intimate causes of old-aging were found to be deeper-seated. The unicell was seen to "age" and die, even as the multicells. The Weissmann hypothesis associated death with sexual reproduction in the multicells, and por-

trayed the causes of death as organic and extra-cellular. We now learned that the causes of death are intra-cellular. Colonies of unicells conjugate to be regenerated by blending and exchange of particles, sexually, not differently in principle from the sexual congress of animals. Unicells increase in number by division of the adult, parturient cell into two smaller "daughter cells," each of which grows and divides into two others, generation on generation, for a limited length of time, but not indefinitely, as was at one time believed to be true of them.

On the contrary, after a certain number of cell generations, such unicells must get together sexually. The millions of rhizopods in a stagnant pool, for example, must thus conjugate or they will cease to be reproductive and the species will die of old age.

As observed by Maupas in 1885-86, and other observers since, sexual conjugation is accompanied by profound changes in the cells. The technique of these changes is of less consequence here than an appreciation of the principle involved. When two of the conjugating cells have paired and come into close contact, the paranucleus, or sex organ, of each suffers a species of dissolution; it divides and appears to undergo a kind of reorganization; certain parts of it are rejected altogether and cast forth, as if worn out, worthless, or deleterious. The remaining parts of the paranuclei then come together and are differentiated as a male and a female pronucleus. All this seems to take place as if under stimulus of contact, or of sexual desire between the two cells. Having paired, these changes in each begin and proceed as above indicated. Immediately then the male pronuclei cross over from cell to cell, the female pronuclei remaining stationary. After passing over, the male pronuclei unite and fuse, each with the resident female pronucleus. A transfer and exchange of germinal matter from one cell to another is thus accomplished.

Following this exchange, a complete reconstruction and reorganization of the entire nucleus of both cells take place. And now the two unicells, having effected this swap-over of germinal matter, and this profound reconstruction, slowly separate to go each its individual way as before. Each feeds and grows and in due time begins to multiply by fission and division in halves,

which form new individuals; and this asexual increase may go on for fifty, a hundred, or even six hundred generations.

Maupas' observations also indicated that sexual conjugation did not take place successfully between unicells of the same family, that is, between descendants of the same parent cell. The disadvantages and observed enfeeblement, which result from inbreeding in animals, and in consanguineous marriages, appear therefore to be deep-seated in unicellular life. Sexual conjugation gave best results when the cells were of "stranger" parentage. If sexual conjugation were too long deferred, till the successive generations had grown very much enfeebled and senescent, it was either unsuccessful or failed to be undertaken. Under natural conditions it took place when the individual generations were at their best.

Why individual generations from the same parent fail to conjugate with entire success, is thus far as little understood in unicells as in animals. The proper elements for the sexual reaction appear to be lacking, as if there were too great a sameness, too much identity or similarity in the sexual elements of the paranucleus and pronucleus. To obtain the needful sexual reaction or stimulus between the cells, they should come from another stock and have been nourished in another place, in a different environment.

Where sexual conjugation did not take place the generations from the same cell parent, as time went on, became smaller and often deformed. After several hundred generations the descendants of a single cell parent all die and the line becomes extinct.

As touching the entire validity of these observations, however, it should here be mentioned, that studies of the proliferation of certain tissue cells, during 1913-14, go to show that under ideally favorable conditions of nutrition, these cells may multiply indefinitely, without visible deterioration.

Yet in the human organism as a whole there is the observed old-ageing of the tissue cell.

What can this mean other than that the delicate sentient structure of the cell — nucleus and protoplasm — is somehow fouled and deteriorated by its life, by the way it is nourished, by its hard, painful sensory experience?

The unicell eats what it can lay hold of, and can frequently be

seen to have a hard and demoralizing struggle with what it ingests.

In this respect the lot of the tissue cell of the animal body is easier; and for this reason it lives far longer. Its food is the highly-wrought plasma of the blood-stream; a serum which certain groups of cells devote their lives to rectifying and purifying for easy, safe assimilation.

But even in normal mammalian blood is this cell food perfect, clean, fit and chemically pure? By no means. The physiological cell dies from it, in time. Can we not by experiment improve this sanguineous serum-of-life? Can we not still further rectify and purify this *flumen vitæ*, this plasma of the blood-stream, till a clean, pure and chemically perfect cell food is attained?

SUBSEQUENT CONCLUSIONS

That last quarter of the nineteenth century was a time of doubt with the believers in natural salvation. For awhile we were inclined to acquiesce in the extreme view that this observed decline and aging of the cell-of-life was due to an inevitable, irremediable exhaustion of the vivific molecules of the cell nucleus. That even if the number of protoplasmic molecules was restored by adjuvant chemical action, we might yet find that the wear and tear of cell life depletes the large mobile molecule, itself; and that the problem of its restoration might be found out of range of the chemical activities and affinities of terrestrial matter. In brief, that death reigned irretrievably on our planet, and that life is possible here only in the parent-and-child mode. For it was easy to go farther and theorize that molecules, atoms, and even corpuscles are depleted, and have to meet, sexually, for renewal. There have been various fanciful theories as to sex in the most minute particles of which matter is composed.

The deduction then made was that the hard conditions of life on the earth cause the cell to wane, deteriorate, or "run down," to the extent that it inevitably dies unless reincarnated by sexual interblending with other cells, that being nature's only method of getting over the inherent obstacles to terrestrial life; that the unicells have found life too hard to live endlessly as individuals;

that under the ordinary conditions of shore and pool, they die out unless renewed by sexual regeneration; — and this is the death of the individual life.

For it is race life, not individual life, which is perpetuated by sexual renovation; the child cell may be like the parent, but is not that parent personally. Those who have observed the profound changes, the commingling and re-grouping of the cell contents, that precede the fission and division of a unicell into two “daughter cells” — even when not immediately antedated by sexual congress — must needs conclude that the parent does not live on in one of these cells, but comes to an end, personally and individually, at fission. So that the declaration of Weissmann and other biologists of that time, concerning the immortality of the unicells, was erroneous from the start, founded on faulty observation; the fact being that a unicell always dies, personally, when it gives birth to offspring by fission; the profound break-up and reassembling of the nuclear contents *being equivalent to the obliteration of the parent cell as an individual.*

But in accepting this conclusion, touching the mortality of the unicells, those who had hoped that the human organism might be perfected for greatly prolonged life, looking toward immortal life, overlooked for a time a most important fact, and failed to take cognizance of what nature had itself been doing to alleviate these same hard terrestrial conditions which cause death in unicellular life. We failed to perceive that in every organism, animal, or plant, a united, continuous effort is made to render cell life easier and safer, to provide a better cell food and secure more perfect nutrition, to eliminate poisonous substances, and remove “dirt.”

We failed at first to comprehend that while in exposed, unprotected unicellular life the individual could not live for more than a few days or weeks at most, and was obliged soon to resort to reproduction to escape race extinction, cells could be found in multicellular organizations, the brain of a man or an elephant, for example, that live for a century, or two centuries. In short, that multicellular life is a long-established, co-operative method on the part of cell life, to live longer and better, looking to complete cell salvation under nature.

At that time we failed to comprehend this larger effort of cell life. Our mental concepts did not then as now embrace the larger

outlines of the Earth's life scheme. Nor did we then perceive that these grand co-operative unions of differentiated and specialized cell life give rise not only to animal organisms, but to a higher, organized, personal life which reacts strongly to preserve and perpetuate the component cell units, and that the more intelligent that personal life becomes, the stronger grows the effort for self-maintenance and self-salvation.

To have a human personality, with mind and reason, with memory running back to childhood, binding the entire life experience together and blending it in a coherent whole, the brain neurons must largely survive throughout the personal lifetime; the cell must live on, its individual life must be preserved.

This marvelously organized animal body which we inherit, the origins of which are in the depths of unhistoric time, has come up under nature, self-maintaining, self-repairing, in obedience to an instinct and impulse to live on and not die. It is the embodiment of the cell effort to be deathless. It started and developed to that end. The impulse to this comes from the sentience of the cells — the sentient side of matter. It is a self-sentient mechanism which feels its hurts and possesses the resource of self-repair. From perception of injury issues energy for restoration, as, for example, when a muscle is wounded, or a bone broken. Even the blood circulatory tubes grow again, and are repaired and reopened, round and about, as the wants of the tissues make urgency. Wherever a sense of loss, damage and danger is felt, this current of *vis viva* stimulates the leucocytes to act and sets the cells of the injured organ in extraordinary activity to produce new tissue. Something more and in addition to chemical action is displayed here; it is chemical action, prompted and initiated by sentience, by a swift current of minute corpuscles, out-flowing at the command of self-consciousness, bearing its will to the cells.

It is the nature of this current, this stimulus from the neurons, that we have great need to study and control; to learn how it may be generated, artificially perhaps, and how it may be used to stimulate repairs throughout the organism.

The growth of biological knowledge, during the decade, has greatly enlarged our conceptions of what the cell-of-life is capable

of doing and becoming. We are recognizing more fully than ever before its inherent plasticity and marvelous adaptability to every form and use in organized life. And when we contemplate these astounding metamorphoses as seen in the intricacies of insect mechanism, the beauty of flowers, the texture of ivory, bone and shell, the coining of spore and germ, the achieved resistance to cold and heat, and, in brain, the elevation of simple sentience to intellect; when we contemplate these marvelous achievements of the cell, past and present, there seems no good reason to doubt that this same cell may achieve greatly prolonged life — if it sets itself to the task. Prolonged life would be a feat no greater than others which it has accomplished in the past. Our survey of organized life constantly strengthens this conception of the cell's plasticity and its possibilities. It may be molded, bent, and directed to do almost anything, perform almost any function and live briefly, or long, as the greater life or personality of the organism enjoins upon it. It is Nature's Proteus and may be made to live a day, or a millennium.

For slowly, over the stumbling-blocks of many errors and misleading hypotheses in the past, we have been drawn to the conclusion, that although the tissue cell is still seen to decline and die with the organism, there is attainable for it an exceptionally well-nourished, well-protected condition where it may live on without time limit. We mean by this that the alleviation of old age is now as largely a question of regulating and controlling the life of the organism — this larger personal life — as of combating intrinsic obstacles to long life in the cell itself; that it is the organism as well as its component cells which must be put in trim for longer life. What the cell needs to insure its continuance in function and in life, is *stimulus from the organism as a whole*, and that atmosphere, or *aura*, of vitality, which pervades a healthy, strong animal body. As long as these stimuli remain constant and strong, and the cells are well nourished, they are not of themselves the sole factors of old age. It is the whole life of the organism that quickens cell life; that is to say, the volume or sum total of cell life in the animal body when well blended in a vital *aura*, seems adequate to stimulate and maintain in healthy function each individual cell of the vast union for much more than a century. Blended together, these millions of cell lives maintain a stable vital

atmosphere, which sustains, invigorates and reacts, and but for *damage, and errata in nutrition*, would do so for great periods of time.

Yet let no misapprehension accompany this deduction. The cell is itself a small organism which, as it at present lives, suffers an old-aging process, a progressive deterioration; although the ideal and intent of the metazoic union is to purvey for the cell a perfect, deathless life.

This ideal and intent are quite possible of accomplishment. If the chemical processes on which life founds could be conducted in the cell as accurately as we often see done in ordinary chemical synthesis, the cell might live forever. By this we mean to say that terrestrial chemistry, at its best, guarantees deathless life to a cell, or an organized union of cells. But the nutrition of the cells, as it goes on in the human organism, is still far from well accomplished.

There is therefore, first, cell old age, and following it, organic old age. Our problem of alleviation is concerned with both, but the former primarily. If we could induce a chemically perfect nutrition of the cell, or even better it largely, the old-aging of the human organism would be vastly retarded, if not arrested.

The unified, organized metazoic life of cells in an animal organism, aims at perfect cell nutrition from the blood, aims at it, but still fails of it.

OLD AGE AS INDUCED BY HEREDITY

Biologically speaking, it has to be conceded that the human organism, as descended from our anthropoid ancestry, is not an ideal one, considered as a basis on which to work for scientific improvement with a view to greatly prolonged life. It is what nature has produced in the teeth of hard conditions. We have to accept it and do what we can with it. Finding fault with it, despairing of it, or flouting its imperfections, will not assist. We have to work with a clumsy apparatus for nutrition, all the features and processes of which are entailed upon us by hereditary bias in the cell, a predisposition so strong, so fixed, that weakening it by desuetude and changing it by better foods, bid fair to be the slow work of time; — evolution which devolves devolution.

We cannot turn back the hands of time for ten million years and begin again with a simple union of cells in the ancestral newt, and give skilled direction to its development to a higher form of organized life, simplifying its necessary organs, eliminating mechanical absurdities, avoiding, too, these strange alternations of plan and the resultant desuete structures which came from changed habitat and changed food, all with their inveterate tendencies to reproduce and perpetuate themselves. In very truth, we may be said to inherit an organism bonded to heredity; a congeries of cell groups, bent, biased and indoctrined, so to speak, by millions of years of bad living. We have come down from a creature that, in the struggle to survive, headed first one way then another; first a swimmer in the waters, then a plodder on the emerging lands; first a savage glutton of the marshes, then a starving, howling climber in the forest. They are in us still, with all their diverse cell tendencies.

And now — in the light of greater knowledge and higher ideals — we have to take that ancient organism, that heirloom from primeval ancestry, that earth-born beast, and transform it to a god!

Little wonder that physiologists and those who know the human body best, who understand heredity most clearly, smile superior on this contention and say the hope of immortal life in a terrestrial organism is an *ignis fatuus* — a fatuous hope which can but end, finally, in a deeper despair. Ten million years of heredity bar the way, they tell us; an heredity which is condensed and bottled up in each tissue cell of the body, and which will condemn the cell to follow a beaten track for all future time. Useless the struggle to break away from our past, or even to greatly improve it. The egg of the crow inevitably becomes a crow; of the ant, an ant. The tiger cub becomes a tiger, even when fed on rice and cream. No change of food or environment visibly alters the human type in one generation. Some little range of individuality is observed. But we revert. The cycle is established. The gates to another order of being are closed by heredity. Despair then of immortal life, they tell us — except possibly as a ghost — and be content. It is all there is for us here.

But friends of the facile judgment, critics of the easy conclusion, with all your erudition, you have overlooked a factor. You

have fixed your attention solely on the conservative faculty of the cell. It possesses another, the creative faculty, and in the last analysis, creation is but change. The cell-of-life possesses the power to change (evolution) as well as the power to perpetuate (heredity). In accord with the conditions on the earth's surface, the cell-of-life has developed the human body and conserves it by heredity. But the same creative power in the cell which produced organism, will change it, when the conditions are changed and call for it; and science is now changing and improving all the conditions under which human beings live. *

TERRESTRIAL LIFE AS LIMITED BY PHYSICAL ACCIDENTS

It has also been argued, that even if disease and old age could be successfully combated and overcome, fatal physical accidents would, as they average, cut personal life short once in three centuries, at longest. And hence, from the very nature of our terrestrial environment, anything like deathless life is a vain dream.

Fatalities from physical accidents, however, are due largely, almost entirely, to the reckless manner in which human beings now live and move about. Death, at best, being held to be certain, they constantly take chances of accident from locomotion, machinery, electric discharges, anger with their fellows and entering dangerous places.

It would follow naturally, however, that a group of persons who had attained immunity from disease and old-aging, would organize a community life in a vivarium, or in a region rendered practically safe and secure from accident. If we were sure of deathless life otherwise, we would, logically, take no chance of accidental crushing or maiming. It is not difficult to foresee that an organized community of deathless beings would perfect for their residence a vivarium which would come to realize the fond human aspiration for "heaven" — a beatified home of life, from which the liability of accident would be excluded largely or wholly. This elimination of physical accidents would, we repeat, follow logically and surely on the attainment of immunity from disease and old-aging.

THE REPRODUCTION THEORY OF OLD AGE

There is yet another probable cause of old-aging and organic death, still obscure and greatly in need of clear demonstration and regulation, namely, reproduction.

As the embryo grows to the infant and the infant to the adult, the tissue cells have room in the still plastic and elastic organism, for multiplication and expansion up to the type limits. When these limits are reached, multiplication of cells in the specialized tissues and organs is repressed by the organic plan, and forced to cease from further growth.

But in the adolescent organism and throughout young adult life, the pressure to grow continues; and, according to this theory, it is the pressure of the component cell life of the organism for more room, that gives rise to the sex passion. Love, the desire for mating, is the stress of the cell to burst its limits and grow somewhere else, namely, in offspring. The manner in which growth pressure finds expression and direction is through, or by means of, the glands of reproduction, which, as the stress increases, are stimulated to maximum activity. Of the reactive processes that here ensue, however, little is known as yet, further than that a factitious sexual salacity may be induced even in old organisms, by engrafting reproductive glands from younger ones.

In other words, it is the longing of the whole cell union to pour itself forth and escape compression: those limits which gravity and the ensemble of terrestrial conditions have set to life in animal organisms.

Forced to cease from actual cell multiplication and outspreading growth in the tissues, the cells of the adolescent and adult organism adopt a new mode of growth and fructify in a species of exceedingly minute *semina*, or cell seeds, which eventually garner themselves in the organs of reproduction; and in the congress of the sexes are given forth to develop as new organisms. Reproduction therefore results from a secondary mode of growth of the component cells brought about by duress of the type limits.

This may be deemed a prosaic view of *la belle passion* concerning which poets and novelists have sung, rhapsodized and sometimes whined, in all ages, and filled vast library stacks of romantic

literature; yet the above is the physiological *raison d'être* of it: — the pressure of the cell life, in the organism, for more room. As the result of that duress of pressure to grow, the component cell life coins or concentrates itself in minute semina which permeate the whole organism, giving it for a season wondrous phases of beauty, strength and ambition. Under stress of this crescent tide of cell semina, the young hero fights, labors, sings *chansons*, or fares forth into far countries to possess himself of a mate in whom he may implant the clamorous surplus of his cell growth. Having found her, he gives it forth, in conjunction with hers, to form offspring; since the child is but a passing of the cell life of the parents to a new field for growth. The entire reproduction period of adult life is a time of cell migration to new organisms. Having filled the type limits, the cell life migrates in offspring, and leaves the parent organism to become desuete and die.

“Growing old,” therefore, by this hypothesis, means a giving up of the constituents of cell life, to be transplanted to new organisms. The reproductive tissue is not a germ-plasm — as Weissmann once told us — which grows independently from parent to child, adown the centuries, but an organ for embodying the fructification of the thirty or more differentiations of cells in the organism, a fructification which is the result of the cell demand for new fields of growth.

Ordinary proliferation of the cells being no longer possible, a necessitated new method of growth begins in well-nigh infinitely minute seeds of cells, which freely traverse, permeate and circulate throughout the organism, in unnumbered myriads; tides on tides of them, each cell giving rise, apparently, to millions, which form a wonderfully invigorating *aura*. It is this effluence of cell semina which actuates the entire reproductive effort of animal life. For we have to conceive of each and every one of these cell semina as embodying the basis and promise of a new cell of the species of the parent cell from which it has emerged.

The actual size of a cell seed is as yet purely a matter of speculation; perhaps not much larger than the protoplasmic molecule, perhaps that vivific molecule, itself, which — much as the electron irradiates from the atom — emerges from the cell by millions. It would not be an improbable conjecture that a well-nigh infinite number of them, each containing the germ promise

of a new cell of muscle, nerve or gland, are garnered in an animal ovum, or a spermatozoon.

The cell-of-life exhibits many different methods, or rather phases, of growth, although the principle and object attained, remain the same, namely, by fission, extrusion, "budding," etc., as the contiguous environment necessitates.

Cell fructification in this case appears to be an effluence of protoplasmic molecules, pressed outward through the cell envelope when there is not room for putting forth a daughter cell entire. For we have come to regard the cell-of-life as an organized community of protoplasmic molecules, which seeks to grow by multiplication of these molecules. When unrestrained by its environment, the molecules increase in numbers up to the type limits of the cell, then segregate by fission of the parent cell and form two new cells. But when the cell is delimited, as it is in an adult tissue or organ of the animal, the new cell cannot burst forth, and growth is confined to an extruded effluence.

Free cell multiplication by fission is not a little as when a new swarm of bees emerges *en masse* from the parent swarm, and practically two new swarms are formed, one remaining in the hive, the other moving on to a new place. But if, as in the case of the tissue cell in the adult animal organism, there was no room for the daughter swarm to come forth *en masse*, the excess of young bees would be compelled to emerge from the hive, one by one, and fly away, to gather together, perhaps, in some far-off place of refuge, where they would be able to collect and organize themselves as a new swarm.

Darwin's conception of cell growth, has given us some idea of the exceedingly minute size of the emanant protoplasmic semina (gemmules) and the voluminous tides of them that are pressed forth into the sanguineous, or the nervous circulation. More specifically defined, the overflow of cell growth when the type limits are reached, is an overflowing of chromatin-heredity germs from the cell nucleus, possibly chromatin molecules; an output from the chromosomes which the sex glands of the organism appear to attract and concentrate in the reproductive cells. It is thus that the heredity-chromatin, or germ-plasm of the race, is transmitted down the generations of mankind. This human germ-plasm is the evolution of millions of years, and goes on

continuously with but slight regard for the individual man; and yet each successive generation of somatic cells contributes new influences which help shape our race destiny — for good or for evil.

Infallibly we are next led to inquire what directive impulse leads all this multiplicity of cell semina in the ovum, to organize in the orderly arrangement of the embryo, each germ with its mates, to form the various tissues and organs, segregating and cleaving apart in the three layers from which the foetus develops. Our theory of it would be that a sentient perception of kinship, or fellowship, leads each living germ of a cell to foregather with its kind, to grow into the future tissues of a new organism.

Founding on this theory, a regimen for the conservation of the cell semina, would embrace many considerations, moral, mental and physiological. Ever after the type limits of the organism are reached, the cells emit a flux of semina, but these, instead of organizing to form new cells, are extruded, enter the circulation, and form a protective, stimulative *aura*, which greatly strengthens the personality. It is, in very truth, an atmosphere of life, since the constituent particles of it are living particles, capable, each, of producing a new cell of the type and species of that from which it has been extruded. Hence originates the organism's wonderful capacity of self-repair and self-renewal.

In this connection it is useful to call to mind the "physiological units" of Spencer, the plastidules of Hæckel, the biophors of Weissmann and Darwin's ideas of pangenesis. Conceptions and theories as to the extrusion of living molecules from the encysted cell-of-life have naturally presented themselves to all who have studied these problems.

Beyond much doubt, too, the migrant protoplasmic molecule is complexly organized, since it has in it the plan of a new cell and also transmits a semblance of memory as to the former life of the cell from which it emerged.

As has been previously shown, too, the protoplasmic molecule has, under favorable conditions, unlimited capacity for self-reduplication. Given unrestricted nutrition, by foods, chemically pure, free from poisonous or refractory substances, this living molecule would apparently go on multiplying itself forever, trans-

mitting to each daughter molecule its own characteristics, its own memory of past life. From which it is argued that if the cells in the human body could be uniformly nourished and not become too rigidly encysted in the tissues, the component molecules would go on reduplicating themselves for centuries, maintaining the *aura* of the personal life.

Sex excesses which drain away these seeds of cells, causing a resultant diminution of them in the ovum and spermazoon, give rise, as is well known, to feebler offspring, possessing less stamina to resist disease and less endurance generally. The reason for this is a partly mathematical one; less vivific molecules are transmitted. If five quadrillions of them are garnered in a normal ovum, and but five trillions find their way there, the inference is not difficult. But the purely fanciful Traduction theory of former philosophers, namely, that a certain fixed number of living molecules were arbitrarily "created" when life on earth began, and that living organisms are steadily but surely expending this original endowment, finds no confirmation in modern physiology. The living protoplasmic molecule has the power to reproduce itself and does so constantly in the animal organism. Animal organisms are not running out an irreplaceable supply, but create one for themselves, when properly nourished. A single cell—a bacterium, for example—if placed in a medium suitable for reduplication, has it in its power to fill a universe with its offspring.

As human life is lived at present, it is evident that throughout early adult life a very undue depletion of the cell semina takes place. The output is squandered. The life-invigorating *aura*, derived from the normal fructification of the component cells of the organism as a whole, is drained off wastefully at the instigation of a wholly abnormal sex passion, amounting to erotism.

The real nature and rationale of what is thus wasted is not understood, or rather wholly misunderstood. The lower animals have their regular periods for sexual congress, after long intervals for rest and recuperation from these expenditures. But human beings, from unnatural stimulation, have made their sex expenditures continuous. Under the conditions of our present civilization, the human imagination has become largely deranged, and normal sex hunger perverted. The young are allowed to regard marriage as license for a constant, unrestrained indulgence in lust. An

abnormal propensity to venery has come to be transmitted from parent to offspring, often manifesting itself in childhood. Improper foods foster it. Much of the fiction writing of the times contributes to lustfulness; the "best sellers" are those most erotic; and not one parent in a hundred realizes, or objects to, the physiological detriment thus done to a generation of young people, born into the world too prurient at the outset, with pelvic nerve plexuses weakly prone to excitation.

The net result of the licensed venery of modern marriage, is seen in successive generations of women, subject to all manner of pelvic weaknesses and diseases, accompanied by a general enfeeblement of the female sex; and in men, by seminal weakness, enlargement of the prostate, and consequent bladder troubles, needing surgical interference by the time the age of sixty is reached, resulting, with at least thirty per cent. of all males, in premature death.

The bearing of these facts on the problem of arresting old age, is obvious.

An abnormal waste of the cell seed (protoplasmic molecules) is set up which by reason of the habitual enfeeblement it occasions, markedly hastens the binding out and encysting of the cells in the adult organism.

The only practical remedy at present, lies in proper physiological education of the young in regard to the procreative function; abolition of erotic literature; and repression, so far as practicable, of the many other tendencies to lasciviousness in children.

DOES GRAVITATION CAUSE OLD AGE?

Gravitation — the dead weight of matter — has also been held to be a primary cause of the old-aging and death of organic life on the earth's surface, as well as fatal physical accidents: a contention not without force in view of the fact that life acts constantly in opposition to gravity, tending to overcome it in locomotion and the phenomena exhibited by living beings generally. Gravity, it is held, tires life incessantly, and in the end, tires it out, as seen in the chronic fatigue of aged organisms. Animal life is thus a long, unrelieved effort to resist gravitation; and thus

far, it is held, gravity has won in the end: gravitation being defined as the final resultant effect of the totality of physical forces, actuating matter universally.

But considered as an irremediable cause of old age and death, it must be borne in mind that life in young, unvitiated cells shows the ability to successfully stem gravitation and continues to do so until enfeebled by other causes.

OLD AGE FROM NECROSIS OF THE CELLS

A physician of New York City, Dr. Fenton B. Turck, has presented a theory of old age from the death of the cell life of the organism. According to this investigator the cells of the tissues die in numbers, and in so doing give rise to a toxin which under certain conditions stimulates new cell growths, but sometimes, when in excess, occasions widespread poisoning of the cell life.

IS OLD AGE FROM THE CHEMICAL AFFINITIES OF MATTER?

Chemical affinities, so called, have also been held to be a primary cause of the old-aging and death of organic life on earth, meaning by chemical affinities, the force, often violent and destructive, with which the elements of matter combine, or the combinations disrupt. Bearing in mind, too, that organic life is maintained only by means of a complex series of such combinations, to wit, oxygenation, assimilation and nutrition of the component cell life of the body.

In every large organism like that of man, a great deal of random uncontrolled chemical action takes place, at times suddenly destructive of the personal life, and probably constantly obstructive to it, always intimately connected with the activities of bacteria in the internal cavities of the body.

Better food, better habits of the body and a general amelioration of the errata of nutrition and digestion, would seem to be the indicated remedy.

OLD-AGING FROM INSUFFICIENT SLEEP

Another proximate cause of premature old-aging is imperfect sleep, lack of proper rest for the brain neurons, from faulty methods and insufficient hours of sleeping. A lamentable number of cases of this occur in adults, as middle life is reached, especially among ambitious, hard-worked business men, who find themselves unrested from day to day, nervously depleted and victims of insomnia. In these cases the kidneys immediately suffer.

Several of our physiologists, Professor Hodge among the first, have demonstrated the visible, physical effects of fatigue in the nerve cell, the shrinkage in substance and lack of functional power; also the direct results of rest and food for the restoration of a tired cell to its normal size and condition of dynamic efficiency.

Sleep, with the diurnal darkening of the hemispheres, is the time when all the millions of brain neurons cease acting in their united, corporate capacity and revert each to its own personal, unicellular life. Through the hours of daylight they act together as a whole, for the good of the entire organism. But now, when sleep supervenes, continuity is broken, the resultant self-consciousness stops short, the personality ceases, and each individual cell attends to its own personal wants, namely, nutrition, expulsion of waste products, self-adjustment, and rest. Sleep is the time when the brain cell is again living the original unicellular life of its remote ancestry, resting, restoring its powers.

So exhausting is the daily, corporate life, that this alternating period of cell rest is necessary to the neuron's restoration. It must have time to attend to its unicellular wants and necessities before again devoting itself to the united brain life of another day.

It is not difficult, therefore, to understand what takes place when from any cause the cell is prevented from properly attending to this its necessary individual life, that is, when it does not wholly break continuity with the other cells; when its waste products, accumulating during the day, are not cast forth; and when it is not permitted to pass into a state of cell rest. Disturbed, broken sleep leads to constant interruptions of these necessary processes of unicellular life. The brain is now like an army of soldiers,

harassed by constant night attacks, to the extent that the individual soldier is kept in line, day and night, with no time to eat, sleep, or attend to his personal wants.

The brain cells, although still unrested, and but half purged of their waste products, are compelled to resume unification in self-consciousness, when a person wakes. In consequence, they enter upon the labor of another day, fagged and unrested — the condition which thousands of our people know so well.

In time, these cumulative effects of unrelieved fatigue show themselves in depressed function throughout the organism; the organic harmony is vitiated; nutrition is permanently impaired; and a shrunken, deranged condition of the neurons becomes chronic. *Pari passu*, the personality slackens, and character sinks to lower levels. In fact, it is not too much to say that humanity at present is composed largely of the chronically tired. The process of cell deterioration begins, and the first downward step is taken, when we rise in the morning with a distinct sense of being not yet rested, and enter on the toils and duties of the day still unrefreshed.

In America, at present, no other one reform is so urgently demanded for the national well-being, as proper, normal rest for the brain cells of the people. After the age of thirty few among us know what natural sleep and sound rest are, or ever will know again. For many have passed the point of brain damage where sound rest can again come to them. Thousands of these hapless ones take refuge in that dreary land of drugged slumber, where chloral, morphia and the later host of commercial nostrums hold nightly orgies over "the carcase of murdered sleep."

All of us who have had a normal childhood and youth, can recall the time when we were wont to wake in the morning feeling rested, with a willingness to rise and resume the business and pleasures of living; when we awakened with a happy sense of having been soundly asleep, so soundly that the world looks almost strange for the moment, in its newness. That is the normal time, when the neurons are properly refreshed and renovated; it is that ideal condition which we should strive to maintain through life.

OTHER OPINIONS OF BIOLOGISTS

In this connection the views and theories of other biologists are of interest. Those of Weissmann, Darwin, Minot and others have been cited already. More recently Muhlmann (1900-14) has advanced the concept that old age ensues from emaciation of the cells, due, largely, to isolation from sources of nourishment.

Delage (1903) has held that old age comes from differentiation, that is, specialization of the somatic cells to particular functions and uses, and that from becoming thus specialized, these cells ere long lose the power for further reproduction and growth.

Kassowitz (1898) attributed old age to accumulation of "metaplasm" in the cell, which may be described as chemically obdurate products of imperfect metabolism. When a cell acts sluggishly, metaplasm forms instead of normal waste products, and in time overburdens the cell life.

Jennings (1912) put forward a theory not unlike that of Delage, in effect that the cells of the organism, from being impressed to the duty of forming muscle, bone, gland, cuticle and other organic tissues, thereby lose their capacity for growth and reproduction.

Enriques (1907) believed that old age and death result from gradual decline in the capacity of the cell to assimilate nourishment, and that this decline is associated with decrease in the amount of active, normal protoplasm — cytoplasm — in the cell body.

Again, according to von Hausemann (1909) it is the atrophy and disuse of the sexual organs, accompanied by the extinction of the germ-plasm (Weissmann), which induces senile aridity and old age.

On the other hand, Minot, in his work on *Age, Growth, and Death*, previously mentioned, held that old-aging begins even in foetal life and is a continuous process, associated with molecular changes in the cytoplasm of the cell, and an abnormal enlargement of the cell nucleus.

Child in his interesting work on *Senescence and Rejuvenescence* (1915) entertains views somewhat similar to Minot's, but only as regards progressive changes in the protoplasm of the cell

body. He holds that cell rejuvenescence in animal organisms takes place when circumstances favor it, and inclines to the opinion that old-aging is by no means a fixed, unalterable law of life. Virtually, as a result of his researches, this zoologist concludes that the cell-of-life, under most conditions, is capable of and still retains the capacity for rejuvenescence: the same position taken, in a work entitled *Natural Salvation*, published from this laboratory in 1903, quite without connection with, or knowledge of, the work being done at the University of Chicago. The coincidence furnishes contributory force in evidence of the conclusion reached.

Conklin (1913) would appear to have come to similar conclusions, although along somewhat different lines of thought.

Jickeli (1902) put forward the hypothesis that senescence results from imperfect metabolism within the cell and the subsequent clogging of the cytoplasm with injurious waste.

Montgomery (1906) believed that owing to restrictions of its environment in the tissues, waste products accumulate in the cell and that certain of these products are poisonous to protoplasmic life, or become so, when not removed. Senescence is a general result of this condition.

In contra-distinction, Butschli (1882) concluded that old age and death are due to exhaustion of the supply of a certain "life ferment," inherited in the embryo; while Muller, and after him Cohnheim, found the causes of old-aging in the general make-up of the animal organism, its physiological imperfections and tendency to "run down," in time.

The impression which must needs follow consideration of all the theories of old age, which from time to time appear, is that each is partial, that is to say, embraces but one aspect of the subject. For example, one investigator holds that old age is due to differentiation of cell function and consequent loss of the power of growth; another, that it comes from cell stasis, owing to unremoved waste products; another, that the cells are killed out by toxins; still another, that the faulty constitution of the animal organism tends to brief lifetimes; yet another, that a progressive change in the protoplasm of the cell leads to age-stiffening, cell torpidity and final cessation of its vital activities. Another finds senescence ensuing from cell starvation; another, from a sediment of metabolism; another from atrophy of the germ-plasm in the sex organs;

and yet another, to the exhaustion of a certain inherited "life ferment."

Critically examined, it becomes evident that many, the most, of these "causes" of old age are incidental and of the nature of sequences, also that none of them accounts for old age *in toto*.

It appears to be a fact that differentiation of cell function, and specialization to different offices for the well-being of a multi-cellular organism as a whole, does impair, or rather lessen the capacity of the cell for reproduction and growth. The mistake made in recognition of this, lies in jumping to the conclusion that the capacity is entirely impaired, or abrogated; it is never entirely abrogated as long as the cell life continues.

In the human organism the capacity for cell growth and reproduction continues to the century mark, in the male; and in the female, cessation, at an earlier climacteric, occurs from causes other than limited cell capacity.

Among biologists uncertainty on the subject of cell growth and reproduction has arisen from non-recognition of the manner in which the somatic cell grows after the type limits of the organism are reached.

The present writer has derived much encouragement for his views, from a perusal of Professor H. F. Osborn's recent work, *The Origin and Evolution of Life* (1917). If my understanding of Professor Osborn's view is not at fault, he believes that hitherto naturalists and biologists in their long quest for the cause of evolution, have made the mistake of reasoning *backward* from the forms which the evolution of life on the earth has taken, instead of *forward* from the cause of that evolution;—the cause of it residing in the intimate nature of energy which has in it not only the potency of life, but directive power to instigate and produce organic life as we see it. I am led to infer, perhaps too hastily, that Professor Osborn conceives of the cosmic energy as living energy, rising, through organization, to higher degrees of consciousness and intelligence.

IMMORTAL LIFE

HOW IT WILL BE ACHIEVED

PART II

THE BREEDERS' METHOD OF LONGEVITY

ADVANCING from the foregoing studies and researches as to the source of life, its methods of evolution and the many causes which limit and restrict it, we have now to consider the means by which life in the human organism may be prolonged at will, and deathless life attained.

And merely as preliminary to this more intimate examination of agencies for perfecting and preserving the human organism, it will be appropriate to glance at a proposed method of attaining great longevity which commends itself to certain biologists, and which may be described succinctly as the Breeders' method.

It has been remarked frequently that if as much attention were given to breeding mankind as is devoted to breeding horses, cattle and dogs, grand results might follow. A prominent American naturalist is of the opinion that a macrobiotic race of human beings whose length of days would, in time, approximate immortality, could be developed by mating individuals whose ancestors were longer-lived than the average; that a progressive gain in the lifetimes of their offspring could be thus secured from generation to generation, until man might come to attain patriarchal ages, and older.

For example, if two young persons whose grandfathers, or grandmothers, or both, had reached the age of ninety, were to marry and have children, the naturalist would expect — accidents of environment allowed for — that certain of the children of this pair would reach greater age than ninety. He would look for a gain in longevity, a gain of a few months, at least, even of a few years.

four or five, perhaps. And later, if the children or grandchildren of these who had reached the age of ninety-five, were to wed and produce offspring, some of these might reasonably be expected to reach the age of a hundred; and from these, *pari passu*, offspring would be looked for some of whom would live to be a hundred and five; — a hundred and ten; — a hundred and fifteen; — a hundred and twenty, *in extenso*; till after one or two hundred generations, and the lapse of six thousand years, let us say, persons would be born whose outlook for life might be for a millennium; veritable Methuselahs.

Necessarily, as to this, the ages of the grandparents and great-grandparents would be the criteria influencing choice of mates of persons of marriageable age, since the ages of their immediate parents would not yet be available for guidance.

Such knowledge as has been gained from experiments in breeding domestic animals would lead us to infer that there would be occasional backsets of the nature of reversions, where even the offspring of long-lived ancestors might not make steady gains in longevity. So many factors enter the problem and so many "faults" exist in the long line of human ancestry — the result of vital disasters in the past — going back a thousand generations, that anything like uniform gain in longevity from one generation to another could hardly be looked for. Nature does not accomplish her ends with mathematical regularity; and there is much that is still inscrutable in heredity.

It is evident also that such eugenic self-management of marriages might be improved by systematic selection of other traits and excellences of temperament, which of itself would act to ensure greater vitality in offspring, and hence prolong life. Equally evident, too, that as marriages of young people come about at present, there is little likelihood of such eugenic procedure being adopted in one in a hundred cases. A long time will elapse before "falling in love" among young people will be tempered by reference to the breeding of a healthier or longer-lived race.

Beyond doubt "falling in love" has its physiological basis and subserves certain ends for the propagation of normal offspring; yet it is evident to the merest tyro in such matters that young persons are constantly marrying who ought not, if the welfare of the race were to have proper directive influence.

It might be noted, too, that the longer-lived the generations became, the more slowly the increment in longevity would accrue. Also the tendency to a slackening of procreative desire in the generations which live long and happily would have to be allowed for; since it is a well observed fact that procreation is most rapid and avid among those who fare hard, live badly and have few pleasures save sexual gratification. Logically and by natural law procreation will cease when the individual becomes deathless, and enters upon joys of a higher order than sensuous.

But judging from what we know of heredity at present, longer-lived individuals could be bred as above contended. Such prolongation of life may be described as a natural method for attaining longevity, one which might go on with little reference to future discoveries. It might, in fact, proceed with no more reference to such discoveries than is seen in breeding the trotting horse, or improved strains of beef cattle, or of sheep for better mutton or longer wool. Would it, like many such breeders' efforts, prove self-limiting in time and periodically revert to original stocks? Something in the terrestrial habitat and present mode of nutrition appears in the end to limit the breeding of a better animal, where the development of brain and the growth of knowledge is not the principal factor invoked.

For it will be noted that all such attempts to breed better animals originate in and are in reality dependent on the brain of man. It is human intelligence that does it; and when that directive intelligence is withdrawn, the animal soon reverts. If applied to mankind instead of horses, it would still be an act of the human brain.

Hence it is not to the breeders' effort, pure and simple, extending through a hundred generations — though this, too, may be invoked as adjuvant — that we are now looking for the achievement of immortal life, but to science and discovery, to the evolution of brain and the growth of knowledge.

The conviction obtains that with the accelerated growth of knowledge it will not be necessary to rely wholly or in large part on "nature" and heredity. The end we seek will be attained more rapidly and come sooner, from applied science. We shall rely on nature only so far as brain is nature; — and the human brain is a phenomenal development. Terrestrial orders of life

tend to race stasis, all except man in the particular of his brain. It is from the particular of his marvelous brain development that we predicate this next and greatest of human achievements.

TWO DISCOVERIES WHICH WE NOW HOPE FOR

Two discoveries, even two, of those now opening to view, both well within the proper province of scientific research, will, we hold, when associated with the co-related progress of science in other fields, bring us vastly extended life with promise of deathless life if we desire it: —

First, improved nutrition, looking to a bio-chemically perfect nutrition, of the cell-of-life in the human body.

Second, the discovery of the intimate nature of brain cell energy, or nerve force, enabling us to generate it, and apply it at will for restoration and maintenance of the cell.

There is generation of electricity by the cerebro-spinal group of cells, also production and projection, by will power, of a certain sublimated, highly vitalized substance which is borne along the nerve trunks by the electricity.

These two lines of research, in co-operation with the psychic factor — mentioned later — are the ones indicated from our present studies of the subject.

The way to a perfected nutrition — the vehicle and means of it — lies, of course, through the blood stream, that veritable river of life, along the banks of which the component cells of the organism are collocated. We have to purify, transform, and rectify this sanguineous stream of nutrient plasma, bringing it to those higher degrees of chemical efficiency where perfect assimilation takes place in the cell, accompanied there by accurate action and reaction without that waste, detritus, or residues, which now induce cell old age and resultant organic old age.

That chemism on the earth's surface furnishes such a basis of action and reaction — as a foundation for scientifically perfect nutrition — is now well demonstrated.

We have first to consider and to study what the organized cells of the human body have done, co-operatively, to produce in the blood plasma a certain desired cell food — produce it by means

of that marvelous joint effort, seen in the stomach, liver, pancreas and intestinal glands. And we have then to take up this blood plasma, test it experimentally and improve it till a perfect cell food is obtained.

Glimpses and hints how this chemically perfect nutrition may be attained through the blood are of late numerous, from the pathological side, and in the guise of the so-called ferments, serums, opsonins, vitamins *et al.* The merest hints as yet. None the less, in that quarter, through a transformed and rectified blood stream, breaks a new day of great hopes for the cell-of-life.

Beyond much doubt at present the ultimate "food" of the protoplasmic molecule of the cell consists of electrons, liberated by the cell metabolism. But the cell as we now have to deal with it, in our first efforts to render it deathless, is a small organism, with a digestive or metabolic apparatus which we have to reckon with. It seems probable, therefore, that a cell food, composed of, or attempered by, organic substances like the "ferments," secreted by the internal glands, may be a desideratum, for a time.

We inherit a large, extended apparatus for the reduction and assimilation of such foodstuffs as the earth has offered us. That apparatus has yet to pass through a period of involution, graduated to scientifically improved food in lesser bulk. The inner cavities of the organism are to be cleansed and safeguarded from the hordes of noxious bacteria which now swarm there. That apparatus of metabolism which we receive from our ruder ancestry, is now ours to regulate, improve and transform to a veritable sanctuary of life, from which everything foul and impure must be excluded.

But first a skilfully compounded cell food — such as a few years of experimentation with the products and ferments from the glands of stimulation and regulation will afford — is what we have in view.

It is these first feeble steps which we are now essaying, these first early efforts of which the world is now so doubtful. The promise in them has not yet unfolded, but it is there. The orient halo of it glows low on our horizon. If only faith, faith to work together, can be awakened, we who now live may see the glory of its dawning, see the great, immortal universe expand ahead, without the black shadow of death for us, personally.

In this connection, too, it seems proper to say again that it is not merely years added to three score and ten that we are seeking. Not merely the control of nature, but larger, grander personal life—the apotheosis of the human soul. Not a “discarnate” soul, “coming back” to rap out inane messages at the beck and call of some abnormal “medium,” but progress, growth in knowledge and thought.

The deathless life which we seek to win by science is but the first step to a greater, grander life, for the evolution of which the present brief human lifetime no longer suffices. More time for growth in knowledge is needed. The brain of man, the human mind, is as yet but an embryo for such potential growth. We shall enter into this greater life only when we have more time for it. Hence the first step is to achieve freedom to live.

PRESENT IMPERFECTIONS OF THE NUTRITIVE PROCESSES

More practical considerations present themselves when the problem of a perfected cell food is examined in detail.

Food is what can be converted within the organism and brought into condition fit to nourish the cell-of-life. It therefore implies the ingestion not only of nutrient particles, but water and air. An improved nutrition calls for solid matter, accurately proportioned to the wants of the cell, clean water and pure air—the latter free from floating dirt which mechanically obstructs the pulmonary tissue, and from noxious gases which poison it: requisites difficult, indeed, yet scientifically possible.

Much as human food has been improved, man still eats like the lower animals, following untrained appetites, bolting food contaminated by putrefactive bacteria, and often containing germs of deadly diseases from which he escapes only by intestinal good luck, or an inherited immunity, from ancestral selection, through hundreds of generations of kindred that perished. By means of cookery he does not swallow quite as much filth and microbic life as the ox, the horse, or the dog, but only a degree less, and the net result inside him is much the same, namely, putrefaction and accumulations of malodorous waste so deleterious, so poisonous

to life, that the only wonder is that he can carry about within him burdens so abominable and yet survive. For the epithelial lining of the lower intestinal canal consists of millions of living cells — the divine cell-of-life — and these artisans of our personality have all their lives to live in contact with this toxic burden of filth. It is, indeed, a wonderful instance of what the cell-of-life may become specialized and hardened to endure. Metchnikoff sought to devise an antidotal dietary for internal putrefaction, and even suggested that a part of the intestinal canal — the colon — might well be dispensed with, by excision.

This latter suggestion has a certain cogency, yet it seems probable that the better path to internal lustration may come from cleansing the internal cavities and, afterwards, watchfulness as to what is ingested.

Emulsion, chylification and oxygenation of foodstuff internally is not of itself a repulsive process. Freed from ingested filth and putrefaction, the various steps of digestion and assimilation are chemically pure and sweet. The foulness and stench come from extraneous causes which set up chemical reactions unnecessary and injurious to life. Curiously absurd is the opinion of certain physiologists that these intrusive bacteria in the lower bowel are necessary to digestion and assimilation; that nutrition could not go on without the adjuvant agency of putrefactive bacteria: a case where an incidental and unfortunate condition is mistaken for a necessitous one. It may be set down as a general law, that what is revolting to the sense of smell, or taste, is hostile to cell life, since smell and taste are the organized agencies for choice of what is good or bad. Inured to foulness and stench the cells of the intestinal tract may have become, but not because they like it, or because it is good for them. It is one of the present imperfections of life in animal organisms. Nor, we repeat, is there anything necessarily foul or repulsive in the reduction of food to a condition fit for assimilation and passage into the blood plasma. The process when normal is sweet and clean to taste and smell. Indeed, the internal cavity of the human body should be, and may yet be made, a very penetralia of life, the sanctuary of a holy purity. It may be well to keep in mind that cell nutrition probably implies a replenishment of electrons. By virtue of the processes of metabolism, electrons are apparently derived from the

blood plasma and go to restore the cell substance. Esoteric processes go on within the cell which draw in electrons, liberated from the breakdown of food substances, and distribute them for the renewal of the component atoms and molecules. All of which is accomplished under nature in the animal organism at present with errata of excess or failure, a per cent. of deficit and damage constantly accumulating through the period known to us as the individual lifetime. It is a perfected nutrition of the cell-of-life throughout the organism which biological science has now in view. Upon such perfected nutrition rests the hope of deathless life.

Reverting to the solid constituents of food, even when these, as a result of laboratory selection, have been skilfully composed, rendered palatable and put in form for ingestion, they must at present be subjected to the organic routine of preparation for assimilation: the routine which we inherit. Our food must still be acted on by the saliva and gastric juices, mingled with bile from the liver, with the pancreatic ferments, and juices from the many intestinal glands. It must be admixed with the secretions of the lymphatic system, and after absorption, must still further be oxygenated in the lungs, and metamorphosed by the secretions of the ductless glands, and by the activities of the abundant cell life resident and natatory in the sanguineous circulation. All of which juices, ferments and cell activities are adapted and graduated to food as at present ingested, with all its crudity, contaminations, and disproportion to the actual wants of the cell-of-life.

At first and at best this will be like giving a fine job to a rude artisan, or a coarse machine; but it is the only course open to us; and imperfect as is the apparatus at present, we need not lose sight of the fact that it is one having in itself the faculty and the power of renovation and readaptation. It is what we find it by reason of the imperfect food with which it has had to deal; and by that same token and that same adaptive power, it will readapt itself to new and better food. We need not lose faith in the cell-of-life to do, and to be, what the organism requires.

The food of the future, compounded in centrally located food laboratories — instead of the millions of household kitchens with their imperfections of dirt and microbic infection — will be a masterwork of organic chemistry, perhaps in tabloid form, most

probably in portions of various sizes, enclosed in sealed glass jars. It will contain the carbo-hydrates and the nitrogenous constituents necessary to the nutrition of the cell, attempered by those ferments which promote assimilation and stimulate cell life.

This perfected food will be ingested in such a state of chemical instability as to relieve in large part the present hard work of digestion, with its vast absorption of vital energy. It will be far less in quantity and tend greatly to reduce the size of the internal cavity, and also obviate accidents of gas, mechanical obstruction, and decomposing waste. It will make possible the elimination of most or all of the morbid bacteria with which the lower portions of the alimentary canal now swarm. It will be attended by a gradual involution of the present internal organs — stomach, liver *et al.* and their functions — not only reduction in size, but changes in the quality of their products and the mutual activities and combinations of these products, all tending to a less exigent, more accurate metabolism. Certain gland tissues may even become desuete, because in the newer, better organic economy, they will not be needed.

DESUETE ORGANS NOT NECESSARILY DANGEROUS

This will infallibly raise the old question of danger from desuete organs, on the supposition, once prevalent, that they become a nidus for disease and foster malignant growths. Physicians at one time inclined to this opinion. Longer observation, however, has led to the conclusion that desuete tissues are no more liable, not quite as liable, indeed, to disease, as the tissues of normally active organs, the vermiform appendix being an apparent exception solely from its situation. Due to its position it is liable to become a receptacle for poisonous waste.

The economic saving, due to use of food requiring fifty per cent. less expenditure of the vital energy for its reduction and digestion, will result not only in an access of physical comfort, but an access of power for greater mental efficiency; since not much under seventy per cent. of the entire potential energy of the body is now expended on food-reduction before it can go to the cells for their renewal. In many organisms, especially aged organisms,

the whole potential energy barely suffices for the reduction of food and passing it through into the blood plasma in a state fit to go to the cell-of-life. Deaths from old age, in fact, and in certain forms of disease result from further inability to reduce and assimilate food.

- A saving of one-half the vital energy, expended on food, will render the bodily health more stable, adding greatly to personal well-being and happiness.

EXPERIMENTS WITH CONDENSED FOODS

Experiments in food rations, variously condensed, concentrated and compounded as to constituents, have proved unsatisfactory thus far. Trial of such foods, usually in tabloid form, has been made in the English, German and other Continental armies, also on one or two occasions in the American army and navy; always unsatisfactory and generally disliked by the soldier, or sailor, for reasons which are immediately apparent as soon as the circumstances are investigated.

Beyond doubt — even in cases where the person making the trial was in sympathy with it, a month, perhaps two or three months, would be necessary to bring the stomach and entire digestive apparatus into condition to act to advantage on the new, less bulky food. Undoubtedly the person making the change would suffer discomfort and feel that his hunger was unappeased. The period of transition would be marked by contraction which, if made suddenly, would be painful or at least uncomfortable. A stomach and intestinal canal accustomed to a certain bulk of food, four or five pounds daily, let us suppose, would no doubt feel painfully empty for a time on thirteen ounces of concentrated food, and even fail to get in proper attitude to act on it. Accustomed to drinking a large quantity of liquids, too, the gland secretions would be dilute and insufficient for concentrated foods. In short, the reasons why concentrated rations have been pronounced a failure are evident enough to one possessing even a rudimentary knowledge of the animal organism, and do not conflict with the principle involved, nor discount the purpose of such modes of nutrition. It is simply that the person making the transition was

not in shape or condition to do it, owing to a previous cumbersome method of obtaining his nourishment; he needed to be gotten in form and condition for it; no easy matter after years of excessive distention. Beyond doubt the process should be gradual, beginning with small quantities of the new food, combined with the old, the process of adaptation continuing through a considerable period of time.

And of course it would be of great advantage if the neophyte was in full sympathy with the effort, and intelligent enough to understand its purport and the personal advantages coming to him from success in it;—instead of ignorance, prejudice and suspicion that it was some new-fangled concoction, gotten up to defraud him, and cheat him out of his proper food, for the benefit of his superiors. Little could be expected from experimentation on ignorant subjects.

Add to this the rather unattractive form in which concentrated rations were prepared, also the generally unpalatable flavor which they carried, and the reasons for their unpopularity with the soldier and sailor are apparent.

In fact the use of a perfected food, designed permanently to reduce the size of the intestinal cavity and relieve the hard labor of present nutrition, has never yet been attempted. It remains for investigation and experiment at a laboratory of co-operative workers.

In the matter of liquids, a sufficient quantity must needs be taken to ensure that normal fluidity which the organic functions require for procedure—no more. The human body at its best estate is not an organism which has need of profuse sudation. Great eaters and drinkers have need to sweat profusely to get rid of the results of excessive metabolism. The healthiest persons the present writer has known, have perspired little. Where there is great oxydation and hence great suffering in warm weather from heat, due largely to eating more than the organism requires, there is of course necessity for much water to facilitate elimination of waste products through the pores of the skin; since there is more waste than the internal emunctories can remove. It is well always to “keep the pores open.” But the idea that a person ought of necessity to perspire a great deal is erroneous. Such perspiration is pathologic rather than hygienic, or normal. What

we term "insensible perspiration" is quite sufficient for a person who does not overeat; nor is any good end attained by constant "flushing of the kidneys" by deluges of water. It is understood, of course, that we are not here speaking of a remedial use of perspiration in case of sudden "colds" which may, if neglected, induce pneumonia or intestinal disorders. Promoting a profuse perspiration and doing so immediately is then a sovereign remedy — the most efficacious of all remedies.

Presumably many different kinds and varieties of the improved foods, solid and liquid, will be devised, as time passes, graduated to the requirements of individual organisms with considerable exactitude. Sufficient data for beginning the preparation of pure foods are already in possession of physiologists. It would remain to compound the necessary constituents in available form, and in such a condition of instability as to avoid present violent chemical reactions in the alimentary canal, attended by excessive generation of gases, and exigent peristalsis. A very few years of experimental work would suffice to inaugurate this effort. Improved foods, however, are no more a desideratum *than the eating of them*. We still ingest food, in response to appetites which are often no better than the established habits of long misfeeding. Nor is there now the least doubt that "appetite" for certain kinds of food, often in excess, is transmitted from parent to offspring, not unlike the craving for intoxicants and narcotics. Man, indeed, is still so much an animal that he eats for the gratification of his mouth and stomach, regardless of reason or common sense. But he who would pass from death unto life *must eat with his brain*, rather than his belly-greed. Literally he must eat to live, instead of living to eat. But this regimen, this higher sentiment of nutrition, will come naturally and of itself with the hope of immortal life. Belly-greed, like sex-lust, will fade out as the sense of deathlessness grows. Nor is there reasonable doubt that the human organism will safely adapt itself to the new, improved modes of nutrition, though of course an infant will do so more readily than an adult, or an aged person.

THE OFFICE AND FUNCTIONS OF THE ENDOCRINE GLANDS

Closely connected with this subject of perfected nutrition and a chemically accurate cell food is an important line of experiments, through the blood circulatory, having for its object to rectify, fortify and give tonicity to the tissue cells, by use of the products of certain glands of the animal organism, or by reagents artificially produced of the nature of those gland products, or by "serums" from the blood of animals which have been thus fortified and rectified.

We have always to keep before us the mental picture that it is by virtue of the nicely-adjusted and nicely-balanced action and interaction of every gland and every organ of the body, that the present vital tonicity of the cells is preserved and their food produced for them in the blood plasma. If one or any of these glands or organs falls out of normal function, the cell life suffers: a condition frequent in aging organisms. We have then to attune the organism to the note or key of adolescence by scientific procedure.

There are, as is now well understood, thirty or more internal glands, sometimes called ductless glands or endocrine glands, variously located in the organism, the office of which is to secrete substances which are absorbed directly into the blood stream and serve to stimulate, or retard, the activity of the cells in certain organs of the body. The secretions from these glands have been classed as *hormones* when they incite cell activity and *chalones* when they retard it — terms devised from Greek words signifying to quicken, or to retard. These secretions appear to have chemical affinities for the cells of different organs, or from another point of view, to be under the guiding control of the subconscious life of the organism as a whole — secretions called into existence by its wants and necessities. These substances give rise to antibodies, so called, in the blood stream, which act and react on the life and products of the tissue cells.

Among the internal glands thus far studied, are the suprarenals, thyroids, parathyroids, thymus, pituitary body, pineal gland, pancreatic glands (Islands of Langerhans), not to mention the

ovaries, testes, parotids *et al.*, not ductless, nor the multitude of intestinal glands. The organism, in fact, has within it a congeries of gland tissue the secretions from which appear not only to incite and inhibit cell activity, but to interact and modify each other in the blood stream;—that river of life, like some great national river, where everything swims: nutrient particles, enzymes, hormones, chalone, cell semina, disease germs, pathologic particles, waste particles as of urea, carbonic acid gas, etc., which every breath oxidates, every indiscretion befouls.

Of the physico-chemical substances which the internal glands secrete, some affect the growth of the organism as a whole, others certain parts or organs only, giving rise to deformities. Certain of them arrest growth altogether and delay functional development. For example, derangement or injury to the pituitary gland beneath the brain may result in dwarfish stature and a general retardation of normal growth. On the other hand excessive secretion from this gland results in gigantism, excessive growth of bone, muscle and adipose, with profound changes in physiognomy and even in personal character. As to what might be accomplished by experimentation with the pituitary gland or the thyroids, the inference is plain. Very suggestive, very potent agencies are here within our grasp.

Nor are these agencies confined wholly to the strictly ductless glands. Certain of the duct glands emit secretions other than those with which we are most familiar. Apparently the spleen, the pancreas and even the liver have their secondary or adjuvant secretions, as also the ovaries and testicles. The secondary incitants to development which come from these latter glands, at a certain age, has long been a matter of observation. Corroborative evidence as to this has been furnished by experiments with capons in which the testicles of young cocks were transplanted, resulting in a re-development of comb, crowing, pugnacity and salaciousness. Nor has it been found essential that the transplantation of these gland cells shall be made within the pelvis, since much the same effect on the organism as a whole is produced, when such cells are engrafted in other parts of the body! It is not the purpose here, however, to enumerate the many interesting experiments which have led to the conclusions above recorded.

In that general decline of the component cell life which we call

old age, the cells of the internal glands gradually grow inactive, torpid, or die, with the result that a lessened, altered or pathologic product takes the place of the normal one, and the entirety of cell life suffers from lack of its former regulative stimulus. It is just at this point where decline and degeneration begin, that our line of research aims to arrest old age, by supplying to the blood the equivalents of these earlier secretions. It is here that rejuvenation must start. It has been demonstrated that every cell of the body can be thus rejuvenated if we can get to act on that cell with the proper reagents in the blood stream. It is a weakened, deteriorated blood stream, often vitiated to a poisonous degree, which induces cell old age.

SUGGESTED METHODS OF PROCEDURE

As regards methods of attempering an improved food, with the secretions of the internal glands or their chemical equivalents, in order to secure invigorating effects from them upon the cells, many expedients suggest themselves. The object, as must be kept clearly in mind, is to introduce into the blood stream which is rapidly propelled to all the cells, that high grade nutrition which in healthy youth is secured from chyle, avidly digested and commingled with secretions from all the adjuvant glands. Adolescent nutrition sometimes presents a picture of what we hope to secure for the cells of all the tissues even in advanced age. We are here following nature's paradigm, perfected during a million years. We hope to reduplicate the best results nature has attained. Hitherto old age has been regarded as a law of nature. I have shown that it is not a law, but a sequence, incidental to the imperfections of life as we at present live, and hence a condition to be improved and remedied by the growth of knowledge.

What we have learned of the effects of engrafted cells naturally suggests implantations of gland tissue, but this implies surgical operations not to be lightly undertaken at present. Inoculation appears more practicable. Endosmosis of fluid ferments to the blood stream, facilitated by currents of electricity, has also been advocated. Certain experiments, too, have led to the conclusion that if the organism is put in urgent want of fluids and nourish-

ment, the pores will substitute as absorbents, retroactively. Dosage by the stomach and alimentary canal is always open to the objection that gland products, thus ingested, may be altered or neutralized by the gastric and other "juices" of digestion.

It is along these lines of research and experiment that a number of years' work now needs to be done, by fifteen or twenty physiologists, working in co-operation: the enterprise which the present author has had in view since 1887.

Science, our future science, may devise a better mode of nutrition for the cell-of-life than nature has yet attained in young organisms; but at present nature's method, through the blood plasma, is the best we know, and hence the one to be pursued — until bio-chemistry has made further discoveries. In the case therefore of adult or enfeebled persons, the present plan would be to recover lost ground by use of *the secretions of the internal glands, or their chemical equivalents, blended as in healthy youth*; — and so work back to the competent cell metabolism, seen in young persons.

There is under observation here at present an adolescent, aged twelve, in whom cell nutrition appears well-nigh perfect; also two young animals. The secretions from the internal glands are manifestly normal and blend harmoniously to actuate cell growth and development to the type limits. The overflow of cell growth — heredity-chromatin — resulting from type limits being reached, begins already to be regulated and given direction by the glands of reproduction. If anything like the health and vigor of the examples cited, can be reduplicated in adult or aging organisms, a long step will have been taken in our quest.

It is also worth remarking here that the renewed health and vigor which it is hoped may be thus reduplicated, will prove remedial and curative for most of those diseases which appear as middle age is reached. Renewed vigor is nature's cure for most of the ills of life. People "get well," if nature can be rallied to make a fresh start.

It is here, again, that experimentation should be begun and continued patiently in animal subjects for several years. New great discoveries, suddenly made, may enable us to supersede nature's methods, even as, in locomotion, steam and electricity have superseded the plodding foot of the vertebrate. Nothing is risked

in making the prediction that ere many years, the nutrition and maintenance of the cell-of-life will come completely within control of applied science; and even that in place of parturition as it is at present accomplished under nature, with pain and risk to life, the human heredity-germ will be incubated outside the mother's body; and that the whole wonderful process of embryonic and foetal growth may be watched day by day under glass. Nature is to be imitated only so far as we have not learned to improve on her methods. Nature is by no means infallible, nor yet to be blindly venerated.

The secretions of the internal glands have been subjects of study and speculation since the days of Brown-Sequard, and before. The difficulties in the way of obtaining them continuously and normally from living animals are not yet surmounted. Extracts made of these glands, excised from animals, are not satisfactory. Synthetic production of the bio-chemical equivalents of the secretions is the indicated solution of the problem; and it is a matter for regret that research in this line cannot be initiated at once.

Complicated as is the problem of perfecting cell nutrition, it yet presents no new factors, and calls only for intelligent experimentation along lines already indicated. Were the work undertaken by a group of trained observers, having this end clearly in view, a very few years would suffice to bring out the data for it. No insuperable obstacle confronts us. All depends on going about it with a formed purpose and an ambition to do it. What we have ever to bear in mind, however, is the fact that the best food now obtainable — considered as food merely — would prove but a useless factor in our quest, if the organism into which it is *introduced does not lay hold of it and assimilate it*. If the ingesting organism does not properly act, that best of foods might prove but injurious, or even poisonous. The constituent cell life of an organism senescent or enfeebled by disease, must be reclaimed and reinvigorated.

How far and to what extent the use of secretions from the endocrine glands, or their chemical equivalents, may enable us to accomplish this necessary reinvigoration and maintenance of the cell life in adult organisms, has not as yet been demonstrated by actual experiment. Something, much we hope, can be done, by attempering nutrition with such reagents.

The problem in rejuvenescence which presents greatest diffi-

culties is the renewal of the cell life in the shrunken tissues of aging organisms, meaning the re-population of tissues with cells in cases where the original endowment from the embryo has died out entirely, leaving only lifeless formed matter, as in old bone and tendon, or where the cells have shrunken to encysted nuclei which are wholly desuete or torpid, not wholly unlike certain small, hibernating animals in their winter burrows.

It has been found that certain ferments from secretions of the internal glands stimulate nature in instigating new proliferations of old cells. Latterly, too, examinations of old tissue, made at this laboratory, indicate that encysted, dormant nuclei of the formerly active cells, exist in nearly all such senescent tissues and in far greater numbers than was at first supposed. These desuete nuclei of cells seem indeed very loath to become vitally extinct, perhaps never do so wholly as long as the tissue continues actually alive, within the cordon of the sanguineous circulation, and under the influence of what has been previously described as the aura of the neuro-electronic circulation. Beyond doubt, too, these nuclei may be reinvigorated, and made to take on cytoplasm again, as long as they remain alive — like certain torpid micro-organisms in pools which have dried up.

DR. SERGE VORONOFF'S EXPERIMENTS

One of the more recent attempts to combat old-aging by implantations of glands from young animals of the same species — following the line of research first attempted by Brown-Sequard — has been made by Dr. Serge Voronoff of the French College of Surgery. Dr. Voronoff's experiments were made with sheep — old and young rams — also senile men in whom glands from monkeys were implanted as grafts. Certain of these experiments were thus described in a Paris journal: —

“ M. Voronoff a pratiqué 120 expériences sur des chèvres et des boucs normaux et châtrés. Le but de ces expériences était de voir si la greffe peut fournir une sécrétion endocrine. Les examens histologiques ont été faits par M. Retterer. Les greffes étaient représentées soit par un testicule entier (25 fois), soit par un

gros morceau de la glande (58 fois), soit par un petit morceau (37 fois). Elles ont été placées tantôt sous la peau (32 fois), tantôt dans les bourses (85 fois), tantôt sous la péritoine (23 fois). D'une façon générale les parties périphériques de la greffe survivent, les parties centrales dégènèrent. Les fragments de la glande se greffent mieux que la glande entière, et au point de vue physiologique les effets sont les mêmes. Quant au siège, c'est dans les bourses que la greffe a le plus de chances de réussir. Le testicule greffé sur les femelles ne semble avoir aucun effet si ce n'est un arrêt du développement des os longs. Par contre l'action est des plus nettes sur les mâles châtrés et sur les vieux mâles. En particulier une expérience sur un vieux mâle épuisé a donné des résultats suivants: quatre fragments de testicule ayant été greffés dans la vaginale au-dessus du testicule normal, l'animal se transforma rapidement. Deux mois après la greffe, il put saillir une chevre et la féconder. La greffe ayant été enlevée, l'animal vieillit à nouveau, et une nouvelle greffe réussit comme la première et eut les mêmes effets."

It is not difficult to predict that gland grafts, as described in Dr. Voronoff's experiments, will not permanently renew the youthful estate. None the less certain well-marked results have attended them. Yet all such efforts are still in their first crude stage. It need not surprise us, nor dishearten us, if no complete, permanent results in the way of rejuvenation have yet been attained; nor that ribald criticism has followed, from certain sources. The effort is in its infancy as yet; better, improved methods are sure to follow. Consider how aviation stood twenty years ago: the feeble, first efforts to fly and the public ridicule that attended them. These efforts at rejuvenation are full of promise. They will ere long prove gloriously successful.

It is the actual chemical nature and composition of these gland secretions which we now have need to study and analyze, with a view to their synthetic production, or practical derivation, prior to introduction in the sanguineous circulation. Ultimately such introduction may be accomplished by means of admixtures with the daily food. Even a decade of systematized study and experimentation along these lines, with this end clearly in view, would set us far on the way to renovation of the somatic cell life.

NERVOUS ENERGY; ITS COMPOSITE NATURE

The other line of research — previously specified — concerns itself with that aura, or “field,” of nervous energy to which allusion has more than once been made, as the neuro-electronic circulation.

This term may prove inapt when we have learned more as to what this emanation from the cells of the brain and spinal cord actually is. At present we know that currents emanate from the cells of the cerebro-spinal system, currents which control, actuate and maintain, functionally, the outlying tissue cells of the entire animal organism. In analysis of this emanation we have proceeded far enough to learn that it consists of electrons plus a more ethereal efflux from the brain and nerve cells; that this efflux exhausts those cells to the extent of rendering periods of rest and recuperation frequently necessary; and also that a marked provision has been made in all animal organisms to insulate the emanation and prevent it from wastage.

Much farther we have not gone at present writing, but deem further experimentation exceedingly desirable.

We wish to know the nature of this emanant current and learn whether it, or its equivalent, can be generated bio-chemically, or obtained in large measure from lower animal life — obtained for remedial action on the human organism.

What is meant and sought for may require fuller definition.

At the outset it may be set down as a general principle that what induces life in the cell — that attribute of energy which comes to us from the sun and gives rise to life in terrestrial matter — is what we have need to isolate and utilize for the renovation of human life when the organism grows senescent. In a word, what causes life needs to be used to renew and ensure life. Once this source, this form or mode of energy, were mastered and brought under control, all the frailties and imperfections which appear, as secondary results, in the larger metazoic organisms, might be made to disappear, as when the light of a smoky lamp is rendered star-like by a better burner, giving perfect combustion.

If Professor Jacques Loeb is correct in his deduction, every

human being differs "chemically" from every other; and human beings, as a species, even more markedly from the lower vertebrates; yet the metabolism and products of the cell-of-life in man are so similar to that of the dog, the horse and ox, that it appears not impossible that the neuro-electronic circulation of groups of healthy young animals may be drawn on, periodically, for the reinforcement of the cerebro-spinal cells of man.

Ultimately the more desirable method of such reinforcement would be, of course, reinvigoration of the brain cells, directly, by that property or mode of the solar energy which causes life. But owing to the great depth in particulate matter at which the sentient property of energy inaugurates life in the cell, the profundities of organic chemistry are not easily sounded; and resort may have to be made, for a time, to emanation from the brain cells of animals.

RESUSCITATION OF DESUETE CELLS

Only further experiments, too, will enable us to determine how great a per cent. of the cells in aged tissues are actually dead, and how many are merely desuete, that is to say, reduced to the condition of encysted nuclei, still alive and capable of being recalled to activity, if they could be reached by appropriate stimuli. The germinal chromatin appears to survive for a long time in cells which have ceased to be functionally living.

There are also certain observed facts which lead us to infer that the neuro-electronic circulation, when intensified, and pervading an organism at full tide, is of itself a power for renewal of the cell life in tissues where it appears to be dying out. By this is meant that even desuete cells may probably be rejuvenated from strengthening the neuro-electronic circulation — by agencies previously mentioned. But all these questions await further experiment and careful observation.

THE PSYCHIC FACTOR FOR DEATHLESS LIFE

Lastly we have to estimate the psychic factor for the achievement of deathless life, the factor which, from many points of view, should be considered first.

For if we are to begin at the beginning, the first step to the achievement of immortal life is faith that it can be done. But because the physics of faith are less easily demonstrated, and exact data are lacking, we have reserved it for final mention.

And by faith is meant not an idle, superstitious effort at belief, enjoined by constituted authority, not a straining to believe something little understood, but that rational confidence, which engenders ambitious purpose, incites the will to persistent activity and leads on to an orderly marshaling of all the discoveries of science for the accomplishment of a certain desired end.

Not without a deep, well-nigh divine insight did the greatest of all teachers exclaim, "Without faith it is impossible to please God" — which, in the less metaphorical thought of modern times, signifies that godlike achievements require confidence for their inception. Supplement this declaration with that of another great teacher of immortality, that "faith, without works, is dead," and we have outlined the rationale of the scientific rebirth of Christianity, the practical realization of its grand ideals of heaven and immortal life on the earth.

Apocryphal accounts and stories of what has been accomplished by faith, may be passed by, as also that voluminous narration of cures at shrines and pilgrimage goals. In much the same category of uncertainty are the cures by faith-healers and prayer-makers. In case of patients with strong imagination and much hypersensitiveness, where their confidence has been fully gained in the healer's powers, remarkable results are reported, some of which seem to have been more than transient.

It appears — and our own studies of nervous energy bear out the hypothesis — that there are not a few persons who possess the ability, or gift, to project through their palms when in close contact with those of their patients, currents of nervous energy from the "field" of their own organisms, which act remedially, for a time, at least. These purely bio-physical phenomena are deserving of study; their bearing is of importance in our quest for the control of life at its source.

As to that organized effort to build up a national faith, now known as "Christian Science," it is, perhaps, too soon to speak confidently. Considered apart from many tenets with which it is now connected, the effort appears to be essentially one aiming to

generate faith on a national scale, to usher in a happy era when death and disease shall be evils of the past. In fact, one of the articles of the Christian Science creed is in effect that there is no such thing as death, the whilom king of terrors being merely an illusion of our mortal minds. A certain mysticism hovers over this portion of the creed. Nor are Christian Scientists, themselves, able to resolve it in terms an outsider can understand. "You must *feel* it," they say. "Then you will *know*." But if the appeal is to our *feelings*, death is something very real and sad.

All this, however, has little to do with faith as a psychic factor, in a great enterprise of research; faith as an intensive agent.

The physics of faith still transcend mathematics, but are none the less real and pertinent to every great undertaking. Faith founds in prevision of truths not yet demonstrated, but divined by the finer, deeper perceptions of the intellect.

Such faith, such prevision, unfolded before the eyes of Columbus, and piloted him across the unknown ocean. Such faith suddenly illumined the soul of Loyola with the ideal of a world, won to Christ, an ideal which led the heroic missionary crusade of the early Jesuits. Such prescient vision inspired Watts, Stephenson and Fulton, when they foresaw travel and commerce in the giant grasp of Steam. Franklin, when he went out to capture the thunderbolt; Faraday, Volta, Ampere and Edison, when they trained it for human service. Lister, when he rescued humanity from the hitherto unknown, unseen assaults of microbic life. Morse, Field, Bell, Marconi, when, with ear prophetic, they heard men speaking across continents and oceans. Always it is this faith, this ideal from afar, which holds up the torch to progress and leads the way.

THE INHERENT MORALITY OF LONGER LIFE

At best, we are but making a start on the quest for deathless life. Yet no prophet's ken is required to discern what might be done if research could be fully organized with this end in view. A quarter of a century might see cell nutrition accomplished with a considerable degree of accuracy; and in the farther future, the eye of faith may even now reasonably foresee the day when these

animal organisms of our inheritance shall be progressively transformed and transfigured to the more "spiritual" bodies of the apostle's vision, when, in very truth, "this corruptible shall put on incorruption." No miracle is needed, no supernatural rescue. The way lies open. Man can reach this diviner life by his own exertions. Nor should the effort be stigmatized as hardy or blasphemous. It will be through such lustration of the process of nutrition, such purging and cleansing from internal foulness, that we shall enter into the greater life.

What will follow the realization that death is not inevitable? What aspect, what guise will our lives assume when we come to know and feel that we have unlimited time ahead? What readjustments of former ideals will ensue? What changes in family life?

Lucretius pictured the calm of the gods. Certain it is that with the constant, daily expectation and dread of death lifted from our minds, a tranquillity will supervene which, of itself, will tremendously conduce to the conservation of life and its continuation. It is the present certainty of death and the chill of its shadow which measurably conduce to dying. We are, in a sense, hypnotized by this image of our doom, as when the springbok, beneath the paw of the lion, gives up and yields to its fate without further struggle, and can scarcely be induced to rise or breathe, even after the lion is shot. For among the many causes of death is the psychic paralysis, the fixed belief that death is certain. It robs us of the power to react from it. Serfs of death, we have resigned ourselves to the yoke, and endeavor to believe that it is the will of God, the predestined order of the universe.

What will follow when hope suddenly fills the heart that we may not die, when the dread shadow lifts? The human mind will, in good truth, be born again, redeemed from "sin," and the wish to sin, by its passage from death unto life.

Hatred, spite, envy, malice are but the weak ebullitions of desperation. Such traits are but incident to the hardships of our environment. Intellect, when favorably developed, does not evince these ignoble traits; they are moral distortions of mind, from thwarting of its natural desires, largely owing to the shortness of life, ill health and limited opportunities. Hence we may confi-

dently look for such traits to disappear from minds endowed with time for the realization of normal ideals.

In like manner, and for the same reason, crime will cease because illogical and foolish. No man, not an idiot, would commit a crime if he knew he was to live and face the consequences of it for a thousand years! But because he expects to live a few years only and may, in the ruck and moil of things, escape the consequences, he decides to risk it;—since crime is but a hasty snatch at illusory pleasure, or relief from the woes of life. It is merely that to get relief, or happiness, honestly, takes more time than to grab it dishonestly. Confraternity is the only condition which can obtain among those who must live continuously together. No other social regime is then practicable. It is these deep sequences which lead the modern biologist to revert with renewed respect to the real ideas of the Youth of Nazareth.

Deathless life is the natural antidote for human "sin," the elevation of human life to a higher plane, the redemption from what is hopeless and brutal;—for that is what "sin" is. Saved from "sin," that fabled "Golden Age" will return, of which poets have sung and seers dreamed. The Golden Rule of Christianity will necessarily become the rational course of human life as soon as we are free from disease and death.

With the hope of deathless life will come redemption from procreation: that gusty draught of Lethe through which we surrender life by passing it on from our own organisms to those of another generation. Yet our only present alternative is this act of transfer, or seeing ourselves die irretrievably and the family name perish; and at its best aspect it means death for the parent; for the child must have its parent's place on earth, and that, too, without undue delay.

When fostered, reared and grown, the child turns to the parent and, to all intents and purposes, practically cries, "Hence. Die. I must take your place for myself and my own children. Why do you linger? You have had your day."

True, there is a decent veneration for parents; but right well the parent knows that he must not enjoy it too long. His acres are expected, his competence bespoken; there is impatience if his tarrying is protracted.

There was an ex-President who, as he neared three score, be-

thought himself to begin life afresh, and make a new home for himself with a second, loved companion-in-life. So far from sympathizing, his adult offspring demurred at once. It was not until he had divided his acquired competence among them, that their clamor ceased, and then only in part. Was it not, practically, his death which his offspring demanded? True, they would have tolerated his easy chair among them for twenty years, perhaps, but they were unwilling to allow him actually to live as a man. Going deeper, we see that what he wished to do controverted the present parent-to-child modus of human life. Whether we wish it or not, whether we feel within us the capacity and the desire to live longer or not, we must die in order to give place to the on-coming generation. It is a phase of the horrible immorality of death and its present alternative — procreation. “But I say unto you that in the kingdom of heaven, they neither marry, nor are given in marriage.” A far divination of deathless life prompted those words, and has voiced them down the corridors of time for nineteen centuries; and they will be better understood nineteen centuries hence, than now: that ideal “Kingdom of God” that pictured itself in all the thoughts and words of that wonderful Galilean Youth; — for he was little more than a youth when they nailed him to a cross. He visioned too much truth to be allowed to live long. Nor could he survive long in the world to-day. He would, peradventure, be put to death, or ostracized, by the very Church which has assumed his name.

A disturbing feature of our present brief lives is haste and constant hurry. Civilization, so-called, urges us on; there are a thousand things to do, a myriad objects to attain, and time is short. Hence the rush for accomplishment before the ax falls. The conscientious mind wishes to do its duty by contemporaries and by offspring — before the to-morrow of death. Always there is the distracting uncertainty when the fatal hour may strike — with so much left undone. Hence the feverish onward push which of itself is a cause of old-aging. Contrast this haggard haste with the vital calm of one who knew that he had all future time for his behoof, that he could work leisurely and joyously. Certain it is, too, that he who had all time at his disposal, would do nothing badly. It would not be worth while. Every job would better be excellently done.

And our fathers, our ancestors, what of them? Instead of dim memories of old faces and aged organisms, long in their graves, our forefathers will, eventually, be with us, grown patriarchal in wisdom, their bodies transfigured by the growth of knowledge. Still with us, leading the way for the improvement of the earth, the control of nature. Our ancestors will be our mentors, our counselors. What unbroken family circles will yet gather at the ancestral homesteads of this imparadised old earth! No more wailing, anguished infancy, painfully learning over and over again the mere alphabet and accident of life, but the perfected adult of that Tennysonian, crowning race, —

“Of those that eye to eye shall look
On knowledge; under whose command
Is earth and earth's, and in their hand
Is Nature, like an open book.

“No longer half akin to brute,
For all we thought and loved and did,
And hoped and suffered is but seed
Of what in them is flower and fruit.”

WHAT HAS BEEN DONE THUS FAR

What the present investigator has accomplished thus far, may be set down in brief.

1. Demonstration (1888) that the causes of old age in animal organisms are essentially ordinary, physical causes, capable of alleviation by human science, and not due to an immutable law of life as hitherto had been the general belief.

2. Presentation of the facts concerning the cell-of-life, namely, that it is the one and the only means or type of life on the earth; and that all the metazoons, including man, are but so many long-perfected organizations of cells, in which the cell type still persists.

3. Evidences of the preservation or natural salvation of the unicells by union and organization in the multicell or metazoon, and the indicated salvation of the still progressive multicell (man) in the organized, perfected nation of the future.

4. Demonstration of the manner (1892) in which the lives of

the cells are unified or pooled, in the larger life and personality of the multicell.

5. Presentation (1892) of the evidence that every cell of the multicellular organism possesses a personality of its own, a little self, and that all the millions of cell selves are pooled and organized in the personal life of man, by means of the nervous system.

6. Demonstration of the unification of the multicells (humanity) in the greater communal life of the nation where, in an imperfect manner as yet, mankind is uniting and pooling its knowledge to accomplish great public enterprises.

7. The evidence that the human brain is a still progressive tissue of the organism, physically, steadily unfolding new capacity for the reception of knowledge. Proofs taken from the entire course and history of life on earth, to demonstrate that it has made a continuous upward progress toward better conditions, from the very first; toward salvation from evil and error, justifying faith and hope for the future.

8. A suggested solution, from the biological view-point, of the much mooted problem of clairvoyance, clairaudience, "second sight," and "spiritualism" generally; dealing with the question of double personality and the psychic powers of "mediums," so styled; pointing out how the human personality lives on in the heredity-chromatin (germ-plasm) of the race; pointing out, too, how a dead person may possibly be recalled from this "spirit-land" of the race life, without being actually alive in the sense of being self-conscious.

9. Nutrition of the unicells and multicells compared, showing how the cell-of-life, by uniting with its fellows in multicellular organisms, has, by co-operative effort, improved its food, from the crude substances which unicells were forced to ingest, to the highly refined blood plasma from which the cells of the human body are nourished; thereby attaining a species of natural salvation for the cell, prolonging its lifetime from a few days to a century.

10. Demonstration of the old-aging of the cells in animal organisms, showing not only that the organism grows old and decrepit, but that the component cells, themselves, become senescent; in short, that old age, as we know it, is but the outward expression of an antecedent cell old age.

11. The part played in old age by the shrinkage of the capillaries, and the resultant obstruction to the circulation of the blood disks.

12. The part played in old age by the thickening and fouling of the alveolar membrane in the lungs, rendering it less pervious to oxygen and to carbon dioxide.

13. The part played in old age by the dying-out of the component cells of organic tissues, leaving these tissues composed largely of the lifeless products of cell growth, which subsequently waste away, without inherent power for self-repair.

14. Indicated methods for a perfected nutrition of the cell-of-life, and its regeneration *in situ*, from which will come — as we believe — relief from old-aging and freedom to live as long as desired.

15. The argument — as here presented — for the achievement of deathless life, and a scientific renaissance of the Christian faith, by the practical realization of its ideals of heaven and immortal life.

Little enough to have done — when looked back on. Others, too, may have done it as well, or better. Science is ever a communal effort, where the researches and discoveries of one student open the way to those of another.

Undoubtedly a great amount of work, patient work, work inspired by a fixed purpose, has yet to be done for fifteen, twenty or thirty years; and the conviction has been slowly forced upon the present investigator that he may not be able to do it alone. "Years steal fire from the mind," and as is so often the case, the unshrinking courage of youth is compelled to heed that wisdom which time leaves in the place of its thefts — the wisdom which puts its trust in well-organized co-operation; that potent pooling of effort by which humanity now carries through its world-labors. Human beings, in the past, have been slow in learning the great lesson of united effort, and even now are often reluctant to work together for grand ends. But if the entire evolution of life on the earth, from protozoon to man, teaches one lesson more explicitly than another, it is the great lesson of co-operative effort, commune labor, team work.

CO-OPERATION, THE KEYNOTE OF VITAL
EVOLUTION

What the cell-of-life is in the animal organism the individual citizen is in the nation, that is to say, the vital unit wherein the national life inheres. The constructive, not the destructive, socialist can find no better model for study than the position and economic relations of the cell in the animal body, as applied to the citizen in the nation. The analogy is close and impressive.

This analogy, too, rests on something deeper than a fanciful resemblance, or similitude. It founds in physical law. The same etheric aura holds and enfolds alike citizen and cell. Each cell-of-life radiates emanations and maintains about itself an aura in the ether. From the confluence of contiguous cell auras arises the personal aura of the animal body, which in greater or less degree surrounds and enfolds every human being throughout life; and from the confluence of personalities comes the national, communal life. This is no imaginary statement, no figment of the fancy, but a physical fact.

Moreover, every life appears to have a degree of tension, or frequency of vibration, of its own, which stirs and influences the ether to vast distances. Contemplate, then, what must follow in terms of harmony or of discord, when a million or a hundred million lives — whether cells of the animal organism or fellow citizens of a nation — attempt to live together. We live wisely or not, or at least easily or not, according as we live in beat and harmony with the whole life of the nation. Eminent, pure and correct lives strike harmonious chords in this great anthem of the world's music. The founders of the religions of humanity — Jesus, Mohammed, Siddhartha — have actually changed the etheric harmony, the key, the pitch, at which hundreds of millions of their disciples and followers live, and even substitute one Life-anthem for another. None the less, even the lowliest life goes to swell the chorus, either harmoniously, or otherwise.

The thousands or the millions of people in a town or a nation irradiate a composite aura which enfolds, modifies and profoundly influences all who reside in that town or country. We shall ere-long be able to demonstrate this emanation in physical terms,

measure it, gauge it and determine the moral tone not only of the individuals, but of towns and nations. A metropolitan aura may be good and helpful as a whole to the individual citizen, or it may be bad and depressing. It is a question of the quality and purity of the majority of the individual lives there. Who but has felt the depressing bio-physical effect of certain quarters of our largest cities? It is the aura of depravity and death.

Organized in the nation, too, the greater composite life of all its citizens is capable of the most gigantic feats. Compared with the effort of one man, working alone, a nation's might is as the strength of the elephant in contrast with the feeble movement of a unicell in the puddle by the roadside. Scientific faith is therefore placed in the organized co-operation of the nation or the race, or more restrictedly, the progressive, enlightened portion of the race.

Better, longer, happier life came to the unicell from organization in the multicell. Greatly prolonged life, looking toward deathless life, will come to the human multicell from co-operative organization in the greater, stronger life of united humanity, or that portion of it which can be brought to recognize the truth and act together.

Far more, even, than our clearest minds are aware, our lives now depend on the larger, communal life of the race. All of history, science and intellect in the higher sense, is due to the reflex action of this larger life on us personally; all that distinguishes the educated man of our times from the bone-cave savage of the Quaternary drift, whose radius of activity described only a four-mile circle around his filthy cavern, whose days were passed in ferocious hunts for food, his nights in shivering fears of attack. Who heard the footfalls of evil spirits behind every bush, saw gods on every hill, and whose religion consisted of rude rites and sacrifices to propitiate these. Who dreaded with good reason the approach of his fellow men, and whose highest feats of strategy lay in ambuscading and massacring them.

Such was primeval man as we first know him, a roving, lurking, unorganized human protozoon. Altruism was as yet unborn in his brain, the advantages of co-operation undreamed of. Whatever we are better off than that bloody-handed hamadryad of the bone-caves, is due to our communal life.

It is owing entirely to that life that we can travel in ease and

safety far from our primitive caves, even around the world, and secure to ourselves the cultivation which comes from such travel. It is due entirely to our co-operative life that commerce goes on and the fruits and goods from every quarter of the planet are brought to our doors; that railways link country to country, and steamship lines continent to continent.

It is due to our communistic life — imperfect as it still is — that we have literature, history, science and the news published for all from day to day; that the sea is underlaid with telegraph cables, the land overspread with wires, which put us in thought-touch with our fellows, thousands of miles away.

To this larger life, too, it is due that remedial, surgical and sanitary science has developed and now adds so much of comfort and assurance to our lives. To the larger life, that invention, architecture and all the arts have made life comfortable.

To this larger life, also, that ideas of right and wrong, justice and injustice, are able to find expression in public sentiment and take the form of law for the equable protection of all.

All these, however, are but the outward and superficial aspects of the communal life. Its preëminent influence and effect are on the mind, the brain, of the individual. This greater life, with all its varied interests and many businesses, holds us up to a certain key or pitch, lifts us to a wider horizon. Isolated from it, the individual man would relapse to an inert, sluggish creature, caring for naught save sensory pleasure — in a word, to a savage. It is the larger, communal life, yielding a constant influx of knowledge from all quarters of the globe, which now develops the individual man, raising him to higher degrees of intellect; not otherwise than in the metazoic organism where the larger life of the man or animal elevates, improves, and strengthens the life of every tissue cell, raising up brain life from simple cell life.

Already the life of the individual is safeguarded and greatly prolonged from living in the larger, organized life of the community; even as the unicell attained longer life from uniting with its fellows in the multicell. By perfecting this communal life of pan-humanity, the analogy would lead us to infer that the life of the individual man may be prolonged a thousand times. The promise of the metazoon to the meta-metazoon of the future would be a lifetime of thirty thousand years to its individual citizens.

Slow and blind, indeed, is he who does not grasp the significance of this great effort of unicellular life. Even so must the sons of men achieve a natural salvation from disease, "sin" and death. It is the great lesson of the ages. Humanity must unite, organize and co-operate, in order to grow in knowledge and gain control of nature. Such is the promise of science. Thitherward lie "heaven" and immortal life.

The obstacles in the way of deathless life, on a globe of matter like the earth, are too great to be overcome by the individual man, striving for it alone. He must augment his feeble might by combining with his fellows; and the point which we wish to make here is that, with a clear understanding of our true situation and a full knowledge of the facts of nature, we might at once organize powerfully and, with this grand object in view, achieve results within thirty, forty or fifty years, such as will otherwise wait and lag for centuries. If even a million or a hundred thousand educated Americans would work together with hope and faith, no obstacle to research and discovery could long withstand us. Deathless life might come speedily. The achievement would depend on the wholeness and heartiness of the co-operative effort. No conceivable task in research or amelioration of the human lot will prove too great for that nation or people which consecrates itself as one man to the effort.

Even in so indifferent an enterprise as that made by the American people at Panama, we see an Isthmus pierced and five hundred million cubic yards of earth and rock cast aside. But what is that compared with what this nation could do if we set to work with faith and enthusiasm! Verily, but the touch of an infant hand to the hammer stroke of Thor, or the giant rush of charioted Achilles, driving to battle.

If that grand co-operative effort to which America gave itself, to rescue the world from a recrudescence of barbarism, in 1917, could be enlisted in the endeavor to win deathless life, ten years might see it an accomplished fact.

If the combined enthusiasm, genius, inventive skill and hard study which have latterly been directed to perfecting the automobile and the aeroplane, could be devoted to the researches above indicated, for prolonging human life, victory over man's last grim enemy would soon be gained.

The mighty walls of Babylon, and the Pyramids were reared by an enforced co-operation of labor. The ideal co-operation is one inspired by fraternal good-will and enthusiasm in the hearts of the workers.

Alas, that this potential giant of the greater life still sleeps, sleeps and dreams of distant "heavens," or "hells."

For the obstacle, and the only one that holds us back from the achievement of deathless life, is lack of faith that it can be done, lack of that faith which nerves every great achievement; lack of faith, and indifference to life on the part of our fellow men; disbelief in the future of life on the earth; apathy and the hundred degrees of pessimism which prevail naturally in a population living largely for sensory pleasures, and the born-thralls of erroneous creeds.

Inventiveness, skill and wealth are not wanting, if one million of people in Europe and America would unite to this end. Some of us now living, even, might grasp the grand prize, and literally pass from death unto life. But as yet we are not able to bring the truth home to the minds and hearts of the living units of our great potential confraternity. Their minds are still inert from doubt. Why? One word explains much of it: Supernaturalism, and its gilded promissory of another life somewhere else.

The new faith here presented offers the strongest motive conceivable for mankind to unite and work together for one common purpose — Life. Supernaturalism still blocks the way. Virtually, it condemns us all to death.

That is ever the cruel, killing feature of it. The discoveries which might come in a decade bid fair to drag along for centuries, when they might come rapidly. Perfected cell food, the extirpation of disease-producing bacteria, regeneration of the tissue cell *in situ*, cumulative control and use of cell energy: all might come in a few years.

In America we are still a huge, forceful democracy, sprawling across the continent like some enormous amœba, segregating in hostile classes and castes of aggrieved, malcontent individuals. Unity or harmony there is little enough, as yet. The potential energy of the great national aura is largely wasted in discordant wrangles. Like the swarming hive we buzz, madly crawl, wrangle and sting each other, from lack as yet of the greater voice, the

deeper signal-note from the queen bee, bidding each worker drop selfishness and stand together for that greater, grander object, the swarm-life That call we still wait. That greater Voice we have yet to hear.

Why sigh for "heaven" in some distant quarter of the universe, or some fourth dimension of space? The outer shell of this old earth is a glorious habitat. Imperfections it has, but it can be transformed to a paradise.

And the grandeur of our situation here!—our feet on these storied strata, our faces to the illimitable fields of sun-strewn space. And we have eyes to see the light of all these galaxies, light that has been thousands of years on its way to us!

And must we die, miserably die, and leave this grand old home-stead of ours, ours from ancestry and natural entail through a million centuries of terrestrial life? Die and miss it all for the endless future, die and lapse into the insentient void! Is not that suffocating thought one to drive us to work for life's sake?

THE NEED OF CO-OPERATIVE RESEARCH

In the past, the great discoveries of science have often been accidental, or well-nigh so, discoveries which have come to light by chance in the course of other, more sordid pursuits.

Oftener still such discoveries have been the lone exploits of some solitary student, or inventor, starving in a garret, to whom no one would give ear or aid. So frequently, indeed, has this been the case, the fallacious idea prevails that this is the normal course and source of scientific discovery and invention—some ill-equipped inventor, working alone and in secret, in a garret or cellar!

Not infrequently, too, in the past and at present, there is personal jealousy between those who are attempting to work out new ideas to be "patented," leading to secrecy and even to deception and the dissemination of false information.

What a humiliating picture does this give of the yet unorganized character of scientific progress! In this respect we are still so many predatory human protozoons, each striving for self, un-

regardful of the advantages of co-operative effort, and too suspicious or too selfish to work with our fellows.

All this must now be changed in the greater interests of the larger life of man. Such primitive, "unicellular" methods of discovery must now give place to organized experiment and co-operative research, where each student and investigator has his pre-arranged part to work out and perfect.

At the biological laboratories of our universities and scientific institutes, no distinct purpose now prevails. Research goes on haphazard, so to speak, without definite object, save abstract science. There is no plan for achieving a great end. Hence scientific experimentation goes forward slowly, listlessly, without enthusiasm. What is needed at all these laboratories is ambition, hope and faith to work for Life's sake — personal life for the worker.

What might not a thousand, a hundred even, or fifty, well-equipped biologists accomplish if brought together to investigate this important problem of a bio-chemically perfect cell food, or the equally important one of analyzing nervous energy, with a view to producing its equivalent, synthetically, or combining in one current the output of nervous energy from a group of persons, for transmission to an infirm subject?

Ignorantly and in a crude way, something like this is brought about in the alleged "prayer cures" and "faith cures." The "magnetic healers," *et hoc genus omne*, also operate and thrive from a knack of summoning their cell energy and projecting it, by an effort of the will, to the organism of a weaker, diseased person.

The emanation projected, appears to be a composite current, containing electrons, but made up mainly of more minute particles of exceeding subtlety. Electrons are present in the current; that has been proven; but more subtle emanations from the cells appear to accompany them. It is already known, too, that a certain rhythm, or consonance, is requisite between the "healer," imparting the emanations, and the recipient, as if a low or high voltage of the current might be involved in the success of the effort, or synchronous wave-lengths, as is requisite for interpreting wireless messages through the ether.

What we have need to discover is a scientific method of com-

binning the cell-energy of a number — perhaps in time of a large number — of healthy persons, or animals, in a powerful current, tide, or aura, regulating its consonance and applying it for purposes of cure or regeneration. What is needed is media of conduction from one organism to another.

As a matter of fact every human being generates and wastes a vast amount of nervous energy, which might be economized, conserved and used for purposes of rejuvenation. For it is by no means impossible for a hundred or a thousand persons to live in such vital harmony, so bio-synchronously, by means of media and conduction methods, that many forms of disease may be successfully resisted and certain steps in regeneration effected.

Bio-physical altruism, this might well be called; altruism in actual practice, physically. Hitherto altruism has been a pleasant theory, held in a somewhat vague, ill-defined way; but by means of this bond of brain cell energy we may set up altruism with our fellow men in terms of physics. In truth, we are but at the beginnings of this great subject of controlling the currents of energy which the cell-of-life produces. As we live at present that energy is largely squandered.

A full tide, or "head," of nervous energy is nature's protection from disease. We fall into abnormal, diseased conditions, from lowered vital tonicity, causing lack of resisting power. Vital tonicity may be intensified, at will, by scientific appliances.

The ideal aimed at in this, is to have at command a full head of "vim," or "nervous energy," for the fortification and protection of the organism, and also for holding it in harmonious function, maintaining that much desiderated condition called "constitution."

Given vital energy at command, to use as needed, it is not believed here that the involution, or devolution, of the cell, known as "old age," will go on, or be initiated. A full head of vital energy in the organism, maintaining a strong aura of life, is the natural antidote to old-aging.

From a bio-chemically accurate nutrition of the cell-of-life will come the gradual elimination of the grossness, coarseness and ugliness of the human organism, often so repulsively exhibited as that organism ages. These unsightly conditions are largely the result of inaccurate, or perverted nutrition of the cells, and the

gradual falling out of harmony of the co-related organs and apparatuses.

With perfected nutrition, will come abiding health and a progressive spiritualization of the human body, realizing the vague religious aspiration for a spiritual body, that is to say, a body less "carnal," less gross. At present our bodies are a sad, strange mixture of foulness and putrefaction in which the sweeter, purer, etheric flame of life struggles and smoulders — the clear result of our imperfect food and the bacteria which we ingest with it. All this may be beneficently changed by accurate nutrition, and our bodies transfigured to realize higher ideals of protoplasmic purity and beauty. With perfected nutrition this progressive spiritualization of the organism will surely come; it can not be otherwise. During adolescence, when nutrition of the cells is best, we sometimes catch fleeting glimpses of what well-nigh divine beauty the human face and form are capable of attaining for a brief time: the veriest glimpses as yet of what is coming in the future and may be rendered permanent. It is one of the prizes for labor along this line of research.

Fourth, on the psychic and moral side, equally beneficent results will be seen to follow naturally. Bad living, bad nutrition, disease, brief lifetimes and the certainty of death are the great immoral factors in human life, at present.

CARE OF THE ORGANISM DURING SLEEP

Care and control of the organism during sleep have also to be made matters of study.

Sleep is ever "a mild form of death" — the temporary death or cessation of the self-conscious mind, covering a period of one third part of our lives.

The proper preparation of the organism for sleep, and caring for it during eight hours of the twenty-four, is therefore a very important consideration. Sleep as entered upon is often injurious, even dangerous. In truth, we have yet to learn how to sleep properly. The field for experimentation here is a wide one, embracing the application of electrical currents, also the use of ozone and added oxygen in the air respired, since it is well known that low-

ered respiration in sleep at times leads to various degrees of carbonic acid poisoning and suffocation, as evinced in dangerous nightmares, terrifying dreams, etc.

The experimentation carried on along this line of research includes many recently suggested adjuvants and safeguards. It is a field of great promise; promise that the eight hours of unconsciousness may very possibly be made a period of depuration and even of rejuvenation.

People sleep so badly at present, so dangerously even, that this line of research may, without the least exaggeration, be regarded as an urgently necessary one. Certain it is that a vast alleviation of the lives of millions may be brought about from one year's study and experiment, with this end in view.

THE STUDY OF MULTICELLULAR REPRODUCTION

Another needed effort of investigation, for a number of well-equipped observers, is the subject of multicellular reproduction, to ascertain what actually goes into the metazoic ovum; whether these germ elements of the heredity-chromatin are reduplicated, as long as the parent organism remains plastic, or whether, as many believe, the cells of the parent organism are depleted by an irreplaceable out-go of such elements, and that old age is the result of the drain set upon the organic cells by the cells of the reproductive apparatus of the body; a drain which goes on quite the same whether the germs are liberated for offspring, or not.

Which of these views is correct, is of immense importance as affecting future plans for the husbandry and renewal of the cell life of the body. These questions deeply concern marriage and the larger communal life of the nation in the future.

In the past, for reasons necessitated by the human habitat and environment, nature has completed the cycle of life, by the parent-and-child method. We have now, in producing the future deathless individual, to learn to conserve and restore the germ-elements to the parent organism; — as if we returned the vast crop of apple seeds to the parent apple tree instead of allowing them to go broadcast over the land; as if we learned to restore the millions of milted eggs to the parent salmon, instead of seeing them go

largely to waste in the beds of the rivers, the parent fish meantime dying at once from the excess of the fructifying process of its cells.

In male animals and man, where continence is practised or enforced, a partial return of the germ-elements is accomplished by absorption into the circulation; and the revivifying effects of such restoration have long been a matter of observation. We know therefore that even under nature's imperfect process, what is equivalent to a partial rejuvenation is effected. We have to perfect this restorative process and substitute economy and thrift for waste and squander of life. Psychic factors also enter here. The theory of Weissmann is well known, as also the gemmule theory of Darwin. Both now bid fair to be found correct in part.

Another question of great and timely importance will be to determine as far as possible how deeply and how radically the life of the brain and nervous system controls and maintains the life of the other tissues of the organism.

To put the question in another light: if it were possible to remove the brain and nervous system from the organism of a man sixty years old, and replace it with that from a youth of twenty, what would be the effect on the life of the older organism? Although purely hypothetical, such a case can be supposed, and gives an idea of the scope and bearing of the proposed inquiry on the psychic old-aging of the brain.

STUDY OF THE PERIPHERAL NERVOUS SYSTEM

The problem of normally prolonged life involves not only nutrition and protection of the brain cells, but the protection of their immediate outlying adjuncts from the wear and tear of terrestrial life, meaning that delicate peripheral apparatus which stands between the central nervous system and the external world, and puts us in touch with our environment. Truth to say, it is an adjunct often neglected, so far as proper recognition goes of the part it plays in animal life and the necessity of guarding it from injury. Owing to its exposed situation, it suffers first of all as the organ-

ism ages. In attributing the self-conscious life solely to the brain, too, a partial error has been made. This often neglected portion of the nervous system carries in it a measure of the personality and has a degree of autonomy. It outlies the brain and cord, like a distant state of the nation, and is connected with it by long sheathed threads, lines and channels of modified nervous substance, which are little more than conductors of nervous energy.

We are referring, of course, to the very elaborate and interesting apparatus by means of which the central nervous system terminates in the human skin, and is thereby put in communication with the external world; that living mechanism which disassociates the ego from the non-ego; the chemico-mechanical medium wherein we end, subjectively, and establish our personal relations with the objective universe.

This portion or adjunct of the nervous system also includes the highly-specialized, terminal cells of the organs of sight, hearing, taste, and smell, as well as the nerve plexuses of the lungs, heart, liver, kidneys, and alimentary tract, within the thoracic and abdominal cavities of the body. But we are now alluding more particularly to the skin and the nerve terminal apparatus lodged in it. This latter consists of what has been variously termed papillæ, "tactile corpuscles," "end bulbs," "corpuscles of Gandry," "Pacinian corpuscles," "corpuscles of Merkel," *et al.*, where sensory nerve fibers from the brain terminate and receive sensations from the external world. Here, too, motor-nerve fibers actuate the sweat glands, sebaceous glands, hair follicles and muscular fibers.

Altogether it forms an apparatus so necessary to sense, to excretion and the general depuration of the blood, that cessation of its functions is soon followed by death. Yet owing to its exposed situation, damage, shrinkage and deterioration begin even during adolescence, and as time passes become grave factors of old-aging. Daily accidents, heat, cold, the action of the air, water and mordant substances, tend constantly to impair and destroy the skin as an organ of life.

What can be done to save and keep it good, becomes, therefore, a proper subject of study.

DEATHLESS LIFE A NECESSITY OF FUTURE
EVOLUTION

All this, even a hundred well-equipped students might accomplish, possibly in a few years, fortune favoring, if they could be brought together and their enthusiasm enlisted.

But if mankind cannot be induced to work together for this end, what then? If longer life cannot be attained, we shall go on, generation after generation, making but a purblind progress, often disheartened, often pessimistic, and it may even be, pass the point of race development where great achievements are possible — pass into the limbo of nature's unprogressive orders of life. There is danger of it. At present the Aryan is on the ascending limb of his race-life; but beyond there is ever a possible descending limb, to the dark nadir of the fossil.

With every order of terrestrial life there seems to be a hey-day when all things are possible to it, even godhood and immortality. The westward-moving Aryan has now circum-traversed the globe; there are no more continents to which he may migrate. He has come around fronting that lofty Asian plateau from which he originally set forth. Will he now rise to a higher type of life, or stagnate for an epoch and hide his bones in the rocks?

The real lack is for student-workers, willing to consecrate themselves to the effort: this grand achievement for which the Age waits.

There was a man (sing his example, O Epic Muse!) whose name was Field. He had made a fortune in business, and instead of retiring, to rot in it, he then, though his years were not a few, threw his whole soul into a grand enterprise, labored long to organize it, to make his fellow men believe in it and work with him. He won. He lived to see that enterprise a *fait accompli*.

Cyrus W. Field sleeps with his fathers in the brain of the race; but the first Atlantic Cable is at his credit there; and his far children of the grander America to come, will want to summon him whenever they have a bold project in hand that daunts their courage. They will want to hear Field's brave voice again.

Horse-racing, private yachts, champagne and the somatic pleasures — how soon all that sort of thing palls is a matter of con-

stant experience with the retired rich. Why relapse to that dry rot of animalism? It is an ennobling motive for the rest of their life, now needed. Not French cookery, not Cuban tobacco, not race-horses, not selfish ease, but that good, clear conscience toward humanity which transfigures the human face.

For whether we know it or not, whether we care or not, our personal subconsciousness, and that of our race, hold us accountable for the money (humanity's money) which we have gotten hold of. That subconsciousness in us will not surcease, nor abdicate. No man will, nor possibly can, long enjoy life who lives along purely selfish lines. That unappeased Nemesis who presides deep in the ancestral brain of the race, soon finds him out, and day by day, with unseen hand, drops loathly satiety in the cup of his pleasures.

There is no escaping that draught. 'Tis to be drunk, good friends, and that, too, from a physiological law, profound in the *intima* of your being; profound in the storied strata of that commune brain-of-man which a thousand generations of your ancestors have confided, temporarily, to your care and keeping, not for you alone, but for generations yet unborn. You hold it only in trust. It is confided to you only in the expectation that you will guard it precious and pass it on, made better by your occupancy; — for it is the precious heirloom of a million years of struggle, of battle, of toil, of martyrdom. Live delinquent, at your peril. The Court-of-the-Dead sits there over your own brow, sits to judge you, and has its own code of exquisite retributions.

Also its beneficent rewards; but always and ever the price of these is labor for your race.

With brows knit and rapt, sad eyes, Life-on-Earth presses forward on her marvelous journey upward, to win Heaven and Immortality for her far-future children. It is the one great, august spectacle of this still mysterious Universe — that Intent sublime of Life-on-Earth.

But the way of that upward journey is long and hard and arduous. Naught less than devotion and our best efforts are accepted, or tolerated. No malfeasance is permitted us. Delinquents are weeded out, without thought of them personally, their names blotted from the Book.

THE OBSTACLES TO CO-OPERATION NOT
OVERLOOKED

The difficulties are not underrated, nor overlooked. Men have not yet sufficient knowledge, it is urged, to comprehend the tremendous advantages of such close co-operation; nor do they as yet really know how to co-operate. Personal selfishness outweighs the larger view. The inherent immorality of a short life, too, prompts us to snatch at personal pleasure and let the next generation take care of itself. It is all a part of this immorality of certain death, difficult to be ameliorated as long as human life is so perilously insecure and brief. With death but a few years ahead at best, human beings work for those few years and continue indifferent to larger interests.

All of which is true in a way. And yet there is always a measure of altruism in the human heart, a balance of philanthropic good-will and a strain of generous heroism, prompting to deeds of self-sacrifice for the common weal.

We would all of us, as a rule, be willing to do more than we do for the common good, and co-operate in mutual undertakings more than we do, but for the impracticability of such efforts, the difficulty of initiating united action, the inertia of existent social, political and economic methods. It is this inertia of olden forms, customs, race antipathies, creeds and national prejudices which so baffles making united effort.

All of which brings us back to the practical question of what can best be done, under the circumstances, to unite the world's resources, combine human intelligence and render both effective for this later, grander enterprise. What is the first practical step to this end?

GENS SCIENTIÆ ET VITÆ

At first it appeared possible to the present writer that something could be done on a world-wide scale, and that the best method of beginning would be a world-league of educated people in every civilized country, irrespective of race or nation; for science is a common nation, a common country. And since there are many

spoken languages and the Latin is the source of scientific nomenclature, it seemed proper to call such a league *Gens Scientiæ et Vitæ*.

It seemed possible that scientific men and educated people, the world over, might thus organize to promote research on a grand scale, with greatly prolonged life in view. It was at once recognized that membership must not be construed as inimical to existent citizenship and allegiance to one's own country, but only as pledging members, individually, to use their best efforts to promote such researches, and in case of impending war, to avert it, if possible. Also, in the case of nationally-selfish legislation, to defeat it in favor of a policy more internationally just.

It appeared possible that such a world-league, having its headquarters in the United States and an extensive membership in every country of the globe, might come to exercise a controlling influence in mundane affairs.

Peace societies we already have, but the *Gens Scientiæ et Vitæ* would have a definite aim, namely, the union of mankind for the application of science and the world's resources to attain freedom from death.

In nearly all civilized countries there are now scientific associations, or what corresponds to them, which might, it was believed, on proper representation, be united for promoting this effort. These societies and associations would serve as the national units of the proposed international *Gens*. Science, which is the main-spring of all present progress, is thus far deficient in methods of working on a world-wide scale, or even of acquainting, save by hearsay of the press, the scientific men of one country with those of another. In many cases, it is not until published papers appear, that scientists in remote lands gain an inkling of what contemporary investigators are doing. Nothing like economic division of labor in scientific research, or in the way of mutual aid, has yet been attempted.

Perhaps nothing less than an engrossing common motive, like that of the achievement of greatly prolonged life, will suffice to unite and bind together the scattered scientists of different countries. That motive, at least, will prove the greatest incentive to united action. The sublimity of the object and the personal stake of each and all in the success of the endeavor would quite over-

shadow the baser sentiment of jealousy between investigators. The biological science of the twentieth century will be, indeed, working for life's sake. This interest will become universal and intense. Each fresh discovery, each new application of remedial skill, will be flashed from continent to continent and be hailed with an ever-growing enthusiasm.

When once the idea has gone world-wide that science has good hopes of removing the causes of death, there will be exhibited an ardent desire to live, such as the world has never known. We grow weary of living and resign ourselves to death only because of the pain and hopelessness of the struggle to live longer — a struggle which will cease in vital calm and rest when research teaches us how nutrition takes place and what chemical substances are the proper food of the cell-of-life, without the present hard, internal labor of preparation.

All this was hoped for when the *Gens Scientiæ* was first proposed ten years ago. The laboratory here was enlarged to afford facilities for fifty associates, with housing accommodations and necessary adjuncts.

The response to the invitation was adequate, but involved many preliminaries and delays. Then came war with its distractions, followed by the untimely death of the two associates on whom the enterprise largely relied. Other drawbacks have occurred. The lives of most men, even ardent students of the sciences, are too circumscribed, too much bound to the wheel of personal necessities, to be able to join, effectively, in such an endeavor. Questions of salary, travel, and domestic ties stand in the way of active participation. Many, the most in fact, are too busy getting a living, too much enslaved to family life, procreation and its attendant duties, to co-operate in a larger effort. They would like to do so, but their *ménage* engrosses them and holds them back.

It is at this stage of abeyance to temporary obstacles that the quest for deathless life stands at present writing.

THE END.