Salvation by science (Natural salvation) : immortal life on the earth from the growth of knowledge and the development of the human brain / by Charles Asbury Stephens.

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Stephens, C. A. 1844-1931.
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Publication/Creation

Norway Lake, Me. : The Laboratory, 1913.

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SALVATION BY SCIENCE

(NATURAL SALVATION)

SEVENTH EDITION

1913

C. A. STEPHENS, M.D.

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SALVATION BY SCIENCE

(NATURAL SALVATION)

IMMORTAL LIFE ON THE EARTH FROM
THE GROWTH OF KNOWLEDGE
AND THE DEVELOPMENT
OF THE HUMAN
BRAIN

BY
CHARLES ASBURY STEPHENS, M. D.



THE LABORATORY
NORWAY LAKE, MAINE
1913

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Longevity.

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19. N. 169.

7154
Apr 7, 1913
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THE COLONIAL PRESS
C. H. SIMONDS & CO., BOSTON, U. S. A.

DEDICATION

Salvation by Science is addressed to all earnest students of Life and dedicated to that greater new era of Humanity which Science ushers in.

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SALVATION BY SCIENCE

PART I

AT THE DARKEST HOUR

THE HOUR BEFORE THE DAWN

FROM many points of view the opening of the twentieth century is humanity's brightest hour; the brightest, the most hopeful since life first came forward on the earth. Scientific discoveries are multiplying and open vistas of promise, which, even while they startle, encourage us to hope great things. And other grander discoveries are, beyond doubt, at the threshold. There is a thrill of expectancy in the air of these opening years of the new century; a conviction that all which has preceded will soon be surpassed.

Inventions have prodigiously increased the powers of men to contend with nature and deal with material substances. Foodstuffs have been improved in quality and variety. Civil liberty to live and act has become better assured. Transportation has been made easy, rapid and cheap. Throughout the length and breadth of the earth, the press, telegraph and telephone diffuse intelligence swiftly, and also enable public sentiment to find prevalent expression. The industries are organized and systematized as gigantic agencies for human advancement. Wealth, too, is wonderfully increased and, despite all complaints and forebodings, was never before so evenly and justly distributed to all men. Never even in the fabled Golden Age have all men, irrespective of rank or birth, shared the advantages which wealth confers so equally. Not that such distribution is yet ideal or complete; far from it; but the present complaints, forebodings and *émeutes* are themselves the signs of a progress in equalization. In no former age and at no previous time has the

so-called " poor man " enjoyed so generous a share of the world's wealth. The wage-earner at two dollars *per diem* reads the same newspaper, rides in the same car, attends the same amusements and eats much the same food as his wealthier fellow, and if he pleases, may live in a house equally sanitary, if not so large, and lie down to sleep on an equally soft spring mattress. The mere possession of a great fortune, indeed, now gives the possessor more care, but little advantage over his less opulent brother-man. Curiously enough anathematized wealth comes of itself to be the instrument for making all men equal.

When we consider the humble beginnings of organic life on the earth — developing as it has done from the primitive unicellular life — the spectacle presented by humanity at this epoch is one of reasonable promise. From the unicells multicellular organisms have developed; and from these lower animal forms, man has arisen. It has been the slow work of millions of years; but it has been done so surely and the progress has, on the whole, been so uniform and so well defined, that it appears highly improbable that this great evolutionary effort is to end in mortal man, incomplete as he is, with his many capacities for further progress undeveloped. Such stupendous balks in the order of nature occur only along the line of catastrophism; a cosmic cataclysm involving the solar system might suddenly or slowly end all things terrestrial. Otherwise a reasonable expectation obtains, that humanity will make progress in the future as in the past.

What inclines many students of history to take hopeless views of man's future on earth is the contemplation of races, peoples and nations that have risen to a degree of greatness and power, and then declined. At short range observation the Seres and Hindûs, for example, seem to furnish evidence that man can move through but a circumscribed arc of progress; that the Cambodia and China of to-day inevitably succeed every upward *saltus* of mankind. Egypt, Chaldea, Persia, Greece, Rome, Baghdad, all present similar instances of rise and fall. If the student restricts his view to the history of any one nation in the past, he may be led to form a similarly hopeless opinion. The progress of humanity cannot be estimated by what takes place in any one quarter of the world, during any one century, or thousand years. Contrasted with what the world was in the days of Pericles and Augustus, who could

have seen any hope for humanity in the year 700 A. D.? Yet the greater era of the Anglo-Saxon, the Frank and the Teuton has succeeded, in due time.

In the large, mankind has developed by rhythmic advances and pauses. Collapse has followed each upward career, but always something grander succeeds. Ten thousand years is the briefest time period by which the progress and probabilities of the genus homo can be correctly measured. Ten thousand years, indeed, is but a yesterday in life's great curriculum on this planet.

Regarded in this larger light, and from the standpoint of progress in the physical sciences, art, and invention, humanity is at its brightest hour.

Grand, hopeful, and benign as is this progress, so prophetic of a mighty future for humanity, it is none the less tinged with an ever-deepening sadness for each and all of us, personally. A magnificent future is dawning, but we shall not see it. A few months, a few years more at most, and personally we must close our eyes in death, and drop back into the insentient void. In truth, it is this very awakening of the intellect, this latter-day vision of the future, which renders death so grievous, so inopportune, so seemingly unbelievable.

It was not so with our ancestors. Life was a struggle too hard, too grim, to be greatly prized *per se;* the ills of life were numerous; they suffered from heat, cold, famine and the malignity of foes. The pleasures of life, too, were chiefly sensory and fleeting; hence their mental attitude toward death was one of comparative indifference; continued life offered too little to be very earnestly desired. This sentiment concerning death prevails largely to-day in the Orient and among savage tribes. Life is not wholly desirable, often the reverse, it holds so little of real enjoyment, so much of pain, fear and general misery.

The case of the well-to-do, well-lodged, and happily environed American of our own times is wholly different. Every day may be a pleasure, devoted to fresh achievements.

The youth of to-day, moreover, has need of vastly more time to realize his expanding ideals. Hitherto it was a hut, food and a wife that formed the sum of a young man's ambitions, the goal toward which his life developed: all obtained during twenty years

of youthful effort. The aspirations of men have vastly enlarged. Fifty years scarcely suffices to realize the plans necessary to success in life. Formerly when the pleasures of life most sought were sensory, the realization was not far to seek, and when attained the vital incentive slackened in old age. But the pleasures most prized by the educated young man of our times require a longer initiative, three or four decades of patient study and sustained exertion. Life and the purposes of life are laid on wider lines for a loftier superstructure — the kind of living that outgrows the brief lifetime of our forebears.

Our ancestors, too, were solaced by pleasing illusions concerning a mythic life-after-death. The " soul " of man was believed to live on, disembodied and self-conscious, after the body died. The founders of religious cults made skilful use of this illusion and framed vast systems of ritual and dogma, in confident reliance on which millions lived and died, and even rushed to death, recklessly, battling for creed's sake. The second of the great religious systems of our era was successfully propagated and has been maintained by promises of paradise to those who fall fighting for the faith. The devout Christian regulates his life with reference to " heaven," and dies in the hope of going thither immediately after death, — and this although the Founder of Christianity apparently taught that the kingdom of God was the earth.

The point here made, however, is in effect, that in past centuries, so far as human beings have aspired to longer life and desired continued existence, the aspiration has been satisfied by a partial faith in " soul " life. Such belief has sufficed considerably to assuage the pang of dying, and incidentally has led the devotee to despise corporeal life and disdain the earth as an abiding place. This, indeed, is the spirit and morale of Christian and Mohammedan life. Terrestrial life is subordinate and desirable only as a period of preparation and a point of departure for a paradise beyond the grave. This has been the consolation and the mental attitude of our forefathers. We are not here discussing either the truth or the reasonableness of this faith. It is enough to say that the consensus of scientific knowledge now precludes it and robs us of such consolation. If the doctrine of evolution and all that we know of life and living matter teach anything whatever, it is that the dissolution of the brain and spinal cord is the end of the

conscious and subconscious life which subsisted there. Our efforts to preserve a semblance of faith to the contrary but embarrass and delay the growth of knowledge and the normal, onward progress of mind. True, there are apostates from science, turn-backs from this normal onward march of mind, men of considerable attainments who, owing to indoctrination of the brain in youth, revert to a species of second childhood as old age steals on them. Two notable instances of such retrogression have occurred during the past decade, yet few of us really heed these " recantations," or lay much stress upon them. The biologist of to-day and the man of science generally, face the fact that death is the end of personal life; no longer the ladder to " heaven," but the brink of unconsciousness. The old faith has left us. Vainly we patch the shards of old creeds together. Nothing of it holds. At heart we know — have always instinctively known — that death is the end of individual life. We live on, that is to say, we continue on, in the brain of the race, but no longer self-consciously. In the brain of the race we sleep with our fathers; and sometime, in the far future, our dormant personalities may waken, or be wakened and called up, by our remote descendants. So far as present researches go, this is all. The " eye of faith " alone sees more. This writer, however, is not a disputant on these themes; nor is *Salvation by Science* largely involved in the question of " spirit " life after death. *Salvation by Science* would so transform and renew the human organism as to make it the *sedes* and abode of deathless life. Even the most ardent spiritist can have no proper quarrel with an aim so purely scientific, neutral and non-partizan.

Touching Christianity the only claim made is that *Salvation by Science* will render practical the great humane doctrines of Jesus. It will, we hold, realize the Messianic ideal of a " kingdom of God " on the earth and, in that consummation, will reunite the Hebraic and Christian faiths.

Psychical Research, so called, has accomplished nothing, as yet, to alter, or relieve the facts and conclusions as outlined above; nor is there the slightest reason to believe that the outcome of its labors will do more than emphasize this " hard condition of our birth," sung by Homer four thousand years ago.

We of this generation share all of primitive man's instinctive

shrinking from death — the natural abhorrence of death which all life exhibits — and, in addition to this grief, we foresee the grand future of man on earth and perceive that for us, like the Hebrew lawgiver, there is nothing but this early glimpse from a mountain top afar. We live a little too early to enter the land of the great achievement. We shall not quite pass from death unto life. For us death will still be an irremediable evil.

But death is not an evil, many thoughtful persons rejoin, or, if an evil, it is, at least, a necessary one. What greater calamity could befall humanity, as human society and human civilization are at present established, than to have the passing generation not pass off, but remain on the crowded stage of human life? Even war and the slaughter of thousands are, by not a few political economists, regarded as a beneficial event for relieving the social congestion of overpopulated countries. If immortality were achieved, starvation, suicide on a national scale, infanticide, or the execution of aged persons would ensue from a necessity.

These are views which are fairly pertinent, although, properly administered, the natural resources of the earth are undoubtedly adequate to the sustenance of six billions of inhabitants, without crowding or poverty, in the place of the billion and a half who now dwell on it. This latter reflection does not meet the objection of over-population, however. Nor is it necessary to meet it, in the sense of providing field for a vast population, since Nature herself has already met it in her plan of vital evolution. The procreative instinct is intensified or diminished in ratio with the duress which human life encounters in the struggle for existence. With the hard-worked and short-lived, children multiply rapidly. Where all the conditions of life are hard and evil, procreation is active.

On the other hand, education, refinement, ease, leisure and the prospect of a long, happy lifetime redound not to increase of population, but rather to diminution. So markedly, indeed, has this been found to be true, that the inference is a fair one, that were enlightened persons, men and women, freed from the fear of death, the cruder pleasures of procreation would be foregone, from choice, for greater and purer joys in a life of higher type. We may, at least, reply confidently that those who are able to achieve

greatly prolonged life for themselves will not over-populate the earth.

More specifically, death often is not an evil, but a blessing to the hopelessly diseased, infirm, and decrepit. Death may even be voluntarily and logically sought by the hopeless sufferer. There are grave doubts whether, if nothing better were to be hoped for in the future by humanity than life as the majority of our fellow-creatures hold it at present, — grave doubts whether unconsciousness were not better than the burden and pain of their lives.

These phases and negations but prove the converse of the question, however. The primary instinct of life is to live. Nature, *ab initio,* makes oath that *to be* is better than *not to be;* nor have all the consolatory sophistries of creeds ever really convinced a human being of normal intellect that he will live on personally conscious, remembering and seeing, after the death and dissolution of his body. Such "faith" may assist a little to mitigate the bitter pang of dying, but never fully reassures; the common sense still perceives the real situation, and cannot, even in its ignorance and weakness, wholly believe the kindly meant promissory. At best, we resign ourselves to lapse from life with a shudder and a sense of awful heartbreak, and on the brink of the great darkness shrink back, and, feebly struggling to breathe again, turn our dim eyes to the beautiful light.

Man has literally fought his way upward; he has battled for life and supremacy, first, with the fiercer orders of the carnivora, the cave-bear, the machairodus, then with his fellow-man for political and moral freedom. His last grim foe is death. "The last enemy that shall be destroyed is death." But as yet, —

> "Death reigns. Dust unto dust must go.
> The nations wail of their dread foe.
> The bitter waters of that Wormwood star
> Which burns malign, from pole to pole,
> Are to be drunk. Who may console
> Their mortal woe? Outwelling from afar,
> The grief of worlds bewails its dying pains,
> A cosmic dirge, moaning it comes, Death reigns."

To all normal, healthy life, death is unquestionably an evil. Nature has nothing in common with those theorists who, making a virtue of temporal misfortune, seek to persuade man that death

is a blessing. Scant must be their souls. Man has developed to live, not to die; and time and space given, man is omnipotent.

How much of literature is a dirge, a cry of mortal anguish for friends departed, for self departing from the joys of life! Dread of death is the spur which will drive men to the achievement of prolonged life.

Over all the past and the present hangs a pall, shot only by the bright intuitive hope that death is not a final law. With the Romans *Mors* was a goddess in black robes, with ravenous teeth, hovering on sable wings over the whole theatre of life, darting hither and thither, snatching its prey. The imagery comports with the Roman character.

With the Greeks *Thanatos* was a god whose reign men mourn, whose mission is to nip the joy of life and blast the well-springs of hope. At his approach they shrank and cried, "*Eheu! Eheu!*" The conception is characteristic of beauty-loving Hellas. Her children ever shrank from that cold, dark realm where there was no sun. The despairing cry of Electra utters the Hellenic sentiment touching death. Burdened as was their faith with the tenets of Egypt, death was still to them the end of pleasure, the tomb of joy. The Greek poets sometimes symbolized Death and Sleep as brothers, twin boys, lying asleep in the arms of their mother, Night; and again Death as a winged boy with sad, white brow and inverted torch; at his feet a butterfly. These last were poetic fancies rather than popular conceptions.

The Hebraic portraiture of death was a solemn and august angel, flying forth from God, armed with a sharp sword to slay the children of men who had sinned. Hence, the strange description of death in the Apocalypse.

To the Hindû death was personified by the soul of Yarma (Adam), the first man who died (according to their tradition), and who thus became the monarch of the dead.

Our old Norse ancestors thought of death as a cold, misty presence, rolling darkly on, like the whirlwind storms of their own northland, wintrily enveloping its victims and sweeping them away, enwrapped and lost from sight forever. With them death was associated with the bleak, elemental forces of the air, the sea, and the night, caught in the strife of which they so often perished.

In our times and in all time the vulgar imagery of death is a

skeleton. Death makes a skeleton of man, hence man makes death a skeleton. In such grisly representation he foresees his fate. It was reserved for the grandeur-loving genius of Milton to draw death at once awful and truculent: —

> "The shape,
> If shape it might be call'd that shape had none
> Distinguishable in member, joint, or limb;
> Or substance might be call'd that shadow seem'd
> For each seem'd either, — black it stood as night,
> Fierce as ten furies, terrible as hell,
> And shook a dreadful dart; what seem'd his head
> The likeness of a kingly crown had on."

It is a curious fact that death, which is a nonentity, has always been typified by substantive imagery. In a word, the utter absence of energy, or force, has been idealized as a monster of the most forceful character. Fancy has run away with fact. Death is *nothing* in itself, the synonym of nothingness, and has never been better defined than as the absence of life. Matter is inherently endowed with that which may become sentient. The human intellect, with this element of immortality within its grasp, shudders and sighs to cease. When the real situation shall become evident to human vision, a new era of mental activity will dawn. No longer vainly praying for miraculous redemption, man will arise to work out his own salvation, and labor for an immortality which will have no uncertain hold on his faith. The task is mighty; but a grand idea never yet perished for want of soldiers. Man, at least, has this record for his encouragement. Men would not be worthy of immortal life, would not be fit for it, if they cannot achieve it for themselves. Whenever in the past man has risen superior either to brute beasts or brute passions, it has been by his own unaided exertions. However piously he may have prayed and trusted, the fight has always been his own. Overmatched, the good and the bad have always been crushed alike. "God" is not on the hither side of matter. What is on its far side we know not. Yet Right, in the long run, appears to be a better soldier than Wrong. We may, if we please, fancy that "God" put this ingredient in matter and, having done that, retired beyond the confines of the material universe.

But during twelve hundred years the average of human life has

not been raised more than twenty years at most, what hope then, of greatly prolonging life in ages to come?

The reply is that the outlook cannot be correctly estimated by this past slow gain on death. Through what unwritten ages did man wander over prehistoric continents, a wretched, fireless troglodyte, a feeder on acorns and berries, yet in one brief moment the first spark of fire was struck, — fire which made him the rich owner of all the metals, which opened a new realm of comfort, warmth and food, and spread the race over vast regions hitherto uninhabitable. In that single moment man rose to a higher plane of existence.

Within historic times, but four centuries ago, human progress was vastly accelerated by a single discovery, which was little more than a lucky accident. Up to the times of Gutenberg, what progress had been made for three thousand years in the art of book-making? Till then, books had been laboriously copied with style and pen, and so far as any one could then have foreseen, bade fair always to be thus tediously reproduced. A copy of the Scriptures cost from two to three thousand dollars, equivalent to six or nine thousands in this century; but a single decade saw the art of printing born.

Dogmatic unbelief may be as greatly mistaken as dogmatic faith. The times are ripe for great discoveries touching life and its co-relative modes of energy. The epoch — and it will be the grandest of human epochs — when the protoplasmic molecule shall render up its secret to human scrutiny is near at hand. Man will then be no longer the abject serf of death, but a belligerent, contending for his freedom, with the prize of unlimited life before his eyes.

There are, it is true, degenerates who aver that all life is an evil. There are said to be clubs that seek out, ponder, and discuss modes of euthanasia. They should be wished success. Such pessimism is an evil diathesis, a mental malformation of which the world would be well rid, by the shortest method. But we are speaking of normal men, not of poseurs, perverts, drug-bemused manikins and alcoholiacs.

For the normal man of science a new and sterner gospel is requisite. The awakening from dreams of paradise has come, and in very truth we have little enough to requite us. The dev-

otee has much the more of solace, and many there are who will prefer the sacerdotal promise to the grim reality. It is so much easier to accept the gilded promissory of the established church than grapple with the real problems of life! Confessing one's sins is so much simpler than actual reformation! What wonder that the earth groans beneath a weight of mosques and cathedrals, or that four continents glisten with church vanes! Devotee and priest have this advantage: they die with great hopes and will never learn their mistake; whereas the man of science dies with the conviction that his course is run. Science alas, has added a pang to death for all her children. It has dissipated the beautiful mirage of dying men.

> "Let the grand future pity those whose weakness
> Had to be fostered by a foolish hope;
> Perhaps without it man had died, the Earth
> Gone fallow to its dead-orb, lunar age."

Without it, perhaps, men could not have been led or driven to work and fight. Temple and pyramid would not have been reared, nor needful experience in architecture been gained. Greek and Trojan would not have sailed the Mediterranean, nor the Hebrew slave fled from bondage to seek his Promised Land.

As soon as man rose a little above his brutal ancestry, as soon as he began to think, to ponder what he saw, he was aghast at death. He would not face the hard fact and persuaded himself that by prayer, burnt offerings, pilgrimages and self-denial, he might escape extinction. The mirage of his hope rose and loomed before his life-thirsty eyes. Erelong, then, as might be predicted, certain guilds took up the business of exploiting the mirage. That the guild itself was often sincere and benevolent does not materially alter the facts of its origin or its tendencies. For guaranteeing the mirage to be genuine Celestial landscape, priest and Levite have been the great ones of earth. Humanity is still in its childhood, but now approaches adolescent years, the age when youth becomes incredulous of fairy tales. And, lo, in place of this illusion of the world's infancy, we are opening our eyes to the greater, grander gospel of manly endeavor and achievement.

If in these papers the writer appears to play the part of an

iconoclast, a ruthless breaker of the sacred images of human faith and religion, it is not from any joy that he has felt in the task. Rather pain.

It is impossible to speak without emotion of that fond Hope of dying men which it is the thankless office of our science to pronounce baseless. So much of solace has centered in it, so much of consolation for the pangs of death; such sweet anticipation of future reunions with dear ones dead have grown up about it, such halos of comfort in adversity, such visions of redemption by Grace, such long ladders of creed, ascending by which we have hoped to scale Heaven and Immortality. Creeds so venerable to the human heart, so firmly implanted in the woof of brain, that the uprooting of them can but cause widespread confusion and consternation.

Such consternation and pain, indeed, that not a few will deem it illy done, if true. It has even been held that humanity would not survive deprivation of this its fond hope of "spirit" life, but like a flower deprived of moisture, would wither on a desiccant earth; that mankind, thus bereft, would shrink in a premature involution to its origins; that the genus homo, shriven of this tenet, would decline to some bestial Ape-type, some senescent, frustrate Order of the Earth-born.

But take heart, ye of little faith. It is but the natural growth of knowledge. The coasts of our Race-life are strewn with the wrecks of great Religions, the old hulks of once mighty creeds, the flotsam of a thousand once fondly cherished tenets which buoyed millions in life and consoled them in death. They were, but they are not; and this is but one illusion more. Ra and Osiris, Baal and Zeus, Og and Duiron; Tau and Brahm, Odin and Thor; and more remote in the vasty past, glimpses of a hundred ancient cults, once very precious to man, now but vanished superstitions. Once they rang all true to the human mind, and gorgeous the pageant, sonorous the ritual; for a "superstition" is but a religion outgrown; and the great plains of the past are covered with their white bones. The Ararats of philology are overstranded with the quaint-carven timbers of these old arks of religious safety, arks which once carried the world's salvation, but which now lie high and dry, deserted by man and beast. For if priest and devotee could only think so, that is the best thing about religions —

they are left behind when the crisis or era that had need of them is past.

There were darker aspects. It has been characteristic of each and every great religion in turn that it arrogated to itself all the truth in the Universe, denounced every other as wicked and kindled fires of relentless persecution. Each in turn was the one and only revelation from the true God, the others devil-born.

That, indeed, is the hardest thing about them all to forgive, or to have charity for: their horrible intolerance of each other, their ridiculous bigotry, their disgusting self-righteousness. Each in turn, Christian, pagan alike, no sooner acquired power than it reddened the earth with blood, the sky with torture-fires. Sincerity there may have been, but a sincerity merciless, murderous, abominable.

> O ye who walk the Narrow Way,
> By Tophet flare to Judgment Day,
> Be gentle when the heathen pray" * * *

But gentleness there was none. From the Stone Age to Mecca and Rome, innocent blood cries to heaven against them all.

It is these dark pages of man's religious history which oftenest make us despair of his future, and which sometimes lead even the optimist to doubt whether the great brain-ape is really worthy of preservation in the universe.

> "So many sects, so many creeds,
> So many paths that wind and wind,
> When just the art of being kind
> Is all this sad world needs."

It was this terribly difficult "art of being kind" that Siddhartha sought to inculcate, yet no sooner had Buddhism become an established religion than it inaugurated saturnalias of persecution.

It was the gospel of brotherly love, mercy, and coöperation that Jesus taught, as the corner stone of his "Kingdom of God" on earth. "Love one another" and "resist not evil." The early Christians were thrown to the lions, unresistant, and dying, prevailed marvelously over the whole world; yet no sooner was Christianity formulated as an established religion, than Christian Rome exceeded the cruelties of Pagan Rome, and taxed all human ingenuity in search of devices of torturing.

So it is well that religious systems pass. No calamity is so great as their survival over time. Buddhism, Mohammedanism, and the Christianity of Constantinople and Rome are now among the greatest obstacles to human progress. Help them to pass, not to be perpetuated.

To minds normal and unperverted, *Salvation by Science* is the most natural thing in the world, the outcome of human progress which would be expected. But it is a curious commentary on the mental condition of people that the idea of being saved from death by natural means *often appears to them strange and unnatural!* Not unfrequently as something portentous and "wicked!" That higher life, which can only be attained by the loftiest culture of the human intellect, *is feared to be impious!* The fetters of old creeds are still firmly riveted. A few, indeed, recognize the truth; but a majority still cling to the fetish of ghost life, and incline to the belief that humanity will run through a cycle of evolution, decline toward the lower animal orders and, in the end, perish from off the earth. They fail to see the significance which attaches to the steady growth of the human brain, a growth which separates and distinguishes mankind from all previous animal orders; and they ignore or depreciate the grand fact that scientific knowledge, accumulating from generation to generation, is changing the entire course of lower nature in man. That lower course of nature is still their criterion for the future.

It is, in very truth, a sterner gospel into which we of this generation have to be baptized. We have partaken of the tree of knowledge. The pleasant illusions of man's early creeds have been brushed ruthlessly away. We face Nature's hard law with no fairy tale to disguise its inclemency. Immortal life will be achieved by the aid of applied science; it is what the whole scheme of evolution moves forward to; it is the dream of all the long-suffering ages of man; it will be initiated on earth within three centuries, perhaps within two, so rapid is the growth of knowledge, so accelerated the march of discovery. But we who have to initiate the great effort will not look upon the dawn of the achievement, nor be among the first of the sons of men who rise superior to death.

We can but feel, therefore, that we live at humanity's darkest

hour — the hour before the dawn. We live too late to be buoyed and comforted by the illusions of religion, too soon to reach the goal and snatch our lives from the grasp of death.

Have we the strength to work on, quite the same, and bravely round the curve for the sake of those more fortunate who shall come after us? Have we the devotion to face the inevitable, turn in our best work and die, uncomplainingly? Shall we demonstrate the spirit, intent and real meaning of the doctrines of Jesus Christ, or see these grand doctrines lapse to a vacuous ritual?

A thousand centuries of life's hard struggle on the earth cry out to speak through us, and bid us win the promise of evolution. We are born to this post of honor and duty. Untold labor and pain have confided it to us.

Are we worthy? Or shall we quit the task, malinger, turn sensuous, skulk back to cover of illusion and cease to be progressive?

If stronger beings on other spheres of space are watching us from afar at this dark hour of our planet's evolution, may they infuse patience and courage into our hearts. We have need of them.

THE PROMETHEAN FAITH

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 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 fore-fathers who so implicitly believed in a life after death.

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. Pondering it more deeply, too, this saving, conservative sentiment contemplates with especial dread the abrogation of faith in immortal life for the individual man, which in some form the higher life of man demands.

Yet year by year, science has gone on, sphynxlike, nullifying the beliefs of our fathers, until to-day little enough of them remains; each of the many, well-meant efforts to "harmonize" religion and science but disclosing more clearly the impassable gulf

between them, and the well-nigh ludicrous flimsiness of the "evidences" on which faith in disembodied soul life rests. 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 antiquity, 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 belief in immortal life, 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 from the creeds of Asia 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. It is the purpose and object here to outline this new faith and fruit of our scientific knowledge.

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?

A general statement of these grounds and summary of the facts will be given in connection incidentally with researches made at this laboratory, during the last twenty-five years.

Marking the progress of these researches a number of papers

have, from time to time, been published, papers now collected as a matter of record in Part II of this volume. Quotations are made from them in Part I. In a general way they give utterance to what had been done at the time they were written. Nothing more is now claimed for them. Some of them go back fifteen years and more.

Let it be said here that in thus mentioning his own work, the present writer lays no undue claim to originality, or priority in research. Often what seem to us our own discoveries are, in reality, the latent work of those who have preceded us; their labors paved the way. There are no purely "original" discoveries. Science is a communal achievement.

Laboratory Stories are a few of the humorous incidents which have attended the progress of this line of research.

Comment and Discussion, at the end, is of the nature of an Appendix, in which I have sought to reply to a few of the many questions by readers, and sometimes to defend the Promethean Faith from erroneous criticism.

A work like the present is easily misunderstood. Let it be said therefore that there is no expectation here of discovering "philosophers' stones," or "panaceas" on sale in bottles, nor that deathless life will be attained by any one such sudden discovery, in laboratory, or crucibles; 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, of 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 by Science,* indeed, is the fruit of that American common sense.

Salvation by Science also deplores that disheartening charlatanry which has laid hold of these new hopes of man for personal profit. Like the harpies of eld, the quack, the medical fakir, the religious enthusiast, have swooped down on this nascent new faith of science, eager to turn it to selfish uses. The advertising columns of the public prints teem with ridiculous promises of deathless life, at the price of a pamphlet, a lecture or a course of treatments. This is incidental, probably, to the growth of these

new ideas, and what must needs be expected. The matter for regret is, that such false promises discredit even the truth for a time, defile it, and retard its progress.

In a wholly different sense also, it is proper — replying to many inquiries — to delimit this purely American idea and effort from any conjectural relations, or partnership, with the remarkably interesting researches of Professor Eliè Metchnikoff, of the Pasteur Institute, at Paris, whose books are now widely read in the United States. So far as Professor Metchnikoff's beliefs are understood at this laboratory, he holds that human life may very probably be prolonged for from forty to sixty years, but appears to hold that old age and organic death are ultimately inevitable.

Salvation by Science holds the opposite of this as regards cell old age, namely, that it is scientifically remediable, and that immortal life, that fond dream of all the human ages, now bids fair to be won by man for himself; and that this grand development of science is what the evolution of life on the earth looks forward to. In the Old World, in Europe, they have not yet grasped this conception of Life. It is a New World idea, characteristic of America.

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 and the practical application of that knowledge; 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 two discoveries to be mentioned presently.

Of immortality itself — a personal life that never ends — it is well-nigh impossible to conceive, even as of its co-relatives eternity and infinity. What is here contemplated is greatly prolonged life, life at will, looking toward deathless life, looking toward that ideal immortal life which has been the highest aspiration of the human mind for thousands of years.

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 re-act strongly on it, to drive it forward for any great length of time. The soul eddy is small and feeble; bad food and hostile bacteria speedily induce "old age;" and death soon ends it.

Nor is the ground taken in *Salvation by Science* that greatly prolonged life is always desirable, especially for hopelessly diseased persons, or even for those who are so hopelessly situated that life grows irksome. Life as the most of us now lead it, is a hard contention with evil conditions. Yet it is plain that these evil conditions can be ameliorated and ultimately removed.

Always it must be kept in view that this longer, happier life is a higher kind or mode of life, implying mental rectification and the elimination of evil propensities, implying the retention of the molecule of life in the organism; in a word, the life of an immortal instead of the present beast-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 this present 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-renewal and completes its cycle in four score years.

The beast-life will die out; it is a higher kind of life which becomes immortal. Into that higher mode of life we must enter or die. Die, too, because death is best for it and natural to it. The passage from death unto life is a higher step in bio-physics.

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. Nature makes oath to this. 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, has been treated elsewhere in these papers. It is one of the problems which solve themselves and need give us no concern at present. 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 pessimistic 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.

Deathless life! In view of the amazing complexity of the animal organism, as inherited by human beings, and the involved, interactive processes upon which organic life depends, the attainment of perpetual 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 solely on the cell-of-life.

It founds on the fact that animal organisms are produced by minute, living 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.

The secret of it, then, the faith in deathless life, lies, we repeat, in this living cell which, under conditions of an ideal scientific nutrition and protection, is capable of living and performing its vital functions indefinitely, deathlessly, let us say, immortally, if we desire it, or as long as matter keeps its present tension and basis of reaction.

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, namely: —

First, a perfected nutrition of the cell-of-life in the human body.

The way to that 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 sanguinous 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 ash, which now induces 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 by scientific methods, till a perfect cell food is obtained. Starting forth with the blood as we inherit it, we have now to perfect it till we make it the vehicle of a chemically accurate cell food. That is the indicated line of study and experiment.

Glimpses and hints how this chemically perfect nutrition may be attained through the blood are of late numerous, from the pathological side, in the guise of the so-called toxins, anti-toxins, serums, opsonins *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, and the actually living substance is "nourished," that is, reinforced, by an influx and absorption of electrons, negative corpuscles, liberated

by the cell metabolism. Beyond much doubt, too, the future somatic cell will be thus nourished and maintained.

But the cell as we now have to deal with it, in our first efforts to render it deathless, is a small organism which we inherit, 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 glands previously mentioned, may be the desideratum, for a time.

We inherit a large, extended apparatus for the reduction and assimilation of such food-stuffs as the earth has offered us. That apparatus has yet to pass through a period of involution, graduated to scientifically improved food in lesser quantities. The inner cavities of the organism are to be cleansed and safeguarded from the hordes of noxious bacteria which now swarm there. That wonderful 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 enable us to compound.

It is these first feeble steps which we are now essaying, with infant eyes hopeful of the future, 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, bright, beautiful, immortal universe expand ahead, without the black shadow of death for us, personally.

Second, the discovery of the intimate nature of cell energy, particularly brain cell energy, or nerve force, enabling us to generate it, electro-chemically, accumulate it, store it and apply it at will for vital restoration and maintenance.

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.

It is this highly vitalized current which incites the somatic cell, i. e. the organism generally, to activity. This sublimated substance possesses the power not only to incite and stimulate, but even to regenerate. Judge then of the effect on an aging, or invalid organism of a full current of this vivific substance, generated externally. It is to this end that a line of research at this laboratory is directed.

Old age is chronic fatigue. Life as we now lead it slowly tires us to death, the terrestrial resistance to nutrition and the vital process is so strong. As the organism ages, from the involution and decline of its cell life, the normal, requisite amount of nervous energy diminishes, nutrition slackens, the vitality flags, and in our efforts to "keep up," we grow tired and disheartened, physiologically and morally. What that means will be readily understood by every one who has reached the age of fifty.

Synthetic production of the brain cell emanation, or its equivalent, will enable us to surcharge the organism with an adjuvant *aura,* or atmosphere of energy, from without; in other words, to rest and reinforce it at will. Nutrition can thus be quickened, the cells re-vivified and the burden of "old age" lifted.

It is a purely physical problem; and even with our existent knowledge, it might be done erelong, if a few hundred well-instructed persons could be induced to work together to this end. Faith, enthusiasm and united effort are all that is needed.

It is one of those cases where it is the first step that costs, the initiative that comes hard. That step and that initiative it is the purpose of this book to take, and to promote.

For always, as all history shows, it is some great idea which lights the human path onward; always it is personal hope and faith which stimulate us to work; and we repeat, that it is here — in the cell-of-life under new scientific cultivation — that deathless life for man will be found.

The growth of science and the pursuit of biological knowledge now go forward steadily, it is true, but slowly, without set plan, purpose or faith. It is a growth lacking aim, or stimulus. What we now desire is to give it aim, hope, ambition and faith, faith that deathless life can be attained.

Once that faith takes root, such progress in knowledge will begin as the world has never before witnessed. An eager new era

of research will dawn. Students will be seen working for life's sake, personal life.

And fifty years would do it, thirty perhaps.

But now most of all and first of all we need faith to light the way, that faith which incites and inspires labor, that faith and courage which emboldens to start forth.

How, by what practical methods, can that faith and courage be generated?

We are now at the beginnings of this great Quest for the Grail of Life. And because human beings have always died in the past, the great majority of mankind believe that they will always die in the future, that death is inevitable, and *must* be so. That is ever the crass incredulity of our fellow men touching all the new enterprises of science. Unbelief, and always, of course, from the religious side, accusations of impiety and "atheism." That appears to be the common order of things and what must needs be expected.

With that incredulity we have first of all to contend.

Nor is this incredulity without what appears at first view to be a strong basis of common sense, and this among those who reason clearly. Few persons, indeed, who adequately realize the well-nigh amazing complications and delicacy of the physiological processes which eventuate in a human life, are inclined at first to regard the concept that all these varied interactive processes may be rendered immortal, otherwise than as visionary.

Of the human organism itself, too, which is the instrument of these delicate functions, one has but to dissect it and study its histology under the microscope, to become profoundly impressed by its exceeding complexity and its frailty as a piece of enduring mechanism.

When, therefore, the concept of rendering such an organism permanently operative, is first stated, incredulity is the sentiment that naturally prevails. Only a visionary, or an ignorant person could indulge in such a hope: so at least think most educated persons of this our present generation; and the better anatomists, or the more skilled physiologists they are, the more skeptical they are likely to be. Of this the author is but too well aware, having passed through these same stages of thought and doubt, himself, during thirty-five years' study of the subject.

In the end, however, one gets past this phase and comes to the truth of the matter. When we have delved deeper in our anatomy and gone down a step lower in our physiological researches, a new light, the clear light of a great truth of nature, breaks in this former darkness, and hope, the hope of a grander immortality, is born anew. For after we leave the realm of organic life, the kingdom of imperfect metazoic life and animal organisms generally, we get down to another realm, the realm of the cell-of-life, on which all organic life founds and is dependent; and we begin to see that when this same marvelous cell-of-life is brought under intelligent control and nourished with chemical accuracy, it is, or may be made a deathless cell; and that all the frailties and imperfections which appear, as secondary results, in the larger metazoic organisms, may be made to disappear, as when the light of a smoky lamp is rendered star-like by a better burner, giving perfect combustion.

In *Long Life; The Intimate Causes of Old Age and Organic Death,* published in 1896, the beginnings of microscopical research to learn the deep-lying causes of old age, were described, with a set object in view for their alleviation and removal.

In 1903 was published the first edition of *Natural Salvation.* In this was depicted the long struggle of the cell-of-life to live deathlessly on the earth and the progress toward self-salvation which it has thus far made, under nature. *This is the key note. Here is the foundation of that greater, future, communal life of man in which our hopes of immortal life from the growth of human knowledge are now placed.*

A second, third and fourth edition of *Natural Salvation,* in 1904-5-7, followed, all designed to serve as prefatory to the practical methods which are here outlined with a view to actual work and experiment now begun. For it may be added, that *Natural Salvation* is not published merely to set forth a contention and prove a point, but to herald and harbinger actual results from work done. Except from having these practical objects in view, the book itself would never have been written.

Let it be repeated yet again, repeated confidently, since too great emphasis cannot be laid on the assertion, that these two discov-

eries, mentioned above, in connection with the culture and husbandry of the germinal elements of the cell, will carry us to the threshold of deathless life.

And it might come in fifty years, perhaps less, if but a few hundreds or a few score persons of means for work and experiment, would unite to do it, and combine their means and their labors.

It is merely a matter of going into it with courage and faith. That is all which is lacking. There is plenty of money in the world, idle, or going foolishly astray. What we lack is courage to begin, devotion to put our resources into it, and faith to work together.

Salvation by Science has come to be called the Promethean Faith, from Prometheus, the Fore-thinker of antiquity, the friend of mankind as against the jealous gods; from Prometheus and Æsculapius, who far from being purely mythic characters, originally, were bold great geniuses of prehistoric days.

In modern times, in its present form, this faith that we can actually win deathless life by applied science and that this is what the evolution of life on earth points to, was first, so far as the author is aware, announced in a little brochure, called *Living Matter; Its Cycle of Growth and Decline in Animal Organisms,* published from this laboratory in 1888. The researches and studies on which *Living Matter* was based, were begun sixteen years earlier, in the fall and winter of 1871-2, and pursued in a desultory manner at intervals of the writer's student life.

The central idea of the faith, namely, that immortal life must come through the sciences, descended, so to speak, to the present writer, from a grandsire who from little biological knowledge with which to defend it, used often to set it forth with a high enthusiasm as the conviction of his sturdy, unabashed optimism and faith in the future of the human race.

Four years later, in 1892-3, the same ideas were re-published in a small volume entitled *Pluricellular Man.* In this the composite and dissoluble nature of the human "soul" was deduced from the histology of the human brain and the manner in which the component cells are associated.

THE CELL-OF-LIFE

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 infinitely 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: the primordial free will of the cosmos.

Amplified by our highest microscopic powers, a cell may be made to look as large as an acorn. The protoplasm, or 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, its holy-of-holies. When stained, the nuclear net-work reveals itself more vividly than the cytoplasm of the cell body, in the so-called chromatin and linin net-work. 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: the low, deep, primitive life of matter itself; that impulse

which humanity has instinctively deified as God; that primordial impulse out of which all animal life is personalized.

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 why and wherefore 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 from the bio-chemical side, by means of reagents of the nature of organic " ferments," or even of *mental* stresses; for 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 multicellular 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, as we know, but which calls them

into existence as cells. "The organism builds its cells, not the cells the organism." (De Bary.)

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 is 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.

Fifty years ago, even Professor Huxley sought often to give expression to his profound sense of how completely the cells of an animal organism are dominated by the life of the organism as a whole, and by the social environment of that organism.

We understand these things better at present and are able to state the matter more definitely as regards this dominating *aura* of the organism.

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,* or organic life, of the body which, acting reflexly, rules, controls and holds each cell to its task. This composite *aura* is the subconscious life of the body. That portion or tide of it which is directed by the mind we term the will, and sometimes speak of it as " nervous energy." It is the cyto-psyche, or cell soul, united by millions in the soma-psyche, or body soul.

How futile, therefore, is the assertion that " the organism builds its cells, not the cells the organism." The " organism," that is, the organic life, is the united lives of the cells themselves!

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 terrestrial matter is the one which displays phenomena which have all along been regarded as vital phenomena. It is in the cell that we first see movements which we term physiological. For that reason it is the logical starting-point for an effort of research which has to deal with terrestrial 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, or more so; all matter, in fact, is living matter. 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.

FORMS AND APPENDAGES OF CELLS

When the environment and mode of nutrition permit, the cell-of-life tends to assume the round and spherical contour. 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 ("soul") 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 life-time, 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

Fig. 1.

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

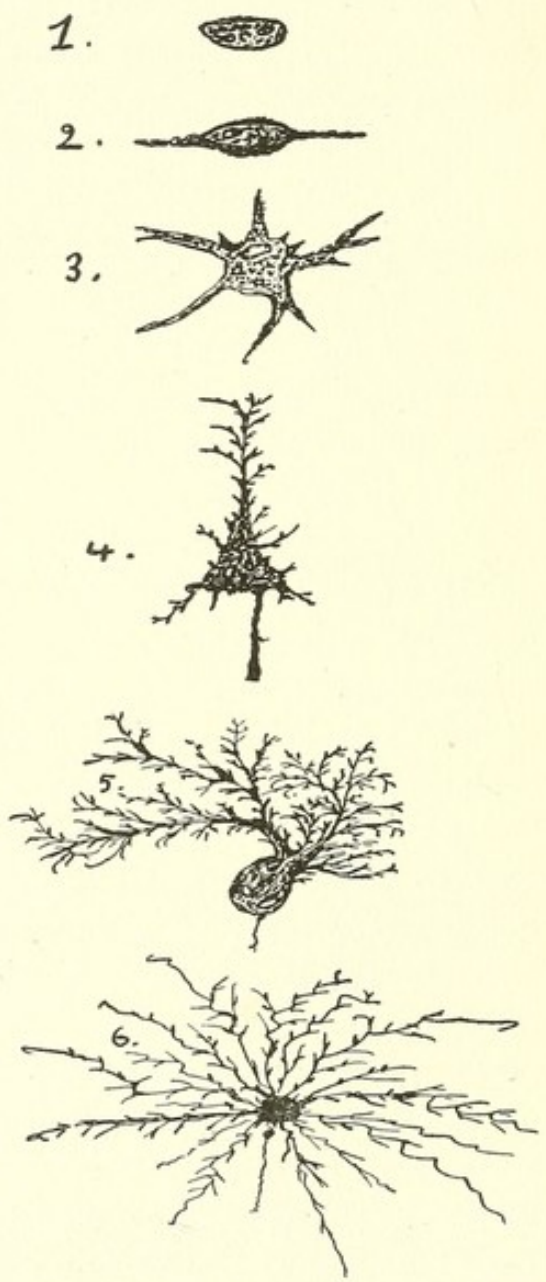
2. Bipolar, or spindle cell from the cerebrum.

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

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

5. Dendritic (Purkinje) cell from the cerebellum.

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



numbers in the first deep layer below the dendrites or multipolar cells of the cerebral cortex. The function of these cells is supposed to resemble that of a sentient balance-wheel, or fly-wheel, for equalization and steadying of the mentation, inaugurated by the large, branched cells of the 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 inclosed 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.

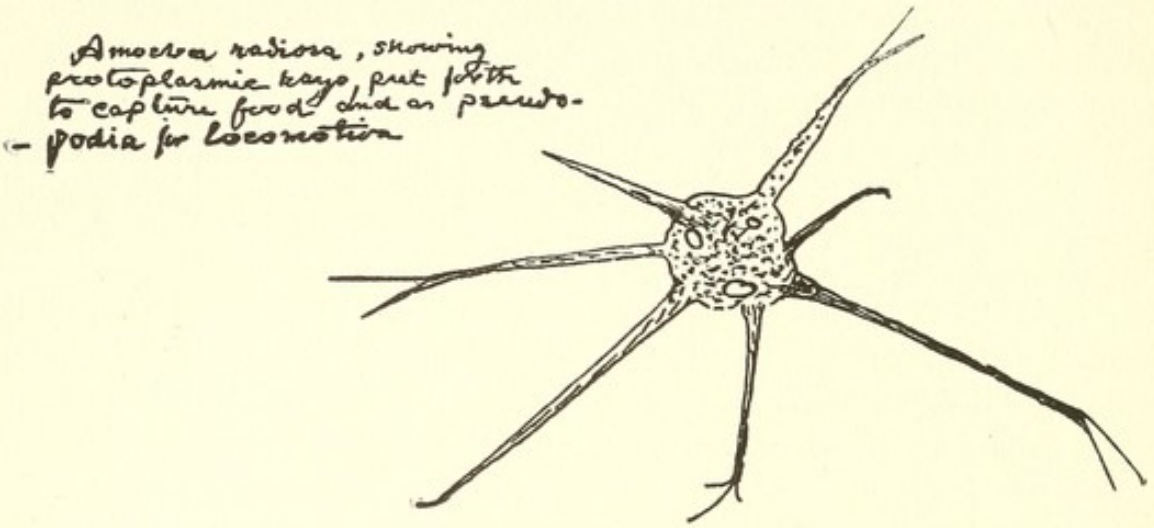
The fifth is similar to the dendrite, yet differing in certain minor characteristics, and found for the most part in the cerebellum and not in the *cortex cerebri.* This cell is usually called the Purkinje cell, from its discoverer. Like the dendrite, it sends down a neuraxone, but smaller, and its functions 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

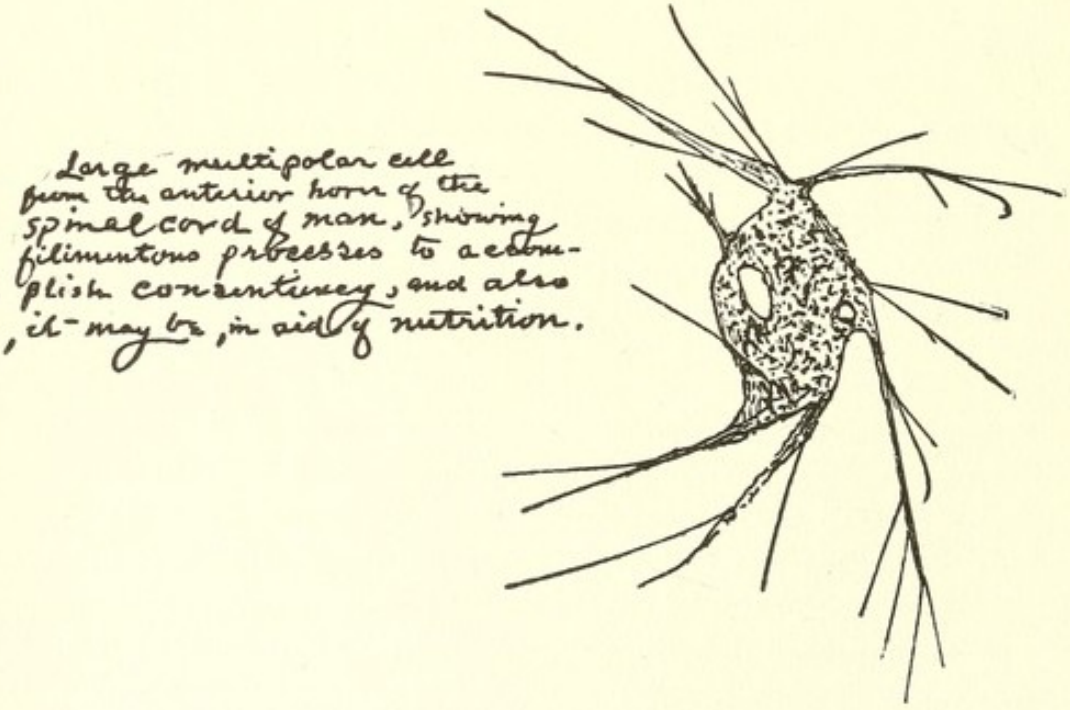
of man. In form, at least, the two cells resemble each other so closely as to suggest a common origin at the outset of life on the earth, and also a common metabolism, internally, as regards biochemical activities.

The more the cell-of-life is studied the stronger grows the con-



Amoeba radiosa, showing protoplasmic rays put forth to capture food and as pseudopodia for locomotion

Fig 2.



Large multipolar cell from the anterior horn of the spinal cord of man, showing filimentous processes to accomplish concentricity, and also, it may be, in aid of nutrition.

viction 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 saprophitic, 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 superficial substance of their cell bodies, to catch and enmesh smaller unicells.

Others of this class of predatory unicells — like the light-armed peltastae 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 or 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 amoeboe 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 intrin-

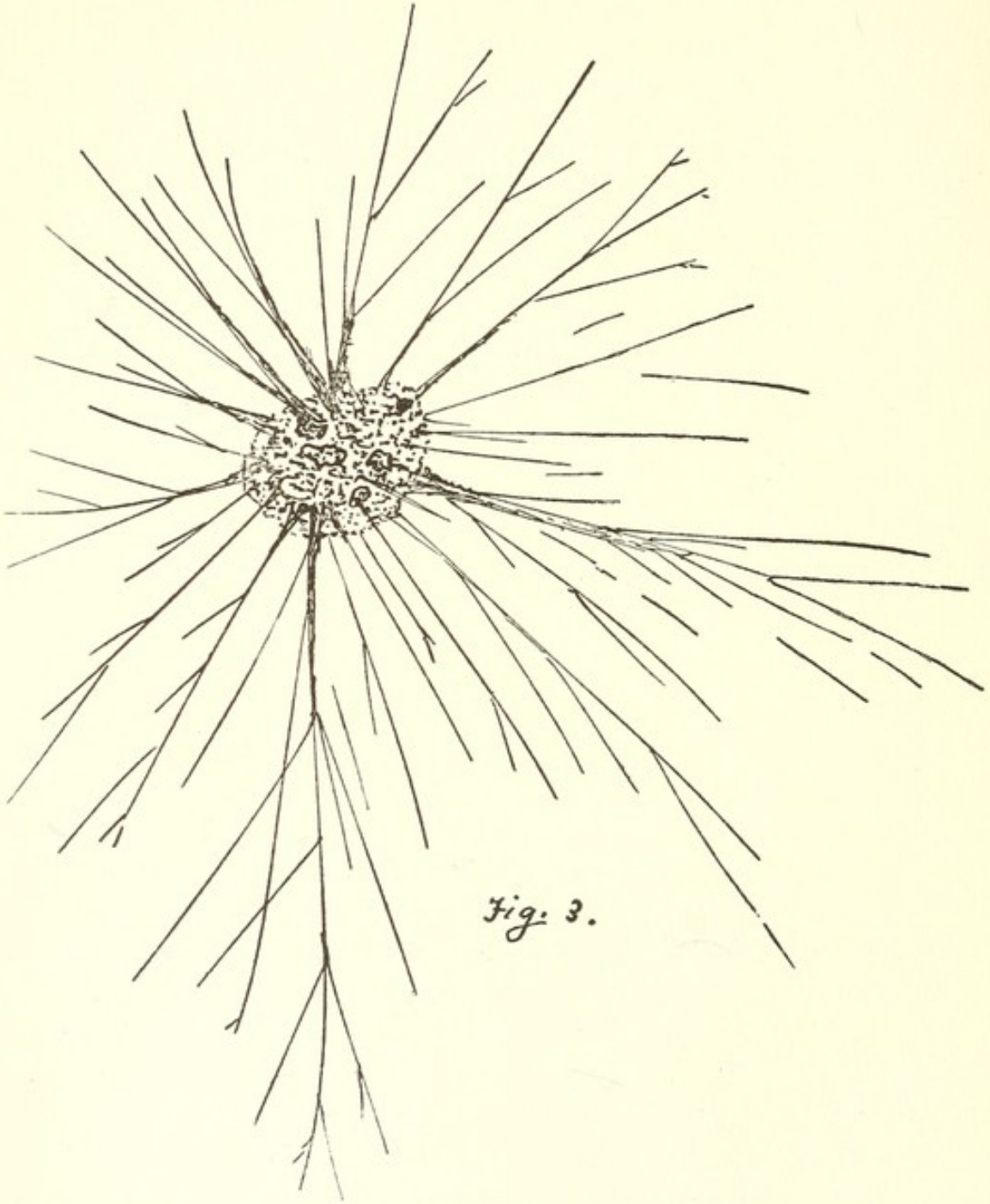


Fig. 3.

sic 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 condits 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. 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, 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

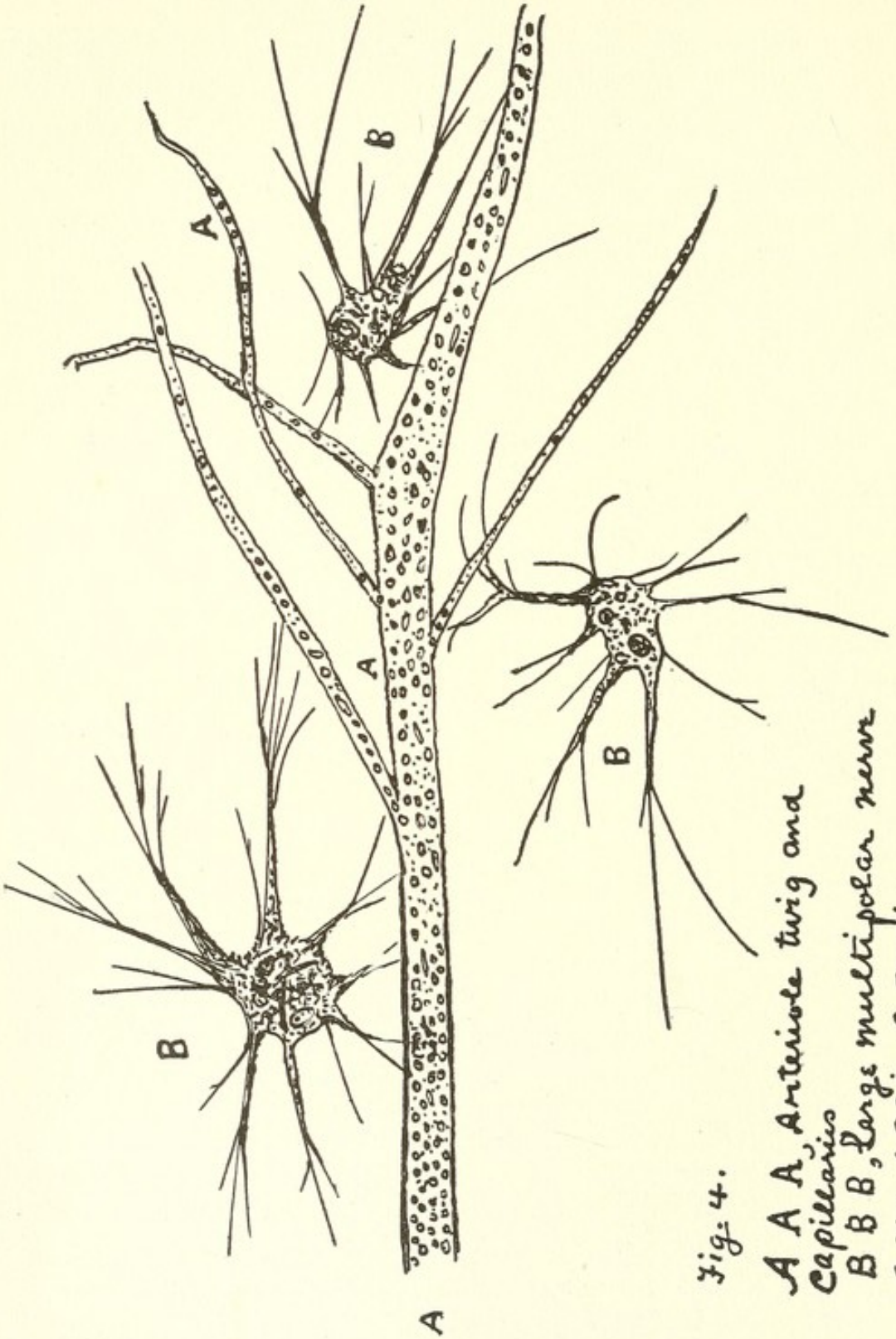


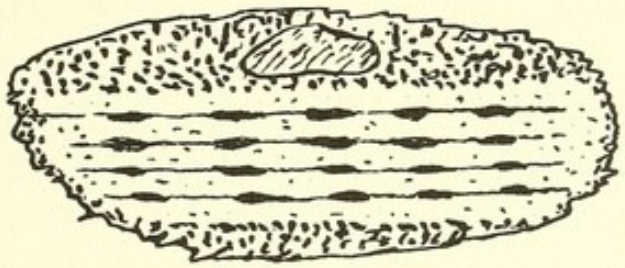
Fig. 4.
A A A, Arteriole twig and capillaries
B B B, Large multipolar nerve cells of spinal cord.

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

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.

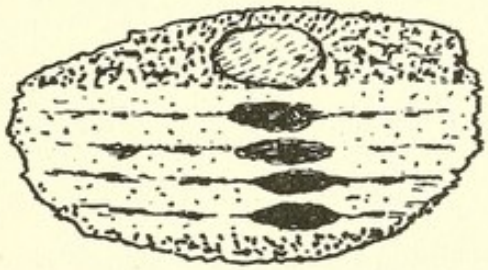


Fig. 5.

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 coöperatively 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 multi-

cellular 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 life-time, 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, at present writing, been kept alive and pulsating for three months, at the Rockefeller Institute in New York.

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.

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.

This latter medium or fluid is vastly composite, consisting of many various emanations from the cells of the whole organism and of electrons, or corpuscles, also generated in the organism. Term it a current or a fluid, it is one of the most wonderful things in nature, embodying the esoteric secrets of organic chemistry. A phase of it we speak of as sensation; — but what is sensation, and how is sensation accomplished?

The apparatus by means of which the neuro-electronic circulation is maintained, is, of course, the nervous system.

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.

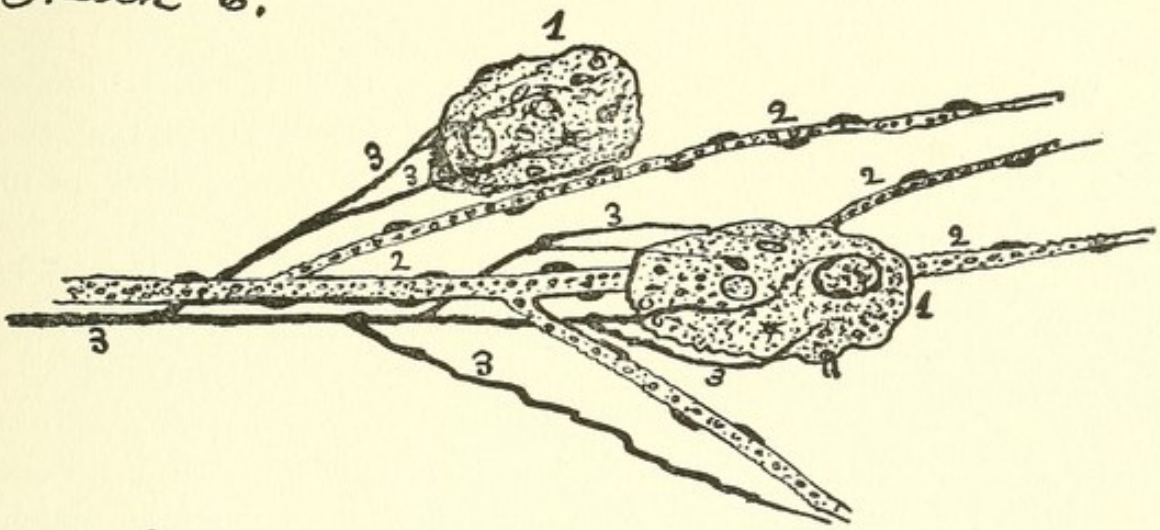
For the most part, however, the neuro-electronic circulation — like that of the blood — goes on subconsciously and constantly, both during sleep and waking hours. It is largely a function of the cell life, below the ken of the cerebral self-consciousness, and is as yet an unentered field of investigation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

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.

which circulates, the electron would seem to be what the red and white blood-corpuscles 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. In the arteriole, or often so, enters a small efferent nerve trunk, branching into nerve fibrils which ramify among the gland cells. By virtue of 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 malignant tumors. 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 circulation 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,

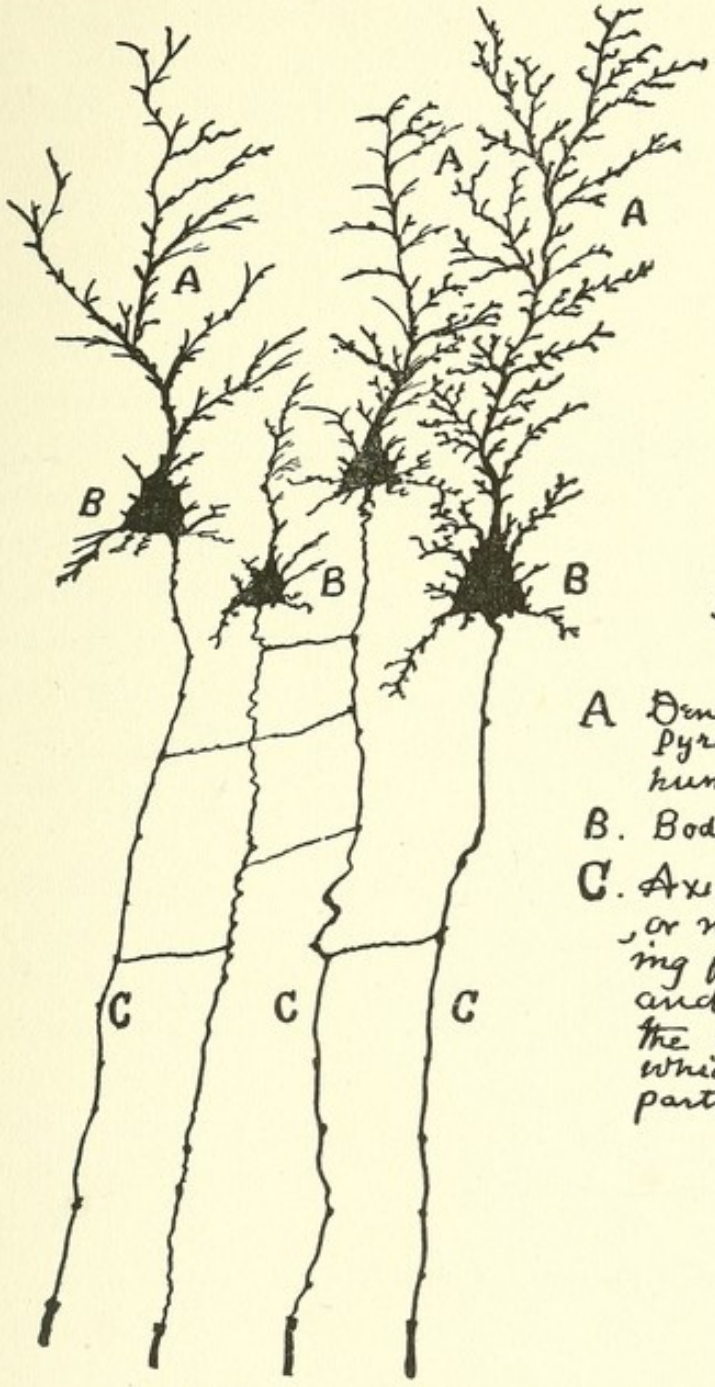


Fig 7.

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 exiting in the sheathed nerves which extend to distant parts of the body.

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 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 anastamose, 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.

HOW THE UNICELL BECAME A MULTICELL

During the year 1883, and for three years subsequently, an extended study of unicellular life was made at this laboratory, comparing unicells and unicell colonies with the tissue cells of

animal organisms, the general result being to establish the following facts: —

First, that there is, in reality, but one mode of life on the earth's surface, namely, the cell mode; this is to say, that all animal life is confined to and issues from the cell. No cells, no consciousness.

Second, that unicellular life, life as single, separate cells, was for long ages, millions of years probably, the sole and only form of life on the earth; protozoons, unicells and colonies of the latter.

Third, that the multicells, or metazoons, meaning animals, insects, plants, trees, did not appear on the earth until later epochs, being of the nature of later developments from the colonizing habit of unicells; the permanent closure, so to speak, of the hitherto loose, temporary colony, growing out of the tendency of unicellular life to band together and live together for mutual support, greater security and better, more easily obtained food. The unicellular colony was therefore the first step toward that extended, vastly varied cell organization for mutual good, which has finally given us the animal organism.

Fourth, signal advantages, remarkable advantages, indeed, to the unicells, resulted from colonizing and from organization. Hence such confederations continued to survive and went on slowly perfecting their modes of living in combination.

In 1893 this deduction was set forth in *Pluricellular Man,* from which the following citation is made: —

" The true terrestrial type of life was and still is unicellular, creatures consisting of a single protoplasmic cell from which are displayed all the functions, in miniature, exhibited by multicellular creatures. These are the protozoons, the first, the standard type; nor is this type of cell essentially changed in the metazoons, or multicellular organisms, since the latter are merely well-organized associations of cells. There is, indeed, strictly speaking, but one mode or type of life on the surface of our globe, the cellular, and this type is preserved in all forms of life. For in the cell alone do we find sentience exhibiting vital phenomena. No cells, no consciousness.

" Pluricellular organisms are a later development from unicellular life. At first the metazoons were small, simple aggregations of the protozoons; and the fact of confederation appears not even to have modified the separate, unicellular lives. Each retained

complete autonomy, performing all the functions of a separate life. Change of the conditions led to more permanent grouping and induced modifications and differentiation of functions, till at length dissolution of the bond which united the several unicellular lives became impossible; and thus the way for further differentiation of functions and the evolution of organic life was opened.

"All the multicellular organisms of which the human body is an eminent example are but extensive, organized unions of what were primarily unicells in which the type of unicellular life still distinctly persists."

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. By division of labor and differentiation of function, the larger, organized colony of cells could obtain food more easily, the confederated unicells could the better defend themselves from the attacks of enemies. Acting together for the common good, they were able to live more at ease, more comfortably and happily, and hence to live longer individually. Vastly more at ease, indeed, and vastly longer, since in the higher multicellular organisms — that of man, for example — we now find certain cells (the remote descendants of earth's primitive unicells) living a thousand times longer than their unicellular ancestry. It is as if a single human being, when joined, hereafter, in the larger life of the race, were to live thirty thousand years instead of thirty! 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 deathless 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 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?

Subsequently, many months were spent studying the lives of plants and animals, considered as organized unions of cell life; or in other words — to use Haeckel's terms — 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 sentiently 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 the theological concept.

And the cytopsyche, or cell soul? Whence does that originate,

and is that, too, an organized union of the souls of even smaller living units?

At that time — 1870 to 1885 — biologists had much to say of "protoplasm," the compound of oxygen, hydrogen, nitrogen, carbon, sulphur and phosphorus atoms, or molecules, which was seen to form the body or basis of the cell. Eminent authorities, like Professor Thomas Huxley, regarded protoplasm as the physical basis of life, the compound from which life glowed forth as the ray from the diamond.

But the cell contained a nucleus and granules, a centrosome and other semblances of organization; and further observation of cells established a number of facts indubitably; first, that the life which they exhibit, depends on the cell organization; second, that as long as a cell lives, a constant stream of material particles enters it from without, becomes for a time part and parcel of it, then departs from it; third, that these particles are particles of ordinary matter; and fourth, that on departing from the cell they take away with them the same properties which they carried into it, and were, clearly, endowed with no other properties while in it.

At that time we knew little or nothing of electrons, corpuscles and the composite nature of atoms; and the ether was then the "luminiferous ether" of Tyndall and Helmholtz. Yet dealing only with atoms and molecules, the hypothesis became a necessity that these particles entering and leaving the cell, possessed a property, or properties, which as organized in the cell, gave rise to the phenomena which were termed vital phenomena.

In the end, there is no escape from this hypothesis as to matter and life; and in *Living Matter* the following convictions touching the intimate nature of matter, universally, were set down: —

"We conceive of matter as sentient. Matter moves and returns to itself through the great cycle of universal phenomena. Matter possesses the *elements of feeling;* hence the universe has everywhere a low degree of *sense* to proceed toward an object. It is that which gives semblance of design in nature.

"What seems the inertia of matter is a condition of equilibration; what appears to be dead matter is only matter at a deadlock, from which it may be released to live. This sentient property is eternal to and inseparable from the ultimate particle. Even when locked in the apparently dead clod, the initial atoms are still living atoms,

robbed of not one whit of their static ability to feel and to live.

" Philosophy taught much concerning certain supposed properties of matter, and has portrayed its impenetrability, porosity, extensibility, ductility, inertia, *et al.* These were held to be its primary properties. As a necessity of theological tenets, matter was depicted as the lifeless material of a manufactured universe.

" But the philosophy of to-day postulates matter, not as lifeless, but as living, not the inert substance of a created world, but the living substance of a self-creating and self-sustaining universe. Matter is of itself *creative* of natural phenomena by virtue of that static attribute which resides at the core of every atom.

" The sentient particles *feel,* and from this eternal well-spring all phenomena, physical and vital, move forth. Rather there are no physical phenomena actuated by insentient forces. Motion originates from the elementary sentience. Hence, 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. The organism of any living creature is the instrument, developed originally from the inherent sentience of its component particles.

" 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 core of each ultimate particle of matter, and illumines the wide deserts of space with the glow of life."

As a physical philosopher Tyndall was drawn to a similar conclusion in 1870; Gassendi to a like idea, in 1640; and in the classic era, Demokritos, Epicurus and Lucretius conceived of matter as possessing such creative properties.

That matter has within it " the potency of all life " is a conviction which has most venerable sanction in philosophic thought during three thousand years, one, too, which all our researches tend to strengthen.

No one, of course, can yet fully define matter, nor predicate its ultimate properties. The properties which at present appear to us as final to it are Substance, Sentience, Energy. That these are its ultimate properties, who shall say? Matter is still the one great

Mystery, the ever Unknown God, afar from the Inner Courts of which we rear our altars.

There are or rather there have been philosophers who believe in the dualistic hypothesis of matter, that is to say in inert matter and " pure " energy.

In ultimate analysis the dualistic hypothesis always becomes untenable to minds capable of carrying through a logical ratiocination, and has to be set aside for the monistic hypothesis, namely, that matter and energy are one. This latter, indeed, is now the well-nigh universally recognized hypothesis of scientific thought.

And so surely as the monistic hypothesis of matter is true, just so surely life on the earth is an organized development of an initial impulse in matter.

No foreign or extraneous ingredient enters into matter to give birth to life, no dualistic or triune combination, no *tertiam quid.* Matter as we see it everywhere has in it the potency of life. The corpuscles and corpuscules of this block of granite will yield a human body and a human " soul," if organized as one.

The matter in this log of wood — the corpuscles, electrons, ions and inclosed ether — would give forth a human intellect, if organized as a human body and a human brain. The basic, initial sentience is there inherent and could be raised up by organization and formed by interaction and reaction with its environment.

That organization, as seen in the human body, however, has been the slow development of one hundred millions of years. The " soul " of a man is a hundred million years old. As seen in the individual, however, it can be destroyed, that is to say, reduced to its initial sentience by an hour of incineration.

Given the low sentient property of matter in the ether, and the intellect, the mind, the soul, is raised up from it by organization, reciprocal sensation and plastic forming of substance.

The lowest, the most archaic estate, or attenuation of matter, concerning which we now have knowledge or intimations, is the ether, so called in lack of a better term; the omnipresent ether which the prescient Mendelieff believed to be one of the argon gases.

The next lowest attenuation of matter of which we have some little knowledge at present, is the corpuscle, self-organized, it is believed, from the ether and manifesting its sentient energy as

negative electricity, causing magnetism, also light, heat, and other phenomena.

The corpuscles have grouped themselves, seriatim, in the atoms of the so-called elements of matter, the gases and liquids, the metals and other substances, with their varied combinations of atoms in molecules.

It has all gone forward under stress of that primeval, sentient impulse to move. There is no other rational explanation of creation or of the universe. It is a self-moving universe and the impulse is from its own initial sentience. In a lowly sense the corpuscle is as much a living being as the cell-of-life. Atom and molecule, too, each lives its life, some of them, indeed, possessing a degree of immortality. The difference betwixt the life of an atom of oxygen and that of a brain cell is one of degree only, due to a more extended organization. It is all life.

And this universal, sentient unity, shall we call it God? Not in the anthropomorphic sense. It does not seem proper to deify it, or worship it. Its life is lowly, unintelligent energy, purblind, unorganized sentience. Yet out of it omniscience and omnipotence may issue, through self-organization, first of the corpuscle in the atom, the atoms and molecules in the cell-of-life, cells in the human organism, and human organisms in the larger life of the race. God is therefore ahead of us, not at the beginning. Omniscience has yet to come. Omnipotence is in the future, not in the past.

Godlike and immortal beings may have developed in past eras and cycles of the cosmos. If so, they would seem to have passed to other quarters of space. Within the flight and range of light and gravitation, we find nothing operative to-day save matter and its sentient energy.

If there is a God behind nature, he now gives no token of his presence save nature itself; and it is more logical, more reverent, if reverence be exacted of us, to conclude that we are not to seek what we have no means of finding. "God" is not on this side of matter except as evinced by matter itself; what is on the far side we know not. Moreover, it is as rational to think of the universe as having existed from eternity, as to conceive of a Creator who antedates it.

The low-sentient energy which drives nature forward amain, is

plainly not regardful of animal life on the earth, nor the hopes and fears of mankind. Indeed, it is not easy to comprehend what this swift, intensive, radiant life of unorganized matter is, in its relation to organized life which rises to intellect. Yet the one comes from the other.

Everywhere above and below the earth's immediate surface, matter is seen to be largely in the atomic and corpuscular condition. It lives vastly, voluminously, with enormous dynamic power, but is apparently unconscious of man. Yet of its intimate nature we have ample evidence that it is true to an end, invariant, and hence beneficent to those who place their lives in accord with it. On the other hand, it crushes out remorselessly those who from carelessness or wantonness go counter to it. Remorselessly, because it recks not of human hopes or fears, and is not conscious, on the plane of human consciousness. To us and our intents it is largely impersonal. We have to learn of it and live by it. It is the eternal fount and well-spring of life and has immortality potential for those who will learn how to avail themselves of its possibilities. Otherwise not. We must learn how to live in accord with it. Immortal life is thus our birthright, under nature; but we must enter into it by our own efforts. It will have to be our own achievement. We are not saved, nor to be saved. We shall have to save ourselves.

In this our epoch of the cosmic evolution of matter, we see the sentient substance segregated into numberless little self-lives, microcosms within the grand macrocosm, a vast cyclic movement toward greater, wiser individuality. The lowly sentient energy of the world-ether whirls itself asunder and apart into unnumbered little personal lives, each a self, living for itself in the midst of the environing universe; each subjective to itself, with all the rest of the universe objective. First the corpuscle, then the atom, each a living self and soul from out the primeval sea of sentient energy. Thus starts personality.

On the surface of our earth the atoms unite in the so-called "protoplasm" of the cell-of-life, with its marvelous gift of memory and mentation. And after long eras of unicellular life, lo, the unicells combine in the multicells, the terrestrial, metazoic life now headed by man.

So far as we know, the corpuscle is immortal, in the sense of

living as long as earth and sun and stars abide. Certain of the atoms appear to be so, but not all. Some of them waste and die, or pass into other atoms; some are enduring.

It is not certainly known how the cell-of-life originated on the earth's surface, nor yet that it may not have come to the earth, as a cell intact, from some other planet or sphere in space. In all probability it originated on the earth, during an early geologic epoch. The electric tension and the chemical affinities at the earth's surface, admit of a grouping of certain atoms and molecules — those of oxygen, hydrogen, carbon, nitrogen, sulphur, and phosphorus — in an organized compound which exhibits a more complex life than that of the component atoms. Moreover, this vivific compound is so internally mobile, so structurally at an equipose, that it is capable of receiving and retaining sensory impressions from the external world; that is, it can be acted on by its environment and retain traces of that action; in other words, it has the capacity or faculty of memory. It remembers what goes on about it.

The evolution of life on the earth founds in this internal mobility and this faculty of memory. The development of intelligence in the cell presupposes this faculty of memory in the protoplasmic molecule.

What the physical or dynamic process of memory is, we do not as yet know; but the later knowledge of matter leads to the hypothesis that it is a change of relative position and relations among the component atoms, and that it is accomplished by currents of corpuscles, or of the ether, setting into the molecule from without. By ether here we mean simply a medium or attenuation of matter, more minute than the corpuscle. Of the existence of such more minute attenuations there are now evidences. In fact, the present hypothesis is, that there are many such attenuations, one within or below another, as the corpuscle is below the atom, going down to more ethereal states not yet possible of demonstration.

Through a long period, not less than a hundred millions of years, the unicells were the sole inhabitants of the earth. Metazoons, grand organizations of cells, were to appear in time; but during all that long period, there is no trace of them in the slowly accumulating strata. We find unicells only, each living its small life,

and giving birth to offspring, usually by simple fission of the parent cell into two child-cells.

As to the psychic character of that simple unicellular life, we have abundant evidence that it was the minute prototype of animal and human life. For the cell-of-life everywhere possesses the faculty of memory in all its component mobile molecules; and memory is the one condition requisite to the growth of intelligence and mind. Every protozoon possessed a mind, a soul, quite as much as does an animal, or a man. The difference between the cell soul and the human soul is one of degree and quantity, not of intrinsic quality; and that difference of degree is due solely to the more extended organization of the animal brain. The higher human faculty of thought rests on the more complex organization and greater mass of the human brain; it is not a difference in psychic quality. Memory and thought are carried to higher, more complex reactions in the brain of an animal, or a man, than in the nucleus of a cell, that is all.

CELL SELF AND MULTICELLULAR SELF

And how is this life of a unicell composed or developed from the basic sentience of matter? The answer to the question is of interest since it strikes the key-note to the origin and destiny of the human soul.

First we have the corpuscle, living its electric life; and we find from ten hundred to two hundred and twenty-four thousands of these individual corpuscles pooling their lives in the life of an atom, such as compose the various elements of matter. The life of an atom is a consentient *blend* of the lives of all its component corpuscles, where each *gives up self* in the larger life of the atom. There is self-surrender in the interests of the larger life.

It is the faculty of pooling individual lives in a larger life which has led certain scientists to conceive the hypothesis that, at bottom, matter, when at its lowest attenuation, is a confluent unity; not segregated, but capable of segregation, an unorganized, etheric world-fluid, to wit, sentience, or sentient energy. The semblance of form and substance begins with segregation.

Whether this hypothesis be true or not, the fact is well established that the corpuscle has the faculty of pooling its life in the

larger life of the atom, the atom in the greater life of the unicell, where true psychic faculties are exhibited.

The unicell lives, hopes, fears, and erelong suffers death, from the inevitable concurrent accidents of its environment; and at death, which is by no means the death of the component atoms and corpuscles, these same atoms and corpuscles reassume each its own individual life and go their ways into other cells, or other combinations of matter. Such is the rationale of cell life, and it offers us the key to the greater problems of human life.

Owing to accidents from the environment, the unicell of the ancient earth lived but a short time, a few hours, a few days it may be; but from the psychic side of its life, it was always seeking to escape death; for that is the nature of all life. And at length, after all those millions of years, we find the unicells combined in coöperative unions.

As to how this was first accomplished, we have as yet no precise knowledge; whether unicells were united as a result of their colonizing habit, as seems quite possible, or whether from some intracellular evolution a double-, triple-, or multiple-celled creature developed. The fact remains that multicellular creatures, metazoons, appeared on the earth: animals in which we find one tract or group of cells doing one thing, for the common good, another tract or group doing another. One cell, or group of cells, acts as eye for the whole union, another as ear, others as muscle, still others as bone; others still as organs for food preparation and carriers of the prepared food; while yet another interior group assumed the function of intelligence for the union, the office of perceiving, reflecting, and deciding what is best for all to do; in a word soul-cells, having the kingly function of brain.

As a result of the metazoic union, too, there was developed a marvelous and still inscrutable method of reproduction of the entire metazoon, child from parent, by a transference and concentration of germinal elements, or psychic patterns, from each cell to certain special cells, devoted to this use, to the end that a younger metazoon might be extruded from the parent and afterwards grow to full size, thereby perpetuating the species and enabling it to survive on the earth. The method is a complicated modification of unicellular reproduction by fission of the cell nucleus.

Of this wonderful process of transference and concentration of germ elements, from the entire cell union, in the reproductive cells, we know very little, as yet. How did it begin? In what does it consist?

Darwin, as is well known, suggested cell "gemmules," Spencer "physiological units," Weissmann "biophors," Haeckel "plastidules." These conceptions are now seen to be inadequate, the actual facts touching down to deeper levels of matter.

All that we can yet say definitely is that such an esoteric method of metazoic reproduction has developed, as a result of the organized, differentiated cell life.

HOW THE BRAIN CELLS UNITE TO FORM THE HUMAN INTELLECT

It had long been a matter of observation that unicells put forth "protoplasmic" branches and emit fibrils of the nature of "darts" and "rays," to aid them in securing their food, or for defence and during conjugation in colonies. Histologists, too, had already described the forms and branchings of certain groups of the brain cells (neurons).

Studies of these forms and characteristics of cell life, during 1891-92, led to definite conclusions touching the unification of the cell life of the brain, and the composite nature of the human intellect. The brain is comparable, sentiently, to a vast and well-organized colony of unicellular life. In fact, that is what it is; for even as unicells, when temporarily united in a colony, put forth protoplasmic filaments to *sense* each other's presence and to *pool* their hitherto separate lives in one larger life, so in like manner, the brain cells have put forth long, branched processes which aid in forming a union of their individual cell-lives in that larger, unified life which is the intellect, or soul of the man.

"We find that the *cortex cerebri* is composed largely of networks formed from these branching cell processes, 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 which minute anatomy has knowledge of. The extent and intricacy of the fibrillar threads, loops, and twigs, formed by the mutual inter-

lacing and interlooping of 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 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 vine-lets and tendrils, which enwrapped and entwined everything in their course. Such a jungle, growing to a height of many hundred feet, would no more than illustrate this astonishing net-work of the protoplasmic fibrils of the cortical cells.

" The histologist is led to inquire with wonder, why this mazy output of living filaments has developed. Is it to facilitate cell nutrition? The present investigator has been inclined to think that the brain neurons have grown up, even as many-branched trees grow in sheltered situations, to fulfil and express each its life; and that originally, at least, nutrition was the object conserved, but that ultimately con-sentience resulted. For, at present, it cannot be wholly, or largely, for the purpose of accomplishing cell nutrition, since these cells are nourished by the saprophytic, or absorptive method, and not by prehension of food particles.

" It is not to accomplish locomotion, for these cells rest nearly stationary on fluid beds, sustained by the nets of neuroglia. The conclusion is reached, of necessity, that these far-branching processes serve a 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 cell through its efferent fiber from the outer world, is known and felt by all its fellows throughout that entire convolution or tract of cells.

" For all this mazy web is demonstrated by the reactive agents of our staining fluids, to be purely protoplasmic 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 net-work to a hundred neighbor cells, and from them is diffused over the entire brain, which thus receives tidings as if it were a single large cell, instead of an aggregation of sixty millions of cells.

" By means therefore of this sentient bond of cell to cell, afforded by the protoplasmic net-works, many millions of cell lives are blended in one common life, having one common sense. By means of this bond, too, a higher life than that of a single cell is rendered possible. For by it thought, which is the business of comparing what one cell 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 no higher than the sentience of the component brain cells individually. By means of this extended organization of cells, something more than a cumulative result is attained. By specialization and organization, a higher plane of intelligence is reached; even, as we conclude, the intelligence attained by the cell is of a higher order than that of the intra-nuclear molecules which are believed to form the basis of cellular organization.

" Biological synthesis would lead us to infer that by means of organization, higher and higher planes of intelligence are successively attained. 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 issue in a higher kind of intelligence, higher because vastly more 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 combined sentience of the sixty millions or more of cells, contained in the brain; that it is an extended development of that sentience, rendered possible by the association and interaction of the cells.

" This association and this organization have, we believe, been

largely due to the wealth of protoplasmic branches and fibrils which the brain cells have thrown out and which bring them into touch and sentient contact with their fellows."

THE DISCOVERY OF CELL OLD AGE

In passing, it may be remarked here, that in 1890-91, these facts were accorded little meed of recognition in America, or abroad. It was not until two years later, when Dr. Ramon y Cajal of the University of Barcelona published similar descriptions of the brain cells, that the importance and great significance of these investigations were recognized. Questions of priority in research are invidious at best. It was a source of satisfaction to know that the work done at this laboratory was fairly in advance of that of the European savant.

The microscopical researches on which the above facts found, were conducted in part at New York City, during the winters of 1890-91-92; 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 which in its treatment of the canine species out-Heroded ancient Athens. At that time a horde of dog-catchers — tolerated for political as well as other reasons — ranged through the city by day and by night, capturing unlicensed dogs. Closed dog-wagons came to the pound at intervals. It was possible to obtain any size of dog, any breed of dog, and, indeed, *anybody's dog that you wanted,* by paying the price agreed on in private with the meretricious Celts in charge of the "probation cages," and the "gas box." But this is digression.

Incidental to these studies of brain and cord cells, as regards their consentient union in the brain, a very important and interesting discovery was made. 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 and centrosomes

smaller, but the cytoplasm was equally diminished. It was fully 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.

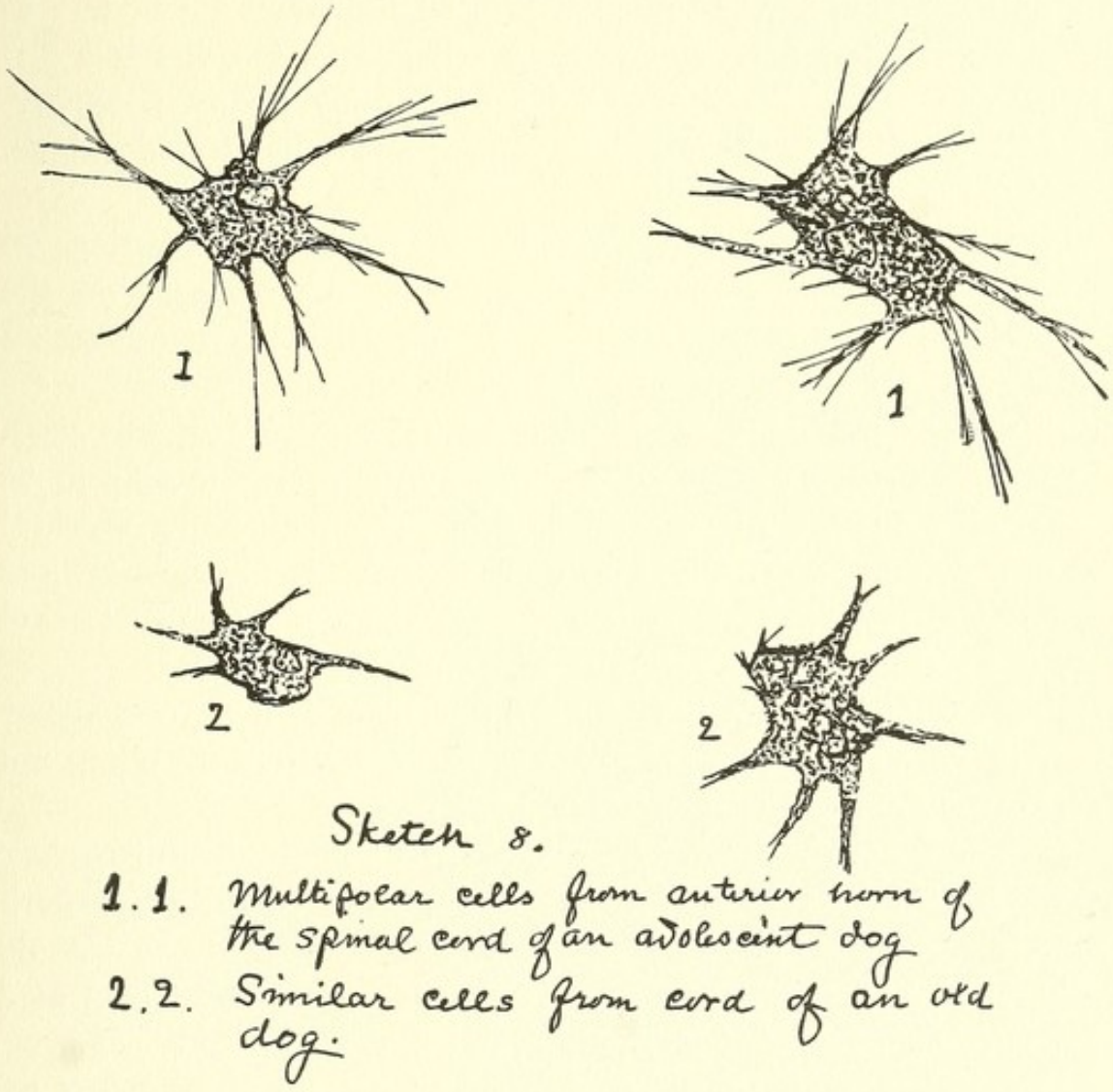
In passing, it may be noted here that nearly all these old New York dogs had lesions of the spinal cord, most frequently in the posterior columns and the column of Türck.

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 vitiation of the results) the same comparative studies were parallelled 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 grow old and 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 coöperative 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 sub-conscious life; slow



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.

poisoning of the cell from unremoved waste products of the whole body; microscope "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 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 mul-

tipolar 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 (methel blue, eosin and fuchsin). 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.

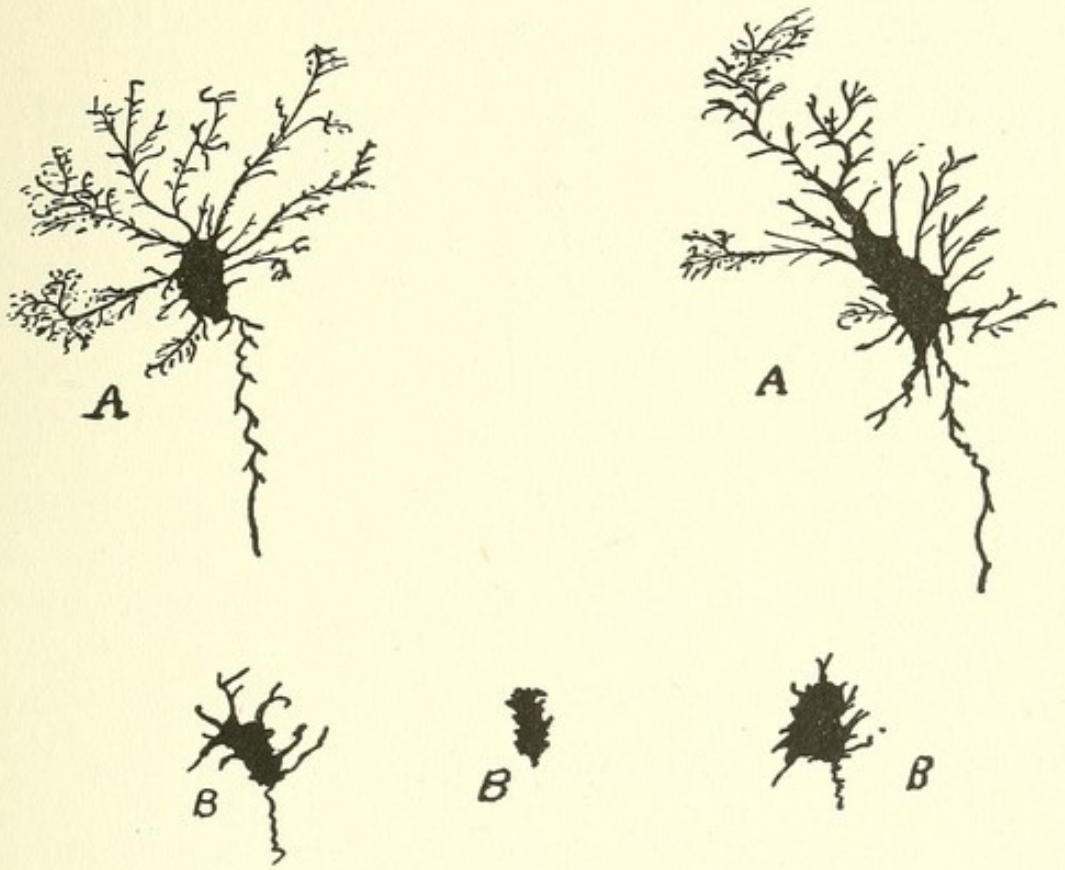
In the pituitary body or gland — exceedingly interesting on account of its influence, when stimulated, or diseased, on the growth of the entire organism — the contrast between adolescent and aged cells was most remarkable. The cells examined were from the posterior lobe, the anterior containing none 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



A A Dendritic cells from the pituitary body of an adolescent dog.
B B B Similar cells from a very old dog.

Fig. 9.

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.

Allowing for all *errata* of the staining processes, either the nitrate 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

One of the most inveterate of these causes is the slow shrinkage of the capillary tubes, the caliber of these diminishing until the white and red blood-corpuscles squeeze through them with difficulty, or cease wholly to do so.

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.

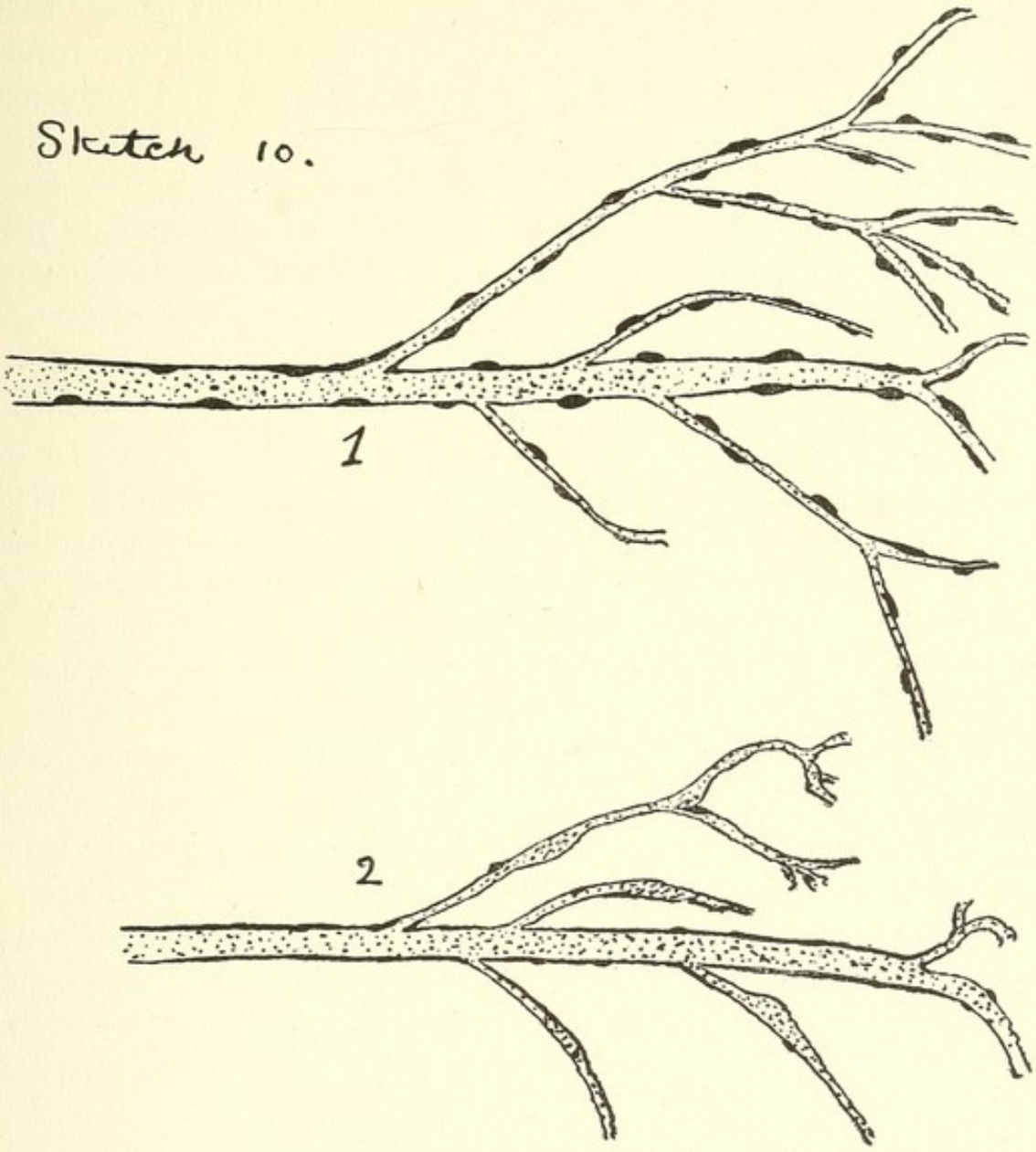
So many, indeed, are these practical difficulties, and so greatly do subjects vary, that it would be unsafe to draw deductions or form an opinion as to the difference between old and young capillaries, from a single comparison. A considerable number of comparisons — ten at least — should be made, and all the conditions carefully estimated, as, for example, the greater elasticity of the young capillary.

The accompanying pen sketch — Sketch 10 — 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, that the calibers of the old capillaries will be



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 present enlargements, and few nuclei visible. Such old capillaries can hardly be termed living tubes.

found of notably less diameter. For instance, where young capillaries have an average caliber of 1-2500 of an inch, the corresponding 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 speaking 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 dilate easily, with 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 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 dilatibility 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 sixteen years ago, 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.

Any well-equipped observer might have made these discoveries touching the old-aging of the physiological cell; and any one may verify them who will.

Cell old age, we repeat, is the deep-lying, final cause of old age and decrepitude in man. It is in the cell that we must begin our work of self-renewal. Hitherto "old age" has been regarded as a "God-ordained law of life." There is nothing divine about it. It is due to purely physical causes, each and all of which can be removed, or alleviated, by applied science.

In this connection it is proper to refer again to Professor Eliè

Metchnikoff, of the Pasteur Institute, at Paris, whose interesting works on the prolongation of human life have been so widely read in this country, and who has of late been adjudged worthy of one of the Nobel prizes.

For five years it has been a matter of surprise at this laboratory to find that Professor Metchnikoff, in his voluminous publications on the subject of old age, nowhere recognizes cell old age, i. e. the old-aging of the individual cells in the tissues, particularly the brain.

Is it possible that this deservedly popular foreign scientist has not discovered that it is the "old age" of the cells which antedates organic and constitutional old age in the human body and is slowly reflected outward in the well-known aspects of human senility? Old age in man may almost be said to be of two kinds, primary and secondary, that is, cellular and constitutional; the old age of the cell and the resultant old-aging of the organism.

Professor Metchnikoff, however, makes no distinction between cell old age and organic old age, and appears not to recognize the former condition as the intimate cause of the latter. Is it possible that cell old age has not yet been discovered at Paris? Is it for this reason — the failure to recognize the old-aging of the cell — that Professor Metchnikoff gravely concedes that "old age" in the human organism, is ultimately irremediable? That all which can be done by science is to rid the organism of noxious bacteria, perfect surgery, and choose food with greater wisdom? By so doing we may, under favorable circumstances, he thinks, prolong human life thirty or forty years, possibly sixty. No hope of anything better than this ahead. Has the new knowledge of matter no significance for this savant whose genius and industry we so profoundly respect?

To-day we are working forward to discoveries which will enable the cell-of-life to be regenerated at will. Nature is no longer fate, for science; science will be fate, for nature. We are soon to master it and do with it what we please. There is deathless life for man, ahead, without "old age," or infirmity. The Kefir bacteria of sour milk may be advantageously introduced into the alimentary canal, but no panacea for the aging of the human organism will be found until the facts of cell old age are recognized and the remedy applied there. The deep-lying cause of old age is intracellular,

not organic, and it is there that we shall have to begin remedial action.

SENSATION AND CELL OLD AGE

In a recent work, entitled *Age, Growth and Death,* Professor Charles S. Minot of the Harvard Medical School, has gone into this matter of the progressive senescence of the physiological cell far more deeply and comprehensively than any of the foreign histologists. He recognizes a structural change in the protoplasm and nucleus of the tissue cell, from youth to age. Incidentally, Professor Minot holds 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 is 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 a structural change in the somatic cell, evinced in a progressive senescence 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 life-time.

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, making it necessary that there shall come erelong a partial or complete break-up of the cell organization, commingling of the cell contents with that of another cell, fission and a new cell organization, in order to escape the results of such long-continued sensation?

THE INFERENCE FROM MAUPAS' OBSERVATIONS

More than forty years 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. More recently 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, or cycle of cells; 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. In the one situation as in the other, the cell ages

and ultimately dies, unless re-blending and re-casting of the cell contents are accomplished by union and fusion with some other cell. Left to its unaided self too long, the cell dies. A fresh start must be made. The initial elements of life are there, but they must be re-assembled, re-constructed. When thus re-grouped and re-assembled, they begin to live and grow again.

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. Hence our contention and hence one line of research pursued at this laboratory. 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?

That at least is one of the present ideals.

CONCLUSIONS WHICH THE FACTS NECESSITATE

Throughout nature, everywhere, we see life rising by successive steps of cell organization and cell coöperation to higher and higher degrees of intelligence.

This union or pooling of individual cell lives in a larger life is accomplished not by the obliteration of the cell self, but simply by placing each cell life in line and consonance with its associate cells, as when many laborers place their shoulders to one wheel, or pull at one drag-rope, or lift together, to raise a heavy timber. There is no loss of self life, but united action with others for the ultimate benefit of that self life. Each cell retains its individuality and,

in a sense, its personality. Each lives its life, but lives it in the larger life of the whole animal organism. When thus banded together, there is insured to each protection from many of the accidents which befell the small unicell, better food and the benefits and advantages which accrue from the greater experience and organized knowledge of all. In all these respects the analogy between the coöperative cells of the animal body and the citizens in a republic, or nation, is very close and instructive.

But mark well the principle on which this grand development of cell life in animal organisms rests: the principle of union, coöperation, organization; the building up of a larger, organized life from many smaller, less complex and hence less intelligent lives; first, the living corpuscle in the atom, atoms in the protoplasmic molecules, these molecules in the cell-of-life and cells in the animal body: a grand evolution of a larger, more intelligent life from millions of lesser lives.

Mark it well, for we must not ignore the sequence, nor shut our eyes to what inevitably and logically happens when that organism of animal life is marred, dies and is dissolved. There is no final loss, no death, no cessation of the basic life, itself, meaning the initial sentience of matter. The instinctive faith of humanity that life itself is intrinsically deathless, has never been wrong; that basic life goes on otherwise and in other forms of matter. It is the union, the larger, coöperative life of the animal which is dissolved and ceases to exist at organic death. The atoms and corpuscles then separate and go each their ways elsewhere, taking each its individual, inseparable life with it.

The union is dissolved, the coöperation ceases, the organized animal life is no more. The components of that life, the corpuscular and atomic lives, go on in a myriad other new forms and aggregations of the universal life. There is no cessation of that universal life, but a passage, a translation, into new forms.

The problem of organic self life lies in keeping up the organization, in the words of the old axiom, in keeping soul and body together. Otherwise, it is resolved back into the lowly, unintelligent life of unorganized matter. When we die we are still a part of the great whole, but not as an organized self, not self-consciously. We are still here, but we do not know it.

Nature in her evolution of life has put forward no plan and

made no provision for the saving of the composite, organized life of a metazoon, an animal, a man, when by accident or disease the organism is destroyed.

Yet self-conscious life everywhere shrinks from death. On this fond, sad hope of a dying world, Supernaturalism has preyed for thousands of years, with its thousand empty promises, in return for tithes, rites, and tribute. That is the burden of Asia's superstitions.

To-day the growth of human knowledge brushes aside all these fond, vain hopes of supernatural rescue. They were but the *mirage,* projected before the eyes of a race of beings that had begun to feel the cruel hardship of death and seek salvation from it. Supernaturalism marks an initial phase only of the world-wide effort of mankind to gain immortal life. An illusion, but one which none the less had promise in it, promise of a future, grand achievement. In place of it science now points out the facts of nature, and shows the way to a *bona-fide* immortality.

And is it not the part of wisdom and of duty to choose this more certain way? Why longer build our hopes on that idle myth? True, a venerable creed, redolent of incense, endeared by ancestral worship, entrenched in costly church architecture and embalmed in sacred literature, exhorts and entreats us to trust the myth. Half the world still tries to believe, while the other half scoffs, or turns its face to other things. The plain truth is that the brain of the race has outgrown the myth of "spirit" life; the facts are too evident.

For what occurs when an animal or a man dies? The heart ceases to beat. The blood-stream to the brain stops. Well-nigh instantaneously the brain cells lapse from consciousness, retract their fibrils and relax sentient contact cell with cell. The personal self-consciousness as suddenly ceases. The organism is no longer a living man, but a cadaver. Immediately then it is invaded by swarming hordes of putrefactive bacteria, and the work of dissolution begins, nor ceases until the organized *corpus* is reduced to the component atoms and corpuscles from which, by so long a labor of ancestral life, it had been raised up to be the mechanism of intellect.

It is the organism, the organization, alone, which has perished and ceased to be; but that organization carries the personality,

the self, the self-consciousness of the man. Each atom and corpuscle lives on, and, departing from the dissolving cadaver, takes its individual life with it. Apparently these atomic and corpuscular lives are deathless. We thus live on in the elemental life of the cosmos, from eternity to eternity. We were a part of it from the beginning, and shall be a part of it on to the end, but not a self-conscious part.

It is thus the elements of the human soul only that are at present immortal. We are not saved, personally, under nature, but have opportunity to achieve salvation. There is liberty to do so. Supernatural salvation is a myth of the world's childhood. But now in the light of greater knowledge we are free to work out our own salvation here; and the new faith of science bids us do it.

DISSOLUTION OF SELF-CONSCIOUSNESS IN SLEEP

During the life-time of an animal or a man the cells (neurons dendrites) of the brain and nervous system, each a separate life, are sentiently pooled and sink their otherwise individual lives in the human personality. It is seen to come about through protoplasmic contact, by means of a mechanism of sentient fibrils which the cells put forth. The cells are the intimate, sole founts of life, but they blend to form the larger personal life of an animal or a man, during the animal life-time. Yet not uninterruptedly, even during the life-time. For at this point of our investigation the phenomena of sleep, catalepsy, trance and other lapses of the self-consciousness presented themselves for consideration and found new, clearer explanation.

The consentient union of cell-lives in the human self-consciousness is not wholly continuous. In sleep the brain cells break contact and for six, eight or ten hours consentience ceases.

With the partial shutting off of the blood supply, the elate cell fibrils are to some extent retracted, the cells withdraw from the consentient union, and, instantaneously, the "soul" stops. It is a beautiful and convincing illustration of the real nature of the human personality, and how it is maintained from moment to moment and from day to day; it teaches what the human "soul" really is, and how easily dissoluble it is, either temporarily, or forever.

PERSONAL AXIS; THE AXIS OF SELF-CONSCIOUSNESS

When these facts as to the composite nature of the human personality became apparent, the question arose, how is this sentient confluence of cell lives in one larger life accomplished? How do the distinct lives of the brain cells (neurons) pool their separate sentiences in the neuropsyche? The interlaced processes and fibrils we have found. Sentient contact we have demonstrated. But what passes or flows from cell to cell to insure the unification of the separate cytopsyches, since they live and act together as a personal unit? It is not only an "e pluribus unum," but a confluent union, a *blend*. By some means millions of minor lives form one larger life and sink their own individuality in it, for the time being, at least. There must be a species of ethereal "circulation" within the currents of which the cells are embraced, like magnetic currents, with polarity, about an axis of self-consciousness. Every personal self has its own axis-of-being, about which the vital activity goes on from moment to moment, hour to hour and year to year, during the personal life-time.

Axis, indeed, appears to be the first great principle or law, involved in the present evolution, or rather devolution, of matter; axis with polarity. We trace our corpuscle (electron), or our still more minute corpuscles, down to the ether, the primeval "argon gas," if gas it be. In that contracting gas we see the corpuscular eddy start whirling, self-centered, whirling about an axis of its own. It has set up to live for itself in the midst of the inchoate, primeval substance. Individual life begins with the first self-centered axis of separate being. Human personality starts and founds there. All that follows in the way of evolution of life is but combination, organization, coöperation. The root of personality is in the first corpuscule that emerged from the ether — and may be resolved back to that. It was a living corpuscule, having its own personal axis, its own lowly self-consciousness; — for to feel is to be conscious. All consciousness is self-consciousness in some degree; consciousness implies *self*.

But what is it that whirls or circulates about this axis? For four years the problem of what "nervous energy" is, and how it stands related to the atomic, corpuscular, or etheric attenuations

of matter, has been the subject of laboratory study here. Meantime Röntgen rays, radium emanations and all the later discoveries touching electrons, afforded aid and abundant suggestion.

"Our experimentation has been directed to determine what emanations, or 'rays,' a living cell gives off. It is hardly necessary to say here that such tests are not easily applied. The only fact established is that the cell-of-life gives forth energy of the nature of both positive and negative electricity; negative electricity when the cell is in a normal condition, positive electricity when fatigued, distressed, or poisoned by carbon dioxide.

"Nerve currents, meaning the impulses that move along nerve trunks from the brain and cord of animals to muscles and glands, are more easily studied by the ordinary methods. The result of our observations has not been to identify these fully as electric currents, but as electric currents plus other and more subtle emanations. Their comparatively slow rate of motion along the nerve trunks also indicates that a more complicated conduction is involved than that of an electric current through a wire, or other conductor. In a word, a 'nervous current' now appears to be a current of negative electricity — since it responds readily to the electroscope — but one either much modified, or bearing along with its component corpuscles a 'charge' of something more ethereal.

"As to the nature of this charge it would be easy but unprofitable to theorize at present. The only point established is that the cells of the brain and cord generate normally — among other products — a great and well-nigh constant quantity of negative electricity which under certain circumstances changes to positive electricity. What corresponds to electric current proceeds from them quite steadily and they remain as constantly 'charged' or surrounded, by a 'field' or 'atmosphere' of an electric nature. Moreover, this 'atmosphere' or *aura,* vibrates, or circulates about an axis, comparable to that around a magnet.

"On a minor scale the same thing goes on in every cell, whether a unicell, living its life apart from others, or a neuron of the human brain. Each cell has its personal axis, its own corpuscular 'circulation' around that axis. Otherwise it could not be a *self,* that is, a separate life.

"When an organized assemblage of cells is pooled or united in a multicell, as in the human brain, a larger, concrete circulation

and a new, greater personal axis takes the place of the thousands of minor cell axes, and lo, a human, self-conscious personality, a soul, flashes forth. This for the waking hours of the brain; but in sleep the cells largely resume, each, its personal life, that is to say its personal axis and circulation. It is probable, indeed, that cell axis and cell circulation are never wholly surrendered, in the larger life, even in sound sleep, never wholly, till death.

" If Thomson, Becquerel, and other eminent exponents of our new knowledge were right, this electrical output from the cell-of-life is nothing else than a stream of corpuscles.

" Elsewhere in nature, something analogous to brain cell phenomena, is displayed in the phosphorescence of *noctiluca,* in the fire-fly, and noticeably in the electric eel. The brain cell is therefore not the only generator of electricity and light, in nature. The cell-of-life everywhere gives rise to similar currents of energy.

" The phrase, currents of energy, might be held to imply that the cell-of-life acts as a battery cell, or dynamo, and undoubtedly it does. But we believe it to do more than this, that it creates energy in the sense of *willing* chemical action and *instigating* or *directing* corpuscular motion, from the life-side of matter.

" We by no means wish to be understood here as carrying the idea that liberation of corpuscles in the cell-of-life is the only process going on there. The cell is, in fact, a comparatively large organism, if we may be allowed thus to express it. Ordinary chemical action and the formation of carbon dioxide go on in it. In the cell we have assimilation and oxidation, and also, as we believe, a liberation of intra-atomic energy." — *Self-Conservation and Self-Maintenance.*

THESE ARE NOT NEW DOCTRINES

In the light of our modern knowledge of matter, it is interesting to revert to the views of the Stoic philosophers and the Hindû sages, of Zeno and Chrysippus, of Anaxagoras, of Epicurus and Lucretius. These thinkers of old appear to have divined the truths of nature, and gave voice to them as clearly as the language and ideas of their times rendered possible. Essentially great minds, past and present, have all believed alike; their apparent differences are due mainly to difference of eras and the quibbles of disciples.

The great natural philosophers of all ages have conceived of a primeval Thing, or Noumenon, from which nature emerged, by a long process of growth. That primeval Thing is known to modern thought as the world-ether, at once the origin and matrix of the universe, the base and the back-ground of the cosmos, that which embraces and holds everything together, that from which all disjunct particles arise and to which they finally return, the ocean of being from which all individual existences emerge.

Corpuscules within corpuscles there may be, even as there are corpuscles (electrons) within "atoms" and "atoms" within molecules. The way down to the basic ether may be long, even infinitely long. But this would not affect our present thesis as to life. Life issues from the sentient side or property of the ether; individual life begins and is embodied in that first corpuscle which set up an axis of its own in the world around it. The corpuscle is a living, personal corpuscle by virtue of its axis and disjunct state. It is the inherent, individual energy of this little mass, self-centered and acting for itself subjectively and willfully against the resistance of the objective universe around it, that marks it as a separate individual life. Every such corpuscle is a living corpuscle.

When the corpuscles group themselves in the "atoms" — a thousand or a hundred thousand to the atom — each is seen to yield and contribute its living energy, or a part of it, to form a larger composite life, the life of the atom which in turn proceeds to center itself and set up a personal axis of its own.

Each "atom" of oxygen, of carbon, or of the metals, has life peculiar to itself. In the "atom" are united, pooled let us say, the lives of thousands of corpuscles (electrons) which for the time — a day or a million years — lend their lives to swell the larger life. But that atom may be disrupted, or waste away like the atom of radium, and all atoms in time, perhaps, in which case each corpuscle goes forth, taking its small, inseparable life with it. The "atom" is then no more; it has died, that is to say ceased to be an atom; the lives of the corpuscles were but lent to it for the atomic life-time.

Exactly so of the "atoms" when, in turn, their lives are united in the complex molecule of "protoplasm," that large, loose, self-

mobile molecule in which memory is possible. Exactly so, too, of cells which go to make up the organism of the multicell.

In every case we have the lesser lives, in myriads, pooled or contributed for the time being, to form a larger life about a greater personal axis. In case of the cell and of the human organism this union or pooling is but briefly maintained. Death and dissolution soon ensue. "Atom" and corpuscle go their ways. There is no loss of the component atomic or corpuscular lives, but a scattering of them to the four winds, as when a seed-pod bursts and the pooled seeds fly far asunder.

A human life is thus made up of an innumerable multitude of lesser lives — of corpuscle, of "atom," of cell — an innumerable company of minor lives which, at the death of the human organism, issue forth to the four quarters of the cosmos.

To be re-assembled — when?

IN THE LARGER LIFE; THE META-METAZOON

The present social evolution of mankind in national life is so clearly a continuation of the metazoic development of cell life, that students of social science will find great help in using the animal organism as their model for study.

The metazoon is the paradigm for the sociologist. For the nation is in truth a meta-metazoon. This is not a metaphor, as many may think, but a physical fact.

From the consentient pooling of the component cell-lives in the human organism there is set up an aura of personal life of the nature of an electric field: the subconscious life in the grasp of which every cell of the organism lives and is maintained, at a certain key or tension.

Quite as true it is that the meta-metazoon — the nation — has its physical aura, emanating from the lives of all its citizens, the good and the bad alike. Within the field of this national aura each citizen — like the cell — lives his life, experiencing its sustaining and restraining influence for good as long as the majority in the nation are right-minded and progressive, for evil when this larger life becomes unprogressive and delinquent.

National, civilized life has not yet gone so far relatively in organization as metazoic life; the individual citizens of the nation

are not yet as fully organized and united for coöperative effort as the cells in the animal body; that is the only point of difference; the principle, the *motif* for uniting, is the same. Even as the unicell was too small, too weak, to live long or happily on the earth's surface alone and unaided, so with the unorganized human life. To gain better, happier conditions, there must be organized coöperation in a larger, stronger life, the communal life of the nation, or of pan-humanity, in which self is not lost, but ennobled by consecration to the common good.

From the corpuscle upward to the cell, and from the cell upward to the human organism, there has been no loss, no obliteration of self, but a consonance, a banding together, to secure stronger effort and greater advantages for all.

Even so in the perfected republic of the future, the individual citizen, by a full, generous coöperation with his fellow-men, will attain the domination of nature, and in the end, freedom from those evil conditions which now uniformly cause death after a brief life-time.

In this larger life of the nation and of all humanity we live, *per force;* and it is to the still untaught, futile struggle of the individual man to live for self alone and make his environment wholly subserve selfish ends, that nine-tenths of the unhappiness, misery, and crime which we see about us is due. In this we have great need to change our present ideals of personal life and our conceptions of what our lives are for. In the very cradle, we now take a wrong apprehension of what we have come into our heritage of life to do; a wrong apprehension which comes from erroneous beliefs concerning the nature and destiny of the human soul. At the outset of life there is dinned into our infant brains the falsehood that this earth is but a dreary bourne which we are soon to leave, instead of becoming a part of its greater life.

Largely due to this initial misdirection of their lives we find the majority of mankind living solely for self, devoting their energies to getting the largest possible share of humanity's hard-earned wealth, by hook or crook, often by any species of legal trick or dishonesty. Yet even as they grasp the prize, the curse from it falls on them and their sons. It is the logical result of the initial untruth, told and sung to the cradle. The child's ideals go wrong from the start. Most of all we need a system of in-

struction for our children, based on natural truth, *versus* the present supernaturalism, such a system as Japan is now seeking for its unborn posterity, instruction to live in the larger life of the nation.

Well-educated people in Christian countries to-day, in England, in America especially, are in the anomalous position of teaching their children for the first ten years of their lives an antiquated supernaturalism which by the time these children are fifteen years of age, they have infallibly to unlearn and reject!

Mind is a growth, a progressive system of molecular architecture, an orderly building of the protoplasmic molecules of the brain cells. We allow to be reared in the brain of the child, at its most impressionable age, when the cerebral cells are most plastic, an edifice of error which, a few years later, has to be razed from its foundation and a new structure reared there on wholly different lines, fronting a different aspect of the universe.

How many of us know, too, with what mental misery and with what keen pangs of conscience this demolition proceeds. Such potent hold and sway over the brain have first teachings when given us by fond parents and venerated instructors!

What wonder that in so many cases morals suffer and a hard unbelief in everything religious supervenes? It is the natural reaction from the Falsehood told to the cradle.

The psychic and physiological damage done the brain by this disaster to its first hopes and beliefs can be but inadequately demonstrated, as yet. To start the growth of a human mind wrong in its essentials, at the outset of self-consciousness, is the most serious of handicaps.

With Romish and Greek Christianity (as with Mohammedanism and Buddhism) the system of tenets has passed into the *rigor mortis* of a dead faith, and become structurally unprogressive. Such creeds, like old trees, may die, but can not be rejuvenated. Much the same is true of the elder Protestant sects.

THE GREAT COMMUNAL MAN

We have ever to bear in mind, too, that church Christianity, as we now see it, is Christian only in name. The Personage, called Jesus, who lived nineteen hundred years ago in Palestine, con-

ceived himself to be the Hebrew Messiah, and sought to found a kingdom of God on the earth, 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 perverted 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?

Equally 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 becomes a madman. 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 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 this "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 nine-

teen centuries in the evolution of an idea like that! This necessary purging and merging of self has gone steadily on. 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, for politic 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 little claim on the believer in Jesus, and little right to the use of that name. Humanity is now turning again to the man of Galilee, seeking 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 necessay 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-prophesied 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 book 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 consciousness 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, a vision of the future reflected back into the past.

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 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 till we all accept this ideal, till every man of us merges his selfishness and accepts pot luck 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. One such new lease it is now about to take in America. Already we feel the thrill of its coming. We hear it even in the discordant outcries of the Socialist mob — that larger life of the still living Jesus, from whose cult we have now to strip away the erroneous, often fantastic eschatology of church Christianity.

It is at this difficult phase of human progress in America, that we now stand hesitant, loath to break with church Christianity, yet convinced that its dogmatic teachings are erroneous. Convinced, too, that when the break comes supernaturalism and everything connected with it must go, *in toto*.

Far more, even, than our clearest minds are aware, our lives enter into 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 edu-

cated 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 foot-falls 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, with a mind no higher than the brute. Altruism was as yet unborn in his brain, the advantages of coöperation 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 coöperative 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 safe-guarded 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 life-time of thirty thousand years to its individual citizens.

In the animal organism the whilom unicell has found a natural salvation; and even so human beings may achieve immortal life and make earth heaven, by organized coöperation and research, invention and the mastery of the resources and powers of the universe. 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 coöperate, in order to grow in knowledge and gain control of nature. Such is the promise of science. Thitherward lie "heaven" and immortal life.

A STILL PROGRESSIVE TISSUE

Advancing from these researches, mammalian brains in the gross were then compared with the brain of man, with a view to determine how and why the latter has so eclipsed all others in inventiveness, reason and the acquisition of knowledge.

These studies led to not a few interesting generalizations; but the result of greatest significance was one wholly unforeseen at the outset, namely, the reflex effect of the growth of human knowledge on the brain itself, and the fact that modern civilized life,

education, science *par excellence,* are developing the brain of man and rendering it a still progressive tissue of the organism, anatomically.

Whether man as a type of terrestrial mammal is still progressive, was one of those questions which naturally suggested themselves to biologists of the generation of Darwin. Many then held that the human type is "fixed," that is to say, structurally unprogressive, and would remain so, for the reason that there are no longer geological and climatic changes, such as compel readaptation of organic life. Comparison of human tissues, bone, muscle, skin, hair, hepatic tissue, renal tissue, pulmonary tissue, with those of the lower animal orders, went far to confirm such opinions.

As investigation proceeded, however, it became apparent that in forming this opinion as to the unprogressiveness of the human type, one tissue, at least, had been overlooked, namely, the human brain, and that it was in his brain that man can still claim to be progressive in type and not "fixed." The brain of man is not only growing in size, but is changing form, and has been doing so steadily for the last ten thousand years, due to the growth of knowledge.

Certain of the conclusions reached in 1895 are quoted here, from a paper which will be found on subsequent pages.

"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 need of greater capacity for the reception and utilization of intelligence. That need still exists and grows 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 much the same; hence, bone and muscle cells long ago reached the acme of their development. The same is true, or true in a large part, of every 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 unpro-

gressive, and as a result show little brain change from generation to generation. It is not so, however, with the 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 arrangement 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 epoch. 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 always 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 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.

"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."

A SUMMARY OF THE FACTS

Such are some of the facts and the researches on which the new faith of modern scientific knowledge founds — the Promethean Faith.

1. The facts of cell life, namely, that it is the one, the only 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, essentially unchanged. Associated with these facts of cell life, is the well-supported hypothesis of the sentient constant of matter: a working hypothesis merely, but one which the entire progress of research so far sustains at every point.

2. The facts 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.

3. Demonstration of the manner in which the lives of the cells are unified or pooled in the larger life and personality of the multicell.

4. Demonstration of the fact that death and dissolution of the cell organization in the human organism ends personal self-consciousness and terminates individual life; that death is, whether from disease or dynamic shock, always of the nature of an unnatural event. Death, like fire, is the antithesis of organized life, a reduction back to the lowly, unorganized sentience of primeval matter. Death blots out that higher intelligence; and nowhere in nature do we find any provision, except reproduction, made for the preservation of a personal intelligence after the destruction of its organization. It has vanished, because each component cell

and corpuscle are now withdrawn from the union and have gone their separate ways, taking with them each its own smaller self-life, those lives of which the greater life, or soul, was a temporary union.

5. Further 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 intelligently and pooling its knowledge to accomplish greater works and achieve grander results than one man can accomplish, working separately and alone.

Here again, in the nation, there is a physical unification of cell energy, from individual to individual, tending to set up a national aura and a confluence of individual lives in a greater national life. The mental picture is that of, first, the consonant organization of the corpuscle in the cell, second, the cell in the multicell, and third the multicell (man) in the nation; all resting on a physical basis; a consonant organization of lower life to form a larger, higher life.

6. The fact that the human brain is a still progressive tissue of the organism, steadily growing and unfolding new capacity for the reception of knowledge.

7. Conclusive evidences that the causes of "old age" and death are purely physical causes within the province of scientific knowledge to alleviate and remove.

8. Proofs taken from the entire course and history of life on earth, to show that it has made a continuous upward progress toward better conditions from the very first; continuous progress toward salvation from evil and error, justifying faith and high hopes for the future.

It is, we repeat, from all these facts, touching life on the earth, that the faith expressed in *Salvation by Science* is formulated; and we assert without fear of contradiction, that when these facts are taken together and estimated as a whole, no other deduction can be drawn from them.

Taken together they can mean but one thing. If they do not stand for the scientific salvation of man, then the terrestrial life scheme is illogical, unnatural, abortive. The longer it is studied, the more certainly the student will come to this conclusion, namely,

scientific salvation from the growth of human knowledge; it can mean nothing else.

And this is the new creed which, after centuries of incubation, scientific knowledge now offers the world, in place of supernaturalism.

So far as the work done at this laboratory is concerned with it, the researches here were begun with no higher purpose than a desire to understand what life is and how it goes on in the cell. I wished to learn what could be done with that form of energy which appears in nature as *life,* whether it could be mastered, harnessed, so to speak, and made, like other modes of energy, to do human bidding. But one by one the above facts and truths flashed forth, as research proceeded, facts and truths which underlie the origin and destiny of life on the earth.

Almost unawares, the new faith emerged from the mists of olden darkness, a loftier, grander faith, wearing the garment of Eternal Truth.

To that faith I have attempted to give voice.

IMMORTAL LIFE THE KEY-NOTE OF ALL CREEDS

Immortal life has been the key-note of all religious creeds. The Hebrew faith, Christianity, Islam, Buddhism, all have succeeded because each in some form held forth the hope of personal immortality. It has been the hope of that life which has nerved men to labor, to worship, to fight. The great teachers of mankind have all realized this.

When the promise of personal immortality, made by a creed, begins to be doubted, the creed declines and continues thereafter only by virtue of ritual, church architecture, brain indoctrination of the masses and social usage; a detriment henceforth and a drag on the intellectual progress of the race. In that plight stands dogmatic Christianity with all its sects, to-day. Its "soul" doctrines are discredited, its promise of immortal life is no longer believed. Henceforward it will go on only by virtue of the uneliminated ignorance and superstition of mankind, for two centuries, perhaps, slowly dying out, as the one great central truth of it, the truth taught by Jesus, comes to be really understood and

assimilated into the new faith of scientific knowledge. Already the soul doctrines of supernaturalism are vanishing like ghosts at dawn; and in this same rosy dawn of our increasing knowledge, educated persons, everywhere, are waking from the sleep of old creeds and searching for a better, more certain realization of the hope of immortal life. Supernaturalism is dead; and the hope of deathless life by supernatural grace, dies with it.

Yet even now as that old hope of immortal life fades out, this new, more realistic faith comes to take its place.

The present century will be signalized in human history as the epoch of this greater new Faith, displacing the former creeds which have come to America with our forefathers, but which America has outgrown.

It is one of the great, infrequent centuries of transition, which come only secularly, once in a thousand or two thousand years; and it will mark an era as remarkable and as distinctive as those from which Time is now reckoned, from Jesus, from Mohammed, from Siddartha.

The new faith is not a modification of the old faiths. It differs from them radically and is opposed to them fundamentally. Attempts to " harmonize " them, the new with the old, will be futile. If the new prevails the old must give place, for the new controverts and reverses the old. It does not renovate, it razes the old from its foundations. It begins afresh with new, diverse concepts of life and of man. Certain truths from the old creeds it adopts, but gives them new guise.

The old faiths are systems of supernaturalism and treat of the supernatural salvation of the human " soul," apart from the body. The new faith is the antithesis of supernaturalism, and treats of the natural salvation of the human intellect in the human body on earth, by the physical renovation of the body. It teaches salvation of the human personality under nature, achieved by man, himself.

The old faiths separate the soul from the body by death, in order to " save " it. The new faith of science finds the soul joined indissolubly to the organism and renews and renovates the latter. It teaches that salvation comes from keeping soul and body together.

The old faiths transport the "soul" to Heaven, to Paradise, to Nirvana: undefined bournes, disjunct from Matter and Time, illocal in Space. The coming faith of which this century is the era, looks to the paradisation of the earth and teaches that man makes his own "Heaven" and makes it here. It leaves all that wide-spread architecture of churches, mosques, temples and cathedrals, beneath which the soil of America and Europe now groans, leaves it desuete and desolate, indeed, so many hollow-echoing sepulchres of past superstition, like the ruined temples on the Nile, in Ceylon, in Cambodia, from which the gods of the past have long since departed.

The new faith of scientific knowledge is therefore, in very truth, a new departure of the human race, an abandonment of supernaturalism *in toto*, as complete as was the abandonment of paganism for Christianity, in the days of Constantine. More so, indeed; the change is even more radical and subversive.

WHAT ARE THE TENETS OF SALVATION-BY-SCIENCE?

And what are the tenets of this new faith of scientific knowledge, it may be asked. What are its articles of faith?

It has no hard-and-fast tenets.

It is all comprised in the simple faith that we can perfect the human organism, transform the earth to Heaven and achieve deathless life.

Strictly speaking, the truly scientific mind has and can have no "fixed" tenets, no thirty-nine articles, to be baptized into, or subscribed to, as a credo.

For science is progress, continuous progress. The faith of science is a progressive attitude of mind toward life and the universe, always with the expectation of enlarging our views coincident and corresponding to each fresh advance in knowledge. In the creed of science we expect to grow in mind, changing and modifying our beliefs as knowledge increases. Our creed is therefore *a hopeful, optimistic attitude of mind toward life, with the purpose to make it better.*

As regards articles of faith — in the church sense — the creed of science might have to be re-written every year so rapid is, or

will be, the growth of human knowledge. Science garners new facts and makes its tenets anew daily.

Where knowledge is growing there can be no unchangeable dogmas. Dogmatism dwarfs the mind and paralyzes the psychic growth of the brain. It is only with unprogressive, or retrogressive races, that a fixed creed can be maintained; and with the retrogressive, the creed slowly degenerates to ritual and superstition. The worst superstitions are but so many former religious systems in decay: religion in the fossil state.

The attitude of mind which the growth of scientific knowledge sets up, is emphatically one of good-will, hope and great expectation for the future. On this planet, after nature's myriad experiments in living organisms, brain, the brain of man, is now making a noble progress. That wonderful colony of living cells, organized to grow in knowledge, is now making grand strides toward the conquest of nature and the universe. Pessimism as to this is but ignorance of the scope and extent of that progress. It has been persistent, continuous, irresistible, for a hundred millions of years. Apparently, too, it is now but well inaugurated; and field appears to be offered it by the natural life of the globe.

Barring cosmic accidents in space, the earth, like Mars, Jupiter, and the other planets, bids fair to revolve for millions of centuries to come. Water and air, too, show no indications of depletion. The well-springs of solar heat, light and electricity are equally enduring. Moreover, these tides of energy from the sun can be conserved and their action on the earth's surface regulated. Climate can be controlled and the planet made a paradise. It is an empire waiting human conquest.

The only element which individual man lacks to enable him to conquer this empire and enter into possession of it is *time*. Individually, his days are now too short for more than to learn the first rudiments of life, and perceive his real situation in the universe. There is not time for more. Before we have fairly learned to live, we suffer from disease and infirmity, and die, miserably die, with all this infinite opportunity to live, unentered, unenjoyed, unpossessed. Death keeps humanity down to a bootless learning and re-learning, over and over, of the mere alphabet and accidence of life. On account of death the human generations but little more than hold their own; for in dying the results of

teaching are almost wholly lost. But little of experience is really conserved; for the tissue of intellect must mature for forty years to become really wise. Death causes all this vast labor to be done over and over again, on the whole a little better. Reproduction is better than extinction, but only a degree better, and not for a moment to be compared with the grand advantages of living on, free from personal death.

Reproduction takes place because we would otherwise die, but is not an ideal mode of survival. The individual with his acquired experience and refinement is the ideal survivor. Infancy suffers what would be needless tortures in learning to live, if the adult could survive in health.

The world-wide demand of educated, inventive man is now for more time. He sees the doctrine of disembodied souls to be a myth, and asks, "Is it possible to save the soul?" The question is one that enters with the newer conception of our freedom in the universe. What we have we must achieve for ourselves. We are alone here, with everything to gain from invention, research, and discovery.

Immortality is the birthright of life and the destiny of man. Men still die, but death is not an irremediable evil. The great terrestrial scheme of life, when grasped in its entirety, points to a purified earth, inhabited by one great nationality, the descendants of mankind, whose lives will be prolonged toward immortality. A *gens* terrestrial and celestial, not overpeopling the earth, nor yet devoid of procreative power, not an assemblage of infirm, aged organisms, kept alive by improved medicaments, but persons fresh in unfading maturity to whom the years will bring, not infirmity, but stronger personality, fuller life, grander beauty and greater wisdom. For this wonderful substance which we from eternity inherit — and now call *matter* — has in it an infinite potency and capacity, the capacity for godhood if we will develop it.

The new and greater gospel of science, as briefly outlined in the foregoing paragraphs, is therefore this natural optimism of the human heart, this faith in future man, this ennobling of self in the larger life of humanity, and lastly, grandly, this new hope of immortal life, achieved in righteousness, on a perfected earth which shall realize our ideal of heaven. This is that grander faith which three centuries of science now offers mankind.

IMMORTAL LIFE; HOW IT CAN BE ACHIEVED

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, that atmosphere of "personal magnetism" 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. We live, move and have our being in a medium of such amazing tenuity, elasticity and sensitiveness, that even our conceptions of the swiftness and subtility of electricity fail to convey an adequate idea of its properties.

For fifty years we called it the "luminiferous ether, concerned in the transmission of light, heat, and electricity," and thought little more about it. From the growth of scientific knowledge on all sides, especially bio-physics, we now know that this omnipresent ether (or æther) transcends all former conceptions as to what matter may be, opens a new world to thought, joins chemistry with psychology, spirit with substance, and is probably the raw material of life and the human soul itself. It were better called *psych,* undeveloped soul; or *Omorca,* after that archaic divinity of the cosmos, while it was still unformed.

From the physical side, Mendelieff believed it to be the last of the lucid Argon gases; but to term it a gas minimizes its wonderful properties.

Indeed, to gain any conception of what we now *know that the ether must be,* we have to stretch all our previous ideas of it to the breaking point, and then evolve new ideas.

Thought pre-supposes the existence of the ether as its medium. The life of a cell — every individual life — sets up a continuous disturbance in this subtly elastic medium, thrills it, so to speak, sets it vibrating. The basis of the aura which surrounds every individual life, every cell, or union of cells, is the contiguous ether about it, vibrating to the beat of that cell-life. Every cell, every plant, every animal, every human life, lives on a certain vital key, or pitch, giving forth what we attempt to describe as rays and emanations. It is this vital radiancy which maintains the personal aura.

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 earth and it may be, even, of other worlds in space. Eminent, pure and correct lives strike harmonious chords in this great anthem of the world's music. Great men, preëminently 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, have changed the harmonics 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 visitor, 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 biophysical 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. The newer, scientific Faith is therefore placed in the organized coöperation 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 coöperative 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.

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 a millionfold by combining with his fellows. In this the unicell showed us the way, thousands of centuries ago.

The present, incipient, social organization of man, little understood, scarcely comprehended at all, has been going on, after a slow fashion, for ten thousand years, and still goes on erratically, by fits and starts, with vague aims and much ignorant clamor. 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 coöperative 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 now being 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 all

set to work with faith and enthusiasm! Verily but the touch of an infant's hand to the hammer-stroke of Thor, or the giant-rush of charioted Achilles, driving to battle.

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. We could do it in fifty years. Some of us now living, even, might grasp the grand prize, and learning the art of self-renewal and self-maintenance, literally pass from death unto life.

But as yet we are not able to bring the truth home to the minds and hearts of these living units of our great potential confraternity. Their minds are still inert from doubt. Why? One word explains 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 grand common purpose — Life. Supernaturalism still blocks the Way of Life. Virtually, it condemns us all to death.

That is ever the cruel, killing feature of it. The discoveries which might come in a decade are to drag along for centuries, when they might come so fast and give us life! Perfected cell food, regulated climate, the extirpation of disease-producing bacteria, regeneration of the tissue cell *in situ,* cumulative control and use of cell energy: all might come in fifty years.

Instead, we must die, miserably die, because this larger potential life cannot yet be organized for work.

Will none of the millennial Christs-of-men appear and wake us to labor for this later Kingdom of God-hood?

Generation after generation must we still stick fast in the sodden narcotism of antiquated creeds? Century after century, must

we see the idle horde of lucky rich persons — who apparently do not know nor care why they are on the earth — squander the wealth of the world in inane pleasures, horse-racing, gambling, champagne, gluttony, debasing themselves, thereby entailing their worthlessness and their diseases upon future generations; — and meantime rousing in the breasts of those less "lucky" these dark auras of hate which bid fair to culminate in bloody revolutions, destruction of hard-earned values and reversals of progress?

That greater communal life, fit and adequate to Herculean labors, is as yet scarcely organized. 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.

Weaklings may sigh for god-ridden "heavens" in some distant quarter of the universe, or some fourth dimension of space. None the less 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 homestead 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, deathless life?

Nor is this greater communal life merely a matter of cumulative strength. Skill is intensified, inventiveness heightened, where many work together, united and agreed as to the object in view. If a thousand students were directing their microscopes to an

examination of the activities, displayed in the cell-of-life, with a view to discovering its internal economy, what one failed to see, another would discover. In the perfecting of the microscope, too, to attain greater power, or invent a newer, better instrument, what one failed to think of, another might find out.

So in chemical synthesis, carried on to discover a pure food for the nutrition of the cell-of-life, if a thousand skilled chemists were to set to work, what proved impossible to the wits of one would be accomplished, or fortuitously hit on, by another. What, indeed, might not a thousand well-trained investigators discover, if all worked together with a common end in view, to produce a substance which will feed the component cells of our organisms, without that waste and those poisonous residues which now wreck the kidneys, contaminate the alimentary canal, discolor the lungs, clog the hepatic cells and harden the blood-disks, literally dragging us down to death?

This, even one thousand well-equipped students might do, if they could be rallied, enlisted, and brought together, to labor earnestly to this end.

What we shall do, if we do not thus unite and work together, will be to go on generation after generation, making but a purblind progress, often disheartened, often pessimistic, and in the end, it may 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?

This problem of a perfect cell food, like that of climate control, the world-wide extirpation of noxious bacteria and the general paradisation of the earth, is one which passes, naturally, to the lot of the greater, communal life — to the meta-metazoon. Hith-

erto scientific work has been the task mainly of the single, isolated, unaided man, the unicell so to speak; but we have now come to greater tasks which demand the united labors of the larger life.

To organize this greater life, organize it for practical work, is therefore the first duty which presents itself, the next step in our quest for deathless life.

And here the pessimist, of course, in all his many garbs and guises, will not fail to cry out that this is visionary and cannot be done. We know him of old; yet humanity has a habit of pressing on toward better things in spite of his raven-croak.

The difficulties, however, are not to be underrated, nor overlooked. Men have not yet sufficient knowledge, it is urged, to comprehend the tremendous advantages of such close coöperation; nor do they as yet really know how to coöperate. 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 horrible 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 goodwill 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 coöperate 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 among the billion and a half of the earth's inhabitants, which so baffles making united effort.

All of which brings us back to the practical question of what can first be done, under the circumstances, to unite the world's resources, combine human intelligence and render both effective for combatting the causes of disease and death? What is the first practical step to this end? Can any plan be adopted by which

intelligent persons of this generation can really get to work and bring their personal efforts to bear on the problem?

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 generally, 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 *lingua franca* of science, it seemed proper to call such a league *Gens Scientiæ et Vitæ,* The World-Nation of Science and Life.

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, by referring the matters in dispute to the already organized peace tribunals. 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 be of wider scope, uniting persons of scientific attainments everywhere, and having a definite aim, namely, the union of mankind for the application of all science and all the world's resources in the coming great struggle to reach the acme of *Natural Salvation;* to protect and rescue the human organism with its human soul from its present hard fate.

It was not believed that the suggested league would make much progress among the alien races, save in cases of educated individuals. The burden of progress and achievement will long rest with the dominant race. Certain of the lower races, like the lower animals, will of necessity be coerced for the general good and for their own good. The "rights of man" are sacred only when man is disposed to make good use of them, and is intelligent enough

to do so. The right to make the world better is a divine right, the natural prerogative and duty of superior knowledge. An ignorant, ill-disposed race or nation, bent on selfish and aggressive courses, may properly be constrained to do right, even within its own ancestral territory. Men or races have no natural right to do wrong, even if never so sincere, never so self-holy.

With the Indo-European rests not only the responsibility to do right for the world, but the duty of seeing to it that others do right. This is, in very truth, "the white man's burden," the gravest of all responsibility.

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 public enterprises of a scientific character. 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, 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 overshadow 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 not only of removing the causes of death, but of so facilitating and perfecting nutrition by improved food, that the struggle and stress of living will be lifted, then 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, in the earlier editions of *Natural Salvation.*

Nor did the idea fail to elicit response. The response, however, revealed the practical difficulties in the way of making the *Gens* operative for the end in view. Willing members were numerous; but how to work together was the problem which soon rose.

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 coöperate in the larger effort. They would like to do so, but their ménage engrosses them and holds them back.

Moreover, we were too far apart, in every sense. Greater wisdom, however, often comes from unsuccessful experiments. The *Gens Scientiæ* was to be a world-wide league. Practically it proved too world-wide; we could not get properly in touch. Something less unwieldy is needed. Who will help organize it?

Why not come forward and help on, you who have inherited a competence, or have gained one in successful business? Instead of living for the rest of your lives in the usual slothful way (pardon the word), why not come and help on, as best you can, this great achievement for which the Age waits?

There was a man (sing his example, O Epic Muse!) whose name was Field. He 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 and lived long, 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 call him up, to live again, whenever they have a bold project in hand that daunts their courage. They will want to hear Field's brave voice again.

Cyrus Field had no technical skill for making or laying ocean cable; — but he had a *soul,* and he saved it, in the only possible manner, for deathless life.

Horse-racing, private yachts, champagne and the somatic pleasures — how soon all that sort of thing palls is a matter of constant experience with the retired rich. Why relapse to that dry rot of animalism? It is an ennobling motive for the rest of your life, which you need now. 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 sub-consciousness, and that of our race, hold us accountable for the money (humanity's money) which we have gotten hold of. That sub-conscience 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 preciously 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 for-

ward 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 Purpose 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.

And what in the way of research and experiment?

Everything which bears on the great subject of prolonging life and making it happier. For example: —

Experiments in combining, or concentrating the nervous energy of several persons in one current, for transmission to another person, with a view to producing curative effects. Three or four investigators might undertake this, working together.

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 corpuscles (electrons) but made up mainly, it is believed, of more minute particles of exceeding subtility. Corpuscles are present in the current; that has been proven; but more subtile 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 combining 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 to recipients, for purposes of cure or regeneration. What is needed is media

of conduction from one organism to another, also means of accumulation and storage.

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 self-maintenance and even for 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 which may be devised, that many forms of disease can 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 — still calling it nerve force — 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.

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 electrification of the sleeping body and the application of electrical currents to certain organs during slumber; also the use of ozone and added oxygen in the air respired, since it is well known that lowered 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 uncon-

sciousness may very possibly be made a period of depuration and even of rejuvenation.

People sleep so badly at present, so foolishly, 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. This investigation may well be undertaken by five or six observers, working together at this laboratory.

Another line of research which needs to be conducted more carefully than has been done heretofore, is extended observations of unicellular life, under the microscope, in respect to nutrition.

In respect to reproduction, Maupas did this many years ago. After the methods of Maupas, or improved methods, we need to do this in respect to the nutrition of unicell colonies as regards their food and the effects of various foods on the life-time of the individual protozoon. Remembering always that a cell is a cell, whether living alone, or organized with others in the multicell.

Parallelling the above is the subject of human nutrition, carried forward from those experiments latterly instituted at Yale University and Washington. These researches and experiments have gone forward to the extent of furnishing an advantageous basis for further work.

Nutrition — an improved scientific nutrition of the physiological cell through the blood — is one of the imminent problems in our quest for longer life.

Food, as we at present view it, seems a simple matter. The lower animals and plants afford it. It has but to be herded, cultivated, harvested, and cooked. What more simple? But of all future inventions and discoveries, the greatest, the most important, will pertain to food.

At present we ingest the errata of plant and animal life. "The dead, alas, are in us," and "death is in the pot." There is lack, too, in the human organism as we inherit it, of energy to maintain the complicated processes requisite to reduce and make it ready for assimilation by the tissue cells. It is our food which renders greatly prolonged life impossible, at present. Nor is it probable that the human organism ever was, or ever could be, bred or

trained to live forever on food such as human beings now eat. The physiological processes by which food is reduced, comminuted, corrected as to its chemical constituents, peptonized, hepatized, oxygenated, and, in a word, carried forward to higher and higher stages of chemical instability, fit for assimilation by the tissue cells, set up a heavy draught on the collective life of the animal body. There is a necessity for putting forth energy on the part of all the cells, which causes an ever-increasing deficit of potential, a growing debt from overwork, a chronic accumulation of the effects of fatigue, which, under present conditions, must sooner or later lead to a running down of the cells.

Under favorable conditions, a cell may gain potential; but the severe, steady draught on cellular energy, necessary to maintain organic nutrition, even on the best food at present procurable, at length bankrupts the collective energies of the cells.

The horse, the ox and other ruminants, that have to do even more hard grinding and furnish more energy, relatively, to maintain nutrition, succumb much sooner than man.

In one sense, therefore, it is our food which brings us to death's door; that is to say, the exhausting physiological processes, necessary to prepare it for cell nutrition, will in the end work the most perfect existent animal organism to death.

It is only when the organism is young, the lungs pervious and the tissue cells little encysted as yet, that a gain in cell potential, for fifteen or twenty years, can be made over the draught on vital energy, requisite for nutrition.

We may properly attach great significance to these facts, since the general opinion is, that food, once eaten and drunk, reaches its proper destination in the body without much expenditure of energy. Yet sudden death not infrequently follows overfeeding, purely and solely from organic inability to summon sufficient power to initiate the process of food reduction.

It is along the line of improved food, as well as regeneration of the somatic cell, that we must look for happier and longer life.

Is such food possible?

Beyond doubt. But at present we lack the data of nutrition. We do not as yet understand how a cell nourishes itself, nor how it might best be nourished. The cell absorbs particles from the blood plasma, and we have a general knowledge as to what those

particles are; but of the modes and processes of intracellular digestion and nutrition we are ignorant. We do not know how much of that food is actually assimilated in the cell, nor how much is rejected. Beyond doubt the blood is a comparatively dirty, vitiated, toxic stream. It is probable indeed that the cells suffer constant injury from minute dirt particles which they ingest. The intestinal tract, or passage along which the ingredients of the blood are prepared for the villi to engorge, is a howling wilderness of disgusting parasites and bacteria, many of which are hostile to and destroy the life of the host when they multiply beyond certain bounds to which the *vis medicatrix* of a healthy organism keeps them down.

As a first step in the study of improved food for the future we have need to see what the primitive cell — the protozoon — has done in this line. For better food has been the object of long effort, since the first micro-organism appeared on the shores of the primeval sea. Protozoons, like rhizopods, ingested food particles which, laboriously, with an exertion of all their powers, they contrived to reduce, digest and in part assimilate. It was a hard life into which they put all their energies; and to their humble efforts we owe a debt of far-off sympathy. One can but think softly of those first toilers in the archaic marshes — so much depended on them.

The protozoon had his small stomach, an improvised colon, and maybe a unicellular liver; and beyond doubt our ancestral amœba had his colics and his jaundices, and was often in mortal agony from terrific peritonitises. It could hardly be otherwise, considering what food chunks his hunger drove him to engulf. But he struggled through by hook or by crook, and finally drifted into metazoic coöperation, and thus took life a little easier.

For after locomotion, better food was the first problem which multicellular creatures undertook. The animal organism, with its blood-circulatory, blood-disks, blood plasma, cardiac apparatus for propulsion, and lung tissue for aeration, offers a most interesting and suggestive study of the way the protozoon, in its later rôle of physiological cell, has handled the food question. It is the object lesson given by the protozoon to the human metazoon.

To secure better assimilable food for brain and muscle, the confraternities of metazoic cells very early in the division of labor

impressed a certain number of cells into service to act at first hand on food substances and make that their peculiar business, so as to get it in more available form; these were the cells lining the food pocket or future stomach. The labor being arduous, the metazoic consentience soon detailed certain other groups, or tracts of cells, to aid those of the stomach-sac; and these afterwards developed variously as liver, pancreas, and other glands, great and small. Still others took up the work of passing the liquefied pabulum to those other tracts or groups whose business was locomotion, and these in time developed as arteries, heart and veins.

But to be transformable to energy and carry on the physical business of the co-partnership, oxygen was needed; the food must be charged with it; and another cell group took up the business of admitting external air and infiltering oxygen. From this group has developed pulmonary tissue. But nerve, brain and muscle cells excrete waste products of the nature of poisonous refuse, to such deleterious extent that another cell group assumed the duty of extracting it from the circulation and washing it away; and from this tract of cells we have the renal organs.

Still there was complaint that the food was not good enough, and another cell group, entering the sanguineous current, undertook the task of still further refining and vitalizing the plasma, now on its way to brain and muscle; and from these labors for the common weal have come various gland cells and the white and red blood corpuscles.

It is at the price of all this auxiliary labor and only by virtue of it that the brain and muscle cells are nourished and are able to live so long and do so much in the way of locomotion and intelligence. Mind would be impossible on a poorer food for the brain cells.

And what is the lesson from this?

Locomotion, intellect and a life-time of a century have been attained by the metazoic cells from a food as good as that which now comes to them in the blood plasma. Yet that plasma still contains noxious particles, despite the efforts of the living organs which labor to refine and improve it. The inference is easy. Science must come to the aid of the organic apparatus and furnish a food clean, pure and easier of assimilation.

This brings us to the fundamental question, What is food? —

a question which has been variously answered. Nor can it be answered at present. Food is that which renews the cells. The cells absorb it from the plasma of the blood. But exactly what portion they absorb, or how much of what they absorb is necessary or best for them, is not known. There is doubt whether the tissue cells are renewed as to their intimate structure, or that nutrition adds ponderable matter to the cell, or is more than a replenishing of corpuscles, or *corpuscules*. We do not know that cell food is, or need be, anything more gross than electrons. That is to say, the idea has begun to prevail, that nutrition as we now know it is an immensely cumbersome and arduous process, attended by great strain and duress of the organism, all of which science may obviate by presenting a food which will not require such hard physiological labor. The excretion of urea has been held to prove that there is structural waste and replenishment of cell substance. As nutrition is at present accomplished, this appears to be true, the result of a species of internal combustion from oxidation in the cell. Indeed, it is evident that the process of nutrition within each cell of the organism is, on a small scale, strictly analogous to what takes place in the stomach and intestinal tract of the larger multicellular organism, namely, that there is intracellular ingestion, excretion, and assimilation of an esoteric plasma which renews the cell. That is what appears to occur; but our question is, need it occur? Is it anything more or better than a laborious, destructive process which may be obviated altogether by providing a more ethereal cell food?

What, then, is the actual cell food?

Keeping in mind that much of what the cells take as food from the blood plasma is still in a gross condition, which necessitates intracellular conflagrations before it is reduced and sublimated, fit for the cell to take up, keeping in mind this fact, I say, what is the real food of the cells? What is this last product of intracellular digestion which goes to cell maintenance?

Beyond doubt it is something refined, "ambrosial," ethereal, perhaps the electron itself. We know not as yet whether there is a decomposition of the atom of carbon, or of the other elements present in "protoplasm." Is the life of the cell dependent on the restoration of the component atoms by an intake of fresh corpuscles, set free by the incoming food-stream? And if something

of this nature is found to be true, is it not quite possible that a dynamic food which may be administered directly to the cells, without combustion, waste and residue, is the desideratum of life on the earth?

We are as yet, of course, at the first outer confines of this great question of cell food. But even now it begins to be evident how much depends on a better understanding of nutrition, and the great desirability of directing research in this direction, backed by the resources of the larger communal life. Immortal life is the stake which science is playing for along this line of investigation. It is a true world-problem, one of those more than Herculean labors of the coming century, which call for the united efforts of mankind.

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, unregardful of the advantages of coöperative 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 cooperative research, where each student and investigator has his pre-arranged part to work out and perfect. Little is realized as to the scientific progress which might be made from organized,

closely coöperative research on the part of a considerable number of investigators, working together along co-related and supporting lines of experiment. It is a new field, the grand triumphs from which are all to come. As yet the world scarcely believes in it and still puts its faith in the lone inventor, the tattered genius of the garret and cellar. It is time for science to abandon the unicellular method, and organize its scattered units for stronger, more successful work.

What might not a thousand students of biology accomplish, if they would get together, canvass the whole subject to be investigated, pool all existent knowledge of it, delegate to each his particular item of investigation and experiment, and then keep in close touch with each other, day by day?

Let us suppose this thousand students to possess each a competence in the way of personal income, or property, so that all could devote themselves unreservedly to the work in hand without distracting personal cares; or that the thousand were elected to enter an endowed institute where the funds were adequate to provide salaries for the personal support and proper recreations of each worker. And let us now suppose that the chosen subject for study and experiment were rectification of the blood plasma, or this tremendously important one of a chemically perfect cell-food.

It is easy to see what issues hang here; and yet this latter is a purely chemico-physical problem; nothing supernatural, nor superhuman about it; just a scientific problem, to be solved, like the spectrum, or the parallax of a star.

Living matter, the "protoplasm" of a cell, will conserve and maintain itself continuously, that is to say, live deathlessly, if it can be nourished with a food which is chemically pure in the sense of doing no inherent damage to the protoplasmic structure or constitution. We have need to get this fundamental principle of protoplasmic life on the earth fixed in our minds at the outset.

Picture then these prospective workers, this thousand good heads, assembled in the amphitheater of the laboratory, or institute, ready for the great undertaking.

The entire subject would then be canvassed at frequent meetings, talked over, and a symposium made of the combined knowledge and suggestions of all. Gradually then the problem presents itself,

unfolds and takes form in the minds of the entire thousand, so that close coöperative effort becomes possible.

Then would come organization into groups of ten or twenty workers along distinct yet co-related lines of study and experiment, each group having its own internal organization, with one special executive group perhaps at the head of all; the idea being to have an elastic, yet closely co-related organization of the thousand, in order that the work of every individual may be known to all, and made to count in the general result.

More specifically, a group of twenty-five might be detailed to gain exact knowledge of what has already been done in the way of pure food-stuffs, and the sanitation of food-stuffs, so far as experiments have been conducted, during the last decade.

Another group might systematically observe and study the nutrition of unicell colonies, by foods similar to the plasma of mammalian blood, giving wide chemical range to their experiments.

These preliminary observations would open the way for close coöperative work with other sections, beginning analytical studies of mammalian blood; for we must regard mammalian blood as the long-wrought result of the metazoic, coöperative effort of the organizing unicells, to produce a cell food. The mammal is a vast organized union of cell life which was originally unicellular life. In the course of that organization the combining cells have labored together to take their formerly crude food-stuff, work it over, refine it, purify it, oxygenate it, then pump it through closed, air-tight pipes, tubes and tubules to each cell of the vast cell confraternity.

To accomplish this, different orders of cells have worked, doing each an allotted part of the labor. The alimentary, secretory and depurative tissue cells have each their preliminary share and function to perform; and finally, swimming in the blood-stream, the millions of blood corpuscles affect oxygenation and bring about the final changes in the rectified plasma.

In reality the presence and activity of the blood corpuscles convert the plasma to a serum, the exact nature of which we have still to study, and to improve in the scientific sense. That is to say, it is in this latter stage that we find it, and it is here that we have to begin our new study of it in the light of experimentation.

Closely connected with this subject of perfected nutrition and a chemically accurate cell food, comes an even more important line of experiments, through the blood circulatory (which might well occupy the attention of one of our larger groups of student associates), namely, to rectify, fortify and give tonicity, or stimulus, to the tissue cells, themselves, by innoculations with 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 innoculated, fortified and rectified.

For example, we now know something of the revolutionary effects on the cells of the organism, produced by the secretion of the adrenal glands, as also of the thyroid gland, pituitary gland, and of the "islands of Langerhans" in the pancreas. These agents have to be combined and attempered one to another.

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 shall have to attune the organism to the note or key of adolescence.

Add now to our mental picture of this, the fact that certain clever surgical experiments indicate that if even a few living cells from one of these glands can be transplanted from the body of a healthy animal to the human organism, and made to live there, the necessary rectification of the organic harmony and tonicity will be produced. That is to say, the product of these gland cells appears to leaven the entire organism. Nor does it seem to make much difference where or in what part of the organism the engrafted cells are introduced, anywhere that is most convenient, the desideratum being only that the product of these cells shall freely enter the circulation and mingle with the blood plasma.

Without entering upon details of technique, the idea and theory of the line of experiments, above urged, cannot fail to be apparent. It is one of bright promise in our quest for the control of life. Where a gland of the human body has perished or become desuete, it may probably be replaced, surgically, from lower animal life.

But of even brighter promise is the general idea of a progressive scientific rectification of the organic tonicity by experiments with gland cells and their products, by means of "grafts" and innoculations.

Organic chemistry as applied to the tonicity and rectification of the cell life of the organism, is, indeed, a veritable new world, only awaiting research and experiment, to yield us great discoveries.

It is not too much to say that the future of the *genus homo* on the earth, whether it shall continue its higher evolution along the paths of knowledge and power, or not, whether it shall fulfil its loftier destiny, attain the freedom of the universe and win heaven and immortal life, or not, rests largely on two factors, namely, a perfected cell nutrition, and the control of brain cell energy, meaning by the word *control* the art of generating it, or of deriving it from the lower animals, and applying it, at will, to the human organism, for purposes of vital reinforcement and the cure of disease.

Results of the greatest importance to human progress and human happiness will immediately follow these two discoveries.

First, life with us will then be, practically, optional. We can live as long as we please. Death will no longer be a necessary sequence to life.

Second, "old age," infirmity and "disease" will become evils of the ignorant past. With perfected nutrition of the cells and the conservation of their germinal products, the tendency to involution (old-aging) of the cell, after adult life is reached, will cease in the absence of the causes of that involution. Disease from invasions of microbic life may be promptly suppressed by re-inforcement of the sufferer's vital powers by adjuvant cell energy from without, thereby heightening the aura of life, that restorative *vis medicatrix naturæ* which has ever to be summoned by the physician. This modicum of restorative energy will be infused to the human body, even as an increased amperage of electric power is now "turned on" a flagging motor.

We now have certain expectations that this surplus, this reserve of nervous energy, may be derived from healthy animal life, depleting these lower organisms for the benefit and behoof of man.

A full tide, or "head," of vital 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 then 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, and 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. "Old age" is initiated when the vital energy begins to decline, as it does shortly after bodily growth ceases. The causes are many, but may be summed up briefly as the total terrestrial resistance to life. That resistance can be overcome by means of the two discoveries outlined above.

Third, from a 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 the manifest result of inaccurate, or perverted nutrition of the cells, the gradual falling out of harmony of the co-related organs and apparatuses, and the consequent distortion of "constitution."

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 life-times and the certainty of death are the great immoral factors in human life, at present. No man would live immorally, or enter on a course of crime, if he knew he could live forever, or at will. Immorality and criminal courses would be illogical to such a life. Immorality and crime are short cuts, weak snatches, at happiness — which mainly fail. If we had *time* to attain happiness otherwise, we would none of us ever turn criminals, or raise our hands against our fellow men. The moral argument for these lines of research, as above urged, is thus apparent. But the moral grandeur of Salvation by Science will be set forth in a future edition of this book, in relation to the communal life of man and the " Kingdom of God " on earth, as first taught nineteen hundred years ago by the Galilean lake. 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, from some mental defect, cannot summon courage and hope to work for it.

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 are reduplicated or generated *ab initio,* 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.

Who will endeavor to go to the bottom of this long-standing mystery, in order to bring up the facts to the light of day? Such investigators, if successful, will be public benefactors.

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 restore the germ-elements to the fructifying cells of 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, in some degree. We have to perfect this restorative process and substitute economy and thrift for waste and squander of life. Psychic factors also enter here.

But first we have to learn as to the nature of these germ-elements (semina cellulæ), whether they exist at all, what they are and also the nature of the drain which they set upon the parent cell. The theory of Weissmann is well known, as also the gemmule theory of Darwin. Both now bid fair to be found correct in part; the germ-plasm undoubtedly sets up a drain on the somatic cell. Confessedly, my own researches along this line have not yet determined anything definitely. We are evidently dealing with something exceedingly minute and subtile. It still eludes the microscope and will have to be approached along other lines.

Another question of great and timely importance in our quest will be to determine as far as possible how deeply and how rad-

ically, 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.

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 organism 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 fibres from the brain terminate and receive sensations from the external world. Here, too, motor-nerve fibres actuate the sweat glands, sebaceous glands, hair follicles and muscular fibres.

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.

Bearing on all these questions, there is already a great deal in the way of useful data, scattered about the world, at distant laboratories, or embodied in scientific papers and books, often in foreign languages, which would be of service in our quest, if only it could be looked up, collected and conveniently tabulated for reference. This of itself would properly afford a line of work for many who are acquainted with one or more of the foreign languages.

Connected with this proposed collection of data, too, is the plan for organizing a more or less permanent party of students, for travel during the winter months, in Southern countries. By this we mean annual winter tours of the party, working together, with a view to enlarge our knowledge and add to our resources for experimentation.

Beyond doubt we can at present best examplify the truths of the Promethean Faith, by living long, healthily and happily, as we work out the greater problems; and one enthusiastic correspondent has proposed that ten, a score, or a hundred associates might unite in building an ideal Vivarium, a veritable little " heaven," equipped and provided with every agency of advanced

scientific knowledge, including our own discoveries, for conserving and prolonging life. We have to make our own "heaven;" we shall never have any other save what we make for ourselves.

Whether in the matter of the "canals" and "oases" of Mars Professor Percival Lowell and others are right or wrong, whether that planet is the home and seat of a highly civilized life or not, even the broaching of so grand an idea is worth much to us as an intimation of what may be done on the outer surface of a globe like the earth, plunging onward through unknown eons of time, into unknown regions of space. The grandeur, the awe, the terror even, of our cosmic situation, when actually realized, passes all conception of poet or philosopher. Yet this bleak outer skin of a peregrine planet may be transformed to a Paradise by future humanity working together; and this our tentative Promethean Vivarium, even in this first early childhood age of scientific man, might prove an example and a pioneer effort in the future paradisation of the earth.

In fancy, at least, we can picture these Martian planet-neighbors of ours as having already achieved immortal life. Perhaps they but wait to "reveal" the secret of it to us, if we can but learn to communicate with them. "Revelation" may come to us from the far off heavens, after all, when interplanetary signals can be seen and interpreted.

Finally, to every reader whose attention is drawn to this effort, the author respectfully addresses the following appeal: —

From your studies, observations, or reflections, can you not send to this laboratory at least one fact, one thought, or one pertinent suggestion which in your judgment bears on the problems which we have to solve?

Any one such fact, or contributed thought, may serve in aid, and is earnestly solicited. We desire to call together, summarize and utilize all the knowledge that exists at present in the minds of educated individuals (even as the neurons pool their sentiences in the human brain) and, from the united volume of this knowledge, develop a larger, stronger consentience with which to work out the solution of these problems of deathless life.

This plan is strictly in line with the metazoic development of mind from the days of the unicells to present times, namely, a

consensus of knowledge and the evolution from it of greater intelligence. Not a metaphor, but a law of bio-physics. Not a mere desultory collection of facts, ideas and notions, but the material from which a larger, organized knowledge may be evolved. Experience shows that greatest aid comes from brief pithy suggestion, or citation of pertinent facts or circumstances.

The appeal is made in the name of the great Achievement to be won. No gainful motive attaches to it, nor can personal profit be promised. It is surely a question of that later, grander, practical Altruism which bids us ennoble our self-lives by pooling them in the larger life and endless future of our race. For along that white path of self-ennoblement from self-surrender, of personal apotheosis from self-consecration, lies the only real, abiding happiness for the individual man of to-day. Personal, self-conscious immortality is still denied to us of the present generation. We have not yet risen to it; but by this hearty devotion of self to the common weal, we are able to project our dying lives forward in time and space, and blend them with the deathless future life of humanity throughout the happier eons which are to come.

Whatever your own faith, reader, whatever your mental reservations as to *Salvation by Science* may be, will you not join in this coöperative endeavor? In and of itself it cannot from the very nature of things be wrong, since it is a practical effort for the growth of human knowledge.

The effort to set forth this new view of immortal life is, as the writer is painfully aware, but a crude one, burdened by all those imperfections which usually attend the first utterance of new thought. For that crudeness I humbly apologize.

END OF PART I.

PART II

THE CELL-OF-LIFE; SALVATION UNDER NATURE

(1898)

It is a part of the unwritten code of science that the investigator shall avoid *a priori* conclusions, look coldly upon theory, and be wary of hypothesis. In a word, that he shall devote himself patiently to the acquisition of data, be content to collect facts, and live abstinent of the ever-present human weakness to play the rôle of prophet.

Nothing, indeed, so surely distinguishes the man of science from the charlatan as his attitude toward theory and his caution in presenting conclusions. A single page, often a single paragraph, of the article, or the book of a writer on scientific subjects, enables us to judge all too accurately of the value, or lack of value, of his entire effort; and, generally speaking, the verdict turns on the care with which he draws conclusions from data.

Science has endured so much of premature vaticination that its best friends and exponents have come to regard all that sort of thing with marked hostility, as detrimental to true progress. There is a disposition to put injudicious enthusiasts outside the pale. A certain regimen has come to prevail; immature publication is held to be bad form as well as futile. Humility and an educated conservatism characterize the truly scientific mind: the attitude of Newton at the end of his grand discoveries.

With all that biology has of late demonstrated, we know too little still to say much of first causes; yet the time has come when the creed of science can be outlined and forecast.

It is in the nature and constitution of the human mind to believe something. The history of mankind shows that those tribes, nations, and races which have gone forward with the greatest energy, have been actuated and incited by confident beliefs as to the origin and destiny of human beings.

In like manner the scientist has often found hypothesis an

adjuvant; for an hypothesis is of the nature of a belief. Some of the most signal discoveries in astronomy, chemistry and biology have been elicited under guidance of provisional theories. There is a use as well as abuse of hypothesis; and, moreover, the theories of science are often *bona fide* glimpses of truth.

So at present, when the old faiths are fading out, like ghosts at dawn, when venerable soul doctrines are falling into desuetude and discredit, glimpses of the truth come and will serve to light us forward in the great outer darkness of the universe.

As such and such only are the present outlines of a greater gospel put forward: glimpses of the truth, seen through the murk of our ignorance, and better than the existent babel of superstitions.

As regards Christianity, biological science now goes far to substantiate and confirm the original scheme of life and salvation, as conceived and taught by the Founder, but will purge it and separate it from those adventitious doctrines which Church Fathers, Bishops and Synods engrafted upon the new religion during the first three centuries of its existence. These doctrines were never essentially Christian, but of the nature of ingrowths from Persian, Greek, and Egyptian systems of philosophy.

Christianity, however, can hardly be said to be more than one of the religious beliefs of America. Allah, Brahma, Joss, and Mormon, as well as the Hebrew Jehovah, are now worshipped among us. Asia and Africa, as well as Europe, have contributed to the amazing *mélange* of tenets which stand for religion in the United States. Never in the world's history has such diversity of belief been exhibited in one country; yet each of these hundred and ten different cults is endeared to thousands of immigrant devotees by ancestral ties and traditions.

If by some megaphonic device we were able to hear, at one time and in one place, the amazing outcry of doctrines which goes up in thousands of churches, temples, and other places of religious worship, the confusion would out-jargon that on the Plain of Shinar.

Such multiples of contradictory doctrines mutually discredit each other. It has followed naturally that the younger generation, born in America and educated in the public schools where general scientific knowledge is imparted, is quite without a faith,

in the old-time meaning of that word, and looks to science for its real tenets.

Nor looks in vain. Even now, already, science is able to outline a new and greater faith; and no prophetic gift is required to assure us that this new faith will be the religion of future America.

For a new hope has come to the human heart, the hope of salvation from "sin" and death by natural means: *Natural salvation*, contra-distinguished from supernatural salvation. Supernaturalism has been the burden of all previous religious systems. In all the past, human hopes have founded on rite, sacrifice, and supernatural rescue. But the keynote and initiative of the message of science is natural salvation: salvation under nature, accomplished by the growth and conservation of human knowledge.

In all the past, man has turned to the skies and prayed to powers beyond the earth for salvation; but now, at the dawn of the twentieth century, he turns to himself and gravely, hopefully estimates the problem of self-salvation.

Moreover, self-salvation, when regarded in the light of our present greater knowledge, is seen not to be new at all, but to have been in progress ever since life first found foothold on the earth's surface! Apparently it has been in the natural order of things from the beginning.

We shall be able to show that natural salvation has been the tendency and trend of the entire evolution of life on the earth; that from the Silurian ages upward, life has put forth and developed toward a naturally attained freedom from evil conditions, "sin" and death; and moreover that the prospect for this is good. There is so much doubt, disheartenment and pessimism in the world that a plain statement of the human situation from the biological point of view cannot be otherwise than morally healthy. The progress of this great life movement on the surface of the globe constitutes a drama of surpassing interest, the grandest spectacle in nature.

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; for life is the subjective side of matter, its personal attribute: that property which renders the corpuscle a " psychon."

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 come into existence 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, 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. To the normal mind 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.

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 raised up 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 infinite 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 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 constantly sustains 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 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, that it is therefore exceedingly simple and recent in the sense of ancestry and heredity.

Another feature of this vast body of terrestrial living matter, the most remarkable, characteristic, and important feature indeed, is the singular mode in which it exists or lives, from moment to moment. Although of such vast bulk and weight when considered in the aggregate, it is never found in continuous bulk, but always exists as minute *modica*, or little measures,

isolated one from another. On an average, these minute *modica* of living matter or protoplasm are not much more than the three-thousandth of an inch in diameter, but occasionally reach the one two-hundredth and larger; and their true or typical form is manifestly spherical. 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 protoplasm, pure and unalloyed, we behold a law of matter, find expression, subversive of gravity, prevalent over it and transfiguring ordinary matter to living matter in spite of gravity, so to speak. 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, as if acting upon matter at a different angle or *point d'appui*. 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 of matter 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 peculiar recoils 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 driblets. 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 sub-

stance, 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*, the tiny thread-like channel from a deep-lying stratum, 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 — oxygen, hydrogen, nitrogen, sulphur, phosphorus — 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 withdrawn from the rest and 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.

The present development of life on the earth began in the age which geologists term the Silurian; but the presence of graphite in the Laurentian, or "azoic" rocks renders it not incredible that there was a previous life development which terminated, or 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 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, protamœbidæ, 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 the sole inhabitants of the earth which was fit for no higher form of life; or, if fit, no higher form had developed. 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.

The point to make here pertains merely to the fact that for ages and epochs, to which all subsequent time is but as an hour to a day, a lowly unicellular life was all that the earth bore.

Observers from afar, if such there were, might well have concluded that there would be no further development; thus other planets appear to our terrestrial astronomers; the epoch of life, or of the higher life-forms, has not yet arrived, or has passed.

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 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 began. 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, when the two hitherto separate cell lives coalesced, like two drops of water on a window-pane. 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, or soul, 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 subverts the present theological doctrine of the human soul.

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," that mental lapse to which certain venerable savants are so prone.

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, far down toward the primary molecules and "atoms" of matter. 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. 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 — 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. 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 though 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 dicœcian 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 temporary 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 metazoons 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 unicells 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 of "cells" 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, 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 preëminently so of the spy cell group which erelong 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 comparison of experiences, some to vision, some to hearing, and some to the estimation of the 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 *rationally;* 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.

It may be added that the later physiology portrays the connection and intercommunication of cells in metazoons as based on and maintained by currents of " corpuscles," liberated and set in motion by the cell metabolism and depicts life itself as arising from the reciprocal action of these biogenetic units of matter.

The passage from the unicellular to organized multicellular forms of life, from protozoons to metazoons, was primarily effected by simple combinations of cells and varying of their functions. It was thus that the animal organism 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 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 life-time 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 life-times 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 coördination 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.

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 cellules 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 preëminence 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 for 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 arboreal 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 in 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 prin-

ciple, 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 speaking, 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 of matter 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 eighty or more millions in the United States, or the forty millions of Great Britain, every person, or citizen, would need to be represented as almost wholly deprived of locomotion, and 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 eighty 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 particle to particle, in the atomic sense, 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 impossi-

bilities, 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 the 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 pack, 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," sentient 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 and "revelations." 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 coöperation and union of all humanity which alone can insure 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. Every other doctrine 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 psychon 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 psychon 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.

If the science of biology teaches anything, it teaches this truth of the possible deathlessness of cell life on the earth; and this truth is to the last degree important and revolutionary. The doctrine that death is a final "law of nature" has been made the corner-stone of that other cardinal doctrine, namely, the "disembodied spirit" myth. With the refutation of the doctrine that death is a "law of nature" will fall this latter doctrine of disembodied souls. For it will no longer have a *raison d'être*. In its place will come that grander gospel that *life* is the "law of nature," not death, and the demonstration, long overshadowed by errors of theology, that the "kingdom of God" is a natural development of life on the earth.

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 and mythical promises of ghost life.

But how? How will this be accomplished? Granted that the cells of the human brain may live for a century, the entire human organism still dies and the cells perish with it. How will this fate be altered or averted?

The answer is plain. It is already outlined and indicated in the manner and the means by which the cell has prolonged its lifetime from a few days to a century. We have but to study the rise and progress of the physiological cell. Its life history is set before our eyes in the animal organism. By union, organization, differentiation of function and division of labor for the common weal, this long-perfected animal organism has been developed. But now, to carry its development forward and immortalize the component cells, an onward step in organization is necessary. The human individual must be made the unit of a greater system, even as the cell has been the unit of the animal body.

And this greater system of union, organization and division of labor has already been initiated, unconsciously, it may be said, on the part of mankind. For thousands of years human beings have been banding together to this very end, unconscious of the real purport of their effort! The personal ends which, individually, men have had in view, as the motive of their labor, eventuate in a greater achievement than they wot of. For it does not follow that the human intellect, composed of cell sentiences, can always comprehend the outcome of its acts. The intellect is not yet sufficiently consentient to perceive and understand the deeper instinct of the component cells. Instinct, of which we have heard so much, is the dimly perceived motive and will of the cells.

But, as has been said, an organization by consentient or " protoplasmic " contact, human being to human being, is impracticable under the laws of terrestrial matter and undesirable for ideal and economic reasons. We therefore resort to a better

kind of union and organization — better because it affords greater individual liberty, based on intercommunication by the use of abstract signs and symbols, and also impress the more ethereal states or modes of matter into our service to accomplish intercourse; so that personal feeling and thought (which is the feeling of the brain-cells) can be freely communicated from individual to individual, as freely and intelligibly as if by contact of protoplasmic filaments. Protozoons, indeed, might never have united to form metazoons had they possessed anything like human facilities for intercommunication. They were dependent wholly on touch and feeling, and on this sentient basis the animal organism, which we inherit, grew up.

The extent to which this humanly developed system of intercommunication has progressed need not here be described. Language, commerce, education, the industries, arts, sciences, law, religion, medicine and the entire social order have come forth and grown up from it. Mails, transportation, telegraphy and telephones are adaptations and inventions to effect a larger intercourse. In fact, the means and facilities for communication are now ample. It is not lack of these which delays the progress of humanity. A most rapid advance is possible. The obstacle to progress is the *lack of the spirit of coöperation, lack of confidence and good-will, lack of understanding of the real situation.* Instead of this essential good-will there is suspicion, envy and hatred, which pave the way to violent acts, war and destruction of the hard-earned fruits of labor.

It is the same ancient dislike of self-sacrifice seen in the protozoon, which so long delayed metazoic life; the same unbelief that the merging of self in the community will redound to the benefit of the individual; the same reluctance to work for the common weal; the same self-love that makes so many millions of our fellows unwilling to share and share alike with others, blinded to the fact that their greater happiness lies in just that act of self-surrender! Blind, too, to that other greater fact, *that along this line of self-sacrifice and coöperation alone lies salvation from disease and death. This is the Way.*

Just as the cells unite their lives and work together for the common good, so must the citizens of a nation or country devise methods and form habits of united effort, to accomplish great

ends. The first step to this is good-fellowship, good-will one to another, mutual confidence, and a determination to coöperate. There is no other way. Selfishness is retrogression. The way to enduring life is through consecration of self to the common good. This is the lesson from the cells. This is the method of nature. By following this method, for example, multicellular man may live eighteen thousand years. He may live forever.

In unicellular life, no separate single cell, by any device, or husbandry of its life, could have lived a century, or a year. It is only by union and self-consecration that the long-lived organism has been developed and the neuron become a partaker in its longer life. And even so in organized, perfected humanity the component individuals will become macro-biotic.

By united effort all are raised up to a higher plane of life. Faulty and imperfect as it is, human civilization has doubled the years of man. Twelve centuries ago the average length of a human life in Europe was evidently less than eighteen years. But compared with what science could do with its present resources of knowledge, existent civilization is but the most rudimentary of organizations. The effort at an advanced civilization is barely inaugurated, as yet. All the great results are to come.

The only obstacle is ignorance; ignorant distrust, ignorant hatreds for creed's sake, or for race's sake; fatuous ideals of patriotism, forgetting that all men are brothers; insensate ambitions to build up one nation in wealth and political power at the expense of the rest of the world, reckless of the refluent wave that will sweep it away in blood and loss.

The priests and preachers of Christianity have made but a feeble progress in convincing the world of the truth and utility of this great doctrine of Jesus, because they have not comprehended it themselves. They have understood neither its scope nor significance. The great doctrine of brotherly love and human equality has been preached rather as a sentimental tenet, a species of Sabbath-day duty, a symbol of allegiance to the church, a kind of holy discipline for the soul, to prepare it for "another world." They have missed, lost and sacrificed the power of the golden rule as an agent for controlling and elevating mankind, because they have made it a shibboleth of church membership rather than a prime requisite of human progress.

The real significance of this doctrine has yet to be made plain to human eyes; its real strength has yet to be manifested. Then, not till then, will the human race accept it and act on it. This deeper-lying truth of life has yet to be instilled in the mind of humanity. Church Christianity has never evinced an understanding of it, never can have an adequate comprehension of it, as long as the "kingdom of God" is believed to be an immaterial realm of disembodied spirits in some unknown quarter of the universe. The Son of David distinctly and repeatedly claimed to be the Hebrew Messiah, the realization of the prophet-promise of Jehovah to the patriarchs. He is a rash commentator who asserts that the Beni-Israel ever believed this promised Messiah to be other than a terrestrial one, the founder of a kingdom of God and of Israel on the earth. There has been a fatal break in the facts of Scripture here, an insincere compromise with Zend-Avestan spirit myths, which has always weakened Christianity as a world faith, and from which science will now shortly compel it to purge itself or fall.

The golden rule is no sentimental phantasy of an exalted dreamer, but a matter of human utility and necessity. This is the Way, and until it is adopted, nationally and internationally, mankind will stick and pause in its onward career. It is a prime requisite to the farther progress of human life, and as such must be recognized by civilized man everywhere. It is that greater Christianity which is yet to come.

The difficulty of initiating an era of good-will and mutual coöperation lies not so much in the perversity of men, individually, or their inherent unwillingness to make those needful sacrifices, as in our present inability to bring about a world-wide understanding and to secure common consent of all parties and peoples. Thousands, yes, millions of the dominant race, are convinced that the highest good of all lies in an unselfish federation and organization of all terrestrial interests. But there are the alien races, speaking other tongues and intensely jealous of the dominant race; and even worse, there are the oppugnant religious systems, each claiming to hold all the truth in the universe, possessing each a supreme deity and sacred ritual of its own, and denouncing the votaries of all other systems as enemies of Good and emissaries of Evil.

Strangely enough — where the converse should hold — it is religion which will longest bar the coming of "the kingdom of God!" Sadly enough, too, it is not those tenets that pertain to life on the earth which have set sectaries so inveterately apart, but doctrines concerning future paradises and gehennas.

The saddest spectacle which the earth presents is that of the zealot millions ready to carry war and devastation, from continent to continent, in the name of Allah or Jehovah. If the biologist ever utters a prayer it is for human deliverance from religion in the fossil state. If one world-task looks harder than another, it is to redeem the human brain from the incubus of religious indoctrination, and set it natural again, capable once more of a normal perception of truth. Herakles of old might have blanched at that labor.

For the brain is "formed" and the courses of thought molded to doctrinal ideas, taught by church authority. When these doctrines have been inculcated for centuries, and then found to be wrong, the task of rectification is a most disheartening one. Considered in the gross, the entire brain of humanity, at present, is under the spell of erroneous creeds, and does its thinking along perverted channels of mentation. The belief that this earth is merely a place of probation for heaven after the death of the body is the worst possible initiative for the achievement of that natural salvation which is, and has ever been, the real goal of life. Mankind cannot rise in opposition to its own faith, nor will the effort to attain a natural salvation begin in earnest until the truth and the facts concerning the soul of man are understood and accepted.

The inference and argument for natural salvation have brought us, step by step, from the protozoon to that wonderful congeries and federation of cells, grouped about the cerebro-spinal axis of man; in other words, to man in his present imperfect social organization; his blindly selfish attitude to his fellow-beings; his weapons and engines of destruction; his standing armies and navies; his wars and his antagonistic creeds. That confident coöperation and good-will to his fellows, necessary to organize humanity for its crowning achievement — the achievement of immortal life — have yet to be inspired in the hearts of men;

and the point to be kept in view is, that this is the inspiration imperatively necessary to future progress, the *sine qua non* of the human situation.

No gift of prophecy, no skill of divination, is required to forecast what might be done on our planet in half a century of good-will and cordial coöperation among men. When the billions of hard-earned wealth, now wasted in war and warlike equipment, are applied to research, discovery, invention and the general application of knowledge to the amelioration of human life, then will begin an era of human advancement to which all previous progress is as a fitful starbeam to the glory of the rising sun! Dull is the mental vision of him who cannot discern this promise of our incipient sciences. It will surely come; but it might come speedily, before the year 2000. It will come from the combining of all human knowledge, the joining of brain to brain by mutual incentive, like cells of an electric battery, joined to raise strength of current, to secure that consentient elevation of intelligence which will carry achievement to an ecstasy of enthusiasm and great hope.

There is inventive talent enough in the general brain of mankind, now lying inactive, unemployed, or perverted, to obviate most of human ills, could this talent and genius be given opportunity and incentive, and be organized for work.

Fifty years of such organized effort would usher in achievements even to predict which would now be thought visionary. Fifty years of confraternal endeavor would so perfect locomotion and transportation that journeying to any portion of the globe could be accomplished in from three to five days, accomplished in ease and comfort, and with a fair degree of safety.

This of itself would be the first and best step to effacing the ancient antipathies of race and religion. The formula for introducing the Golden Rule among men is intercommunication versus ancient isolation.

Within fifty years, perhaps much less, we might come to understand the internal economy of the cell-of-life, and might master the problems of its reproduction These problems are already outlined; but we are still ignorant why the somatic cells wax and wane, from youth to age; or more explicitly, what charge of corpuscles, "biophors," or "gemmules" is concen-

trated in the cells of the germ-plasm; how this marvelous recharging of life from generation to generation is accomplished; why the commingling of cells from the two sexes is advantageous, or requisite; and, in general, the nature, chemical composition and mode of production of these minute germ elements of the organic tissues.

These are studies and discoveries which urgently wait the scrutiny of earnest, well-equipped students of our science. That they are beyond human discovery might have been believed once, but will hardly obtain credit in our times. In fact, we are on the brink of such discoveries.

We need to know the composition of the animal ovum, of what the germinal matter consists, how and whence it arrives there, and how it may be produced artificially. We have to discover of what selected components — electrons, psychons, or biophors — this animal ovum is composed, to the end that the various tracts of somatic cells issue from it and coördinate in the tissues of the organism. We have to learn on what actual physical basis old-aging proceeds: whether as animal life goes on the tissue cell is slowly depleted of its initial complement of germinal matter; whether the original "charge" of ancestral life-germs is gradually exhausted in numbers or potency; or whether the contents of this body cell are homogeneous, and old-aging ensues from imperfect foods and the ravages and deleterious products of bacteria.

In short, we have to learn whether the somatic cell runs down, from expenditure of its concentrated biophors, or whether it is simply smothered, poisoned, slowly encysted and suffocated by the weathering, infiltration, and induration of the tissues in which it lies embedded; whether old-aging is a slow form of starvation from the contraction and hardening of the capillary walls and the thickening of the lung membranes. Or yet, whether all these causes operate together, namely, slow starvation and suffocation, combined with depletion of the inherited germinal matter.

For exhaustion or expenditure of the vivific units of the somatic cells, some process of inoculation, kataphoresis, or inward radiation may be devised; for the progressive suffocation, poisoning-out and starvation of the cells, an amelioration of all

the conditions of life as we now live it, must be accomplished, viz., the extermination of bacteria, purification of the atmosphere and the use of foods adapted to protoplasmic renewal; all purely physical problems and properly the subjects of scientific research; and all in line and continuation of that natural salvation of the cell-of-life from accident, disease and death, which has been in progress since life began on the earth.

Parent and child, through a hundred generations, constitute 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 Weismann hypothesis of life, death and heredity is so well known and so generally accepted, in part, among English and American biologists, that an extended statement of it is unnecessary here. It has taken its place in our science; and the two important modifications to which it must be subjected are now fairly well outlined. Professor Weismann has been termed the Darwin of cell development; to the present writer it seems

that he might better be called the Lamarck, and that the Darwin of the animal cell has yet to appear.

Weismann's positions are (1) that death is not an inherent necessity of unicellular life. The unicells do not die, but divide, giving rise to offspring by fission. "No amœba has ever lost an ancestor by death." Weismann defines death as "a definite arrest of life." "The proof of death is that the organized substance which previously gave rise to the phenomena of life forever ceases to originate such phenomena." Death implies the presence of something dead. An amœba, for example, produces offspring by dividing into two amœbæ. By this act of fission the parent disappears in the two children, but has not died. Hence arises Weismann's conception of the natural immortality of the protozoons. The protozoons die only from accidents of heat, cold, or violence. This view, however, has now of necessity to be modified.

(2) These deductions apply not only to protozoons, but essentially to all living creatures which produce offspring by fission; and it is on this basis that Weismann has built up his theory of the origin of death, briefly this: since amœbæ and other unicells which reproduce by fission are naturally immortal, death must be regarded as peculiar to multicellular organisms (metazoa). In the metazoons where the cells are organized with differentiation of function, there are two distinct classes or groups, those which develop to form the animal body (soma), and the reproductive cells, confined to the generative tract. The former (somatic cells) grow till the organic limits are reached, live for a time and fall into senescence; the latter (the reproductive cells) are the units from which the next generation will be developed. The somatic cells are concerned only with the life and welfare of the individual, the reproductive cells with the continuance of the species. Of the two classes of cells the reproductive live on from generation to generation, never die in fact; the somatic cells alone are subject to death. The reproductive cells are immortal, as the amœba is immortal; they die only by the — to them — accident of the death of the body.

(3) It is an error to regard the animal or human organism (soma) as the essential or important part. The reproductive tissue (germ-plasm) alone is of importance. The soma is sub-

ordinate and exists for the purpose of carrying forward the germ-plasm. It is its vehicle of life, exists for no other object, and has no other *raison d'etre*. In the opinion of Professor Weismann, the human brain exists solely for the purpose of nourishing, protecting, and bearing forward the group of cells lodged in the organs of generation.

(4) He further holds that the origin of death is found in the consideration, that it is advantageous to the species that the individual animals, or humans, shall die. " If for a moment we imagine that one of the higher animals were to become immortal, it is perfectly obvious that it would cease to be of value to the species to which it belongs. On one hand, there is the necessity of reproduction, on the other, the utility of death." He argues that the duration of individual life is, in all cases, that which is best for the species. For example, the May-fly lives but a few hours, because no more time is needed for depositing her eggs. With mammals, on the other hand, years are required for the rearing of offspring sufficient to make good their places in nature.

(5) With regard to the proximate causes of death, Weismann holds it to be due to the somatic cells losing the power of growth and multiplication after a certain length of time, or a certain number of cell generations. " Length of life in the individual is dependent upon the number of generations of somatic cells, which are able to succeed each other from the original endowment in the ovum."

(6) As regards heredity and inheritance, Professor Weismann discredits the common opinion that the personal lives, habits and efforts of parents affect the character of their offspring. His theory of a distinct germ-plasm controverts the concept of Darwin that " gemmules " from all the somatic cells are garnered up in the reproductive cells, and thus reduplicate the parents in their offspring. Nothing of this, from the soma, is conveyed to the germ-plasm, or affects, save in extreme contingencies, the reproductive cells.

Like Herbert Spencer, Weismann conceives that life on its lowest plane, unmodified by environment and unorganized, exists through or by virtue of " physiological units," which he, however, terms *biophors* (life-bearers), a conception not unlike that of the *plasomes* of Brñcke, or the *plastidules* of Haeckel.

In the lowest forms of life, the biophors are little organized; but, under the influence of the environment, as evolution proceeded, the biophors assumed certain persistent relationships to each other and formed themselves in fixed groups. Such groups determined the character of the cell, and to these Professor Weismann has given the name of cell-determinants.

Numbers of determinants are associated in larger groups, termed *ids*, and ids again as *idants:* relationships of biophors which form parts of the centrosome and chromosome of the cell.

(7) It is Professor Weismann's conception that death — touching its origin — is intimately connected with sexual reproduction.

That the protozoons are naturally immortal and that death is confined to the metazoons has been refuted since Professor Weismann put forth his hypothesis in 1881. Maupas had shown that certain protozoons exhibit the phenomena of senescence and die out, from intracellular causes; also that protozoons conjugate sexually and are thereby restored. The hardship of the terrestrial habitat affects even the lowest, simplest forms of life, perhaps even the "biophors" themselves. The latest advances in physics indicate that "atoms" tend to waste away, and future researches may prove that the electrons are not stable units. Avoiding death is less a question of ultimate, incorruptible atoms than of making scientific repair excel natural waste.

That many groups of the somatic cells tend to senescence and exhaustion, in time, is apparently true, but this tendency should not be looked upon from the standpoint of the fatalist. Beyond doubt it is a tendency and a condition which can be remedied. The science which discovers the condition, will erelong discover the remedy. The brain group of cells tends least to senescence.

It is but natural that having brought forward his hypothesis of the germ-plasm, Professor Weismann should attribute a leading rôle to this group of cells and give it marked prominence. This is seen in his unqualified assertion that the individual exists solely for the purpose of bearing forward the germ-plasm from generation to generation. This deduction is true in a sense, but hardly in that sense of finality which Professor Weismann is in-

clined to ascribe. Beyond doubt it is difficult to say why life exists at all. The purposes and intents of creation are not as clear to the biologist as to the theologian. Professor Weismann holds that the individual animal, or human, lives as long as is necessary to bring forth and foster offspring, no longer, then dies because its death is necessary for the good of the species, or, strictly speaking, the good of the germ-plasm. If this assertion, with its incident fatalism, were restricted to evolution in the past and cast no black shadow on the future of evolution, it would be more rational, less repugnant to the bond individual, who is made to play the rôle of a hopeless serf of death. We cannot resist the conviction that ultimately, at least, the germ-plasm exists or will exist for the good of the individual, not the individual for the germ-plasm; that the brain group of cells is of greater consequence than the generative group. But again we admit that it is rash to say that anything exists for any purpose whatever. Purpose, conscious purpose, does not come in until there is brain. There is apparently no purpose in lower nature, or if a purpose, it appears to be an unconscious one.

According to the Weismann hypothesis, the reproductive cells give rise to offspring by virtue of the permutations and combinations of their own constituent biophors; the somatic cells do not contribute to the germ-plasm either from their substance, or otherwise. The soma, indeed, grows from germinal matter in the reproductive cells, but exerts little or no influence upon that tract. The germ-plasm lives apart and to itself, and is sufficient in itself for all which we know as heredity, unaffected by the life or culture of the soma.

But when we consider the intimate relation in which the reproductive organs stand to the whole organism, when we contemplate the close nervous connection and sentient sympathy between this group of cells and the brain, when we consider the constant streams of electrons which are poured to these cells from the brain and other organs of the soma, when we picture the steady circulation or corpuscles from the brain cells through these cells — it seems well-nigh marvelous that this group (the germ-plasm) should be so little affected, so little modified, as Professor Weismann would have us believe.

Later researches afford indications that the intimate causes of old-aging are resident, primarily, in the cell nucleus. It has even been held by one observer that the cell nucleus lives, individual and apart from its cell host, originally intrusive and parasitic. But if so, it has become so well domesticated as to participate naturally in the life of the cell.

The nucleus is found to be made up of a series of net-works, composed of a granulated substance chemically rich in phosphorus, to which the name of *nuclein* is given. These net-works take aniline stains very readily, and are thus seen to be connected one to another by the substance *linin*, which is not coloured by the same dyes. Thus examined in old and young cells, the quantity of nuclein in the latter is found to be so uniformly greater in many instances that the deduction is made that there is a progressive diminution of nuclein granules from youth to age, as the nucleus divides, giving birth to new generations. As the nuclear granules diminish, the somatic cell falls into senescence, sinking to a condition where fission ceases. For a long time it rallies and divides again, but produces an enfeebled offspring, till finally it encysts itself and forever ceases to be parturient. The present theory is that no new nuclear granules are engendered in the somatic cell. Like the worker-bee in the apiary, it is differentiated and specialized beyond the power to produce offspring. In like manner isolated ciliates lose the power of reproduction, unless opportunity is given them for conjugation with other individuals.

Brown-Sequard conceived the idea of reaching and restoring the somatic cell by injecting triturations of reproductive glands, as medicines; and beyond doubt methods of restoration by inoculation, or vivific foods, will be discovered.

The rapidity with which the remotest tracts of cells in the organism are influenced and permanently affected by the introduction of minute quantities of remedial substances into the blood-circulatory is now well known to the medical profession. Such inoculation affords more direct access to the cellular seats of life than the alimentary tract with its modifiying acids. The blood is in immediate relations and actual close contact with the cells which, in all cases, must be reached before remedial effects are produced. Nothing acts in the animal organism until the

cell is reached and its sentient economy affected. Many eminent physicians are, therefore, of the opinion that injection into the circulation offers the best method of administering certain medicines.

Inoculation to produce immunity from diphtheria, small-pox, hydrophobia, *et al.*, has been successfully practised for many years, as also by veterinaries as tests for tuberculosis. The procedure is in its infancy, as yet, but is one of great promise, since it is the cell which must be acted upon, and the rapidly propelled blood, reaching it almost instantly, comes in touch with its sentient surfaces. As soon, therefore, as we can discover and compose regenerating substances, or those which will stimulate regeneration, the blood-circulatory affords an efficient route to every cell in the body.

What these substances are, we do not yet know, whether artificially propagated nuclein, or reagents which stimulate its growth *in situ*. But if anatomy and histology offer us one hint more significantly than another, it is that the blood may be made a breeding-ground for the regeneration of the somatic cell. A thousand well-equipped investigators, starting off with enthusiasm and rivalry to study this problem, would hardly fail in twenty years to set us far on the way to the control of all life. What our rich men spend yearly in their vacuous craze for horse-racing alone would more than equip and maintain these researches. Such inane squander and misdirection of the world's hard-earned money cries down Heaven's condemnation. But they know not what they do! Misled and bewildered by erroneous creeds and futile ideals, they know not how otherwise to spend the millions which they even believe belong to them.

A hopeless phase of thought has come to many biologists from regarding the ordinary course of nature as final for the human race. Whereas, nothing is more probable than that we shall come to direct and control the processes of nature in the cell. What takes place in the nucleus and the causes of nuclear exhaustion will yet be found a simple chemical problem. The control of life in matter is unquestionably before us; the entire progress and trend of research look to such achievements. But for this outlook of hope, we might well accept the dictum of Bichat, that "from infancy we die, day by day." The cells of the *soma*

develop in a certain way and to a certain end; nor is there the least likelihood that the human organism, of its present physiological bent, would ever reach great length of life.

We mean that the somatic cells, unaided by the human intellect, would continue to produce an organism, subject to growth and decline. The ancestry and nuclear endowment of the cell carry it to a termination of its activities. This is more apparent in the dark-skinned races of mankind than in the dominant race, and still more evident in the lower animal orders.

Lower, unassisted nature would live and die in alternate generations as long as the earth offered a foothold for life. The chemical affinities and electric tension of terrestrial matter foster this method of vital expression. There would be little hope of anything much better or longer-lived. The earth is not, in its present condition, a habitat for deathless life. Its inclemency, its extremes of heat and cold, furious winds, hours of darkness, variant electrical condition and, more inimical still, its hordes of hostile bacteria, — all are against enduring life-forms. We see, therefore, that in a manner the primary instinct of the early races of man is right; this earth, unregenerate, is not the place for immortal life. Some improved condition is to be sought for that, some promised land, some realm of godhood. Not till this century has the vision of all these human ages begun to be interpreted. Alchemists had dreamed of a sporadic immortality by magic potations; but not till now have men come to see that vastly prolonged life is to be the outcome of brain evolution and the growth of knowledge.

We look up to the disk of the earth's older sister planet and see its surface spangled with a strangely familiar geometry: parallel " canals," or belts of vegetation, and at the intersection of these canals " oases " which may be the Martian realization of " heaven," from which the germs of disease have been excluded. What interplanetary rivalry in good works do those " oases " suggest! Will our earth ever turn its face to the gaze of the universe, seamed by such giant engineering?

When we ask the question broadly, Why does the human body grow old and at length cease from function? putting the inquiry in the bio-physical sense, the answer seems to be that the personal life embodied in the organism is at length

overcome and overmatched by the totality of the resistance to life which it encounters, from the embryonic stage onward; more specifically, to the general telluric resistance, physical, chemical, molar, molecular, which the protoplasmic molecules of the organism meet with, as long as they maintain the personal life. After adult age is reached, they lose ground in the struggle and at last succumb. The downward curve of the somatic cell has begun. But there is a period, during adolescence, when the cells gain ground, when they make head against the terrestrial resistance to life and prevail joyously, with a sense of victory; when the inherent energy of the personal life is more than sufficient to breast the opposition.

We have, therefore, to picture this personal life of the cell as an impulse which for a time rises superior to the resistance, then slackens and falls away to cessation.

Yet its source in matter is apparently a constant in nature, inseparable from the material corpuscle and persistent in matter at a uniform tension. Why then, in the human organism, is it exhibited thus intermittently, in adolescence and senescence, in youth and old age?

The answer is that human life, even as waves on the ocean, or sound waves in the air, has fallen into the rhythmic, wave mode of life, as a general result of the terrestrial resistance to life; and that the cessation of vital energy, seen in aging organisms, is apparent rather than real, marking a transfer of life from one generation to another.

The transfer of life by means of the reproductive elements, and the subsequent death of the parent organism, is a mode of life into which all animal orders fell far back among the earliest metazoons, if not in unicellular life itself.

It is manifest, too, that this tendency or life habit of humanity is very deeply rooted in the cellular elements of our being. The cell determinants are cast for growth and decline. Sterilization of the reproductive tissue in the individual, removal of these tissues, or the most rigidly enforced continence, has little or no effect as regards the aging and death of the organism. The tendency of the body to follow its inherited cycle of growth and decline is inveterate, and not to be changed by the exercise of the will. Something, indeed, this will-power of the personal

life may effect, but not that radical transformation of being which the perpetuation of the individual implies. It is to our science that we must look for prolonged life.

Procreative desire rapidly slackens in individuals to whom life offers sufficient attractions to live on for life's higher, more refined pleasures; and in this circumstance we have a certain earnest of evidence that the higher intellectual life of the future will physiologically redound to a prolongation of individual life. Decline of the procreative instinct follows naturally when the individual has hopes of surviving; and such decline and self-continence react to prolong life; yet centuries would scarcely suffice to alter the deep-seated trend and course of our ancestry. It is to our sciences — the superior intelligence of brain — that we look for aid in prolonging our lives. Man has already passed the point where he relies for his progress on the tedious course of terrestrial nature, unassisted. He reaches forth a Promethean arm and, in the light of his stores of knowledge, bends lower nature to his wishes. We expect to bring our sciences to act upon the cellular basis of our lives and accomplish its regeneration.

Under low nature, man would never surpass the purely animal cycle of organic growth and decline, of adolescence, maturity, and old age. It is only by rising superior to the lower course of nature that man has become something more than an animal order of life, recording experience in written language, kindling fire, smelting the metals, impressing the lower animal orders into his service, and even dominating the forces of nature, in order to travel by steam and speak around the globe by electricity. He has put lower nature in harness and now directs natural law.

In view of these grand victories, why should he despair of altering the lower course of nature in his organism and of directing the life of the cells of which his tissues are composed? The question is a novel one, in this sense. Hitherto, biologists have assured us that we must be content to be what our inheritance would make us. That is the old cell doctrine in a nutshell. Weismann and, in general, the German, English and many American histologists base their theories of life on this assumption, namely, that the ordinary course of nature must be final as to man's future. Nature is fate.

But brain is higher nature, the acme, at present, of natural development. Everything which makes man a civilized and enlightened being has been obtained by brain mastery of lower nature and the diversion of her ordinary courses to his advantage. Why should we not expect to thus arbitrarily change and facilitate the nutrition and life of the cell? In point of fact, that is what has been done and is being done constantly in a hundred ways already. The position of not a few biologists on this question to-day is much as those who would argue that since a man can walk but fifty miles in a day, afoot, by his natural means of locomotion, or swim but twenty miles, he can never go to San Francisco in less than sixty days, or reach Liverpool in less than five months. Three hundred miles per day are as natural to brain as twenty miles to muscle.

It is to science that we look for the control of cell life. Biological science, it is true, is still in its infancy, but it is a very hopeful infancy; and it is the opinion of many of its best exponents that within another quarter of a century we shall have penetrated the secret of cell nutrition and growth, and opened the way to a scientific renovation of the tissues.

But faith has to be engendered as well as discoveries made. Enlightened man, indeed, is but just awakening to the idea that he may possibly escape death by setting his wits to work to this end; and, as ever, there is the olden outcry of impiety raised against the conception, as if it were wrong to try to live! As if it were not natural to live on!

But greatly prolonged life implies an amelioration of all the conditions of the terrestrial habitat, and within fifty years well-nigh complete control of the aerial currents and rainfall might be attained if only a modicum of the intellect of the race could be concentrated upon these problems. This achievement would go far to bring about that physical paradisation of the earth, needful to redeem it from the imputation which it has so long endured, of being " a dreary bourne " and a place of exile to homesick souls who long to flee away to some better land. The earth will yet be made one of " the garden spots " of the universe. It is a purely physical problem, and not a little of the data for its solution is already in our hands. Foretelling the weather is the first step to controlling the weather. It is a question of the

electrical distribution and regulation of the solar heat which falls on the earth's surface, and the direction of the "trade," or retro-rotary winds due to rarefaction and the earth's axial motion.

The electrical distribution of the earth's share of the sun's radiation will make it possible, not only to regulate the rainfall, but gauge vaporization from the ocean and lakes. Droughts and freshets, tornadoes and frosts, might soon become disasters of a past age, if the resources of control which are already coming within our grasp can be applied. What is expended in national preparation for war, in a single year, would suffice to initiate the preliminary plants and stations for experimentation in heat distribution.

Climate is as much a terrestrial condition to be controlled as a city's water-supply. A bad climate will be quite unnecessary in the year 2000. The problem of irrigation is properly one of a regulated rainfall as well as of dams, canals, or artesian wells. Vaporization and rainfall are the factors to be controlled. An equable distribution of solar heat and a regulated electrical tension are the agencies to be used to this end. The whole problem of climate-control is already outlined in physics, as to its methods. We need but the wasted war appropriations and the labor of idle soldiers to put it in operation.

Such a half century of rational coöperation would see even more revolutionary advances in our methods of communication, now effected by mails, telegraphs, and telephones. Not only will messages and general news be transmitted, electrically, but be accompanied by photographic and phonographic representation of passing events. But of far greater significance to life, its prolongation and improvement, will be the conquest and extirpation of those teeming hordes of bacteria which infest the animal organism and render all organic life abnormal and precarious. Human life in the future is to be liberated not only from known "germs of disease," but those swarms of less deadly, but yet deleterious micro-organisms of which the human body is the host and which, by their presence and products, enfeeble life and maintain diseased conditions. The human body must be regarded not only as living amidst and externally exposed to microscopic life of a hostile and noxious character, but as being

infested by such life which entering the blood-circulatory either with food, water, or air, penetrate to every tissue and organ.

Ninety per cent of all human casualties are due either directly to the presence of micro-organisms, or are induced by the more or less remote effects of their activity. The extirpation of bacteria will be a long step toward the achievement of vastly prolonged life. Like all the others, it is a purely physical problem and only waits combined action on a great scale on the part of mankind. The habitat of man has to be purged and cleansed from these now well-known causes of death. The task is too great to be undertaken by individuals, and remains over for the organized effort of nations and races.

To summarize *Natural Salvation* as outlined on the previous pages, we have first of all to record and emphasize the later, better conception of matter. That protean mystery of the visible universe is not the dead, passive clay of a Supernatural Potter, wrought, moulded, and formed only beneath his hand, but is itself the Potter, both potter and clay: the basic substance of a self-moving cosmos, an infinite and eternal entity.

This sublime conception alone comports and corresponds with the evolution of mind, its desire of infinite opportunity, its tendency to unlimited growth and its hopes of immortal life. The universe is endless, the field which it offers life boundless. On the infinite breadth of Void lies outspread this inscrutable mystery which the physicist now terms *matter*, but whose real name mortal lips have never yet spoken, perhaps never will, never can; since to define it is to rob it of its most sublime attribute.

Whence it came, or whitherward it moves, none can answer. It is the unknown. We feel, see and study certain of its phases, but of its origin, or destiny, we know nothing as yet.

Even our present scanty knowledge of matter enables us to perceive that such are its attributes; and ever as the horizon of our science broadens and the clouds of our ignorance lift, we are led to regard matter with new awe and greater reverence. Fresh from the mutations and catastrophes of a thousand world-deaths, it emerges ever new, with the same omnipotent power to

create afresh. Yesterday, to-day, forever, it is the same exhaustless well-spring of motion, beauty, feeling and life.

One of the attributes of matter as observed in nature — its primal attribute, probably — is a sentient property by virtue of which it displays the phenomena which we term life. Matter lives.

The first manifestation of life of which we have knowledge is in the cell, as observed in unicellular life. Beyond doubt chemism everywhere is attended and, indeed, initiated by a low degree of elemental *feeling*, yet this property is at a great depth below what we designate as life in the cell. Cell life is the result and product of an extended organization of the lowly-sentient atoms, electrons, or psychons, if these terms may be used as names for the most minute particles of matter of which we have knowledge. In the cell we have many billions of corpuscles — each from its behavior a sentient particle — extensively organized to accomplish nutrition and reproduction.

Incident to the sentient property of matter there is a lowly degree of selfhood, or incipient personality; and when the corpuscles are organized in the cell, we find, *pari passu* with the cell organization, a corresponding *bund* of selfhood, evinced in the cell personality.

It is from studies of the cell organization that we have come at length to grasp the principle and *raison d'etre* of all natural organization, namely, to accomplish elevation of the lowly sentience of unorganized matter to higher degrees of sentience, having apparently as its ultimate object and end, animal intelligence and those still higher degrees of intellect displayed in the human brain.

Nowhere do we find intelligence without organization of the basic substance. The small mind of the cell exists only by virtue of an orderly arrangement of its protoplasmic contents. This small, self-conscious life presupposes organization. Only by means of organization is the low basic sentience of unconditioned matter, the untrained instinct-force of chaos, raised up to intelligence.

Here is our master key to Nature: organization and intelligence, rising hand in hand from elemental matter, each dependent on the other, neither able to exist without the other. Mind

no more able to exist without its organized body and brain, than body and brain can go on existing in the absence of the conscious and subconscious mind. The one is the co-relative and component to the other. They can no more be separated, nor exist apart from each other, than the elemental corpuscle can be sundered from its primary sentient property. Sundered, were that possible, matter would no longer be matter; the universe would vanish on the breadth of Void.

This, then, is the principle which the future psychologist and theologian must grasp and incorporate, or find their doctrines as a house built upon the sands.

On the earth thus far there has appeared only the cell type of life, supplemented by more or less well-perfected combinations of this type. From this vast substratum of unicellular life has developed a complexity of cell unions, organized as plants and animals.

By virtue of this extended organization, the estate and condition of all the coöperative cells have been greatly improved, their tenure on life enormously lengthened, their psychic power as enormously enhanced.

From the Silurian ages there has been a continuous progress, extending upward through plant and animal life to human life in civilized communities, until as a result of the whole grand scheme of organization, we have in the brain of man the highest type of united cell life and unified cell intelligence, where the cell (neuron) now lives a hundred years, and by further progress may become immortal.

And it is to this entire coöperative effort of life-on-earth to improve its condition and preserve itself, that we have given the high yet humble designation of *Natural Salvation.*

HUMAN PERSONALITY

ITS COMPOSITE AND DISSOLUBLE NATURE

(1893)

BIOLOGICAL science places the long-debated problem of human personality under new lights. We are now able to demonstrate how one particular group of cells in the human organism — cells such as were originally, in the earlier ages of the earth, separate unicells — combined, became modified and finally united to form one larger, organized life, in conformity with the law of vital progress, through organization, pointed out in the first paper of this volume. The human brain, indeed, is the grandest terrestrial instance of this symbiotic progress.

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 organism as we inherit it from our ancestors, is an association of cell life, each cell a small organism by itself and a descendant, far back, of a protozoon that once lived apart from its fellows and was capable of making its way alone in the world, having matter-moving powers and guided by a lowly intelligence which stood to it as mind.

The present functions of the tissue cell of the animal body, of muscle, bone, cartilage, gland, 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 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. The capacity to so do is latent in him still; — and that is much the status of the tissue cell of the human body as compared with its ancestral unicell of the ancient earth.

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. While the remote ancestry of the neurons was the same as the muscle, bone, or gland cell, its differentiation and training has been distinct; for the neuron has been the cell whose task compelled it to extend its primary quotum of intelligence and develop its lowly wits.

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. Whether the human intellect can exist and does exist apart from the human body, after the latter is dead, 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 even 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 insure simultaneous action to a certain end on the part of all the cells. The same is observed in the volvocine colonies. This is the first step to a nervous system — the transmission of a directive impulse from cell to cell.

At this early stage of differentiation of function, any cell of the colony may act as a brain or nerve cell. The capacity is inherent in all cells at the outset of multicellular life. The protozoan unicell exhibits functions of muscle, brain, and gland. One cell, living alone, may do all that any multicellular organism can do, on a small scale. But in a colony of unicells — from which multicellular creatures originated — and 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, those which propel the colony. 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.

There seems to be nothing very wonderful in the process by which the virgin sensibility of the unicell has been raised to the condition of intellect. 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, let us say, for the sake of a familiar word. 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.

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 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 wonderful 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 human self-consciousness.

Under the microscope, as we are now able to use it, the entire scheme of the soul's origin and maintenance is displayed. We see and are able to map out the mode of its growth and discern how its manifold virtues, aspirations, instincts, traits, and beliefs

have come into existence and stand linked together in a composite whole. Here is revealed as on a chart the physical basis of psychology — the new scientific psychology of the 20th century; — and it were better if the old, erratic, creed-attainted treatises were burned, and the site cleared for the truth.

For when free of the taint and bias of religious indoctrination, the new science of the soul can be made so clear, so simple to the understanding, that the average boy or girl of ten will learn it in a few easy lessons.

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 very 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 consentient 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 fibres, 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.

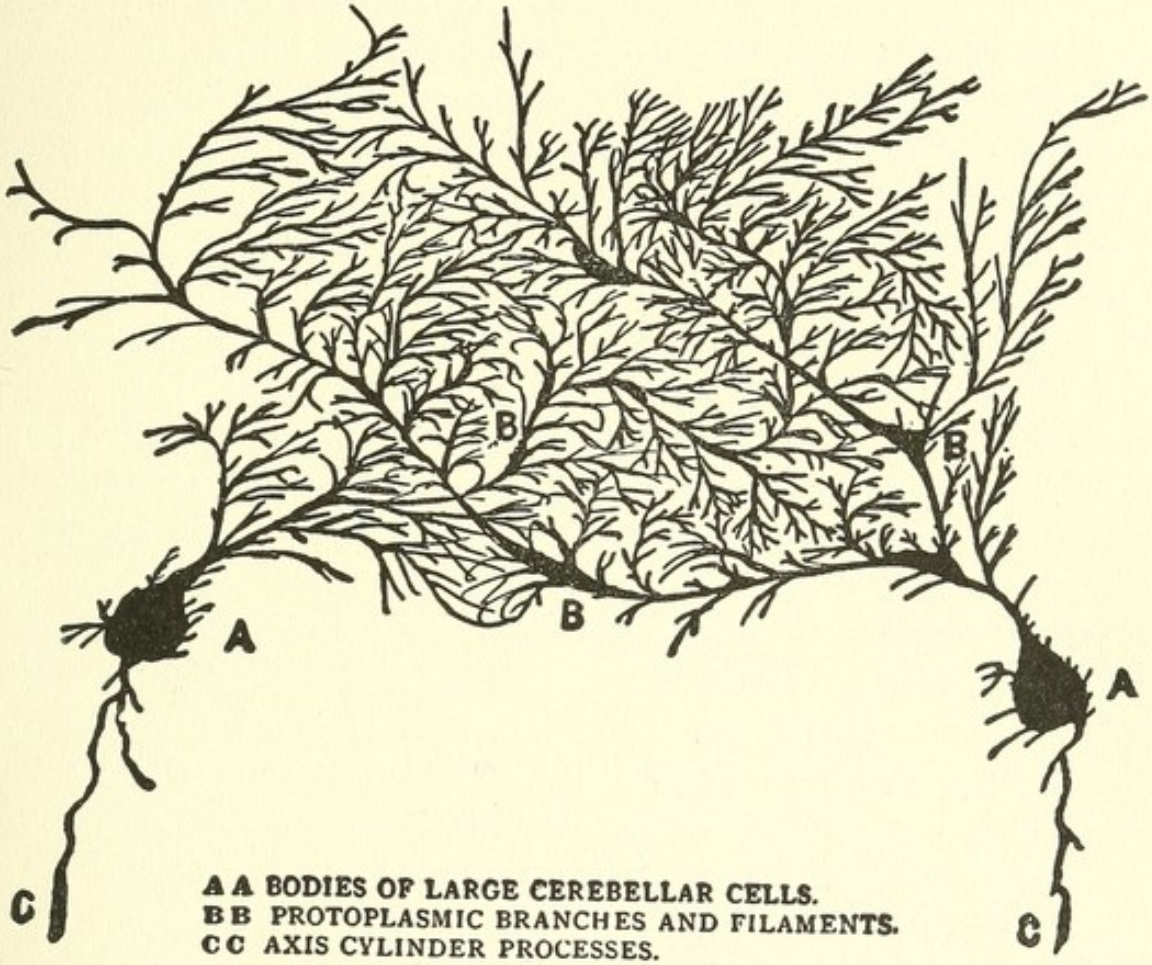
The cells of this class, or species, from the human cerebellum, or lesser brain, differ considerably in size and general appearance from those of the cerebrum, and also from those of the spinal cord; but from their position and connections, their psychic rôle is believed to be similar, since they are 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 fibres which emanate from them are of far greater extent.

These cells are collocated in a layer at a depth of less than a



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

millimeter in the outer stratum of the foliated cerebellar surface, and are nourished from a rich capillary plexus. They are supported, 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.

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.

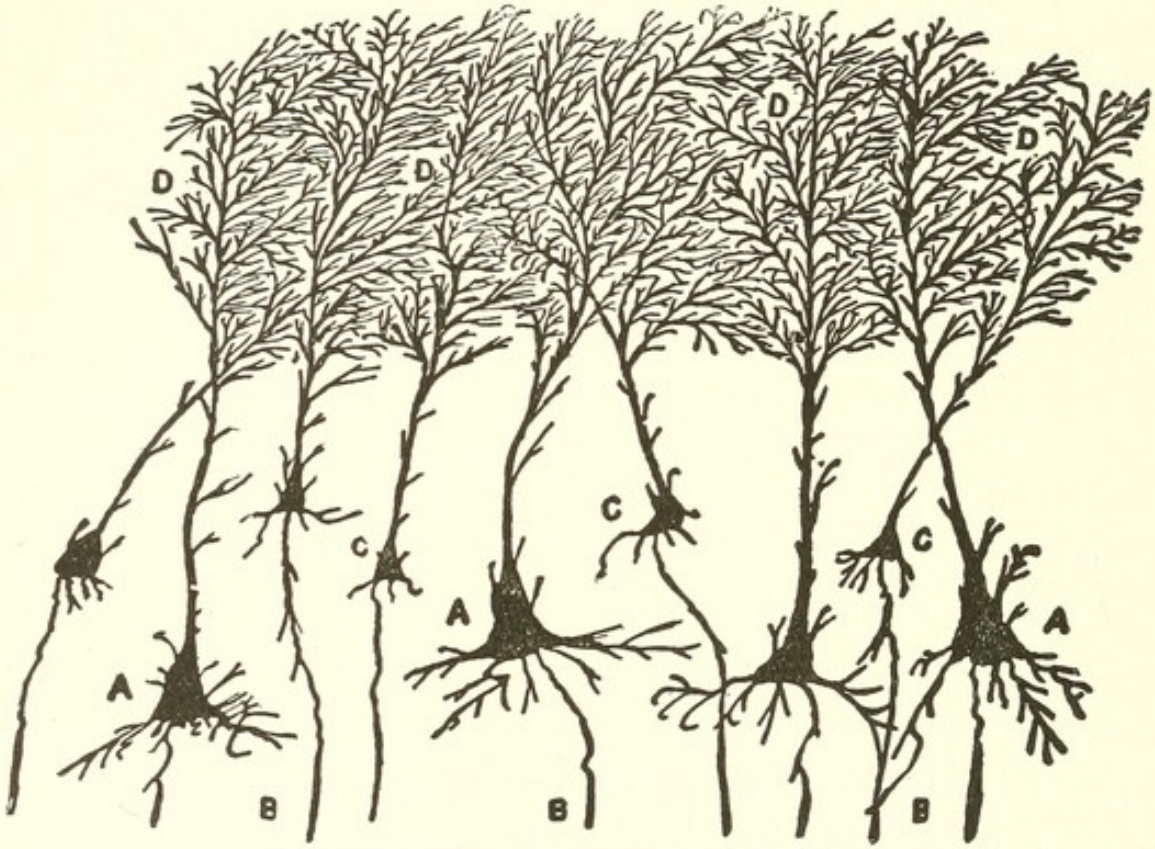
Many of these have small fibrillar processes, one of which is sometimes seen to rise toward the " molecular " layer while the other dips downward amidst the white *fasces* of fibers. The function of these smaller nuclear cells is not easily divined.

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 con-



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.

volutions, 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 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 consentient 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. *Amœba 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 continuously extended.

Revert for a moment and grasp the underlying principle of this vast development of the human personality by the neurons. *Ab initio*, it founds on that esoteric property, or primal ingredient, of living matter by virtue of which the sentient corpuscles combine in the " atom," the atoms in the self-mobile molecules of protoplasm. For that great mystery, matter, is not a dead fabric, but an ever-living, sentient, self-moving substance. Out of this ever-living substance the physiological cell, as we find it in the human organism, has developed by a complexity of evolution which, if we could see it microscopically unfolded, would rival even that congeries of interlacing neurons in the human cerebrum. Yet we now make this neuron the unit of brain architecture. The infinitesimally minute fibrils by which corpuscle established sentient relationship with corpuscle, to form protoplasmic molecules and set up the personality of a cell, are invisible, as yet, merely a matter of conjecture. But the wonderful mechanism of filaments by means of which the brain cells establish sentient contact to form the human personality, is now visible.

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; as if earth and moon came in contact and a new center of gravity were set up in the contiguous masses.

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. Never was there a doctrine more at variance with the facts, or founding in greater ignorance of the human brain.

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, each a cell personality. We are able to show how the cells (neurons) unite, by what means the greater personality (soul) 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 eternal cessation of that personality. There is no longer excuse for ignoring these facts, or for teaching or assuming that self-consciousness is an infrangible unit, that lives " unscathed amidst the crash of worlds, untouched by the death of matter itself." Such " long bow " may do for sermons to hopelessly indoctrined sectaries, but has no place in modern physiology. Not " the crash of worlds," merely the impact of a cobble on the human cranium will cause the sentient neurons to retract their interlaced filaments, for a few moments it may be, or for hours, or forever. Self-consciousness ceases until they resume contact. If the blow was heavy, it is never resumed.

So ephemeral a thing is this self-conscious personality, this soul of man. 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 from less perfect sentient contact of the cells.

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 dry.

From out the well-nigh infinite atomicity of matter, swift tides of corpuscles, or electrons flash and flow through the combined mass of the neurons; and it is conjectured that this etheric medium forms the base of mentation. This is not yet science, but surmise, not yet demonstrable. There is reason to theorize, however, as to such a "spiritual body" within the "natural body" of the human organism; a subliminal emanation or etheric eddy in which the neurons and other cells lie saturated or surcharged. There are many evidences, physical, electromagnetic, actinic, that go to render the surmise a probable one. It falls in line with what we know otherwise of the marvelous attenuation of matter, its fluidity and almost inconceivably rapid motions. Something of this sort must exist, just what it is biological science does not yet undertake to prove; whether the residual corpuscles of the universe form the "luminiferous ether" of the older physicists; or whether, as is most probable, there are particles of lesser mass, having far more subtle and approximately instantaneous motions; a descending series of such particles dropping into profound depths of atomicity which the human plummet has not yet sounded, and where science, perhaps, never will find bottom. For matter is the one great mystery of the universe.

It is in the amazing flux of these tides of etheric matter, that all "spirit" phenomena, past and present, found and hold their place in popular credulity. The point always lost sight of by priest and devotee, charlatan and dupe, alike, is that it is only by virtue of long-perfected organization that a "soul"

is raised up to self-consciousness; that the human personality requires and presupposes an organized brain which only the entire evolution of the human race has brought into existence; that intellect and mind result from organized union of the millions of neurons which form the brain and nervous system; that personal identity exists only by virtue of the coalition of these cells, and no longer than they coalesce; that self-consciousness depends on that perfected mechanism of sentient filaments by means of which the neurons pool their self-lives to become consentient; and that when this mechanism of union is impaired or destroyed, personality ceases, being resolved first to the inferior intelligences of the cells and ultimately to the lowly sentience of elementary matter — when the cells themselves die and are reduced to their component molecules and atoms.

It is this point of the long-descended organization of living matter, which the biologist has ever to keep in mind; for if our science teaches one truth more conclusively than another it is that intellect and mind are never seen to exist in the absence of a delicately organized union of cells.

At the present stage of popular credulity concerning disembodied spirit-life, the ground is taken by many, many even who lay pretension to scientific attainments, that as ion and electron appear to possess a psychic property, they may be aggregated in a " spiritual body " which is liberated at the death of the organism, to fly, or float away, still continent, with personal faculties intact; that this subliminal self coheres and remains individual; that it still sees without eyes, hears without ears, smells without olfactory tract, and tastes without gustatory follicles; that it still reasons without the interlaced pyramidals and moves without sensory ganglia and motor nerve fibers.

According to this loose conception, indeed, the physical apparatus is really not at all necessary, being a kind of superimposed clog on " soul life " which sojourns in the animal organism rather than forms an essential inseparable component of it, the point being that at death, it somehow frees itself, gets away, and preserves the much desiderated self-consciousness.

The argument is never very clear as to ways and means, but takes such jumps as are necessary to gain the object sought.

And grave professors of psychology announce with dignified aplomb, that they " see nothing inconsistent in this view."

What volumes do such naïve admissions speak for the present dense ignorance of this same self-exalted psychology! What utter lack of comprehension of the first principles on which nature acts for the production of the human personality!

The human soul is not a nebula of confluent ions, not an undeveloped gas of sentient atoms, not the raw diffused base of sentience, but a fabric long-developed from this sentient base. Ion has combined with ion, " atom " with " atom," and molecule with molecule in long-perfected, orderly union to give utterance to the lowly intelligence of the cell — the protozoon. That lowly intelligence is the cell's soul. It exists in such degree and at such a height of intelligence only by virtue of an intricate arrangement of its component molecules and reciprocal action between them. To give utterance to the cell soul the sentient particles of which cell and nucleus are composed have to bear certain relations to each other, occupy certain positions one to another, and exert on each other a series of impulses, to and fro, direct and reflex. Moreover, they have to preserve these relations and keep these positions one to another, in order that the personal identity of the cell may be preserved from hour to hour and day to day. The cell soul depends on the stability of this *form* — to use the word in a German sense. There is a progressive development of the sentient substance to something which is reciprocally very mazy and complex, before we get the cell soul; and while that cell soul continues to exist, the *form* must be preserved intact.

Crush the cell, scatter those sentient ions, atoms, and molecules, and you have indubitably lost your cell soul; it has sunk back to the basic sentience of universal matter. That the ghost of it goes floating about the universe is contrary to everything we know of nature; for nature produces degrees of intelligence only by complex combinations.

The human organism differs from the cell only in being larger and more varied; since it is composed of cells, organized, cooperative, and consentient. In a general way, the human organism is to the cell what the city or the nation is to the individual citizen. In the organism we have a more voluminous life than

that of the cell, but life of the same character and quality. The cell is an epitome of the human body, the body an organized multiple of the cell; the cell sentience is the essential unit of the human life, and, indeed, of all terrestrial life. A human life is, therefore, the consentient product of the cell lives of which the organism is made up.

In the course of these long organizations of cell life, sense organs and apparatuses have developed which put the consentient colony or mass of brain cells in wide, extended communication with the external world, in touch largely with the universe, with the result that this personalized mass of living matter becomes the recipient and repository of sensations and impressions of all sorts from all quarters. In a word, it is made the repository of knowledge, and while thus receiving and recording, becomes what we term educated, cultivated, refined, by a continuous process from infancy to old age.

The cells of the brain not only interlace, but act reciprocally one to another and reflexly, setting up a well-nigh inconceivably delicate *form* which remains *in situ* during the individual life, or is but slowly modified by fresh accessions of knowledge from without. Each cell neuron of the colony-blend is thus enabled to profit by the experience of the whole and is *formed*, moulded, modified by the greater life and attainments of the whole organism.

High degrees of intelligence are thus reached, the intellects of great thinkers, our Darwins, Weissmanns, Thompsons, Gladstones, Spencers. In each we have an inherited mass or colony of neurons of exceptionally good quality and then, personally, a continuous development which, could it be displayed microscopically, would exhibit organization of such delicacy and complex arrangement, and yet such permanence through life, as would go far to set psychology on a new basis, and prove nothing less than a revelation of Nature's method of producing a human soul!

Upon this whole delicate organization and upon nothing less, personality depends from moment to moment, and from year to year. It is only by virtue of this mazy organization of living matter that intellect exists or can go on existing.

What happens at death?

First, the interlacing neurons let go their hold on each other —

and self-consciousness of the person vanishes. It goes out, as flame vanishes when atoms of carbon and oxygen no longer combine.

What next?

The heart no longer propels the life tide of refined food in the blood to the brain — as in sleep — and after a few minutes the neurons themselves die from suffocation and starvation. All those thousands of little individual lives vanish, as did the larger self-consciousness of the person; for in each the consentient bond of living molecules, atoms, and corpuscles is disrupted.

What next?

The dissipation of the brain as cadaver is a somewhat slower, more heterogeneous process, involving invasions of bacteria, disintegration, and reduction to more stable compounds, but tending ultimately to a return from the highly complex living substance, with all its maze of organization, to the abysmal base of the primeval ether and its lowly endowment of life-potential.

What was once the soul has been resolved back to this elemental life-potential of unorganized, unconditioned matter. To think of it or represent it as self-conscious is to deny the first principles of Nature. Human self-consciousness is the long-derived result of evolution by organization of cell life. Intellect is the outcome of a million years of brain. The human soul is the flower of terrestrial life, and at present, alas, almost as evanescent as a flower. What the scientific world has most need to apprehend is *the principle by which Nature works to form a soul.*

The theological penchant for conceiving of the soul as an irrefrangible unit or entity, leads constantly to erroneous conclusions concerning it and concerning its fate after the death of the organism. Even introspection shows us that self-consciousness is but a play of the primary sentience of matter over an organized fabric of brain; that we are intelligent as far as the experience of life has impressed itself on that brain fabric and no farther; that obliterate this recorded experience of life, ancestral and personally acquired, and naught remains to us of personality; naught save impersonal *feeling*. Individuality, personality, soul, comes only after an axis of self-consciousness has been set up in living matter; it grows up about such a life-axis by virtue of organization of the living substance. Under

certain favorable conditions the low-sentient property of unorganized matter appears able to inaugurate unicellular life.

The conception of an unorganized " spirit " personality afloat in space, coming and going, formed and unformed from time to time, is an anomaly which presents itself with growing absurdity as one's knowledge of Nature increases.

In the case of a colony of unicells, combining for a common life, the resultant consensus of cell lives is a simple one, differing little save in volume, from that of any one of the component cells. In the human personality — not differing in principle — we have the consensus of cell lives extensively developed. The cells of the optical tract, for example, are stored with scenic impressions that come to them through the apparatus of the eye; yet do these stand connected sentient and perceptive, with every other cell of the brain, and flash to each their pictures of the external world. In like manner the cells of the auditory, olfactory, and gustatory tracts transmit to the entire aggregate of cells with which they are in touch, sensations of sounds, flavors, and odors of which they are the recipients. From the sympathetic system, from the heart, the lungs, and the other organic apparatuses, as also from the peripheral nerve cells, come constant tides of sensation which impress every cell in the brain. So extended and perfect is the mechanism of contact that each distinct impression from the external world, or from the different organs of the body, is flashed to, and pervades the whole unified group of neurons. In greater or less degree they all take part, although the organized division of labor has delegated to the motor neurons the function of response.

To trace the education of brain and describe the development of intellect from the interaction between the sentient fabric of cells within the cranium, and the external world, would exceed the purpose of this paper. The picture presented is one of manifold sensation, impression, record and adaptive growth, from birth to adult life. The coherent mass of neurons stands all-cognizant about a common axis of self-consciousness; for sentience, like the other attributes of universal matter, displays polarity. A more detailed account of how personality develops, grows to its zenith prime, and wanes in " old age " toward a nadir of extinction, is reserved for the future.

In extreme " old age " there is in truth little left of the " soul " to save, either by divine intervention, or human achievement. Personality, has, indeed, become but a " shade " of its former self, a feeble, lambent corpse-light, flickering to its cessation. It is the cell-neurons which need a reincarnation; 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*. Such is the present human situation. Is it not better to face this situation bravely, and start afresh in our quest for immortal life on the firm ground of natural salvation?

And are we really worthy of immortal life, would it be best for us, until we can achieve it for ourselves?

BRAIN

A STILL PROGRESSIVE TISSUE OF THE HUMAN ORGANISM

(1895)

WHETHER a higher type of life will 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 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 are many indications which appear to controvert the affirmative view. Not a few of those whom we know to be best equipped for forming an opinion on this subject, appear to hold 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 typical 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, cartilagenous, 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 no secular change from generation to generation.

Moreover, the bone, muscle, cartilage, and other tissue cells of man resemble very closely those of the lower grade 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 geodetic, 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, has been 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 has 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; and hence the prayerful appeal for a more favorable theatre for life elsewhere.

The apparent cessation of evolution on the earth 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 morals 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 of this brief paper 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 tending to reach, type limits.

I shall show furthermore 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 these 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 inter-dependent one upon another until one order cannot live without the presence and function 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, are no longer progressive. Even their abnormalities are unprogressive. 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. The type of cell has assumed permanence.

There is, however, a tissue of the organism, an order, or differentiation of cells, which we have not yet mentioned, 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 parasite 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 filaments; how the special sense organs took form; how at length the cerebellum came to be lodged in the forward end of the pluricellular 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, unchanged in character; 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 arrangement 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 always 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 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 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 a score of other unprogressive 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 unprogressive 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 unprogressive tissues? We have now good hopes that it can.

THE ETHER OF SPACE; ITS RELATION TO HUMAN PERSONALITY

A PROBABLE SOLUTION OF SPIRITISM

(1908)

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 electroscope, 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.

I therefore define a "psychic" as a person who is able, temporarily, to drop ordinary perception by the five senses, discontinue life in accord with such perception, 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 the whole universe. The marvellously delicate protoplasmic web of the cell organization vibrates to the ether thrill. For even as each corpuscle carries its electric charge, so every last particle or vortex of the ether carries its sentient, monistic charge of life.

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." It is a question of the delicacy, density and instantaneously-acting properties of the connecting medium. 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." The explanation it offers is explicit. Instinct is etheric or psychic perception, nothing more nor less; and these isolated, infrequent cases of it, as instanced above, are what is left in the multicellular animal of the original, unicellular endowment.

On account of its small size, relatively, and the nature of its protoplasmic activities, the cell-of-life lives largely in relations with the ether. By this we mean that protoplasm — the delicately organized living matter of a cell — acts and reacts by means of the ether as its vehicle, and has little to do with gravity and the earth's aerial envelope as a means of communication, cell with cell. It is a creature of the ether.

Every cell-of-life, therefore, whether a protozoon, living alone, or a cell of organized, multicellular life, is from environment and constitution clairvoyant and clairaudient, that is to say it possesses this far-perceptive faculty through the ether, in the clear-perceptive sense. Although organized life, like that of the human body, has

come to depend on the five " senses," that was not the method of the ancestral unicell; and even in the human organism the tissue cell has never wholly surrendered nor relinquished its natural clairvoyant and telepathic powers. It still retains a latent faculty of perception through the ether.

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 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 back-ground on which the universe is built up and from which it has been evolved.

We know of matter as attenuate as the corpuscle (electron); and we may define the ether as everything below, or smaller than the corpuscle. That is the best we can do at present in the way of a definition. It is the low-sentient 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 corpuscle,* that is to say, all particles smaller and finer than the corpuscle, or electron.

Below the corpuscle, 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, we know not, to infinity, perhaps.

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. By estimate of Mendelief the atomic weight of ether particles is one-millionth that of the atom of hydrogen, or one-thousandth that of the electron.

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^{29} 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 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 subtile 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, a certain component chord, 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, 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 electro-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, comparable 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 window 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 redacts on the cell-of-life.

The existence of the ether and of its transcendent properties is now as well established as the existence of the electron; nor can the phenomena, above alluded to, be traced to any other source or medium. The negative evidence that it is etheric grows conclusive as we investigate it further. 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; our most recent studies of living matter and the ether virtually compel this or a very similar hypothesis.

In truth we are but beginning faintly to realize the transcendent tenuity and sensitiveness of this all-embracing "argon gas" of unknown vacuum; there are no symbols with which to compare many of its intimate properties. Moreover, it appears to be a composite thing, field within field of greater and greater degrees of tenuity, medium within medium. And in the midst of it we live our lives, each life a center of self-hood and feeling and also an engine of kinetic activity; — an activity that stirs the enveloping medium far into the depths of space, no thrill of which is ever lost, but comes reflected back from the infinite in the eternities of the future. With all its mighty potentialities of mass, of density, of boundless elasticity and of titanic energy, this ether is yet the

repository and reservoir of an imagery, physical, psychic, moral, no trace or other impression in which is ever lost, but goes, pictured, mirrored, and " echoing " on forever: a vast, vibrant, mixed imagery which often takes what seems to us 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 as seen recently in Alaska, 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 ethereous 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.

THE ETHER IN RELATION TO NATURAL SELECTION AND ANCESTRY

In the protoplasmic as in the nascent state matter appears to be remarkably sensitive to the formative, guiding influence of this wealth of imagery in the surrounding ether. Nowhere perhaps is this sensitivity and the effects which ensue from it seen so impressively as during the very earliest stages of embryonic life *in utero*. Every mother, animal or human, is at this time a "psychic" in some degree. The formative influence of the mirroring ether at this period remains a subject for future study. We have to inquire, too, as to this constant, omnipresent influence in the organism as the germs of a new life are prepared and matured — the ovum and the spermatozoon — in connection with the translation of ancestral personality from one generation to another, or as it is more commonly termed, the transmission of inherited traits and characteristics; heredity generally.

Protoplasmic matter is sensitive to mnemonic impression from without to a degree simply marvelous. The ether, as vehicle, carries the impression, but in the protoplasm of the cell the impression is "fixed" and remains there as a memory. This faculty of the cell to *remember* is apparently limitless, its capacity to retain such impressions unbounded.

Personally, from imperfection of the larger, functional apparatus, we forget our experiences; that is one thing; but in the protoplasm of the cell, itself, no impression or experience seems ever to be forgotten, and probably is not as long as the protoplasmic structure is preserved. We shall ultimately come to the deduction, that all consciousness, self-hood and all of human personality are here contained, abide here and here only.

From the standpoint of biological progress, the deductions which these later studies of the ether and its content necessitate are important and interesting in their bearing on the much debated problems of natural selection, sexual selection, etc., where the earlier, cruder "Darwinism" and "Weissmannism" fall short and fail to explain many of the present enigmas of life.

Whitman, Wilson, Kellogg and a full score others of our prominent American biologists (to say little of the German revolt against Darwin) have for a long time, as is well known, tacitly acknowl-

edged the insufficiency of natural selection and all other, older theories of the evolution of life. An unknown, formative, guiding power, deeper-lying and more constantly operative, came to be recognized by Whitman and many of his pupils and contemporaries, recognized not in the sense of a weak reversion to abandoned theistic beliefs, but a tacit recognition of a great natural cause, thus far unexplained.

In the omnipresent ether, with its content of coercive imagery, everywhere reflected and compelling imitation in the protoplasmic web of cell life, we deem it possible that this hitherto unknown cause will be found; the formative hand which underlies alike natural selection and every other special hypothesis of vital evolution. Rather these older theories are but the superficial glimpses of this deep-lying cause, this semblance of design in nature. It is a cause that has been cumulative, one which has gained strength, since the first unicell by earth's early seas thrilled its feeble life into the void etheric medium. Before turning spiritists in haste let us go on, therefore, learning more of the ether.

PSYCHICAL RESEARCH; A HARSH CRITICISM

A former member of the American Branch of the *Society for Psychical Research* (while the branch society existed as such) in a very harsh criticism of *Salvation by Science* remarks, "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, the late Dr. Lombroso, Professor William James and others.

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 are doing good work to advance the truth, even when — like Sir Oliver Lodge — they manifestly fail to discern it.

"The dead have never really died at all!" exclaims the venerable Alfred Russell Wallace, triumphantly.

"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 for what it is worth, in the hope that it will be tested experimentally by others.

It is a view and a solution which have come incidentally to other researches and studies in quest of chemically perfect cell nutrition, a scientific rectification of the blood plasma, and the analysis and control of brain cell energy. And from being incidental, I have to confess that it is presented here in a somewhat fragmentary manner; yet the reader will probably be able to put together whatever of it is properly essential and pertinent to the subject.

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. If these worthy scientists had withdrawn their minds from "discarnate spirits" sufficiently to do this, the results might have proved of real service in our quest for truth.

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 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 Russell 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 is seen to "levitate" a table, her own weight, when sitting on a scale, is 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 the celebrated " Katie King " 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. Each and every cell of the multicell — the human body, for example — is a self and a life by itself, living about its own separate axis of sensation and consciousness. In the tissues and organs of the human body, preëminently in the brain, the cells are organized in a communal life for mutual benefit. Yet each retains its self-hood and lives its separate cell life. It has its own distinct metabolism, its own emanation and *aura,* and its own personal axis of self-consciousness. It pools its cell-life with others, for a part of the time, in order to join in a larger effort for the common good, yet never, night or day, ceases to be an individual life.

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. The concept of a self-conscious fluidic or etherous body without cell metabolism is an illusion — the fond pet illusion of all spiritists.

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 organization 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 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 per-

sonality 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 sub-conscious 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. Often-

est, 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, archaic rocks wither 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. Back to him, to that far, sentient dot, we trace our ancestral tree. That little life began moulding, forming, putting the rudiments of our present characters — our "souls" — into that speck of self-sentient jelly. Nay more, it is that selfsame, self-reduplicating dot of living jelly which survives, with all its acquired impress — the record of all its hundred millions of years — in the brain of man, to-day.

The one marvelous substance, found on this globe of matter, the substance which has endured and will no doubt endure through the equally long epochs and æons of future time: the substance which grows, not wastes, nor rusts, as centuries pass, grows and incorporates in itself the name and fame 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 *æs 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 — on these six billion ounces of human brain — 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 dimen-

sion 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 erelong 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 lately 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 intrusted 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, unequalled 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, premo-

nition, 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" which inhere in the ether and in unorganized matter generally.

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 spirit-land, 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 recalled 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. And if we have worked for that grand day, they will love us.

Morituri.

But that thought is our compensation, our solace in death.

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 beatified 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.*

It is easy to say that " God is merciful," and " God is love."

But is he?

We mean, is nature and this boundless, eddying cosmos benevolent, or regardful, or even cognizant of man?

There is absolutely nothing thus to reassure us. The trapped animal makes the long nights doleful with its anguished cries — in vain. There is no pity. The entombed miner prays and sobs to " God," to " Heaven!" There is no pity. Sorrowfully we have come to learn that such faith in " God " 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. His luckless " soul " might even be held down for ages under glacial ice, or tortured in pent, hot caverns of slowly-wrinkling strata, smelting to lava, and no heed be taken. We are ever face to face with this mute, blank impersonality of the cosmos. It carries the " elements of feeling " only. It neither lets nor hinders; and the great lesson taught from it all is that we must push on, grow in knowledge, get control of it and save ourselves. It is controllable by those who can learn how. That is our lesson. That is the religion to come. That is the Faith to which the five creeds of old Asia are now giving place in America. It adopts the best from all of them, but unfolds a new plan of salvation: salvation by science.

THREE HUNDRED LINES OF LUCRETIUS

Prefatory Note

THE degree of enlightenment, one may say civilization, which a nation, or race, has attained, may be quite correctly gauged by the ideas concerning matter that underlie its ethics and literature.

Of the truth of this Greece in classic days furnished a concrete illustration. Parallel with Hellenic civilization ran, or rather underran, those ideas concerning matter put forth by Anaxagoras, Zeno and Demokritos.

The military Romans never advanced much farther in their conceptions of matter than a fashionable adoption of the Greek philosophies, much as Vergil followed Homer in poesy, and Cicero Demosthenes in oratory.

One great exception there was — Lucretius.

Avowedly, Lucretius recapitulated Epikuros, but did so in vivid epic numbers, and, like Tyndall of our own era, he originated one grand phrase which has come echoing down the centuries: *semina rerum.*

More than a millennium later an analogous growth of ideas as to the intimate nature of matter appeared in the more fanciful philosophy of the Arabians. As Arabian literature and science grew, under Islam, its philosophers engaged in quite similar studies of the great problem of substance and being.

As Buddhism, too, passed to the estate of an established religion, we find its more scholarly votaries displaying the same reverent curiosity, and indulging in similar deep ponderings as to the nature and origin of matter.

Even on that lofty plateau of the Peruvian Andes, where Manco Copac once taught, there were crude efforts to portray the parts and properties of the one great universal substance.

The same is probably true of all the now forgotten cults of

prehistoric man. As knowledge grew, matter became more and more a subject of speculation and discourse.

After Lucretius, and after the long lapse of mediæval times, Gassendi appears to the present writer to have contributed, albeit blunderingly, the next most important idea concerning matter, when he broached the concept of " vital heat " in matter; — meaning an intrinsic component, something esoteric to matter which gives rise to life.

To this Tyndall added the phrase, " living matter: " two words which carried us farther than hundreds of volumes from his contemporaries. Those two words will live when everything else discovered and taught in the nineteenth century is largely obsolete and forgotten, since they guarantee, in advance, the sentient hypothesis of matter, the origin of species and the descent of man.

Out of them all has come the present scientific concept which portrays matter as the one great mystery of the universe, alike subjective and objective, sentience and substance, from which issue the ether, the electron, the " atom " and the molecule.

Lucretius epitomized pre-existent ideas as to matter, bridged the three centuries from Greece to Rome, and added his one glowing conception: *semina rerum,* the seeds of things, the first glimmer of the future cell doctrine.

So great indeed is the debt of modern biological science, and of all science, to Lucretius, that neglect to venerate his memory is of the nature of impiety. For centuries Supernaturalism heaped obloquy upon his grave, and strove in a thousand foolish tomes to make his " materialism " a term of reproach. None the less, the grand renaissance of science, during the last two centuries, is a re-incarnation of his doctrines of nature.

For crude and meager as was the Epicurian and Lucretian materialism, embracing as it did only *the lifeless side of Matter,* it was nevertheless, the first intelligent step toward the study and comprehension of natural phenomena. The " atom " of Demokritos was the corner-stone of modern chemistry. The *semina rerum* of Lucretius were the seeds of modern biology.

Mindful of this boon from the mighty dead, a humble student of this long-silent master ventures like a school-boy, to translate his three hundred lines.

Warned by the failures of versifiers, no attempt has been made

here to render classic verse into English rhyme. My effort has been to translate the words of Lucretius into plain English, ardently desiring, but as often failing, to embody his earnest, poetic spirit.

T. LUCRETII CARI, DE RERUM NATURA

Book I., 1-14

Æneadum genetrix, hominum divumque voluptas
Alma Venus, cæli subter labentia signa
Quæ mare navigerum, quæ terras frugiferentis
Concelebras, per te quonium genus omne animantum
Concipitur visitque exortum lumina solis
Te, Dea, te fugiunt venti, te nubila cœli
Adventumque tuum, tibi suavis dædala tellus
Summittit flores, tibi rident æquora ponti
Placatumque nitet diffuso lumine cœlum.
Nam simul ac species patefactast verna diei
Et reserata viget genetabilis aura favoni
Æriæ primum volucres te, diva, tuumque
Significant initum perculsæ corda tua vi.

Translation

Fostering Venus, Mother of Rome, Delight alike of men and of the gods! Thou who, beneath the ever-moving signs of the zodiac, givest Life to the fruitful earth and the navigable sea!

For verily through thee every species of living creature is conceived and, borne forth, beholds the light of the sun.

At thy approach, Goddess, rude winds and clouds flee away.

For thee the varied earth puts forth flowers.

For thee the broad expanses of ocean shine and the calmed skies beam with light effulgent.

For as soon as the vernal influence of day unfolds and genial breezes stir abroad, the birds first of all signalize thee in song, their hearts pervaded by thy power.

Book I., 14-27

Indeferæ pecudes persultant pabula læta
Et rapidos tranant amnis; ita capta lepore

Te sequitur cupide quo quamque inducere pergis.
Denique per maria ac montis fluviosque rapacis
Frondiferasque domos avium camposque virentis
Omnibus incutiens blandum per pectora amorem
Efficis ut cupide generatim sæcla propagent.
Quæ quoniam rerum naturam sola gubernas
Nec sine te quicquam dias in luminis oras
Exoritur neque fit lætum neque amabile quicquam,
Te sociam studeo scribendis versibus esse
Quos ego de rerum natura pangere conor
Memmiadæ nostro, quem tu, Dea, tempore in omni
Omnibus ornatum voluisti excellere rebus.

Translation

Then the wild herds gambol in their pastures and swim the rapid streams.

All living things, in fine, captivated by desire of thee, follow whithersoever thou leadest the way.

Over seas and mountains and rushing rivers, in the leafy homes of birds and amidst green fields, thou, infusing love in the breasts of all alike, incitest them eagerly to propagate their kind.

Since thou alone art queen of nature, and neither without thy favor can any living creature issue to the pleasing coasts of light, nor become joyous and gladsome, I earnestly desire thee to be the companion of my song and of my verse, which I aspire to compose concerning the nature of things for my friend Memmius, whom thou, O Goddess, hast willed ever to excel others, accomplished in all respects.

Book I., 54-61

Nam tibi de summa cœli ratione deumque
Disserere incipiam et rerum primordia pandam
Unde omnis natura creet res auctet alatque
Quove eadem rursum natura perempta resolvat
Quæ nos materiem et genitalia corpora rebus
Redunda in ratione vocare et semina rerum
Appellare suëmus et hæc eadem usurpare
Corpora prima, quod ex illis sunt omnia primis.

Translation

For now I shall begin to set forth much pertaining to the gods, and take into estimation the origin of the universe and the manner in which nature creates, nourishes, and sustains all things which have life, as also the mode of their dissolution; such elements as, in the elucidation of our theme, we are accustomed to term Matter and the germs of things, assuming them to be primary bodies from which all objects in nature are derived.

Book I., 62-79

Humana ante oculos fœde cum vita jaceret
In terris oppressa gravi sub Religione
Quæ caput a cœli regionibus ostendebat
Horribili super aspectu mortalibus instans,
Primum Graius homo mortalis tollere contra
Est oculos ausus primusque obsistere contra
Quem neque fama deum nec fulmina nec minitanti
Murmure compressit cælum, sed eo magis acrem
Inritat animi virtutem effringere ut arta
Naturæ primus portarum claustra cupiret.
Ergo vivida vis animi pervicit, et extra
Processit longe flammantia mœnia mundi
Atque omne immensum peragravit mente animoque,
Unde refert nobis victor quid possit oriri,
Quid nequeat, finita potestas denique cuique
Quanam sit ratione atque alte terminus hærens.
Quare Religio pedibus subjecta vicissim
Opteritur, nos exæquat victoria cælo.

Translation

When Human Life lay foully torn and exposed, crushed to the earth beneath the heel of Religion that reared her head in the heavens, impending over mortals with malign aspect, a Man of Greece was the first to raise his eyes resolutely against her and stand at bay.

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

Therefore the vivid force of his mind has prevailed and, entering within these barriers, he has proceeded far beyond the flaming walls of the world, and in thought and conception has journeyed through the immensity of space.

Thence he now returns to us as a conqueror, able to teach us what can take place and what cannot be; in short, how and why the powers of nature have their limits and are held within deep-set boundaries.

By his victory, therefore, Religion is cast down from her place of pride; and we, in turn, are made the peers of heaven.

Book I., 80-101

Illud in his rebus vereor, ne forte rearis
Impia te rationis inire elementa viamque
Indugredi sceleris. Quod contra sæpius illa
Religio peperit scelerosa atque impia facta.
Aulide quo pacto Triviæ virginis aram
Iphianassæ turparent sanguine fœde
Ductores Danaum delecti, prima virorum.
Cui simul infula virgineos circumdata comptus
Ex utraque pari malarum parte profusast,
Et mæstum simul ante aras adstare parentem
Sensit et hunc propter ferrum celare ministros
Aspectuque suo lacrimas effundere civis,
Muta metu terram genibus submissa petebat
Nec miseræ prodesse in tali tempore quibat
Quod patrio princeps donarat nomine regem;
Nam sublata virum manibus tremibundaque ad aras
Deductast, non ut solemni more sacrorum
Perfecto posset claro comitari Hymenæo,
Sed casta inceste nubendi tempore in ipso
Hostia consideret mactatu mæsta parentis
Exitus ut classi felix faustusque daretur.
Tantum Religio potuit suadere malorum.

Translation

In these themes I fear lest perchance thou mayest think, O Memmius, that we are entering on prohibited topics, as if beginning a course of crime.

But on the other hand, this same Religion has frequently incited men to wicked deeds, as when at Aulis the chiefs of the Greeks reddened the altar of virgin Trivia with the blood of Iphigenia.

Her maiden tresses, released from the fillet, dropped to equal length beside each cheek, and at once she beheld her grief-stricken sire standing before the altars, the expectant priests, concealing the sacrificial knife, and her fellow-countrymen in tears.

Speechless from fear, she dropped on her knees to the earth; nor did it avail the unfortunate maiden in a crisis so evil, that she had been the first to bless the king with the sacred name of father.

Lifted by the hands of zealots, she was dragged trembling to the altar, not that, a solemn rite being performed, she should hear the joyous hymeneal hymn, but that chaste in her virgin prime, she should be foully immolated by that father's hand, in order that a prosperous voyage might attend the fleet.

To such enormities has Religion prompted men!

Book I., 102-119

Tutemet a nobis jam quovis tempore vatum
Terriloquis victus dictis desciscere quæres.
Quippe etenim quam multa tibi jam fingere possunt
Somnia quæ vitæ rationes vertere possint
Fortunasque tuas omnis turbare timore!
Et merito; nam si certam finem esse viderent
Ærumnarum homines, aliqua ratione valerent,
Religionibus atque minis obsistere vatum.
Nunc ratio nulla est restandi, nulla facultas,
Æternas quoniam pœnas in morte timendumst.
Ignoratur enim quæ sit natura animæ,
Nata sit an contra nascentibus insinuetur,
Et simul intereat nobiscum morte dirempta
An tenebras Orci visat vastasque lacunas

An pecudes alias divinitus insinuet se,
Ennius ut noster cecinit qui primus amœno
Detulit ex Helicone perenni fronde coronam
Per gentis Italas hominum quæ clara clueret.

Translation

And wilt thou, too, Memmius, terrified by the frightful stories of poets and priests, seek to escape me?

How easily, indeed, such visionary tales can be invented to disturb the course of your life and mar your pleasures with idle forebodings!

Nor is it wholly strange that this should be so. Yet if only men knew that there was a fixed boundary to the ills which can befall them, they would be able to withstand these threatening fictions of religious superstition.

But since now they fear eternal punishment after death, they can summon no faculty, no courage to resist.

For especially they are ignorant what the nature of the soul is; whether it is produced in our bodies and engendered with them, or whether, on the contrary, it is implanted in us at birth; whether it perishes with the body, dissolved at death, or glides away to haunt the vast and gloomy lakes of Orcus; or yet, undying, insinuates itself into the bodies of other animals. Even as our Ennius has sung of it, who first brought from immortal Helicon a crown of perennial leaf, celebrated throughout Italy.

Book I., 146-158

Hunc igitur terrorem animi tenebrasque necessest
Non radii solis neque lucida tela diei
Discutiant, sed naturæ species ratioque.
Principium cuius hinc nobis exordia sumet,
Nullam rem e nilo gigni divinitus umquam.
Quippe ita formido mortalis continet omnis,
Quod multa in terris fieri cæloque tuentur
Quorum operum causas nulla ratione videre
Possunt ac fieri divino numine rentur
Quas ob res ubi viderimus nil posse creari

De nilo, tum quod sequimur jam rectius inde
Perspiciemus, et unde queat res quæque creari
Et quo quæque modo fiant opera sine divum.

Translation

This fear, this darkness of the mind, therefore, is not to be dispelled by sunshine and the bright darts of day, but by reason and a knowledge of nature.

Of this knowledge the first principle set forth in our discourse shall be that no visible object, or thing, is ever produced from nothing, even by the gods.

But now everywhere mortals are restrained and held fast by fear, because they behold phenomena on earth, and in the sky, the causes of which they are unable to perceive, and hence fancy that divine intervention is present.

But when we shall have clearly perceived that nothing is ever directly created from nothing, we shall follow our theme more clearly and shall comprehend in what manner every natural object comes into existence and how all things are done without the intervention of the gods.

Book I., 215-217

Huc accedit uti quicque in sua corpora rursum
Dissoluat natura neque ad nilum interemat res.

Translation

It happens, too, that nature resolves everything into its own original elements and never reduces anything to nothingness.

Book I., 322-329

Postremo quæcumque dies naturaque rebus
Paulatim tribuit, moderatim crescere cogens,
Nulla potest oculorum acies contenta tueri;
Nec porro quæcumque ævo macieque senescunt,
Nec mare quæ impendent, vesco sale saxa peresa

Quid quoque amittant in tempore cernere possis,
Corporibus cæcis igitur natura gerit res.

Translation

Moreover, whatever time and nature add to objects, little by little, compelling them to gradually increase in bulk, no power of vision, never so carefully directed, enables us to perceive.

Nor indeed is what wastes away perceptible in old age. No more can one discern what the cliffs which overhang the sea, eaten by mordant salts, lose as the days go by.

Nature therefore carries on her labors by the use of invisible particles.

Book I., 329-340

Nec tamen undique corporea stipata tenentur
Omnia natura; namque est in rebus inane.
Quod tibi cognosse in multis erit utile rebus
Nec sinet errantem dubitare et quærere semper
De summa rerum et nostris diffidere dictis.
(Qua propter locus est intactus inane vacansque.)
Quod si non esset, nulla ratione moveri
Res possent; namque officium quod corporis exstat,
Officere atque obstare, id in omni tempore adesset
Omnibus; haud igitur quicquam procedere posset,
Principium quoniam cedendi nulla daret res.

Translation

Nor yet are all bodies held fast, bound by natural substance on all sides, since there is void, or empty space, between all such bodies.

This indeed is a truth which it will be especially useful for you to recognize, for it will preserve you from wavering in mind and constantly inquiring as to the constitution of nature, as also from distrust of my teachings.

Therefore let it be set down as a fact, that there is void in nature, intangible, empty, vacant.

If this were not the case, by no possibility could bodies be moved

to and fro; for it is the nature and property of a body to oppose and obstruct movement; and this property is present in all bodies. Hence nothing would be able to move, since nothing could begin to yield, or make way.

Book I., 346-358

Præterea quamvis solidæ res esse putentur,
Hinc tamen esse licet raro cum corpore cernas.
In saxis ac speluncis permanat aquaram
Liquidus humor et uberibus flent omnia guttis.
Dissipat in corpus sese cibus omne animantum.
Crescunt arbusta et fetus in tempore fundunt,
Quod cibus in totas usque ab radicibus imis
Per truncos ac per ramos diffunditur omnis.
Inter sæpta meant voces et clausa domorum
Transvolitant, rigidum permanat frigus ad ossa,
Quod nisi inania sint, qua possint corpora quæque
Transire, haud ulla fieri ratione videres.

Translation

For although some things may be thought to be solid, it is still possible to discern that they have pores within their substance.

In rocks and caves the moisture of water permeates the stone which everywhere weeps abundant tears.

In living creatures, too, food insinuates itself throughout every portion of the body.

Forests grow and yield fruit in their season, because nutrient particles are diffused through the trunks and all the branches, from the smallest twigs and deepest roots.

Voices penetrate the walls and fly through the closed doors of houses.

Stiffening cold enters even to the bones of our bodies.

All of which you would never observe to happen, if there were no void spaces to which certain minute particles find entrance.

Book I., 358-370

Denique cur alias aliis præstare videmus
Pondere res rebus nilo maiore figura?

Nam si tantumdemst in lanæ glomere quantum
Corperis in plumbo est, tantundem pendere par est,
Corporis officiumst quoniam premere omnia deorsum,
Contra autem natura manet sine pondere inanis.
Ergo quod magnumst æque leviusque videtur,
Nimirum plus esse sibi declarat inanis;
Ac contra gravius plus in se corporis esse
Dedicat et multo vacui minus intus habere.
Est igitur nimirum id quod ratione sagaci.
Quærimus admixtum rebus, quod inane vocamus.

Translation

Finally, why do we see some objects surpassing others in weight, although no greater in bulk?

For if there is as much substance in a given bulk of wool as in an equal bulk of lead, they should weigh the same, since it is the property and function of matter everywhere to press downward.

But void, on the contrary, remains everywhere without weight.

Hence that body which is equally as large as another, but lighter, gives evidence that it holds within itself more of void.

But on the other hand, the heavier body shows that it contains more substance and has in it much less empty space.

It is apparent, therefore, that what we call void and seek by a searching investigation to demonstrate as such, is admixed with all material things.

Book I., 418-429

Sed nunc ut repetam cœptum pertexere dictis
Omnis, ut est, igitur per se natura duabus
Constitit in rebus; nam corpora sunt et inane,
Hæc in quo sita sunt et qua diversa moventur.
Corpus enim per se communis dedicat esse
Sensus; cui nisi prima fides fundata valebit,
Haut erit occultis de rebus, quo referentes
Confirmare animi quicquam ratione queamus.
Tum porro locus ac spatium, quod inane vocamus
Si nullum foret, haut usquam sita corpora possent

Esse neque omnino quoquam diversa meare;
Id quod jam supera tibi paulo ostendimus ante.

Translation

But now that I may repeat and finish the argument already begun, the universe may be stated to consist of two parts, since there are material bodies, and void or empty space in which they are located and moved to and fro.

For the common sense, or perception, proves that there is such a thing as substance or matter.

Of the existence of the latter, indeed, unless the primary assumption of it is well grounded, there will be no premises by reference to which we may proceed, or in abstruse thought be able to steady and confirm the mind.

And to continue, if there be no space which we may term vacant, objects could not be located anywhere, nor any movement of them take place, even as we have pointed out a little above.

Book I., 459-464

Tempus item per se non est, sed rebus ab ipsis
Consequitur sensus, transactum quid sit in ævo,
Tum quæ res instet, quid porro deinde sequatur.
Nec per se quemquam tempus sentire fatendumst
Semotum ab rerum motu placidaque quiete.

Translation

Time, too, in and of itself does not exist as an entity. But the perception of it follows on from the sequence of events taking place in the past, also in the present and what may ensue in the future. Nor yet has any one been able to conceive of Time as separate and distinct from the progress of events and the quiet rest of objects.

Book I., 483-503

Corpora sunt porro partim primordia rerum,
Partim concilio quæ constant principiorum.
Sed quæ sunt rerum primordia, nulla potest vis

Stinguere; nam solido vincunt ea corpore demum.
Et si difficile esse videtur credere quicquam
In rebus solido reperiri corpore posse.
Transit enim fulmen cæli per sæpta domorum
Clamor ut ac voces; ferrum candescit in igni
Dissiliuntque fero ferventia saxa vapore;
Tum labefactatus rigor auri solvitur æstu;
Tum glacies aëris flamma devicta liquescit
Permanat calor argentum penetraleque frigus,
Quando utrumque manu retinentes pocula rite
Sensimus infuso lympharum rore superne.
Usque adeo in rebus solidi nil esse videtur.
Sed quia vera tamen ratio naturaque rerum
Cogit, ades, paucis dum versibus expediamus
Esse ea quæ solido atque æterno corpore constent,
Semina quæ rerum primordiaque esse docemus,
Unde omnis rerum nunc constet summa creata.

Translation

Bodies, moreover, are composed in part of the primordial elements of things, and in part of those substances which result from combinations of such elements.

The primordial elements proper no force nor violence is able to break up, since they maintain themselves prevalently by virtue of their solidity.

It may seem difficult to believe, perhaps, that anything in nature can be found so surpassingly solid. For verily the thunderbolts of heaven pass through the walls of houses, as do also noise and voices; iron glows in the furnace; rocks, grown fervid, burst asunder from the fierce energy of pent-up vapors; the firmness of gold, yielding to heat, is loosed; the frosty cold of brass, conquered by flame, is liquified; penetrant heat and cold enter silver, since we have felt each when, according to custom, holding cups in our hands, hot or cold liquids have been poured into them at feasts.

Whence it would appear that there might be nothing wholly solid in the world.

Nevertheless, since by good reason I hold the opposite opinion,

give me your attention, I pray, while I make it plain in my verse that there exist elemental bodies (or atoms) of inveterate and eternal solidity: elemental particles which constitute the germs of things and from which, as we teach, the world has been generated.

Book I., 503-511

Principio quoniam duplex natura duarum
Dissimilis rerum longe constare repertast,
Corporis atque loci, res in quo quæque geruntur,
Esse utramque sibi per se puramque necessest.
Nam quacumque vacat spatium, quod inane vocamus,
Corpus ea non est; qua porro cumque tenet se
Corpus, ea vacuum nequaquam constat inane.
Sunt igitur solida ac sine inani corpora prima.

Translation

Primarily, since the nature of things is found to consist of two dissimilar components, namely, matter and void space in which all the operations of nature are carried on, it follows of necessity that each exists of and for itself, distinct from the other.

For wheresoever space stands empty, which we call void, there is no matter.

Likewise, where matter exhibits itself, empty space by no manner of means is present.

Primarily, therefore, matter is solid and without void.

Book I., 511-519

Præterea quoniam genitis in rebus inanest,
Materiem circum solidam constare necessest,
Nec res ulla potest vera ratione probari
Corpore inane suo celare et que intus habere,
Si non, quod cohibet, solidum constare relinquas.
Id porro nil esse potest nisi materiæ
Concilium, quod inane queat rerum cohibere.
Materies igitur, solido quæ corpore constat,
Esse æterna potest, cum cetera dissoluantur.

Translation

Furthermore, since there are empty spaces, or pores, in objects, solid matter must inclose them. Nor can anything be demonstrated, by strict argument, to have or to conceal void within its own body proper, unless you yield the point that this which incloses and contains it is solid.

But that which has the power of thus inclosing void in objects can be nothing less than an aggregation of matter.

Matter, moreover, which consists of solid substance, may be indestructible, while its derivative compounds are subject to dissolution.

Book I., 520-531

Tum porro si nil esset quod inane vocaret,
Omne foret solidum; nisi contra corpora certa
Essent quæ loca complerent quæcumque tenerent,
Omne quod est, spatium vacuum constaret inane.
Alternis igitur nimirum corpus inani
Distinctumst quoniam nec plenum naviter extat
Nec porro vacuum. Sunt ergo corpora certa
Quæ spatium pleno possint distinguere inane.
Hæc neque dissolui plagis extrinsecus icta,
Possunt nec porro penitus penetrata retexi
Nec ratione queunt alia temptata labare;

Translation

Still further, if there were nothing which we call void, the whole world would be solid.

On the other hand, unless there were substance to fill space and maintain all things which exist, empty void would prevail everywhere.

Matter therefore presents itself as distinct from void by antithesis and contrast; since the latter neither exists as wholly filled nor entirely empty.

There are present therefore certain primary bodies which are

able to give demarcation to space and distinguish it as empty or full.

These bodies can neither be fractured by blows given them externally, nor dissolved by decomposition from within. Nor yet can their integrity be made to yield by any manner of assault upon them.

Book I., 540-551

Præterea nisi materies æterna fuisset,
Antehac ad nilum penitus res quæque redissent
De niloque renata forent quæcumque videmus.
At quoniam supra docui nil posse creari
De nilo neque quod genitum est ad nil revocari,
Esse immortali primordia corpore debent,
Dissolui quo quæque supremo tempore possint,
Materies ut subpeditet rebus reparandis.
Sunt igitur solida primordia simplicitate
Nec ratione queunt alia servata per ævom
Ex infinito jam tempore res reparare.

Translation

Unless, indeed, matter were thus indestructible, all things, before this, would have been reduced to nothingness; and we should behold whatever comes into existence created out of nothing.

But as I have demonstrated previously, nothing which is created ever arises from nothing; nor is any created thing ever resolved into nothing.

Hence the primordial bodies or germs of things must be of an indestructible character, in order that material may be supplied from the wasting away of objects, for the repair and renewal of the world.

It is argued, therefore, that the primordial particles (or atoms) are of intrinsic, pure solidity; since under no other supposition could they have served for the constant use and repair of the world through the infinite ages of the past.

Book I., 551-565

Denique si nullam finem natura parasset
Frangendis rebus, jam corpora materiæ

Usque redacta ferent ævo frangente priore,
Ut nil ex illis acerto tempore posset
Conceptum summum ætatis pervadere ad auctum.
Nam quid vis citius dissolvi posse videmus
Quam rursus refici; qua propter longa diu
Infinita ætas anteacti temporis omnis
Quod fregisset adhuc disturbans dissoluensque,
Numquam relicuo reparari tempore posset.
At nunc nimirum frangendi reddita finis
Certa manet, quoniam refici rem quamque videmus
Et finita simul generatim tempora rebus
Stare, quibus possint ævi contingere florem.

Translation

Otherwise, if nature had set no bound to the destruction of things, the primary particles of matter must long ere this have become so wasted, worn and broken from long use that no new thing could be produced from them in the allotted time of growth and increase, or attain its appointed size and dimensions.

For it is apparent that anything can be much more speedily demolished than constructed; and therefore, that which the vast ages of time past had broken and worn out, marring and wasting it away, would never be able to be restored in time for future use.

But it is evident that there have been set bounds and fixed limits to what may be destroyed, since we behold everything renewed with regularity, and at regularly appointed times in which everything, after its kind, reaches the full perfection of maturity.

Book I., 565-577

Huc accedit uti, solidissima materiæ
Corpora cum constant, possit tamen, omnia, reddi,
Mollia quæ fiunt, aër aqua terra vapores,
Quo pacto fiant et qua vi quaeque gerantur,
Admixtum quoniam semel est in rebus inane.
Ac contra si mollia sint primordia rerum,
Unde queant validi silices ferrumque creari
Non poterit ratio reddi; nam funditus omnis

Principio fundamenti natura carebit.
Sunt igitur solida pollentia simplicitate
Quorum condenso magis omnia consiliatu
Artari possunt validasque ostendere viris.

Translation

It follows therefore, although the primary particles of matter are quite solid, yet in order that objects composed from them may be soft, air, water, earth, vapors, for example, by whatever compact they exist, or by whatever power they may be maintained, void must be admixed in them.

But on the other hand, if the primordial particles are soft instead of solid, no reason can be rendered why flints and iron have been created as hard as we find them.

Nature, in fact, would be unable to have made a beginning or a foundation for her structures. The primary elements of things are therefore of a perfect solidity; and by the close combination of these elements objects are able to exhibit both strength and obduracy.

Book I., 615-635

Præterea nisi erit minimum, parvissima quæque
Corpora constabunt ex partibus infinitis,
Quippe ubi dimidiæ partis pars semper habebit
Dimidiam partem nec res præfiniet ulla.
Ergo rerum inter summam minimamque quid escit?
Nil erit ut distet; nam quamvis funditus omnis
Summa sit infinita, tamen, parvissima quæ sunt,
Ex infinitis constabunt partibus aeque.
Quod quoniam ratio reclamat vera negatque
Credere posse animum, victus fateare necessest
Esse ea quæ nullis jam praedita partibus extent
Et minima constent natura. Quae quoniam sunt,
Illa quoque esse tibi solida atque aeterna fatendum.
Denique si minimas in partis cuncta resolvi
Cogere consuesset rerum natura creatrix,
Jam nil ex illis eadem reparare valeret

Propterea quia, quae nullis sunt partibus aucta,
Non possunt ea quae debet genitatis habere
Materies, varios conexus pondera plagas
Concursus motus, per quæ res quaeque geruntur.

Translation

Moreover, unless there shall be some least limit or nether boundary, where the primordial particles of matter cease to be divided infinitely, these particles would each consist of infinite parts, since the half of a body would always have its half; nor would anything ever be limited or reach an end.

What therefore could be distinguished between the greatest and the smallest, between much and little?

There would be no difference. For although the universe as a whole may be of infinite extent, yet the least objects will equally consist of infinite parts.

Since strict reason precludes this and denies that the mind can admit it, the position must be taken that there are primary bodies, or particles of matter, which have no parts, but exist as the least possible in size and substance.

And since there are such indivisible bodies, you can but acknowledge, O Memmius, that they must be both solid and indestructible.

Furthermore, if Nature, the creator of all things, had not been in the habit of resolving objects into these minutest parts, she would never be able to renew the world from them; because those objects which are renewed by the addition of no such parts cannot be claimed to have those properties which generated bodies are known to possess, to wit, adhesion, weight, motion, and the power of giving and resisting blows; in a word, those properties which mark the behavior of matter under nature wherever observed.

Book I., 951-968

Sed quoniam docui solidissima materiæ
Corpora perpetuo volitare invicta per ævum,
Nunc age, summæ quaedam sit finis eorum
Necne sit, evolamus; item quod inane repertumst
Seu locus ac spatium, res in quo quæque gerantur
Pervideamus utrum finitum funditus omne

Constet an immensum pateat vaste que profundum.
Omne quod est igitur nulla regione viarum
Finitumst; namque extremum debebat habere.
Extremum porro nullius posse videtur
Esse, nisi ultra sit quod finiat; ut videatur
Quo non longius haec sensus natura sequatur.
Nunc extra summam quoniam nil esse fatendum,
Non habet extremum, caret ergo fine modoque.
Nec refert quibus adsistas regionibus eius;
Usque adeo, quem quisque locum possedit, in omnis
Tantundem partis infinitum omne relinquit.

Translation

But since I have taught that the primordial particles of matter are quite solid and fly hither and thither perpetually, unconquered and unworn by the ages, attend now, O Memmius, that we may demonstrate whether there is any end to their numbers or not.

Likewise, let us peer into that which has been found to be empty space, or void, in which Nature carries on her operations, and learn whether the foundations of it are limited by set bounds, or extend in vast, illimitable profundity.

It is evident, as I hold, that there exists no limit, no boundary, on any side, or in any direction; for if bounded, it must have some extreme point.

But it is apparent that there can be no extreme point of anything unless there be something conceived of beyond it, which thus sets limits to it.

In short, it would appear that the universe extends farther than any sense which we possess, enables us to follow.

Now since it must be conceded that nothing exists and extends beyond the entire universe, the latter can have no end; therefore it is beyond limit, or measure.

Nor does it matter in what region or tract of it one may stand, since in whatever place he takes his station, the whole remains equally boundless on every side.

Book I., 968-984

Præterea si jam finitum constituatur
Omne quod est spatium, siquis procurrat ad oras

Ultimus extremas jaciatque volatile telum,
Id validis utrum contortum viribus ire
Quo fuerit missum mavis longeque volare,
An prohibere aliquid censes obstareque posse?
Alterutrum fatearis enim sumasque necessest.
Quorum utrumque tibi effugium præcludit et omne
Coget ut exempta concedas fine patere.
Nam sive est aliquit quod probeat officiatque
Quominu' quo missum est veniat finique locet se,
Sive foras fertur, non est a fine profectum.
Hoc pacto sequar atque, oras ubicumque locaris
Extremas, quæram quid telo denique fiat.
Fiet uti nusquam possit consistere finis
Effugiumque fugæ prolatet copia semper.

Translation

Moreover, if all space be conceived of as having a boundary, and one were to run forward to the extreme confines of it, and were then to throw a swift dart, would you picture to yourself that dart, propelled with great force, as flying far forward in the direction it was cast?

Or would you rather be inclined to suppose that something would finally stop it?

For one or the other alternative you must of necessity adopt; but either one precludes escape to you from the conclusion that the universe stretches away without a bound.

For whether there is anything which may act to stay it in its flight that it may come to an end of it and become stationary, or whether it is borne onward continuously, it has not proceeded forward from a boundary.

And thence, on this supposition, I shall go on, and whenever you locate the farthest shores of space, I shall ask you what may happen in the case of the dart.

The outcome will be that an end of its flight can never be established, and that its escape will still find space in which to glide away.

Book I., 988-996

Praeterea spatium summæ totius omne
Undique si inclusum certis consistere ovis

Finitumque foret, jam copia materiae
Undique ponderibus solidis confluxet ad imum
Nec res ulla geri sub cæli tegmine posset
Nec foret omnino cælum neque lumina solis,
Quippe ubi materies omnis cumulata jaceret
Ex infinito jam tempore subsidendo.

Translation

Besides, were the space of the entire universe included within fixed boundaries, the stores of matter would before this time have flowed together at the bottom of it, on account of its weight and solidity; nor could the operations of nature be carried on beneath the dome of heaven.

Indeed, there would be neither heaven nor light of day, since all matter, sinking down through infinite time, would be cast in one accumulated mass in the nether sphere.

Book I., 1008-1012

Ipsa modum porro sibi rerum summa parare
Ne possit, natura tenet, quæ corpus inani
Et quod inane autem est finiri corpore cogit,
Ut sic alternis infinita omnia reddat.

Translation

Nature also takes care of her own accord, that the totality of things shall not be thus amassed upon itself, but sees to it that void shall invest matter and matter divide void, in order that by such alternations the universe may be rendered infinite in extent and variety.

Book I., 1021-1028

Nam certe neque consilio primordia rerum
Ordine se suo quæque sagaci mente locarunt
Nec quos quæque darent motus pepigere profecto,
Sed quia multa modis multis mutata per omne

Ex infinito vexantur percita plagis
Omne genus motus ex coetus experiundo.

Translation

For assuredly the primordial elements or atoms neither arranged themselves in their places by virtue of any plan or mental sagacity of their own, nor yet moved forth from a previously concerted agreement.

But because they are changed in their courses and acted on in many ways throughout the extent of cosmos, agitated and vexed by blows from eternity, they have, after experiencing every possible vicissitude, obtained such aspects and conditions as we now see that nature presents.

THE INTIMATE CAUSES OF OLD AGE AND ORGANIC DEATH

(1905)

Classic fable records the catastrophe of the Earth-born who, rashly importunate, strove to scale Heaven; and Hindu 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 rarify in the fire-dust of another universal nebula. Not till then may the Lords of Life and Death loose our mortal bonds.

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

" Him neither fear of the Gods, nor thunder-bolts, intimidated, nor portents in 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 untrammeled liberty to seek knowledge and use it.

To-day, in these opening years of the 20th century, we face the greatest, the gravest problem which has ever engaged the

attention of men, the problem of controlling life and prolonging our lives at will.

Medicine, all medical practice, is an effort to prolong life, or postpone the immediate dissolution of the human body. From the 13th to the 18th 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, Haeckel, 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 on the earth. Follows from the natural growth of knowledge in the human brain, 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 dream of all the human ages. It is the voice of nature — nature that everywhere makes oath 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 for salvation to supernatural powers. In their ignorance of nature and the causes of natural phenomena, a vagrant belief in disembodied spirit life took form: the " shadow," 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, solace for the hard fate of individual life. The hope of more life has never been given up, never can be given up, since otherwise life would not be life; but as death appeared inevitable, our far human ancestors comforted themselves with this quasi belief in " soul " life after death. The comfort was always hazy; the hope had always to struggle against common sense, and faith was ever infirm; yet, after a manner, 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 in ghost life. What had been merely a fitful belief 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 invented, and blind faith exacted under ban and penalty. Fane, shrine, temple, mosque, and cathedral were reared, and vast guilds of insolent priesthood organized. " Religion reared her proud head in the skies; human life groveled foully in the dust."

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, the long-night incubus of faith in the supernatural, 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.

Ten thousand years of supernatural religion.

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

Passing over the old-time theories and beliefs as to old age and death — 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 defence. As years pass it becomes impossible to calculate from cause to effect the damage done by bacteria. We are able only to draw a general conclusion that the vital coefficient of the organic life, which in theory should be biostatic, is thus slowly diminished to a point where the personal life succumbs to almost any fresh attack from without, or new insurrection within. For certain disease germs become intrenched in the tissues, so to speak, and there bide their time to deliver further assaults, and go on forays up and down the blood circulatory. Moreover, the roaming white cells or corpuscles of the blood sometimes assume the rôle of

intra-organic assailants; — and this brings us to consider one of the latest theories of old-aging, that of Prof. Eliè Metchnikoff, of the French Institute, 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 distinguishes 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 sees reason to hope that these invasions of putrefactive bacteria may be combatted by ingestion of the *kefir* microbe, found in specially soured milk, and himself makes use of it. He also believes 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 announces his belief that the present span of human life may be prolonged by from sixty to eighty 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. Professor Metchnikoff's idea of human longevity is similar, his view being that although diseases and improper modes of living now hold human life down to seventy or eighty years, these evils and bad conditions may be so far ameliorated, that old age will come three score years later.

We do not understand Professor Metchnikoff to teach that

greatly prolonged life, looking to immortal life, can be attained by applied science. His position is, that "old age" may be deferred, not remedied; that it is in the end an unavoidable sequence to all organic life. The conception that sentience in matter is a constant, a deathless property or attribute of the ultimate corpuscle, or ether, and hence that, founding on this constant, immortal life is potentially attainable and logically possible in organisms, perfected by applied science, is an essentially New World idea, a concept of the American brain, which is not as yet much recognized in Europe. It is one of those great dominant ideas of the human brain which has unfolded as the westward-moving Aryan passed to a new hemisphere.

"This sentient property of matter is a constant like its co-relative, gravitation, and indestructible as matter itself. It is the eternal well-spring of Nature.

"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 core of each ultimate particle of matter.

"Death comes to us, then, not from a law of nature. The law of nature is life, not death. Universal matter *lives* from eternity. It never dies, not even the least particle of it, but lives immortally. Life is the grand law of the universe from eternity to eternity.

"Our problem is to make a certain definite mass and form of living matter — an organism — live on this earth as long as the organism shall *will* so to do.

"Each and every one of the causes of old age and death *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 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 greater knowledge with us, not that we die from any immutable law of nature as heretofore held and taught.

"At length, after centuries of dogma, erratic faith, and equally erratic doubt, we are in possession of facts from which a creed

may be rationally forecast. Those facts demonstrate the continuous evolution of life, under nature, from lowliest forms to man: a long, weary, and unaided struggle upward through organization, from the elemental sentience of matter to the human intellect. But is all this grand effort to terminate in the semi-brutal, half-developed creature, man, with his ideals unrealized? Has evolution ceased? On the contrary, it is our faith that we have as yet seen but the nether limb of evolution. Its grand complement has still to be disclosed in the perfecting of the human organism and the removal of the causes of disease, old-aging, and death; in a word, the achievement of immortality. Immortal life will be won by applied science. Man will save his own soul. Earth is to be made heaven. 'Salvation' is to come from knowledge and the apotheosis of the race. This is what evolution means. This is what life on the earth is struggling upward to win: Immortality, Happiness, Heaven; ideals to be realized by human effort. The tenets of all the great religious systems foreshadow it. It is time to understand this. It is time to realize our true situation on the earth, and cease from chasing mirage. We have now sufficient knowledge to begin to save our own souls. As well face the facts of our mortal condition to-day as spend another thousand years doting on fond illusions. If we would live, we must save ourselves. This is the religion of life; the religion of self-salvation. It is not 'atheism'; not 'materialism,' in the old crass sense. Not 'infidelity'; rather fidelity to the best and the essential doctrines of all religions. Not 'skepticism,' but Hope and Faith in Life. Not the 'idle, new dream' of 'Scientific Materialism,' but the Dream of all the Ages, the grand scheme of Nature, maturing and going into effect since first our earth became the theater of life." *

So far as we are aware, too, cell old age, the primary cause of organic old age in man and animals, has not been discovered in Europe.

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

* *Living Matter*, 1888.

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 coöperative 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 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 entire 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 numbers 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 "constitution" is broken up and discordant action ensues. Most persons die of this organic discord.

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 any future effort 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 visible 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-aging, 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 ingested 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 is gratuitous and far from 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. Is the somewhat discolored, more rigid, less elate condition of the fibrils of a brain cell, in an aged organism, due to infiltered, accumulated dirt?

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 hopeless struggle with dirt?

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

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.

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 substance 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, molded, or impressed in such a degree, that a recent 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 bepicturing 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.

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 no resemblance to photography. A human intellect, with memory, implies a co-related, coöperative 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 forever 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 " 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 hunan 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 and with current theology.

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 to me 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.

It is now more than doubtful, and is discredited, whether anything of the nature of a migratory germ, or " biophor," ascends

from the tissue cells to the seed, and is thus transferred from plant to plant and year to year.

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 on the part of sentient matter. 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.

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 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.

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 schlerosis, 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.

A quarter of a century ago, 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 fact, if fact it had proved, 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. Systems of such cell husbandry began to be outlined for practical use; and in the minds of many, the "fond dream of all the human ages" seemed to be on the eve of realization. The hope was logical, the deduction legitimate, if these premises concerning the natural deathlessness of the unicells were true.

Prof. 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; 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 originally derived from them; 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 diseased 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 species, indeed, as conceived of in the Weissmann hypothesis, was merely an abstraction; the individual after all was the desideratum; — but little points like this sometimes escape the minds of great philosophers.

It must be confessed, too, that something equally nebulous attaches to the Weissmann theorem of *The Germ-plasm and Heredity*.

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 combi-

nations of the germinal substance, 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, mold, 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 cause 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 portrayed 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 affected 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 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 dis-

advantages and observed enfeeblement, which result from in-breeding 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.

In principle nothing different takes place in multicellular life in animals and man. There are modifications of the same method, due to the extensive organization of the cells, but no departure from the principle of cell renewal by an interblend of the nuclear substance of two cells. This point should be kept clearly in mind, since it helps to place the whole subject under better lights. Cells from the reproductive tissue of one parent (spermatozoa) meet a cell from that of another parent, and the same interblending and fusing of nuclear elements takes place, followed by a recast of the blend, and then a new life developing in due course.

At first, and for a number of years, the discovery that the unicells age and must have recourse to sexual conjugation, to escape death, was most disheartening to the earlier hopes of natural salvation. Death appeared to run far more deeply in the warp and woof of living matter than had been supposed.

For a time 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.

These were years of doubt for the natural salvation idea. 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: obstacles incident to gravitation, avid chemical activities, and the heterogeneous mixture of matter on the earth's surface. And this deduction touching unicellular life is a true one. The unicells have found life too hard to live endlessly as individuals. 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.

It is race life, not individual life, which is perpetuated by sexual renovation; the child 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 came 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 ob-

servation; the fact being that a unicell always dies, personally, when it gives birth to offspring by fission; the profound breakup and reassembling of the nuclear contents *being equivalent to the obliteration of the parent cell as an individual.*

But in accepting this grim conclusion, touching the mortality of the unicells, those who had hoped that the human organism may 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, coöperative 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 outlines of the Earth's life scheme. Nor did we then perceive that these grand coöperative unions of differentiated and specialized cell life give rise not only to animal organisms, but to a higher, organized, personal life which redacts 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 life-time; 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 phagocytes 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.

We have a working hypothesis as to how currents of negative-electric corpuscles are derived in the cells, to issue forth as the vehicle of their will. Apparently it comes from decomposition of the atoms in the protoplasmic molecule; a decomposition initiated by the cell's self-sentience. It starts from the sentient side of matter, and involves a great law of nature and the cosmos; — but the scientific evidence in proof of this is not yet in form for statement.

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 redacts, 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, and is vitiated by errata.

In 1892, while conducting a microscopic 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, first become shrunken, smaller and senescent; and our human old age is a resultant condition, reflected outward, from this old aging of the tissue cells.

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.

Such is the human situation on the earth, a situation which appears to have come about under nature, without let or hindrance from external worlds. It has been an unaided and so far

as the scientific evidence goes, an unwatched, unprotected evolution from the lowly, primitive sentience of matter.

At what will it finally arrive?

Or, in the light of our growing knowledge, what can we make of it?

This, at least, is fairly certain of it, that the continued effort at natural salvation will remain our own, unhelped, unhindered. If we can save ourselves from " sin " and death, well and good. There seems to be liberty to do it — a working chance for it; and the question constantly recurs, what can we do to this end, personally, individually, to forward the grand intent of life to natural salvation? What can we accomplish, or illustrate by personal effort in our own organisms, in unison and harmony with the deep cosmic push of life?

Undoubtedly one of the first, most practical steps to this end is the subjugation and extirpation of the disease-producing bacteria. This great campaign, along the well-known lines of sanitation, sterilization, and immunization, is now fairly inaugurated; its progress is a matter of daily news.

The second step in order of importance and timely need, is an extended study of nutrition — the nutrition of the somatic cell — with the acquisition of accurate knowledge how the cell assimilates and of what its proper food consists, having in view to supply that food, or form of nutriment, to the cells and to relieve wholly or in part the present hard, exhaustive processes of digestion, peptonization and rectification, which set up so heavy a drain on the powers of the whole organism, and now devote the human body largely to animal and vegetative functions.

A third most promising line of effort lies in the husbandry of the nervous system, and the intelligent cultivation of the brain colony of cells.

This is a wholly new line of effort, to which little or no attention, in this sense, and from this point of view, has ever been given.

Education as we now obtain it is an exhaustive process, pursued without regard to the life of the brain cell and, in truth, without recognition of its existence.

In organic and in cellular old age, the cells of the brain and spinal cord share at length and are borne down to death, but as

a rule, are the last to give up the struggle. Soft and easily dissoluble as brain appears to be, it is yet the most vitally resistant of tissues, perhaps because the best protected and best nourished. Brain cells secure nutriment from the blood-stream, while muscle cells, bone cells and gland cells starve. Intellect confers strength and endurance. Here, as throughout nature, knowledge brings an endowment of power. The brain colony is the most enduring of cell unions.

To begin with conditions easily recognized, it may be stated, without metaphor, that after the age of thirty-five, most persons, especially Americans of this generation, die because they are literally tired to death. After education begins, the brain cells are rarely or never sufficiently rested from day to day, and there follows what may be termed cumulative fatigue. Improper food taken at bad hours, with abnormal excitements and untimely stimulation, play their part, with the general result that there is an increment of unrelieved fatigue going over from week to week and month to month, until an abnormal condition is reached where restful sleep is no longer possible.

In typical American cases, these cumulative effects of unrelieved fatigue begin in youth and set up a series of changes in the brain cells which result either in the popular "nervous prostration," or more frequently, in an abnormal shrinkage of the mental life, a diminution of personality, accompanied by sub-innervation and lowered vitality.

In this latter condition the organism is dangerously subject to invasions of the disease bacteria. This lowered vitality from insufficient or faulty innervation — the result of chronic brain fatigue — is primarily the cause of many prevalent diseases, since the germs of these diseases are always quite constantly present, and whether they are resisted by the nervous aura and destroyed by phagocitosis or not, is largely a question of normal as against sub-normal innervation.

This condition is often set up in children at school, under improper conditions of study, faulty nutrition, or eye strain, in some cases going on rapidly to complete nervous break-down before the age of twenty is reached, but in most instances impairing clear mentation and inducing various phases of ill health before middle age.

A lamentable number of cases also occur in adults, as middle life is reached, among ambitious, hard-worked business men who may have passed school and college with nervous systems not greatly impaired, but encountering the cares and exigencies of business life, 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 the 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, the cells let go hands, so to speak, continuity is broken, the resultant self-consciousness stops short, the personality ceases, and each individual cell attends to its own personal affairs, 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, the maintenance of the intellect, that this succeeding period of unicellular life 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 ex-

tent 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, 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." These are, indeed, "lost souls" who, like weary Macbeth, will never sleep properly again.

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 wakened 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.

SELF-CONSERVATION AND SELF-MAINTENANCE

THE CULTURE AND HUSBANDRY OF THE BRAIN AND NERVOUS SYSTEM

(*Practical Methods*)

(1907)

CONFESSEDLY then, our hopes of immortal life for the individual man are placed in those future achievements of research, discovery and amelioration of the human lot which the greater, communal life of the nation and the race will render possible. That is the clearly indicated course and promise of life on the earth, from the unicellular ages to present times. That is the way and the law.

But meantime — pending the retarded organization of this greater communal life for these larger labors — what can the individual man do for himself, what can we do, personally, in the line of self-salvation?

We can do much. At least, not a little. We can put ourselves in trim to utilize the greater discoveries as they come. By individual effort, with the data already in hand, we can measurably prolong our days and prolong them in health, by a trained use of the output of energy from the brain cells. By culture and husbandry of the brain and nervous system, we can conserve our lives to a considerable extent.

That, indeed, is what we see being done in a kind of blind way by "faith cure," "Christian Science" and the psycho-therapeutics of certain churchmen. What is thus attempted is a reflex effort of the mind on the body; practically stronger innervation, under stimulus of personal encouragement and mental training.

Self-salvation — salvation of the individual man by personal effort alone and unaided by the larger communal life — resolves itself into the simplified question, How much can the isolated fifty or sixty ounces of the central nervous system which stands for the human personality, do to conserve and maintain itself in the midst of the illimitable universe about it?

And the answer is, that by husbanding and training its small powers it can really do something in that line; something, but not everything. The reflex action of mind on body, to the degree we are now able to exercise it, produces an appreciable, curative effect, particularly in functional disorders. It is a demonstrated adjuvant for health and prolonged life; and hence, as such, is well worth cultivating and training. Let us study it.

Animal physiology founds on cell physiology; animal physiology, indeed, is cell physiology in its larger, grosser aspects. To comprehend in any proper, modern sense the functions of organic life, we must first study the life and functions of the component tissue cells; for this cell life is to the animal life what the single note is to the whole oratorio.

In our study of the thirty or more groups or tracts of tissue cells the lives and functions of which make up the composite life of man, our attention and interest come inevitably to center in that remarkable group which, originally not unlike other protozoons, have as metazoic life developed, become the brain and nervous system; the tissue of the personal self-consciousness and intellect.

The protozoon, every cell-of-life, indeed, feels, is self-conscious, possesses rudimentary psychic powers and lives a lowly personal life. But in the animal organisms, preëminently the human organism, we find a certain group of cells which has made psychic effort and thought its business; just as the muscular group of cells assumed the business of contraction and locomotion. To the brain cells fell the magisterial function of *sensing* the environment for all the others, and directing what all should do for the common good. And hence as the organic evolution proceeded, we find this brain group of cells putting forth fibrils and filaments to the superficies of the whole united mass, filaments which in time assumed the form of the sensory nervous system; and also

other filaments to all the other tissue groups for conveying the behests of the brain group, to become in time the motor system of nerves.

The better, too, to accomplish the function of sensing and thinking for all, we find the brain cells uniting in a consentient mass by means of a mazy system of interlacing fibrils, thus enabling the entire congeries of cells to live together and think in unison, as one great cell might feel and think. We find all the principal cells, or neurons, of the brain group thus sentiently united and unified.

The brain cell group therefore presents the aspect of a group within the other groups, protected and housed about by thick bone and tough integument, sentiently unified about a single axis of self-consciousness and devoting itself entirely to psychic operations, governing all the other groups, innervating all and compelling all to act each within its province for the common good. In a word, holding all together in a human life.

In the human organism the sway of the brain and cord cells is far greater even than is self-consciously apparent to the person; for the larger portion of it is sub-conscious; for example, the functions of the cerebellar and medullar centers and those of the spinal cord. This cerebro-spinal group of cells, indeed, upholds, maintains, directs and governs all. It is at once the personality, the intellect and the source of innervation. Deprived of it, the other groups of cells cannot go on living together, nor yet living at all.

It is apparent therefore that every effort to conserve and prolong human life must be made through this exalted brain group of cells; the brain and its out-reaching nerves. Yet every unicell of the ancient earth could do in minor degree everything which a brain neuron can now do. It could feel, it could see, it could hear, it could smell and taste; in a rudimentary way, it could think and it was self-mobile; it could generate, *by willing*, dynamic impulses for locomotion, or for aggression, or for defence.

We now wish to examine and study this latter power or capacity of all cell life, namely the power to generate dynamic impulses *intra se*, by willing it, and make those impulses felt on its environment. And it need hardly be added here, that this is the most

wonderful transformation of energy known in the universe, the correlation of self-consciousness with matter-moving energy; the inauguration of chemical activity in protoplasmic matter, by an exercise of the self-conscious will of that matter. The matter in this dot of protoplasm, the protozoon, is ordinary matter, differing from that about it only in its arrangement and organization; but here we see it display self-consciousness and the ability to *will* motion in its own substance, and set contiguous matter in motion.

The static self-consciousness of the cell wills motion and motion results. In the will of this living dot of protoplasmic matter, we see the germ of omnipotence. This embryo omnipotence resides in the brain cell, in every cell of life. Deeper, it resides in every last corpuscle of universal matter; for the cell is but a self-organized aggregation of corpuscles and atoms.

It is here therefore that our studies, looking to the control of the energies of matter, the conquest of the universe, must begin, to wit, in the cell-of-life, and in the light of our new knowledge of matter.

By the phrase, "our new knowledge of matter," we refer of course, to those later discoveries concerning the intimate structure of "atoms," with which the researches of Thomson (Lord Kelvin), Rutherford, Becquerel, the Curies and many others were identified; researches of the greatest importance to the biologist as well as the physicist, since it is by aid of them that we now gain a deeper insight than formerly into the nature of cell life. For matter ever presents itself to our inspection in two-fold guise, the objective and subjective, the physical and the psychical, the personal and the impersonal, the *self* side and the *other* side.

The atom of our older chemistry is now demonstrated to be a dynamic union of vastly smaller bodies, known as corpuscles, or electrons. Moreover, the "atoms" of certain elements of matter are known to lose their component corpuscles and waste away, becoming erelong the "atoms" of another element of less atomic weight, as in the case of uranium and radium. In a word, that the "elements" of matter are subject to evolution and devolution.

It has been shown further that these corpuscles or smallest

bodies of matter now known to exist, are apparently identical with negative electricity, giving rise to the conclusion that matter, at bottom, is electric and dynamic, not inert and dead, what seems its inertia being but an illusion of the senses which fail to perceive its intimate constitution.

The " atom " of hydrogen, for example, is believed to be made up of nearly a thousand corpuscles, revolving swiftly in orbits within the atomic dimension; the " atom " of oxygen of at least sixteen thousand corpuscles; the " atom " of radium of two hundred and twenty-five thousands. The orbital velocity of the corpuscles is estimated to be not less than twenty thousand miles per second. It is this enormous initial velocity of the corpuscle, revolving on intra-atomic orbits, that gives the " atom " its hard, separate individuality.

The " atom " is therefore a small solar system, so to speak, of those minute orbs, the corpuscles, a microcosm within the macrocosm; and the amount of energy locked up in their intra-atomic velocities is so enormous as well nigh to defy computation. As a result of his calculations Lord Kelvin concluded that one grain of hydrogen has within it energy sufficient to lift a weight of a million tons to a height of more than three hundred feet; that a grain of oxygen contains sixteen times more than this, and a grain of radium fourteen times more than oxygen.

Indeed, all our previous conceptions and estimates of energy are so dwarfed by these later revelations of science, that one stands appalled by the immensity of Nature's resources! Our old-time atom is a veritable magazine of *vis viva*. Here, in smallest compass, is stored power sufficient to set the industries of a planet in motion.

No practicable method of liberating the intra-atomic energy of the " elements " is yet known. The atoms of several of them, however, radium, uranium, thorium, *et al.*, disintegrate naturally and constantly, being what is termed radio-active, and giving rise to the remarkable phenomena now associated with these substances. Within the next half century methods will be devised for utilizing the intra-atomic energy of matter. Erelong a ton of coal, or oil, or gasolene, will be made to do the work of a million tons as at present burned. Unlimited power lies here under our hands. We have only to learn how to use it, to seam the surface

of this planet with the canals of Mars, to maintain genial warmth, to change our climate to the " summer of paradise " and obliterate noxious germ life.

Radio-activity and the resolution of " atoms " into corpuscles have incidentally brought to notice other minute bodies, among these the " ion," so called, which emanates from gas flames and red-hot metals, and carries a charge of positive electricity, in contrast to the negative charge of the corpuscle. The size and weight of ions are believed to be nearly equal to that of an atom of hydrogen, or about a thousand times greater than a corpuscle. The nature and constitution of the positive ion are but little understood as yet; beyond much doubt it is a highly complex system of still smaller bodies.

All the variously named " rays " to which the radio-activity of matter gives rise, viz. Becquerel rays, Niewenglowski rays, Roentgen rays, Alpha rays, Beta rays, Gamma rays, *et al.*, are associated with these exceedingly minute bodies, and propagated in a still more attenuated medium.

Uranium, radium, thorium are demonstrably radio-active elements. But even oxygen, hydrogen, nitrogen, carbon, sulphur, phosphorus may be slowly, secularly perhaps, radio-active, under certain circumstances, as for example when associated in the cell-of-life.

The corpuscles (negative electricity) are the lowest resolution of matter at present demonstrated. But that these minute bodies are the smallest that exist, the ultimate resolution attainable, may well be doubted. It is quite possible, much more likely, indeed, and more in keeping with what has been learned already, that the corpuscle is itself composite, made up of systems of yet smaller corpuscles; and these in turn of smaller still.

Gradually, in view of the steady growth of our knowledge of matter, we are coming to adopt Mendeleif's view that the ether is an element far below the corpuscle, from which the corpuscle is developed.

More explicitly, that the corpuscle is made up of still more minute *corpuscules* of the ether, revolving in orbits about a central point or axis, even as the atom of hydrogen is composed of a thousand or more corpuscles.

In view of certain phenomena, too, associated with the act of

willing, the present writer has been drawn to a working hypothesis, that it is this etheric corpuscule which is liberated in the cell and is the active agency, when will power is exerted.

At present, however, we are able to estimate currents of nervous energy from the brain only by means of instruments which measure and record ordinary electricity. To these instruments the ether is still imponderable; but this apparent imponderability should be attributed to the imperfection of the instruments.

In good truth, all that we are now learning of matter — the periodicity, or rhythm, of its so called "elements" and the radio-activity of their atoms — goes to substantiate the now nascent hypothesis, that it is a spectrum of energy, an energy which is at bottom Sentient Impulse, and that we shall ultimately resolve it to that, and work with it as such. Life comes from the life-side of matter, its personal side, its potentially divine side.

Upward from the life-side of matter, the cell has developed as a small personal being, a self, in the midst of the world of unorganized matter. The matter in the living portion of the cell is to a degree segregated from the rest of the universe, its bond to other matter in part disrupted, and new bonds formed within itself. The atoms and molecules thus living together in a cell have formed new relations with each other and broken certain other relations in which they formerly stood toward other unorganized matter.

What then is this new bond of self-hood set up in the cell? In what does it consist?

From the very nature of things we can hardly hope ever to see *sentience* itself, or observe *feeling*. That would be to pass over from what is naturally visible to sense, to what is naturally to sense invisible; in other words to expect sense to sense itself. The senses are concerned with things external to themselves.

Yet we may hopefully wait to learn more of the process by means of which the atoms of matter stand in vital relations with each other in a cell, how they do it and what takes place in order that this small modicum of matter may behave as a living personality. In the past this has been the great puzzle of biology, the unsolved riddle. Master minds have long pondered it; but

they lacked the data which has come from our later knowledge of the constitution of matter.

It is with the sentient side, the self side of matter, that life and the personal intellect of man are concerned. Beyond any doubt the corpuscles, or their more minute corpuscules, of matter universally possess this sentient property in low, undeveloped degree. Each is a minute personality and lives a lowly individual life. When assembled in a certain way, a group of them may pool their individual lives in one, forming of their thousands of small selves one larger self to which those thousands of corpuscles are all subjective, embraced within the cordon of one personal life.

What then is the nature of this bond or cordon which is capable of extending the *sense of self-hood* from one corpuscle of matter to another, in such a manner as to embrace thousands of them in one self?

What takes place between these hitherto separate particles of matter, these separate selves, which thus unifies them as one?

Where an appreciable mass of matter is found thus living as a self, a bacterium for example, we have long been accustomed to term the mass "protoplasm," although the word has now little significance. Hitherto we have known nothing of the actual physical relation of one particle of the mass to the others, nor why the mass cohered and gave rise to life. It is certainly a peculiar relationship, not easily set up, since so far as we know at present, undeveloped matter on the earth's surface does not now enter this state, and life is only transmitted from parent to child, by means of fission and division of the parent cells; in other words, that life now only comes from antecedent life.

Working from this basic knowledge of matter, our experimentation has been directed to determine what emanations or "rays" a living cell gives off. It is hardly necessary to say here that such tests are not easily applied. The only fact established is, that the cell-of-life gives forth energy of the nature of both positive and negative electricity; negative electricity when the cell is in a normal condition, positive electricity when fatigued, distressed, or poisoned.

Nerve currents, meaning the impulses that move along nerve trunks from the brain and cord of animals, to muscles and glands,

are more easily studied, by the ordinary methods. The result of our observations has not been to identify these fully as electric currents, but as electric currents plus other and more subtle emanations. Their comparatively slow rate of motion along the nerve trunks also indicates that a more complicated conduction is involved than that of an electric current through a wire, or other conductor. In a word, a " nervous current " now appears to be a current of negative electricity — since it responds readily to the electroscope — but one either much modified, or bearing along with its component corpuscles a " charge " of something more ethereal.

As to the nature of this charge it would be easy but unprofitable to theorize at present. The only point established is, that the cells of the brain and cord generate normally — among other products — a great and well-nigh constant quantity of negative electricity which under certain circumstances changes to positive electricity. What corresponds to electric current proceeds from them quite steadily and they remain as constantly " charged," or surrounded, by a " field " or " atmosphere " of an electrical nature.

If Thomson, Becquerel and other eminent exponents of our new knowledge are right, this electrical output from the cell-of-life is nothing else than a stream of corpuscles, and sometimes of positive ions.

Thus far we are on firm ground. Nor will it be deemed a wholly unjustifiable hypothesis, if we conclude that this stream of free corpuscles is generated in the cell by the disruption of atoms there, since to maintain the cell in bulk and substance, from minute to minute, requires a constant incorporation there of adjuvant atoms from the blood.

Elsewhere in nature, something analogous to brain cell phenomena is displayed in the phosphorescence of *noctiluca*, seen at sea, by night; in the fire-fly, and noticeably in the electric eel. The brain cell is therefore not the only generator of electricity and light, in nature. The cell-of-life everywhere gives rise to similar currents of energy.

The phrase, currents of energy, might be held to imply that the cell-of-life acts as a battery cell, or dynamo, and undoubtedly it does. But we believe it to do more than this, that it creates

energy in the sense of *willing* chemical action and *instigating* or *directing* corpuscular motion, from the sentient or life-side of matter. Protoplasmic matter is staticly conscious of itself, and motion is the expression of its conscious will.

We by no means wish to be understood here as carrying the idea that liberation of corpuscles in the cell-of-life is the only process going on there. The cell is, in fact, a comparatively large organism, if we may be allowed thus to express it. Ordinary chemical action and the formation of carbon dioxide go on in it. What we have described above is rather, as we conceive, what takes place within the protoplasmic molecule than in the cell as a whole. In the cell we have assimilation and oxidation, and also, as we believe, a liberation of intra-atomic energy.

There is much in support of this view. The amount of energy often termed vital, which is generated in animal organisms, has never been fully accounted for, when referred to oxidation of the food. It is more than can be accounted for; but physiologists have assumed that it must come from oxidation.

Hence the animal organism has been constantly cited as by far the most economic machine known for the generation of power. Compared with it the best coal-combustion engines are but one-tenth as effective. A pigeon, for example, with but two ounces of seed food in its crop, expends energy in flights of hundreds or thousands of miles, and in maintaining its body heat, vastly in excess of the oxidation of twenty times that amount of food. This has been set down to the utilization of a surplus, stored up in its body in advance, even though no corresponding decrease in body weight is demonstrable.

The chickadee of our northern forests generates in its tiny body an amount of heat, during the long winter nights, impossible to account for from the few grains of moss spores which it ingests. Twenty times the heat that comes from its food would seem to be required, in zero weather, to maintain the little creature's body at 100 degrees Fah., for fifteen hours of darkness.

But if our present experimentation is trustworthy and our hypothesis from it correct, the puzzle of this great output of energy from the cell-of-life is solved. It is far from being all due to oxidation; it is largely intra-atomic energy. Life in the cell taps the reservoir of energy within the atom.

But how?

How is disintegration of the atom and the liberation of the energy which the corpuscles carry, accomplished?

Is it from sentient contact there?

Does this mysterious impulse — the initial, sentient impulse of life — act to break up the iron clutch of death in the atom and set free its living corpuscles, or their more minute corpuscules?

We can conceive no other hypothesis. It is as if, when in this peculiar protoplasmic juxtaposition, the atoms were so placed relatively to each other, that attractions to and fro, or affiliations begin, causing depletion of their corpuscles and a liberation of corpuscular energy.

In fancy, at least, we may sketch this, and picture what goes on when the corpuscles of the component atoms in "protoplasm" are liberated, to form outward-flowing currents and that *aura*, or "field," which is necessary to enable two or more cells, a million or a billion, to live together in one personality. For we may be sure that this pooling of separate cell lives in one greater life — the human personality for example — has a physical basis. At present this basis seems to be a reciprocal confluence of corpuscles, or their more etheric corpuscules, first from atom to atom and, in larger volume, from cell to cell. And the energy, thus liberated from the corpuscular velocities, constitutes not life itself, but the will power with which life acts.

The bearing of this hypothesis on the problem of cell preservation and cell restoration in the human organism will scarcely fail to be apparent. If verified, it would prove a long step toward our hoped-for control of life at its sources. It is but hypothesis, however, at present, and nothing more is claimed for it, until further proof is obtained.

What we do claim as established by our experimentation, is that the brain neurons, in the exercise of their function of stimulating and actuating the subordinate tissue cells of the organism, generate and emit a flow of corpuscles of the nature of electric currents.

On the other hand, certain physiologists contend that the nerve currents which emanate from the brain originate solely in the oxygenation of the blood, and that the great relative amount of

electricity within the cranium is accounted for by the greater relative volume of blood which goes to the brain.

We are far from arguing here that even this latter contention may not contain its modicum of truth. Nature has this constant trick of mixing effects from her agencies; and nothing is more erroneous than ascribing concrete effects to single causes.

Nor do we assert that a more minute attenuation of matter than the corpuscles is not present in nerve currents. But we are now able to prove that a tide, or "atmosphere," of corpuscles is present in the brain; at this stage of research we can speak positively of no other.

Around and throughout the affiliated mass of brain cells there is a swift "circulation," so to speak, of the emitted free corpuscles, comparable to an eddy, or vortex, ensuring practically instantaneous, reciprocal action of cell on cell; so that the whole assemblage of neurons is instantly unified in one consciousness, to wit the human personality. Within its containing walls of bone and membrane, the brain is charged and electrified by this scintillant aura of free corpuscles which fly to and fro with the velocity of light. The mazy arborizations of the neurons — their interlaced fibrils, making protoplasmic contact — facilitate the process of sentient unification and have plainly developed to this end. But it now appears to be the swift circulation of the corpuscles which is the immediate agency for pooling the separate cell lives in the one greater life of man.

Moreover, this circulation or scintillant eddy appears to go on around a center, or axis, which we have elsewhere termed the personal axis, or axis of self-consciousness. It is akin to the "circulation" of corpuscles (electrons) which goes on around a magnet.

Keeping to the firm ground of what is proven concerning the constant out-put of corpuscular currents from the brain, and its residual charge, or aura of the same, it may be definitely stated, that this is the key-note to metazoic life, the agency by means of which the brain cells actuate and control the organism. The paramount importance therefore of keeping this agency constant and normal becomes apparent. Many, in fact most, of the ills of advancing years start here and are due to slackened tension of the currents and weakening of the corpuscular aura.

This, it may be said, is an unavoidable concomitant of old-aging. During adolescence the tissue cells grow forward to the organic dimensions, cease growing when the type limits are reached, and pass thereafter into the stasis of adult life, yet retaining for fifty years or more the capacity of further growth for organic repair, if from accident a demand is made for it. But even by the end of adolescence certain restrictive causes have begun to inaugurate organic decline. The organism at first so fresh, clean-tinted and plastic, shrinks, chemically hardens and wastes at a thousand points. Growth having stopped, the cells fall into a condition of desuetude and dormancy from which they are only roused by some urgent need of the organism, as from a wound, or a broken bone.

As the time-effects on the organism continue and the hardening and shrinking of the tissues go on, the cells are not only desuete and inert, but become encysted, smothered by their hardened products and lose the opportunity if not the potency, to live longer. They die out in skin and bone and muscle fiber. For nutrient particles from the blood no longer reach them freely through the shrunken capillary tubes; nor do the toughened, hardened nerve fibrils transmit freely, as in youth, currents of incitation from the brain and cord. They are insulated from the actuating neuron, isolated from each other and lose touch with the rest of the organism. Hence they slowly die out. Such is old age.

Yet we must ever keep in view, that all this is due to ordinary, mechanical causes, such as are within the province of science to deal with and remove. Nothing worse, more final, nor more esoteric.

We must also keep in view this other fact of human physiology, namely, that owing to the growth of knowledge, and hence the coming of larger interests into human life, with greater ambitions, brain has become a progressive tissue of the human body. That is to say, much more so than muscle or bone or any of the other associated tissues or groups of cells. Brain is the cell group which is now leading off in human evolution, drawing the other groups after it. The human brain would now live two centuries instead of one, were it not dragged down to death by the growing infirmities of the inferior tissues.

With the incentives and opportunities which modern life now offers, there is, in fact, almost no limit to the life-time of the brain neurons, if only the rest of the human organism held out and was equally progressive.

Equally, too, and less hopefully, we have to reckon with that other fact that these very incentives to brain evolution have disturbed the natural balance betwixt brain and the inferior tissues; that modern life, especially in America, tends not only to develop brain, but to repress the development of the rest of the organism and enfeeble it. In a sense the strong incentives to brain activity and brain growth monopolize the vitality of the whole organism. Hence we constantly see persons, men in the heyday of intellectual life, cut off by the bursting of a blood vessel in the brain, failure of the renal or hepatic tissue, or a breakdown of the alimentary tissues. The fundamental reasons and causes of these disasters must be kept sharply in mind, in devising rational systems of self-conservation.

As prefatory, too, we must again call attention to a premature deterioration of the brain cells in ninety-nine out of every hundred adults in America, from lack of good habits of resting them. Ninety-nine out of every hundred of our people, as middle age is reached, drift into bad habits of sleeping, resulting in insufficient brain rest from day to day and year to year. The neurons shrivel and become wizened from worry and lack of normal rest. This is the physiological fact, and the physical aspect which examination reveals: to wit, prematurely shrunken, blighted neurons.

On the psychic side we have the well known, joyless mental condition, the haggard, hurrying mind, with scarcely a smile on the face; the type one sees on the streets of our great cities. Instead of a pleasurable process, thinking appears to have become a pain, a hot, tremulous effort of cell activity.

Under continued pressure of business, the goad of ambition to attain wealth, the miscarriage of plans, or the dread of financial disaster, the brain cells go on for months and even for years, never once normally rested, refreshed, or freed from the incubus of worry. Often there is insomnia, inducing a condition of anguish from which suicide is a blessed relief. Unrested neurons may come to that bad pass where life is a torture and the personality that

rises from their combined sentiences so much condensed wretchedness.

Such a life is not worth living, but the victim does not well understand the causes. Generally he takes more coffee and tea, or resorts to whiskey, chloral, morphia, *et al.*, all of which adds to the misery of the unrested, over-wrought neurons that uphold his self-conscious life.

Unless properly rested, this congeries of cell life within the brain cannot be adequately nourished from the blood. There must be sound, normal sleep, allowing these cells to cease from their corporate labor and free themselves from the unremoved waste products of waking life. That is what sleep means; that is its object under nature. These at-one-time protozoons, now affiliated in a brain, must revert to their erstwhile unicellular life and live it again, separate, for eight or ten hours daily, to restore and refresh themselves for the great task of producing the human personality for another day. For them it is a true labor of Hercules. So heavy a labor, indeed, that it must be intermitted regularly and patiently; — but our exigent American life often garbs them with the shirt of Nessus!

The sense of mental comfort, well-being and personal enjoyment can coexist only with well-rested, well-nourished brain cells. The cells — each a living creature — must be comfortable and happy in their small lives, in order that their consentient union in the human self-consciousness may be a happy one.

Disturbed sleep, beset by dreams, but illy rests the brain. One has only to examine the arrangement and relations of the neurons to each other — their fibrils, their tentacles, so to speak, for united activity — to understand what the physiological basis of the personality is and see the reason why sleep is so necessary. It seems to be a case of making and breaking contact. The pooling of the cell lives ceases when we fall asleep. The elate, erectile condition of the cell fibrils sinks down; the whole brain occupies less space in the skull; on the part of the neuron there is a reversion to unicellular life. The onerous nature of the united or personal life renders this imperative.

Experiments with electroscopes show that fatigued brain cells yield diminished currents of nervous energy. There is subinnervation, also unequal innervation, some organs and appara-

tuses receiving more nervous stimulus than others, the solar and lumbar plexuses appreciably less. In passing it may be remarked that this latter observation falls in with the frequent manifestation of renal disease in organisms nervously depleted.

It is, indeed, not only remarkable but ominous, how little disturbance in innervation from the brain and cord suffices seriously to impair the organic harmony. Sub-innervation of the organism also opens the door to microbic attack, and of non-resistance to sudden chill which induces pneumonia and other maladies. Tired brain cells naturally crave narcotic and alcoholic stimulus, where well-rested cells would feel no such craving. Normally rested neurons feel no appetite for alcohol, coffee and tobacco, rather a revulsion; nor yet for morphia or chloral. These all may be termed not inaptly the jaded neurons' "desperate refuges," so many proofs of sub-innervation.

Still further, it is demonstrated that the person with jaded neurons is different mentally and morally than on occasions when these cells are normally rested. Following brain fatigue, character sinks to lower levels; the person is less optimistic, less resistant to temptation to evil courses; there is loss of "soul." The sub-innervated person almost invariably takes dark views of life, lasping insensibly to pessimism. Normal innervation from rested neurons is therefore a question of public morals. The tired brain reverts to savage instincts and grows insentient to the call of mercy, honor or truth; — as witness the frequent exhibitions of ruthless savagery, trickiness and relentlessness at the "Wheat Pit" and Stock Exchange. One has but to walk the streets of New York and other large towns of America in times of financial excitement, to see the faces of men who are going back to savagery by leaps and bounds!

But the remedy?

At the present stage of our knowledge, but one line of advice can be given.

Whatever the circumstances, whatever the seeming necessities for going on, whatever is at stake, stop short and rest those tired cells. Any loss is preferable to the loss of your "soul" by reversion to the far-off brute from which, by so long a labor of evolution, we have arisen. Stop short. Stay abed. Sleep.

Sleep may not be easy where long-standing fatigue and stimu-

lants have been at work. But keep abed all day. If insomnia and throbbing cerebral arteries drive you up to rush to and fro, do so for the time, if you must, but return to rest and persist in it until you sleep long and well; and the calm, rested feeling of your young days returns to you, with comfortable sensations, gentler, nobler sentiments and cheerful, hopeful views of life. They will come back to you, if you stick to your resolve to sleep ten hours in a night, for a week or a month. But get it back. Save yourself from that inferno of unrested brain cells. There is profound wisdom in the slang of the Western drummer who counseled his tired comrade to, —

> "Beat it home and hunt the feathers.
> Take a good long snooze."

The effort is worth while. It means the return to normal mentation, the redemption of character, the elevation of judgment, the purification of thought, the lustration of intellect. In a word it means self-salvation.

If a battle has to be fought with previous use of stimulants, it is of the greatest importance to sleep much and keep well rested while the struggle is made. Even in cases of inveterate habit, the craving is less when one sleeps a good deal and brings as little stress and strain as possible on brain and nerves.

With this preface, I shall attempt, though not without diffidence, to outline a method of brain cell husbandry, which I believe will give gratifying results to those who have faith and patience to practice it. It will never, as I am painfully aware, prove a popular panacea, since it calls for self-effort and self-control, and does not humor the inveterate human propensity to swallow a large "dose" of something, and then wait for internal wonders to be performed. It is doubtless true, too, as often alleged, that our average contemporary does not care enough for prolonged life to make a sustained effort to live, but prefers the pleasures of food, drink, sex, dress and recreation of a type better described as dissipation; in a word for the purely animal pleasures which go, physiologically, with a short lifetime; that mode of living which inevitably runs the organism down in sixty years, or less.

Of the higher joys of living and looking forth on the infinite, life-bearing universe, with the sublime sense of growing in knowledge of it, there is, as yet, but little appreciation. The brute in us has but begun to look up fitfully from his daily prey and feel the mind-stir of those diviner joys.

Many, too, are so pitifully chained to the wheel of life, that they have not, or think they have not, time for anything save their daily task. Tired, or rested, they must plod the treadmill — or think they must.

So that it is to a few only, a few hundreds, or a few thousands, that my present method of prolonging life will commend itself.

Briefly, it is a method of conserving nervous energy in the cells of the brain and cord, that is to say, carrying a greater residual charge of such energy there, a fuller " head " of vim in the brain. *Vim* is a good and well-derived word for it. In the phrase of the ancient Greek stadium it was *ichor*. Vim is perhaps the best term to use here, for the time being.

We are not now regarding the brain cells merely in the light of a storage battery, although the galvanometer shows that they carry a considerable residual charge of electricity which may be increased or diminished.

In healthy adolescence, too, and in exuberant young adult life, potential often accumulates in these cells to a degree markedly exhilarating, beautifying the whole body, giving abundant evidence that such augmentation of potential there is possible and natural; — although youth as a rule immediately squanders it, in excesses.

Augmenting it is an art which has to be learned from practice and habit, the first almost irresistible tendency of the untrained person being to dissipate the increase of potential, as soon as he feels exhilarated from it. Training and practice will alone ensure self-control in carrying a fuller residual head of vim.

Incidentally, it may be remarked that nothing is more universally common than the frittering away of nervous energy in aimless, semi-involuntary activities, the least heightening of nervous potential being sufficient to set the person off in various ways. The first efforts, therefore, to raise a head of vim almost invariably result in muscular, mental, or sexual excess; the animal

impulses run away with the neophyte; he has not yet got himself in hand; and some perhaps could never acquire sufficient self-control. Practice and *a realization of the object for which he is working*, will at length found the habit of self-retention.

This, however, is not the task of a day; six months or a year may be required for it; — but the result, when attained, will be found worth the effort. The personality will be found to have been raised to a higher plane of intellectual life by the achievement.

It is not easy to give a rule or rules for such self-control; temperaments differ greatly; but the principle of it lies in keeping the object aimed at constantly in view, steadying the mind by proper reflection and pulling one's self up short the instant undisciplined impulses are felt. And for a time these tendencies will be found insistent and importunate — the tendency of the sleek, well-fed horse to prance and bolt. But he who would conserve and prolong his life must resolutely check such instincts and form a habit of ignoring them. He must steady himself, hold himself in hand and apply the hard brake of his purpose to his vagrant propensities, realizing that in so doing he is preserving his personality, conserving his life, saving his " soul."

This great art of prolonging life has yet to be acquired by human beings. It will come only from mental discipline and mental evolution. It is a regimen which can be enforced only at the call to a higher life — the greater life of the intellect with its better joys, the life which outgrows the animal in us and leaves brutish propensities behind.

If asked to describe in what this head of vim consists, or explain what it is, I should have to say that, aside from the electrical charge which is embodied with it, we do not know. It is electricity plus something else more ethereal which we know as yet only by its vivific effects on every tissue of the organism: it is the true elixir of life. It is vivific matter which invigorates and holds in closer, sentient union every component cell and every intracellular molecule in the organism. So long as this vivific tide can be generated and a head of it maintained in the brain and cord, there will be no death; it is death's antithesis.

This full, sustained head of vim when held in mental control, tends to diffuse itself along the nerve trunks and fibrils, to every

muscle, gland and tissue cell of the organism. It reinforces and holds all together in a sentient entity, around the axis of personality. It heightens sensation throughout the body, renders the special senses more acute and adds perspicacity to each mental concept. It makes the person more vigilant, more careful in danger, more clearly discerning, more moral, that is to say normal, in his relations with his fellow-men.

Furthermore, a full, sustained head of vim in the organism is the best of insurance against disease. Barring a few of the filth diseases and contagious diseases, an organism surcharged by nervous energy, is practically immune, and often moves scot free amidst contagions.

Advancing from this consideration of the facts, we come logically to look for some method of regulating, conserving and applying this greater head of vim which the cells of the brain and cord place at our command, some method of using it rationally for improving and lengthening our lives, instead of allowing it largely to run to waste, as is now the case in most human organisms.

It should be possible to devise some practical method of self-renewal, or at least of self-maintenance, from this fund of vivific energy which nature yields us, some method of reversion and restoration.

This, of course, is an effort, or an art, which is still in its first incipiency, never before attempted on a set plan, with such an object in view.

Before attempting to outline so novel an effort and put it in the form of a method, let us consider two well-established facts. First, that the cell neurons of the brain and cord are capable of generating and, in ordinary life, do continuously generate a current of nervous energy which, in electrical terms, is equal to half a milliampere at a very high voltage, since it has the effects of light. This may be set down as the energy-producing capacity of the brain, used ordinarily in mentation and the instigation of muscular and glandular activity.

Second, in our study of the various forms of life throughout nature, we observe that the cell-of-life has in it the power to turn its stock of energy to almost any purpose which its needs

demand, and transform that energy to other modes, even to effect chemical changes. For example, as cited above, the fire-fly and glowworm produce light at will; the gymnotus eel, electricity, the rattle-snake, the cobra and the adder, deadly chemical combinations of matter.

While it is true that the light-producing and the electricity-producing cells of photuris and gymnotus have been a long time developing to their present condition, it is none the less true that they had to make a beginning and that this beginning was made from sentient impulse. Also that the weak cell impulse of insect and low animal life is as nothing in intensity, compared with the will power of a human being. In these and numberless instances we see what the cell has actually done with its potential. It teaches in a general way what transformation can be made and what chemical changes in living matter can be accomplished, when backed by the will.

It is after an examination of these effects, produced under nature, in the course of life on earth, that we have ventured to outline the following method of using the potential of the brain and cord for self-restoration.

First of all there must be formed a fixed resolution, followed by an effort of the will, to turn the current of vim to a particular use, — as when the gymnotus *wills* to give an electric shock, or the firefly to produce a flash of its light. Nature shows us that these things can be done by *willing to do them*, that is to say, willing chemical changes in the living substance of the cell.

Self-restoration, as set forth here, founds on the facts of scientific research, but requires scientific training to put in practice. We can demonstrate the existence of this current of nervous energy, as also its preservative, curative effects on the organism. We have it at our disposal and have learned that it can be accumulated in the organism by skilful culture and husbandry of the brain cells; and we observe throughout nature what *will and sustained purpose can do with it.* In the light of our growing knowledge of nature and life, it is now our purpose to utilize this great vivific form of the universal energy, put it under intelligent control and use it remedially.

But what is the method of application?

An answer to this question introduces a kind of effort, or exercise of self-control, which is both new and novel to mankind. And because novel, many will, of course, exclaim that it is impossible. In very truth, it demands that the *debutant* practise a purposive effort, by will power, such as human beings have never hitherto attempted upon any set plan. When done in the past, it has been sporadically, without purpose or plan behind it. It is a new use of nervous energy and the human will; and first efforts, too, are always crude efforts. Hence it is with diffidence that a *modus operandi* is suggested. Yet the writer fully believes that it can be done, and that once begun, increased facility will come from practice.

For the neophyte the first suggestion would be, rest your cell neurons until you feel that you have a full head of vim in the organism, even if a week or a month is required for it. Rest and recuperate until you are in the best condition possible. This is the necessary first step, the *sine qua non:* a head of vim to work with.

Then let us suppose that you wish to bring this head of nervous energy to bear on the lower dorsal and lumbar region, " the small of the back," where fibrils from at least sixteen pairs of the spinal nerves lead to and connect the brain and cord with the sympathetic system of nerves and ganglions, which supply and control the abdominal and pelvic viscera; the liver, kidneys, cyst *et al.*

This region is first mentioned because it is the one which, in nine persons out of ten, is the weakest portion of the organism, the one most in need of curative innervation. Here the brain has many of its connections with the " vegetative system " of the organism, so called, which acts for the most part automatically and independently of volition.

For as all students of anatomy and physiology know, the human body consists of two distinct sets of organs, or apparatuses, first that of self-consciousness, thought, will, special sense, muscular activity and locomotion, meaning the brain, cord, eye, ear, muscles, bones and their appendages; and second, the organs and apparatuses of food preparation, assimilation, circulation, excretion, etc., namely, the stomach and intestinal canal, the liver, pancreas and other glands, the spleen, kidneys, etc.

The aspect presented is that of a double series of organs and apparatuses, presided over, each, by a different system of nerves and nerve centers, to wit, the brain and spinal cord for the first, and the sympathetic system with its many ganglia, including the solar plexus, the semilunar ganglion, the hepatic ganglion and others, for the second.

In the early days of anatomy, it was believed that these two nerve systems were wholly distinct and without connection one with the other. But we now know that, although essentially different systems, the two are associated by means of numerous small nerve fibrils, through which the self-consciousness and will of the brain may to a degree act on the sympathetic system and influence its operation. It is in the lower dorsal, lumbar and sacral regions that the connection is mainly accomplished, and here, therefore, that the will can be brought to bear on the organs of digestion and excretion. Brain cell energy appears also to be transmissible by conduction through the tissues, otherwise than along nerve fibrils.

Given then your accumulated, conserved head of vim with which to work, seat yourself comfortably in an arm-chair, and place the hands and fore-arms on the "arms" of the chair, in such a manner as partly to support slightly the body weight on them. (This or any other posture that appeals to the individual preference.) In this position concentrate the attention on the small of the back for five seconds, summoning the will ready to act. Then by a muscular effort retrovert the lumbar vertebrae backward and upward, thus increasing the flexure of the spine, and by a sudden, strong exercise of will power, cast nervous energy into the tissues.

We may use the word *energize* for the act. Energize those tissues. Synergize, however, is the better term, since the act results from a combined and reciprocating effort. The act itself may be properly defined as a synergy.

It is best accomplished by a calm, purposive effort (not a feverish, frantic one) and synchronous retro-flexures, six or eight efforts, let us say, during a minute, to be repeated two or three times after an interval of rest, daily, or night and morning.

For some reason the backward and upward muscular flexure of the spine aids the process.

Many persons catch the knack of doing this immediately; others find it difficult and have to practise it at intervals for a considerable time; and there are those, perhaps, who cannot learn to do it, through some insufficiency of volitional power, or deficient nervous connection between the two nerve systems.

In one case, I have known the art to be acquired suddenly after repeated failures. For it may be remarked here, that there will be no doubt or uncertainty, when the act of transmitting nervous energy is really done; that is, when the effort of willing vim from the cord into the sympathetic system is actually accomplished. It will be felt to go.

It is the writer's opinion that this act, or art, can be attained by practice, and accomplished much more effectively by continued practice, so as to become a step in the progressive control of the organism by will-power — the ideal complete control toward which we are moving.

For brain is a still progressive tissue of the organism, and has possibilities of future evolution and growth which look to this complete control and maintenance of the organism from the intellectual side, through indefinite periods of time. We mean by this, that the brain shows capacity to grow into a much larger, more powerful organ, able to generate currents of nervous energy, or vim, which may be directed to the restoration of all the associated organic tissues. Our nascent " art " or method, as sketched above, is therefore strictly in line with the entire scheme of human evolution and natural salvation.

Direction and application of nervous energy, by will power, to the lower dorsal and lumbar region, is suggested as one *point d'appui* of it merely. The vivific energy can be applied equally to an arm, a leg, the lungs, or even the heart; to any tissue of the organism. Rest, nourish properly, conserve nervous energy and use it remedially, purposively, on the organism, by will power, under the intelligent direction of the mind, that is to say, *a clear mental concept as to what is to be done with it.*

The historic instance of John Quincy Adams' eyes is an illustration of this regulated application of the cell energy for curative effects. At that time the statesman, himself, believed the preservation of his sight due to daily manipulation of the eye-

balls with the tips of his fingers. The preservative effects were undoubtedly due to the purposive transmission of cell energy to the organ of sight.

No organs of the body respond more hopefully to this purposive stimulation of their functions than the ears. After middle age is reached, the ears should be massaged daily on the plan of concentrating vim in the entire organ of hearing; applying the tips of the fingers low about the external ear, exerting a bearable pressure, imparting a rotary motion and by an effort of will transmitting cell energy to the parts within.

Barring acute inflammatory attacks, no one need lose his hearing who will learn to practise this treatment and form a habit of it. Well-nigh perfect audition may be conserved up to the century mark.

The author is convinced that the habit of applying brain cell energy to those organs and tissues of the body which need it is one which can be established in six months, and that a greater degree of efficiency will be developed constantly from practice, *even* up to the *point of maintaining function undeteriorated* and *holding one's own for twenty-five years in the very teeth of Time!*

This is, of course, a bold assertion. None the less I feel sure that great future possibilities lie in this purposive application of the brain cell energy for bodily maintenance. It redacts, too, to the greater growth and development of the brain and cord, looking to a full ideal mastery and control of the entire organism by the mind; for that is the ideal in view, namely, to raise man above the animal orders and make him the arbiter of his life and destiny.

Borne in mind be it always that this effort at *energization* is a calm, purposive one, *not a frantic straining*. Rather it should be a steadied direction of the attention. The direction of will-power to best advantage is never " nervous," or violent. Much of its efficacy depends on bringing that great tide of brain energy, termed the subconscious mind, to act in consonance with the will. Of the medullar and cerebellar control of the organism we have little or no self-consciousness; yet these centers can be influenced by " suggestion "; they can apparently even be influenced to act in a certain way or upon a certain tissue during the night, by suggestion and by *willing* them so to do at the last moment before

falling asleep; — and this, too, is a species of habit worth acquiring.

The act of willing cell energy to a particularized organ, or tissue, is never effectually accomplished unless there is a full head of vim in the organism to draw on. We cannot conserve our lives and use them otherwise at the same time. This is cause and effect. To labor, mentally or physically, all day and then attempt to use cell energy for restorative purposes, would do one greater harm than good. The *modus operandi* in view here is to save up surplus energy, then apply it wherever it appears to be needed, with an intelligent purpose to restore, maintain and even rejuvenate. It is needful to put oneself in economic training to this end, namely, to generate such a surplus and live with a higher head of vim aboard the organism. This greater head of energy ensures health of itself, since it is highly protective against disease.

We are not here dissenting from a skilled use of drugs or other remedies for bringing the organism into harmonious action. Every adjuvant agency should be used to this end, when such use proceeds on an adequate knowledge of the subject. We believe vim, as above defined, to be a current of corpuscles and, it may be, of the ether itself, modified by the will, changed in frequency or otherwise, in a manner to accomplish what the impelling intellect and will, resident in the cerebrum, desire. Chemical modification of living matter by sentience and will is in fact the oldest thing in nature, seen in the thousand phases of insect and animal life. It is the key-note of metamorphosis in all metazoic life. This, indeed, is the principle on which the method founds, namely, the domination of mind over protoplasmic matter, by will-power. It is assumed that the human will, by trained, persistent effort, is strong enough to produce transformative effects in the protoplasmic matter of the tissue cells.

Ordinarily, as the average human being lives, the currents of nervous energy from the brain and cord go to accomplish locomotion, muscular contraction and the usual activities of life. When not used in this way, it is diffused, often dissipated, without thought or intelligent direction. In healthy subjects it goes, at a certain tension, to maintain the corpuscular " field "

or aura, which stands for the person's vital tonicity, or "constitution," and is closely correlated with his character and morals.

At the present stage of human evolution, physical and intellectual, this is wholly or very largely subconcious and, in that sense, self-acting.

What the present system of self-conservation and self-maintenance aims at, is to promote and foster the potential out-put of nervous energy from the neurons, by rest, correct living and careful nutrition; to husband it in the brain and cord; and to use it methodically, to maintain and restore the organic tissues.

In this sense the present suggested method is a new departure in bio-physics. It attempts to educate the will to a higher degree of efficiency, as a director and transformer of nervous energy.

It is perhaps too early in the progress of this art to speak of facilitating or aiding the action of the will in throwing nervous energy into the organic tissues, by use of extraneous currents of energy, generated outside the brain, and applied to the spinal cord. Or, indeed, of schemes for uniting the will-power and nervous energy of five, ten, twenty or more persons, to act synchronously, in combination, for healing the sick. Beyond doubt this may be done and remarkable curative effects produced, as soon as we can devise media and apparatus sufficiently delicate to combine the nervous energy of many persons in a single current or impulse.

We are still at the beginning of using will-power rationally, in combination. Its great future is all before us. Yet even in ancient days, we learn of untaught attempts at healing the sick by united prayers on the part of many devotees, gathered together. In cases of sudden panic, too, affecting great crowds of people, and also at popular religious assemblages, we have evidence that the violently excited nervous energy of hundreds of persons sometimes combines or coalesces, spontaneously, to produce wild, overwhelming effects. Such manifestations rest on a physical basis, beyond question. Hitherto this has been wholly within the realm of superstition; but it offers a proper field for scientific investigation and promises very hopeful results for the control of life. There is no good reason why the will-power of a thousand persons may not be united in one volume or current, and directed to act remedially on the organism of a

single patient. Experimentation of this kind, having in view combination and transference of will-power (vim) is already going on.

I am fully aware that many who glance at this suggested " art " of self-conservation will say, " Nonsense! This is trying to lift oneself by the boot-straps! "

But try it, my Thomasian, try it fairly, earnestly, for two weeks and see. It runs deeper than you think. Will power touches down to the lower, self-motile levels of matter and is of the nature of transformative energy there.

Others will say, " You are making the brain cells restore the other tissues of the organism; but what is to restore them? You cannot get nervous energy otherwise than from your brain cells. If you use up their capacity to generate vim — as by your method — what will replenish it or restore the personality at its source? "

Passing over the physiological fact that the brain cell group is the most enduring tissue of the organism, also that it is the best nourished, the last to perish in cases of famine and starvation, and in general the most vital and the longest-lived; passing these considerations, we come to the higher, psychic truth, that in the hope and reasonable certainty of longer, happier life, we have a replenishing agency. Hope or faith that we may live longer, happier, more successfully, affects life at its source and strengthens its upward correlation from the lower planes of elemental sentience.

Life, meaning the elemental sentience of unorganized matter, struggles upward through the mazes of protoplasmic organization, to attain greater intelligence, greater happiness. To this psychic end, " creation groaneth and travaileth together "; and whatever extends the hope and promise of more life and happier life, increases the intensity of life in the protoplasmic substance of the brain cell: in other words, replenishes it at its source. It is the hope of achieving immortal joys which will carry us forward to the attainment of immortal life.

At present writing an interesting line of experimentation is in progress, using electric currents (those from a static machine, for example) to steady and intensify the application, by will power, of nervous energy from the brain and cord to the *soma,* generally: its organs and apparatuses, seriatim.

PART III

LABORATORY STORIES

AN ENTHUSIAST IN TRANSIT

It is one of the diversions as well as one of the embarrassments of life at a laboratory for investigating the causes which shorten life, with a view to prolonging our years, that the place becomes a Mecca for cranks (the inventive, not the criminal variety), enthusiasts and men of grand ideas.

I have little hesitation in classing the subject of this sketch as a typical American enthusiast; and it is a class to which we owe much. For be this said of enthusiasts and cranks: they are often the liveliest, brightest, most lovable persons in the world. Some of them, it is true, are quite wild in their theories; some are laughable; some, in fact, are precious near being lunatics. The majority, however, are merely a little peculiar, from disproportionate mental endowments. It is often a matter of hobbies. Some are distinctly tangential. Some are on moderately safe parabolas; others, alas, on hyperbolas, and will ultimately be lost forever in their own immensity of ideas.

But with all their eccentricities, they are exceedingly interesting and often profitable for acquaintanceship. The atmosphere they bring along with them is cheery. They are all persons of hope and faith. They believe that something *can be done.* They never grunt pessimism which is but another name for a disordered body or mind. As a class and altogether they afford a vivid though *bizarre* picture of that restless American inventiveness which marks this great formative epoch of the world's progress.

Moreover, they are the most unselfish persons in the world; in fact, they are never thinking of themselves at all, and hence are often robbed of their inventions by commercial *Bashi-Bazooks;* and the very sweetness of temper with which they endure these outrages is proof that they are not of this world, but of a better.

Sometimes, as I listen to their ardor, I half believe that they are

" inspired." I have never known one of them that could not be trusted implicitly, or that ever seemed to have a thought of guile or deception in his heart. It is along of their self-forgetfulness and the touch of star-fire in their souls. It is their faith in humanity, the out-welling of an exuberant altruism which has never yet thought of thus classifying itself.

Considered as people to meet, they are a thousand times to be preferred to the Pooh-bahs, the men of fixed ideas *et hoc genus omne,* in which stupidity and the lack of ideas so often pose as a superior conservatism. Contrasted with this latter dull throng, let me live and die with cranks, enthusiasts, and men of grand ideas. They are the *lux mundi.*

The '87 Graduate had been making a summary of the differences between old and adolescent muscle cells that day, and, well pleased with his results, was in an exceptionally good humor, as we talked before the laboratory fireplace that night. It is on such occasions that he holds forth to us on the " Grasshopper theory of Humanity;" and if I remember aright, he was generalizing as to the estimation in which human beings are probably held by the inhabitants of other worlds in space, when we heard a Voice at the outer door, making inquiries of our chore boy. It was a Voice *sui generis.* The Neophyte dropped his much-elevated heels from the jamb of the fireplace.

" 'Tis one of the ' inspired! ' " he exclaimed. " Now keep quiet, all of you, and let me play him."

When ushered in, the Voice proved to be incarnate; and as the stranger came down the room into the warm firelight, we perceived that he was the usual brown-haired, gray-eyed American, five feet nine, and apparently about thirty years old.

" My name's Stetson," said he. " There's no money in me for anybody, yet. I'm merely a harmless crank."

" We knew it," said the Neophyte, genially. " Sit down, Mr. Stetson, and be one of us. We are all cranks here, and more or less harmless. That basket-bottomed chair, the red one with rockers, is a good sitter. Haul that forward."

Mr. Stetson made himself comfortable and tried once or twice to start himself off on general topics of conversation — flat failures, in spite of the fairly good second we extended him. He was too full of his idea.

"I may as well out with it," he said, "although it sounds precipitate. I've got an idea. That's why I'm here."

"This is rhyme, at least," observed the Neophyte. "How old is your idea?"

"Almost a year," replied our frank visitor.

"That is a good age," said the Neophyte. "They don't degenerate into hobbies under eighteen months."

"And I may as well out with it," the transient went on, "for I want to ask a favor here — not money," he added, seeing that the '87 Graduate shuddered as from the twinge of an old wound; "just a chance to hammer and hack a little."

The '87 Graduate looked relieved.

"What is the Idea?" said the Neophyte.

The transient visitor swelled with the magnitude of it.

"CYCLONE- FIRE- AND LIGHTNING-PROOF DWELLING-HOUSES," said he, with enkindled eye and a joyous, sweeping glance, to mark whether we were capable of appreciating it.

"That is truly a great idea, particularly the first part of it," remarked the Neophyte.

"Isn't it, though!" exclaimed the Transient Enthusiast. "Right in line with your researches for prolonging normal, healthy human life, too! You cannot but feel an interest in it. Let me explain more in detail. Or, excuse me, would you mind?" He drew a crumpled manuscript on brown paper from his overcoat pocket. "I have prepared an article describing my invention. Oh, it's very brief!" he exclaimed, overhearing a groan from the Casual Worker. "Just a few paragraphs. May I read them?"

And he did so. Briefly, it was a structure, with an iron skin like a steamship, but of oval form, or rather half an ovoid, split on its long diameter, so as to present no angles, or gables, to catch the violence of the wind. As devised it would probably withstand a tornado.

"Immense!" the Neophyte exclaimed; "but where does the *Fire* and *Lightning* part come in?"

"I was just coming to that!" cried the Transient Enthusiast. "Excuse me. A few sentences more only. Not three minutes more, I promise you," — and the Transient Enthusiast resumed his manuscript.

"At present date, the American dwelling-house is a more or less

comfortable, often showy, but makeshifty structure; and, save in cities, the building material is commonly wood, as follows naturally in a new country, much of which, when first entered, was covered with forest. Pioneers and first settlers have not the means as a rule to build otherwise than with the material that comes easiest to hand. The style of architecture is in some degree from Old World and even classic standards, but is also in a degree peculiar to the country and to the material, and is as yet of no well-determined character.

" The disadvantages and dangers of wood as a building material are well known, and have been frequently pointed out during the last quarter of a century. Its cheapness and the ease with which it can be manufactured and handled have hitherto recommended it to the temporary poverty of the people.

" Americans are so habituated to the fire-fear, and bear it so constantly in their minds, that they are after a manner reconciled to it. Yet let the slightest odor of pine smoke be wafted to the householder's nostrils, sleeping or awake, and he leaps to his feet with terror in his eye, and the startled thought, ' My all will burn.'

" As one of the results of wood building in the United States, we have a phenomenal development of the business of fire insurance, such as has never been seen previously in any country. It is variously estimated that from eighty to one hundred millions of dollars are required to replace the structures destroyed by fire, annually.

" If a spectator with a wide-ranging eye could mount to a sufficient height to be able to overlook the whole country, he would never, on any day of the year, see less than a hundred dwelling-houses on fire. By night, especially, the glare of consuming homesteads would be continuous. The scene presented to the Tutelar Genius of the nation — if such a genius we have — must indeed be a sad one. The smoke of incendiary fires, ' insurance fires,' fires from carelessness and fires from lightning, rises to heaven constantly and never will cease to rise as long as houses are built of wood. For man is also a fire-making being and daily kindles his culinary blaze inside his combustible house. The marvel is not that there are so many fires, but by what grace and mercy of our household gods there are so few!

" Later generations will probably read of this age of combustible

houses with astonishment and wonder that their ancestors survived the fire-traps which they set for themselves.

" For the age of wooden houses now hastens to its close. It will terminate largely in the natural order of things within the next half century. For although an improvident population would no doubt go on building of wood if lumber were cheap, the devastation of the woodlands wrought by lumbermen and the general deforestation of the country incident to rapid growth of population will ere long render lumber expensive and practically unavailable as building material. Already in many sections, indeed, where wood is used, it is no longer cheaper than stone, brick and metal, but is employed for conventional reasons and because wood carpenters and joiners are more conveniently hired than masons and metal workers.

" The wooden house, moreover, is the plaything of the cyclone.

" Throughout the great midland west and northwest, twenty millions of people, during the spring, summer and early autumn months, live in a species of diurnal fear and trembling at the sight of every dark cloud that rises in the sky. Ever present in their minds, tingeing all their pleasures, is this *Atra Cura,* this Black Specter of a possible cyclone, lightning-armed and furious, — an aerial Titan gone mad, dealing destruction and ruin on every hand!

" A little less constantly present, but a genuine life-fear none the less, is the apprehension from lightning stroke, which with many persons is a source of seasonal misery and transforms the refreshing grandeur of every summer shower to a phantasmagoria of terror. As nearly as can be gathered from local newspapers and other sources of information, nearly five thousand houses and other buildings were struck by lightning in the United States during the year 1894, and nearly eight hundred persons either killed or seriously injured. The popular fear of lightning is therefore a well-grounded one.

" It cannot be but that this continuous apprehension and anxiety concerning cyclones, fire and lightning stroke act as a vital depressant in the life of the entire population, tending to make human existence less happy and care-free; and that such sources of unhappiness and anxiety tend to shorten life.

" Now it will not have escaped attention that our proposed cyclone-proof house is also a fire-proof house.

" It will be apparent, too, to all possessing even a rudimentary knowledge of electricity, that the iron frame and iron skin, connected by the fifty iron cellar rods with moist earth eight feet below the surface, offer a complete protection to the inmates from lightning — even from the most forceful thunderbolt which ever fell from the clouds. Such a house may be pronounced absolutely safe from lightning stroke, since the thick masonry between the iron covering and the rooms will act as a non-conductor and completely insulate the occupants. Here the householder may sit down and watch the fury of the black thunder squall with serene mind and a sense of perfect security. The thunderbolt may fall, but the huge metal shield will conduct it harmlessly into the earth.

" It is the opinion of architects, that a cyclone-proof house of this description need by no means be found lacking in external architectural beauty; and that so far as utility, fitness and strength constitute comeliness, such a house, handsomely painted and ornamented, may be made very attractive, needing only the sanction of ' fashion ' to commend it readily to the popular eye.

" Porticos, window awning frames, cupolas, piazzas, balustrades at the apex of the domed roof and around the eaves line, for artistic effects, in iron, or even wood, may be liberally added externally without injury to the stability of the house, even if these light structures were carried away by a tornado.

" Well, gentlemen, that isn't all. I have not described the internal plan. But I will stop here," the Transient Enthusiast broke off reluctantly. He had heard the '87 Graduate yawn. " You can all read my paper when it is published. Now tell me what you think of it."

" 'Tis a great thing, if you can float it," replied the Neophyte; and we all said so.

" I knew it would strike you! " cried the Transient Enthusiast, with conviction.

" Now, what I want," he resumed, in a less exalted, more matter-of-fact tone, — " what I want is a place and a chance to make my dummy, my model, you know; and I thought perhaps you would give me work room here, tools and things to do with, you know."

Welcome was extended to him.

"No man with an Idea is ever turned away from this place," remarked the Casual Worker.

"There's work-bench, lathe, anvil, and all the tools you want in the basement. Go ahead and God speed the Idea."

"That's kind!" cried the Transient Enthusiast. "That's the sort of men to meet! I'll abide by any rules, regulations, or requisites that you happen to have here. Are there any?"

"None," replied the Neophyte. "It is necessary merely that a *debutant* here shall be a crank, an enthusiast, or a man with a grand idea; you fill the whole bill, Mr. Stetson."

"Oh, one thing more," the Transient Enthusiast added, apologetically. "I suppose I shall have to sleep and eat once in a while, — but I can sleep anywhere and eat anything," he qualified.

The resources of the place were sufficiently stretched to provide for him, and without further ado he became one of us.

He sojourned with us for five weeks.

He hammered and he pounded.

He made a horrible din.

He never picked up after himself.

He dulled every tool in the workshop and broke not a few.

And every night, after work, he sang peans to us, loud roundelays of hope, joy, and approaching triumph, of which the '87 Graduate nearly died.

Yet we loved him, in spite of the tarantula dance which he led us.

His dummy weighed seven hundred pounds! It required the united strength of us all, with levers, to box it and get it out of doors.

He left for Kansas City with it, May-day morning.

"I shall not write a word to you till I get started," he said.

And he hasn't written yet.

His plan was to form a company in Kansas City, Omaha, or St. Louis, and then go about with his model, in the wake of cyclones — wherever he heard of one.

In its present form I believe his idea wholly impracticable. But it is one of those things of which we say, "There may something come out of it."

THE PRESCIENT DISCOVERER

PLASMODIUM SENECTUTIS

We knew that he was a man with an idea, or at least strongly suspected it, from the moment he called at the laboratory; the symptoms of such possession were well-marked.

But he proved non-committal, being of a temperament and habit of mind more self-contained and less centrifugal than enthusiasts run. The Neophyte failed to "draw" him; and the Neophyte has grown skilful at this sort of diagnosis. He is making a study of American enthusiasts, and aspires to become an expert in them.

The Prescient Discoverer remained all day with us and disclosed nothing; and at night he departed as if to go his ways for good. Moreover, he was but a youth, fresh from one of the most reputable medical schools of the country, and the interest and appreciation which he evinced in examining certain of our preparations showed that he had been well instructed.

The Neophyte was puzzled. "That fellow has got an idea of some sort aboard," said he, "but he is crafty. I think that he came here to crib an idea to inspan with one of his own. It's that, or mere modesty."

It was modesty. The Prescient Discoverer came back next day, and at luncheon he unbosomed himself, with a blush at first, till the Idea began to speak through him; then, indeed, he was as bold as the best of them. For none so brave as the man possessed by a grand idea. It casteth out all fear, and putteth strength into the weakest knee.

But though a little tardy in delivery, his idea was a bouncer when born; had its teeth all cut, so to speak, and had already toddled forward into a theory of human salvation.

"I would like to have you examine a series of slides which I have lately prepared, and which I have brought here to-day," he said to us. "I am confident that I have made a discovery, from the bacteriological side of modern research. I have discovered *plasmodium senectutis.*"

"What, really? the microbe of old age?" said the '87 Graduate. "Then, indeed, you are the very man whom we want to see here."

"I have discovered a micro-organism within the cells of nearly every tissue of the human body, which I am convinced is of the nature of an intruder, a hostile parasite, a worm in the bud of life. I believe that it is this bacterium, or intrusive plasmodium, which saps or eviscerates the tissue cell and causes that slow and as yet unexplained decline of the organic life which we term old age," the Prescient Discoverer asserted.

"But in the matter of priority, an Italian biologist has already laid claim to such a discovery, also a Frenchman and one or two amateur bacteriologists in America," the Casual Worker observed.

"I have recently heard something of these claims; but my researches have been conducted quite independently of others," replied our visitor, a little disturbed. "I do not even know what these people claim to have found; I only know and have brought here what I have myself found."

"In the cells of what tissues does it occur?" the Neophyte asked.

"In the brain cells and in muscular tissue, in hepatic tissue, and in a few instances I have found them in ordinary connective tissue; and I believe that I can show you two slides where I have demonstrated it in bone cells. It is not infrequently found embedded in leucocytes, and occurs in the true blood corpuscles."

"Your material was taken from aged subjects, I suppose?" observed the Casual Worker.

"All of it, save that on my control slides; those were from adolescent or young-adult cadavers; eight subjects in all," replied the Prescient Discoverer.

"But admitting that you have found what you think you have found, namely, an alien micro-organism, similar to the alleged plasmodium of malaria, within the tissue cells of the human organism, what evidence have you that it produces the phenomena of old-aging?" the '87 Graduate asked. "Do you mean to tell us that you have worked it out in conformity with Koch's laws? Those constitute our present criterion, you know. Before you can legitimately christen this new bacterium as *plasmodium senectutis,* it must be shown to exist in aged subjects. It must be propagated in cultures. It must produce old age in subjects inoculated with it."

The Prescient Discoverer laughed.

"Well, naturally, I have not inoculated anybody with either my newly discovered plasmodium, or its virus, or ptomaïnes. And if I had, there would hardly have been time to develop a case of typical old age in the patient," he said.

The Neophyte and the Casual Worker joined in the merriment; but the '87 Graduate stood to his guns.

"Then you had better abrogate your christening of *plasmodium senectutis,* or at least place a conspicuous interrogation point after it," he rejoined.

"That is the bane of scientific research," he continued, "the abuse which most brings discredit on science, — this wild jumping at conclusions, this zealous crowing before day, this premature guessing at facts. It is bad form. It is wholly unscientific. It is positively immoral."

The Prescient Discoverer's feelings seemed to be hurt. He was on the verge of anger.

"What would you have?" he asked. "Please reflect; I have as yet published nothing. I have found a bacillus, and I have come to you, another bacteriologist, to show it to you and confer with you about it. Is this so devilish improper? It seems to me that you are yourself the one who has gone off at half-cock!"

The '87 Graduate came down promptly.

"Very true," said he. "I spoke hastily. I feel warmly on that subject."

"Or a little sensitive, perhaps?" and the Prescient Discoverer raised his eyebrows slightly. "Somebody has 'crowed' in advance of you, perhaps?"

"Perhaps," replied the '87 Graduate humbly.

"But let's see your slides," said the Neophyte, impatient of this irrelevancy. "New bacilli are by no means rare. But a supposed plasmodium of old age is interesting. Did you say that you had made a culture of it? Have you actually propagated colonies from it? What did you use for your nutrient media, gelatine, bouillon or agar-agar, — acid or alkaline?"

"Agar-agar. But I confess that I had bad luck with my cultures. I sterilized carefully, but I had the worst of luck."

"That's nothing. Everybody has such luck till he gains knack from experience; and even then he will have bad luck," remarked the Casual Worker.

"Well and good, but what did you get your 'seed' from — not from the tissues of cadavers, surely?" observed the '87 Graduate.

"Yes, I did. My theory is that this is a spore-producing plasmodium, and that the spores survive for days or weeks or months in cadavers."

The '87 Graduate looked incredulous. "Have you any other theories regarding it?" he asked. "In what manner do you conceive that these spores are constantly transmitted from one generation of human beings to another, from parent to child, I mean?"

"Through the blood," replied the Prescient Discoverer.

"What! the placental blood of the mother, enfiltrated to the embryo or the fœtus?"

"That may even be. But I imagine that all old persons give off these spores by millions in all their excreta, and that we constantly ingest them from early youth upward," replied the Prescient Discoverer. "I imagine that it is as if phthisis were a hundredfold more common than it is. From my point of view, old age is a universal disease. Not only man, but every organized form of life, except perhaps infusoria, has it and always has had it, and died of it, from remote ancestry downward to present time."

The Casual Worker laughed.

"Well," said the '87 Graduate, "don't tell me that you stop there. A man with your wealth of imagination must surely have struck out some means of curing this — this universal disease?"

"It is a physician's business to cure disease," replied the Prescient Discoverer, with an assumption of dignity. "Yes, if my theory of this plasmodium be correct, I hope to cure its ravages. I hope to obtain a culture virus; I hope to inoculate dogs with it and continue the inoculations on a series of dogs, until they are immune. Then, on the same plan which has been successfully pursued with the bacillus of diphtheria in horses, I hope to use the blood serum of the immunized dogs as an anti-toxine for *plasmodium senectutis*. Or, if this method proves impracticable, I shall try other methods of procedure to obtain a remedial agent."

"No one can impeach your motives or intents," replied the '87 Graduate. "I bow to them with all respect. Now let's see your slides."

The Prescient Discoverer undid his grip and produced two slide boxes. "I did not bring a microscope stand," said he; "I knew

you must have plenty, and also objectives. I have used a 1-12 mostly."

The Casual Worker made haste to set his fine new stand under a good north light.

"That's a 'bute!'" cried the Prescient Discoverer, enthusiastically; the vernacular of the undergraduate had not yet wholly left him. "Wish I had such a stand. The working distance of my objective is all too short."

The Casual Worker attached an Abbé condenser, screwed on a 1-20 objective, and set cedar oil and xylol handy.

The Prescient Discoverer then selected a slide from box No. 1, labeled "Nerve Tissue." "This shows you *plasmodium senectutis* in four large and two small pyramidal cells of the human cerebrum," he said. "The tissue is from the cortex cerebri of the superior frontal lobe, right hemisphere. It was hardened thirty days in alcohol and stained very lightly, as you will see, with eosin and hæmatoxylon. The subject was eighty-one years old; sex, female."

As he spoke he put the slide on the stand, applied a drop of cedar oil, focused and looked attentively.

"This is, indeed, a fine instrument," he murmured, with his eye at the eye-piece. "What a light! what amplification! Here must be twenty-eight hundred diameters, and clear as a January morning! And here they are," he continued, moving the slide slightly to and fro. "Here they are, right in the center of the field to the left of the cell nucleus," and he stood aside for the '87 Graduate to look at them.

The latter has a slow eye, albeit a sure one when it has taken hold. He looked for a full minute by the clock. The Prescient Discoverer evinced impatience. "Well?" he said.

"Your microtome was none too sharp when you cut this section," observed the '87 Graduate at length, without looking up. "You should sharpen the blades with an oiled strap, after honing.

"Your hæmatoxylon solution had been made too long when you stained this section," he went on, still looking. "But you have learned to stain lightly; that's a good point."

"But what do you see in those cells?" exclaimed the Prescient Discoverer.

"Oh, many very interesting objects," replied the '87 Graduate, withdrawing his eyes and going to the window, as if to rest them.

The Casual Worker took his turn at the eye-piece, and then the Neophyte. Both wore a thoughtful expression as they withdrew.

The Prescient Discoverer regarded them with an anxiety verging on indignation, which, however, he would not allow himself to manifest.

"Let's see more of your slides," observed the Neophyte, tentatively.

Without replying, our visitor selected eight others, which he arranged in order on a rack by the microscope; he seemed disconcerted, or doubtful, but proceeded to place the first of the series under the objective. "This one is cortical cerebellar tissue, from the same subject," he said, after focusing. "In the right center of the field you will see a large Purkinjé cell, in the cytoplasm of which, near the nucleus, one of these same plasmodia is visible. Below, to the left, is a second, and moving the slide slightly to the right, still a third will come into the field. The similarity, I might say the identity, of these plasmodia with those on the first slide will be apparent to you, I think."

We experienced no difficulty whatever in seeing the intracellular objects which he designated; but a sense of estrangement had supervened, which threw gloom over the exhibition.

The next slide was a muscle preparation and the fourth osseous tissue, both from a male subject seventy-nine years of age, we were told. Then followed a slide on which two white blood corpuscles were in the field, in both of which were appearances resembling those above particularized.

"Shall I show you others?" asked the Prescient Discoverer, coldly. The estrangement and the lack of sympathy had now grown quite melancholy.

"Not unless you wish to do so; but I would like to see your cultures from the spores of this plasmodium," replied the '87 Graduate, with a reserve deep as the snows which cover Maine in February.

Self-wrapped and distant, our visitor placed three slides, successively, under amplification. By this time, the estrangement was suspicion on his part.

Dionysius of the Ear was not less bereft of human confidence than is a modern scientist in the presence of a fellow investigator pursuing the same line of research.

The Prescient Discoverer wiped his slides and replaced them. We perceived that he was inwardly cursing himself for rashly bruiting his discoveries, and was perhaps meditating a rapid rush into print, lest some one of us should forestall him. Alas for poor human nature, which pursues fame over seas of piracy, and is something of a buccaneer itself!

"I have come here and shown you my work in a rather boyish way," the Prescient Discoverer observed, frostily. "Of course, I do not ask you to give away your opinions," he continued, after replacing the slide boxes in his bag. "When I came here, however, I had an idea that some such exchange of views might be pleasant. Apparently I was mistaken," he added, still more icily, after a moment's pause.

"No objection whatever to giving you my opinion," said the '87 Graduate, bruskly. "But I do not believe that you want it."

"What is your opinion, then?" said the Prescient Discoverer, defiantly.

For reply the '87 Graduate went to a case which contains his own collection of mounted objects, and fetching a slide, put it in the microscope. "Look at this," said he; "and when you have done so, we will take another look at that slide of yours — the one you showed us first."

The two slides were examined one after the other. "Do you see resemblances?" queried the '87 Graduate, grimly.

The Prescient Discoverer flushed; his hand shook as he changed the slides for a second inspection.

"Now do you want an opinion?" asked the '87 Graduate.

"Give it," replied the Prescient Discoverer, sitting down in a chair and facing us with a face that had grown suddenly wan.

"Well, then, what you call *plasmodium senectutis* in these cerebral cells, from this aged female subject, is nothing more or less than a rather large, faded pigment granule, such as are not unfrequently found in nerve tissue cells. Their office and effect on the cell life are not well understood, yet there is no reason to suppose that it is anything very formidable."

The Prescient Discoverer rose suddenly, protestingly, to his feet, and again examined the two slides.

"My God! I believe you are right!" he exclaimed, and sat down again.

Only a microscopist can realize what a knock-out blow he had received.

" In these other slides of yours," the '87 Graduate continued, " there are a variety of things which you have ingeniously, though in perfect good faith, picked out and classified together.

" On the cerebellar slide your plasmodia are again pale pigment granules in two cases, and a dead nucleus in a third; in the muscle cells they are simply dead nuclei and vacuoles; in the hepatic cells they are really, I think, intrusive bacteria, or else small secondary nuclei, either degenerate or dead; and in these white blood corpuscles there are two encysted bacteria which are not sufficiently well shown to be classified. And finally from your cultures you have three quite common forms of cocci. I hope you are not offended," the '87 Graduate concluded.

" No," replied the Prescient Discoverer, doggedly. " No doubt I ought to thank you."

" You had," said the '87 Graduate, calmly. " We have extricated you from a scrape. We do not profess to know very much here, but in this case we have been able to save you from a serious mistake. If you had published your ' discovery,' you could hardly have recovered in a lifetime from the confusion which it would have brought upon you. Older microscopists than you have fallen into such errors. The tissue cell, as at present prepared for examination, is a great field and contains many curious things; and when an investigator starts off with an already formed theory, as you did to discover *plasmodium senectutis,* he is quite likely to find it!

" I know exactly how you began your researches, for I once did almost the same thing," the '87 Graduate continued.

" You first read a great deal about the germ theory of disease; and one fine day the idea popped into your head that old age was a slow disease caused by a ' microbe.' Full of enthusiasm, you then set to work to prove that your theory was true. You prepared a great number of slides from the various tissues of many subjects; and it would have been strange, indeed, if from them all you had not found what you were in search of; for, as I said a moment ago, the physiological cell is a very fertile field for discovery! A man isn't safe to go prospecting alone in it, until his imagination is fortified by considerable experience."

" But these other bacteriologists who claim to have found a bacil-

lus of old age — what of them?" demanded the Prescient Discoverer.

"I do not know what they have found," said the '87 Graduate. "Whatever it is, it must require a long time to demonstrate it in accordance with Koch's laws. The fact that any one should so immediately announce the discovery of a 'microbe of old age' appears strange on the face of it. Thirty years would be a short time to demonstrate such a bacillus by Koch's third law."

"At this laboratory then you have found nothing of this description as yet?" questioned the Prescient Discoverer.

"Nothing."

He went away sorrowful, as one who has lost great possessions, or lingered too long at Monte Carlo. The enkindled eye had quenched its inner spark; his step was not as light, his elate mien had turned listless.

Ah, but it is a sad thing to have a beautiful theory come toppling down about one's ears!

THE BIO-OSCILLATOR

THIS will sound like an echo from out the past, since it occurred in 1898, before the world had quite heard the last of the then famous "Keely liberator," — not the "Keely cure." Yet even so long ago the incident is still typical of many of more recent date, incidents which mark the growth of the great new Idea which now begins to take form in the Promethean Faith.

To the skirts of every such new idea charlatanism clings fondly, for a time, at least, eager to turn its needful penny. As well be tolerant, perhaps, even as we toss the penny to the other mendicant.

Well I recall the day. There was hilarity at the laboratory. The Neophyte was trying his 'prentice hand, with the aid of a new Leits microscope, in quest of the bacteria in ordinary vaccine matter, taken from the quills of a well-known producer whose heifers are warranted "perfectly healthy animals."

The Neophyte had found fifteen different kinds of cocci, bacilli, and spirilla, and, so he announced to us, was hard after a sixteenth, when a visitor entered.

Now experience shows that, besides transient callers, two species of visitor come to the laboratory, the person with a grand idea which he burns to unbosom, and the person in search of one to crib.

The observant, gray eye of this caller seemed rather to place him in the second category. He was a man of good personal presence, of cultivated, or at least worldly-wise bearing, and yet a man, as one would have said, with the ghosts of not a few defunct enterprises haunting his face and mien — ghosts which had but sharpened his glance and which drove him onward only the more keenly to new ventures. The inventor's heart-break rarely falls till fifty, and here and there a Keely works on with a westering eye till far past the half-century mark, before the last *icon* is taken down from the pillar of his earthly race.

Otherwise our visitor was a spare, brown-haired, bony man, above middle height, well attired and silk-hatted to date. And the allusion to Keely was suggested by him, I should think; for after

presenting a card which bore the name of Thomas C. Thurston, M. D., he preluded with a few introductory and complimentary remarks, and asked a question: —

"Are you familiar with the discoveries of the inventor, Keely?"

"Hardly," I replied. "Is anybody familiar with them, let me ask?"

"No and yes. But I mean that you have of course heard of the 'Keely motor' and the 'etheric liberator?'"

"Heard of them, certainly."

"It is true that but a few persons, comparatively, know how fully in earnest Mr. Keely is, or realize on the verge of what world-revolutionizing discoveries he has arrived. Two public failures of his 'motor,' so called, to do continuously what its inventor hoped it would do, have undoubtedly injured his reputation popularly."

"You believe in it, then?" I said, by way of continuing the conversation, which I feared did not promise great things.

"Undoubtedly," replied Dr. Thurston. "I should say, indeed, that his invention was already in the list of accomplished facts."

"Meaning the 'etheric liberator,' so called?"

"Yes; it bears that name."

"You have knowledge that it will actually liberate intra-atomic energy, as claimed?"

"I have seen it do so."

"That should be a comforting knowledge to not a few persons."

"Most people, forming their opinions from what is printed in newspapers, believe that Mr. Keely is an impostor whose business it has been to prey on the pockets of credulous rich men," remarked Dr. Thurston. "The reverse is the fact concerning him. The man is a devotee to his idea of a grand, slowly unfolding truth of nature. And he will triumphantly demonstrate it."

"But what is the latest Keely conception of the ether? How does it now stand to him?" I queried, in continuance.

"Quite like the common scientific conception, that of a rarified medium of matter of exceeding tenuity and perfect elasticity which pervades all space, even the pores of solids and fluids; and also with this in addition to that conception, namely, that this tenuous, elastic medium is not a passive medium, but powerfully charged with energy; that it is in itself the last embodiment of energy; a storage medium for the universal energy which seethes there, so to speak,

at a tension of which we have or can acquire but a slight conception; this energy being constantly exhibited in it as a *quiver* of intense vibratory motion."

"And the 'liberator?'"

"Is adjusted to receive and set up vibration, synchronous with those of the ether, and by thus getting 'into beat' with it, is able to take its impulse, or motive power, directly from the ether, or in other words directly from the entire universe, from all nature."

"A truly magnificent theory, which sounds so fine that one would wish to have it true," I remarked. "I have heard it described somewhat differently, however; and in both instances, I have been struck by the resemblance of Keely's etheric liberator to Nicola Tesla's electric oscillator, another theoretical device, nearly perfected, it is said, for deriving unlimited electrical power from the earth's electrical 'charge,' or otherwise getting *en rapport* with the source of all our electricity."

"I was about to speak of the Tesla oscillator," said Dr. Thurston. "It is plain to me that what Tesla describes as the earth's electrical charge is nothing more or less than the Keely ether, or corpuscular matter surcharged with energy. Tesla has approached the subject from the standpoint of an electrical engineer, Keely from the less special grounds of a natural philosopher; hence their differences of terminology; but both are in pursuit of the same game, and it is a matter of great curiosity and interest to see what each will develop. In any event, what has been accomplished by these two experimenters appears to me to bear a very suggestive relationship to the theory of elemental life in matter which you seem to make the basis of your researches at this laboratory."

"Possibly; but what relationship?"

"Why, you hold that matter is, at bottom, sentient in low degree; that the ultimate atoms or particles feel and are, in a lowly sense, living particles; and that all living creatures have risen step by step, developed from this primary sentient attribute; in short, that matter first feels, then moves and lives, after a purblind fashion at first in the simpler organisms, afterwards more sentiently and intelligently as the organic structures are improved."

"You have expressed the view held here fairly well," I said.

"If I apprehend the principle correctly," Dr. Thurston continued, "the primary impulse of all energy in nature is *feeling*. Matter

moves because it feels. It is not an insentient dead universe, but a *living* one. Life, meaning consciousness and self-consciousness, is the sentient side of the matter contained in the individual organism. It is the natural bio-static condition of matter, risen, by means of complex organization, from low sentience to a high intelligence."

"You are outlining our views very well," I remarked, with some curiosity as to what was to come next.

"Well, then, it seems to me that if Keely can devise a means of obtaining unlimited power from the ether by getting 'in step' or 'in beat' with it, and if Tesla can draw limitless electrical energy from the earth by finding out the 'period' of its vibratory motion, or its electrotonus, and putting his oscillator in beat with it, *there may be a means discovered* of vivifying or revivifying the human organism, of restoring and renewing the flagging life of human beings by getting in beat, in synchronous vibrating harmony, with the bio-static condition of the ether, the earth, the universe, all nature. In the language of Tesla concerning electricity, we may say that by the proper devices we may connect the human organism with the eternal, universal life of Nature and live directly from her."

"That is a very grand conception," said I. "Your idea is to put each human life 'in beat' with the biotonus of the earth, or, to apply Tesla's phrases to life instead of electricity, to make human lives consonant with the vibratory period of the earth's life 'charge.' Is that the idea?"

"Exactly, to a dot!" exclaimed Dr. Thurston.

"May I surmise that you have already made some progress in the way of a practical solution of this problem?" I ventured to ask. "That you have in mind some device in the way of a *bio-oscillator,* if I may coin such a word?"

The Doctor appeared lost in thought for a moment, then said, suddenly, "I have a lady with me. She is sitting in a carriage outside. May I — is it quite proper — shall I ask her to come in here?"

The Neophyte, who was in his shirt-sleeves, made a rush for his coat and plucked at his cuffs. Ladies, alas, are not every-day visitors with us; the scrub-woman comes and goes, but the gayer flowers of her sex find little to attract them here. Two, it is true, have come within a year, gay flowers indeed they were, seeking, boldly, devices for the renewal of facial bloom; but what we could

suggest in this line required both self-restraint and time, and hence did not elicit their gratitude which was keyed for immediate results without painstaking.

We summoned our smiles and looked for a clean chair with a cushion and rockers, and after an elemental sort of pause Dr. Thurston re-entered, followed by a young lady of truly remarkable physique, whom he introduced, generally, as " My companion, Miss Althea Estes."

As I have spoken of her appearance as somewhat remarkable, I may add that although her general mien was youthful, seemingly that of a girl of twenty, her hair was quite white, luxuriant hair none the less, combed upward and backward from a wide, low forehead. A health-abounding woman, with full red lips, large, clear gray eyes, and a clear-tinted complexion verging to brunette. A strong woman of good height, broad shoulders and the waist of a Hygeia, to whom I was minded to compare her from the species of girdle which confined her thick white wool dress, and the easy grace with which she wore her outer garment, — an astrachan coat, if I recollect aright. She had large, shapely wrists and hands, and wore, as we had occasion later to observe, very beautiful rings in unusual number.

Miss Estes entered, as I have said, and quietly acknowledging our commonplaces, took her station among us as one who thoroughly understood her part. Indeed, she had no more than spoken, in a voice low, but of unusual timbre, than I felt sure that she must have enjoyed the advantages of a histrionic as well as a carefully guided vocal training. She seated herself, as did the rest, save Dr. Thurston, who remained standing near the lady's chair at her left hand. He then resumed the previous conversation.

" Now an infant, a child, or any very young person, may be and generally is, I think, much nearer ' in beat ' with the life of nature than an old person," he said; " yet bad ancestry acts here and many or the most of infants come into the world ' out of beat ' with the earth's life. Then, too, as we grow older and become more selfish, and form ' set ' personal habits, we no doubt become more isolated, more out of chord with the bio-static condition of nature. My own idea is that this is why we die of old age. That, in fact, would be my definition of old age, a falling out of synchronous vibration with the earth's life. We live only as we keep ' in beat ' with it, and

slacken to final cessation as we gradually lose our relationship, our consonance with it.

" Now my companion to-day, Miss Althea Estes," the Doctor continued, with a smile and a polite bow to her (and he never failed in addressing or speaking of her to make use of her full name), " is an admirable instance of this theory. She is in perfect health, in the full prime of womanhood and, as I think, in well-nigh perfect synchronism with nature or with the earth's ' charge ' of life, if you please. She appears to be able to draw from that life charge of nature and to communicate such impulses to others."

The Neophyte whose mental condition is " synchronous " with beauty at sight, attempted at this point to short-circuit a top-lofty compliment, which fell sprawling, however; yet the lady kindly acknowledged it and helped him set it on its legs.

The Doctor went on, however, without noticing the interruption.

" A human life is, physically, a complex series of chemical actions and reactions, accompanied by constant magneto-electric disturbance of its environment, and by a personalization of the sentience of matter. If we were to say that a human life is a bio-magnet which maintains a constant ' field ' of energy and influence far and near about it, as long as it lives, we should not have hit on a bad simile. It can hardly be otherwise, therefore, but that one life should influence others about it. Why such influences are not more commonly felt is probably due to the difficulty of establishing a really synchronous, or symbiotic condition, between two organic lives. They are not ' in beat ' one with another. It becomes a desideratum, therefore, to bring them into the synchronous relationship."

The Doctor paused to audit criticism, but no one volunteering any, he proceeded to our better comprehension of the object of the visit.

" I have long been a believer in the art of symbiotic healing, and my more recent studies have led me to practise it in a somewhat empirical manner, in the hope of developing my theories into a science, or a system," he continued. " And I can say of these experiments, what an empiric in drugs cannot be so sure of, that my ignorance and my failures have never done any harm, even where they have failed to accomplish cures. I have, therefore, seen nothing wrong or deleterious in such attempts to cure patients by symbiotic

agency, and learning as I go on, from such cases; for I have always been too conscientious to dally or experiment in urgent or alarming cases.

" Now in Miss Althea Estes I have found a subject who appears to me to be more nearly symbiotic with nature, or to return to our former borrowed phraseology, more synchronous and consonant with the earth's life, or life-charge, than any person whom I have previously met; and some very pretty and convincing results have at times followed our efforts to relieve suffering by placing the sufferer in chord with nature, through her instrumentality. These effects are so tangible as to be distinctly felt by well persons as well as the sick, as we shall be happy to illustrate to you here at the present time and place, if you can afford to give us a few moments more of your time."

Churls, indeed, and blind should we have been to plead lack of time to witness an experiment of such moment, — a bio-oscillator " in beat " with the earth's or nature's " vital charge! " We assented by acclamation.

" Well, then, to the details," continued Dr. Thurston, briskly. " Animals and plants, no doubt, live in closer harmony with the earth's life than human beings; and my own conjecture is that plants are more synchronous with the elemental life than animals, for the reason, perhaps, that they are rooted in the soil. At least my co-laborer here, Miss Althea Estes, is of the opinion that she establishes the symbiotic continuity with the earth more easily and more completely by the use of a tree as an intermediate connection, or conductor. Is there a near tree? " the Doctor asked, stepping to the window.

A very fine sugar maple stands about twenty meters distant from the end of the building, and a large, very vigorous apple-tree nearer still.

Dr. Thurston rapidly looked the locality over. " If the weather were not quite so cold, I should suggest that we adjourn to one or other of those trees," he observed. " For Miss Althea Estes has a feeling that she acts most effectively when standing erect, with her back to the trunk of a living, large tree. The tree, she believes, assists her as a kind of conductor; but a copper wire connection with the tree also aids her, she believes; and this opens the very interesting question whether the earth's life is identical with the

earth's electrical ' charge,' or whether, as is most likely, it is a factor or ingredient of it, and can be conveyed with it as by means of a wire. I do not undertake to say anything as to that; I do not yet know as to it. But would it be convenient to make a connection with that apple or maple and bring the wires in here?" Dr. Thurston asked.

In a few minutes a coil of rather heavy copper wire was carried from a window to the apple-tree, bent three times about it near the ground and returned, both ends being connected with a metal plate placed in the bottom of the chair in which the lady was to sit. Some fragments of plate glass were also brought and the chair insulated by placing one beneath each leg.

" Some of these details certainly look like hocus-pocus," Dr. Thurston observed. " I do not undertake to endorse them in the scientific sense; it is simply our experience, or rather Miss Althea Estes's opinion, that they aid her.

" And now there are a few additional details which, by rude minds, might be misunderstood," the Doctor continued, " but which will not here be thought to militate with delicacy. It is necessary that the five persons present who participate shall sit in a circle, the chair of each being insulated, like that of Miss Althea Estes; that we should clasp hands, and further to facilitate the symbiotic connection, that our bare feet should either be in contact, or all of them touch a metal conductor, resting on an insulator.

" Undoubtedly the best results in symbiotic healing are obtained by bringing the entire body of the patient in contact with those of well, strong persons," Dr. Thurston went on. " This, in fact, is a matter of history and observation from most ancient times down to the present. By contact of the entire body, or large areas of it, something nearest like direct protoplasmic contact and direct smybiotic connection is obtained. But our natures and habits at present have their limitations and infirmities; and compromises have to be made, even although such may impair the efficacy of our efforts.

" A perfect scheme of symbiotic healing would be to bring the bodies of a score or more healthy, strong persons into plenary contact with the patient. But as that is not at present practicable, we do what we can do with due regard to human weaknesses.

" Observe, please, that I am not attempting to teach anything as

to the nature or the manner in which the symbiotic healing impulse acts; I do not know. It may be an ethereal current, wholly distinct and *sui generis;* or it may be a form or mode of electricity; or again electricity may be the vehicle or medium by which it is conveyed from one organism to another, or from one protoplasmic cell to another. What we shall attempt to demonstrate to-day is simply the fact that a sensible impulse, presumably of a bio-dynamic nature, is actually imparted."

A large hollow copper globe about eighteen inches in diameter, which had once been used at the laboratory in electric experimentation, was brought forward as a means of this symbiotic pedal continuity, if this detail of our experiment may be thus described.

Heat, meantime, had been admitted to the room and the temperature raised to about 80° Fahr. An anteroom was made to serve the lady as a dressing-room. Each of the others made his preparations; and at a signal from Dr. Thurston, all approached — in slippers — and took their places, the one lady setting us all a beautiful example of utter unconsciousness of any other sentiment than a purely scientific one. That example the rest of us followed so chivalrously that the Neophyte alone was afterwards able to declare that " it was a regular Trilby foot — two of them — a perfect daisy of a foot!" But the Neophyte is still a very young man.

Such, then, was the situation: our hands clasped, sitting in a circle on insulated chairs, with all our feet pooled about that copper globe, which rested on a large pane of glass placed upon a low foot-stool.

Dr. Thurston held the lady's left hand; the Neophyte, rogue, had her right hand. We fixed our eyes on the circle of feet about the globe and sat in silent, but far from sad, civility.

Several moments passed. The Bio-oscillator seemed, I thought, to draw in deep breaths which expanded her grand chest. She appeared to concentrate herself as if making some sort of effort. Then presently an unmistakable impulse was felt, similar to a slight faradic shock. After another deep breath on the part of the Bio-oscillator, this was repeated more perceptibly, three times.

" I feel something," said the Neophyte. We all acknowledged that we did.

Without rising, conversation was resumed for some minutes, then another effort was made, when four or five distinct, moderately

powerful impulses were communicated. There was no doubt of their reality. The only question was as to their nature, whether electrical or what?

Miss Estes herself made no attempt to explain anything; Dr. Thurston did the talking. His idea was that Miss Estes was symbiotic with nature and in period with the earth's " vital charge."

" But I do not deny," he added again, " that electricity may be the medium or agency by which the symbiotic impulse is imparted. I only know of it that it appears adequate to cure disease. We have been unusually successful with nervous diseases, some of them inveterate cases."

Still a third illustration was given, and I then bethought myself to introduce a galvanometer into our circle; but the lunch bell had rung, and one cannot ask a lady to sit barefoot indefinitely.

Our two visitors remained to lunch with us, and a remarkably pleasant hour was passed ere they took leave. Dr. Thurston proved a wonderful conversationalist, Miss Estes an equally wonderful listener. Little part as she seemed to bear in the conversation, however, we began to perceive that she was the directing spirit of it; her manner simply of attending to what was said led others to continue or to drop a subject.

As they rose to take leave she remarked to the '87 Graduate that Dr. Thurston and herself were trying to make progress with the abstruse subject of symbiotic healing, adding that they also had their way to make, and asked that we would kindly certify, in writing, briefly, to what we had seen, but neither more nor less than the facts.

" Certainly, to what I have seen, or rather *felt,* I will bear witness most cheerfully," replied our associate, diplomatically. " But the subject is so interesting that I wish you would give us a fuller knowledge of it and a greater opportunity to certify. Will you not come again to-morrow, or soon, and let us see more of your gift?"

Miss Estes hesitated for the moment. " I do not know how Dr. Thurston may have planned his engagements," she said; " I will speak with him as to that."

They consulted briefly, when the Doctor said, " Willingly, and thank you for the invitation. To-morrow at the same hour, if that will suit your convenience."

They then drove back to the village at the railway, where their arrangements had been made for visiting us.

For my own part I had hastily jumped to the conclusion that the lady was one of those by no means very rare individuals known as " electric girls," something in whose physiological economy constitutes them living, walking electrical batteries. I had little confidence in the earth's " vital charge," as postulated by Dr. Thurston, but a great deal of confidence in electricity, even as a remedial agent in some forms of disease; and by the use of a galvanometer introduced into our circle of clasped hands when they called next day, I anticipated proving beyond doubt that the " symbiotic impulse " of the Bio-oscillator was an electric shock.

Talking the matter over before the laboratory fireplace that evening, — for cold squalls were howling down from the White Hills, — I cited the cases of our two most celebrated " electrical girls," and ventured the opinion that Miss Estes would prove an equally celebrated third.

The Neophyte laughed.

" The Bio-oscillator is a fine, grand, wholesome sort of woman," he exclaimed, at length. " But she is an actress, I take it, and I will bet my new sheepskin that she has got either a little storage battery or a dry salts battery under that classic tunic of hers. That's the kind of ' electrical girl ' she is, take my word for it; and how to find out in a decent, slick way just what kind of an outfit she is carrying around is what I'm studying on to-night. For it will never answer to let that precious couple come here and do us out of any kind of an endorsement."

The Neophyte, as will be seen, is still in the gall of latter day bitterness, whose unregeneracy not even the wand of Venus can temper.

The '87 Graduate and myself were scandalized.

" And I have it! " exclaimed the Neophyte, unabashed. " I have it. Just you all keep quiet to-morrow and watch out; you may hear something drop."

Next morning we heard him hammering down in the basement; he bored holes, too, in the laboratory floor. It disturbed the '87 Graduate, who was inoculating guinea-pigs. " Hope that young cock-sure will not outrage decency and common politeness to-day."

he said, testily. "He has started up a faradic battery down-stairs; I heard it buzzing when I was in the basement."

Our visitors came at ten in the forenoon, as on the previous day, and after greetings and pleasantries, we prepared for another exhibition of the lady's powers as a bio-oscillator. The same arrangements were made as on the day before; the chairs and copper ball, in fact, had not been removed from their places, and we sat down in the same order as previously.

Again, after a few moments' silence, we felt a faint impulse, then a second and third. In the interval of time which succeeded, Dr. Thurston told us of a case of locomotor ataxia which they were treating in Philadelphia, with a marked improvement and apparent arrest of the progress of the disease.

Another exhibition of the symbiotic impulse was attempted. We had joined hands. As if inadvertently, the Neophyte then moved his heel, when, shade of Volta! we were all brought to our feet simultaneously, and the copper globe spun round!

The Bio-oscillator screamed, then flushed. Her clear gray eyes searched our faces, seemed to read our souls and rested on the Neophyte with a magnificent sparkle of anger.

But only for the merest instant. An equally grand burst of good temper and abounding *bonhomie,* such as only a great soul in a healthy organism will rally to, succeeded it. She laughed outright.

"Oh, you bad young man! That wasn't nice a bit. You hurt me, you did!" she exclaimed, in mellow outcry, her face suffused with color, and one great tress tumbling wildly down her cheek.

"Oh, I confess," she continued, reading our faces intuitively. "You have trapped me. Oh, but you did it cruelly" (this last to the Neophyte, who stood watching her, agrin). "I own up. I make a clean breast of it. You shall see just how I managed it," and with an impulsive movement of both her hands she undid first a brooch, then her dress from the neck, and amidst a frou-frou of pink laces hastily unbuckled and drew forth a long, wide, thick belt that encinctured her person.

The '87 Graduate and myself were too greatly perturbed to direct anything more than casual glances to this bit of apparatus; and as for Dr. Thurston, he seemed like one who is with difficulty keeping up with the rapid course of events. But the Neophyte says that it was some sort of electrical battery, consisting of the usual

elements, contained most ingeniously within insulating substances and an outer sack, provided, too, beneath the left arm, with a circuit closer which could be opened or shut by alternating pressure of the elbow, or upper arm.

Miss Estes threw the belt across her knees, for we had sat down again, and fastened her brooch. "Now, you think that I have tried to play a trick and that I am an impostor," she said, frankly. "In a sense, I did; and in a sense, I am. Yet I am not wholly an impostor. I honestly believe in symbiotic healing, as does Dr. Thurston. I believe that I actually cure patients and do good. I cannot doubt it, because they get well and remain so. But I have found that the symbiotic impulse is more effective when accentuated by a current of electricity. I do not know why; perhaps the electrical current aids to convey a vital healing impulse from me to them; perhaps it is merely because the sensible shock of it aids their faith and gives their confidence something real, tangible, or sensible to hang upon. Who shall say? How much of all medicine, homœopathic, allopathic, is faith? There is the faith cure, simple, and 'Christian science,' which is but another name for the faith cure. It is plain that faith on the part of the patient is a factor of some importance. It is desirable at least that the patient should have faith. In symbiotic or vital healing, however, we claim that an actual current or impulse passes from the physician directly to the patient; I know this to be the fact from the sense of exhaustion which I experience after treating the sick. After even a few hours nothing save sound sleep and good food will restore and recharge my nervous system. I actually give them largely of my life, my vitality. Hence my own profound faith in my art.

"We do it but badly yet," she continued, with a sigh, and rearranging her fallen hair with an absent movement of her fine arms. "When I see people suffering, dying, and think what might be done by symbiosis, if only we could in some way organize and get into vital connection, so as to bring the strong combined life currents of a score or a hundred or a thousand healthy human organisms to bear on one sick person, why I am sometimes quite transported by my faith and believe that miracles of healing, like those described in the New Testament, might be wrought. I do believe it. And isn't that really what Christianity means, this new

altruistic phase of it, namely, the combined and controlled action of our vital currents to cure disease? To rectify error and set all the erring right by a universal consonance of vital action; by getting 'in beat' or harmony with Nature's life, and working together to secure the health and well-being of all humanity."

The woman seemed transfigured by her earnestness and her enthusiasm. An actress she may have been, a grand one, but there could not be the least doubt of her earnestness and of a great ardent purpose actuating her. The incident of the belt, which she twirled in her hand as she made her appeal, suddenly sank to the insignificance of the old family physician's bread pill; nor was it even reverted to while they remained our guests.

It can hardly be denied, however, that there was something resembling an attempt at deception — an attempt to give us the bread pill — which rankled a little afterwards.

But the Neophyte, with all his young hardness of heart, had forgiven it out of hand, quite forgotten it.

"She's a good egg!" quoth he, looking regretfully after them as they took leave and drove away. "She's a peach. I would like her, myself.

"I served her just right, though," he added, reflectively. "She knew that I did, too. But oh, didn't she face the music good and large!"

"But now how do you put it up about Dr. Thurston?" the Neophyte suddenly resumed that evening, before the fire. "As near as I can differentiate it, he was as much at sea about that belt as any of us. I don't think the doctor was in it. I think that was a little private risk of her own, and not a part of the firm's regular business."

The subject seemed to weigh on the Neophyte's mind. He sang and whistled softly to himself as he filtered agar-agar next forenoon; but he used up filter paper by the sheet.

"Now that was a grand idea. I don't see how it ever found place in a woman's head," he observed to the '87 Graduate.

"What, the belt?"

"Oh, no, no! that idea of symbiotic Christianity; that scheme she broached of uniting a thousand or so of healthy persons and, by some special apparatus, combining and concentrating their vital force on the sick to cure them. I tell you that was a big idea. I

take stock in it, too. There would really be something *to* religion, then. That would be taking hold of the world's ills to some purpose. That would be business. That would be the millennium, wouldn't it? Why, I never knew what that word really meant before."

AN IMPASSIONED SOCIALIST

PROFESSOR HAMLINE remained with us but half an hour, and would probably never have found his way to our laboratory in this out-of-the-world corner of Down East but for the death of a relative whose obsequies he had come two thousand miles to attend. Once in Maine, some whiff of local rumor that certain persons were looking into the causes of old age with a hope of prolonging life, piqued his curiosity and led him to call on us. Perhaps I should rather say militated with his Idea. For the mien of our visitor was from the first that of dissent and superior wisdom; yet he appeared to think it worth his while to call and set us right.

Hence, on one dripping wet afternoon last April there appeared at our door a tall man of thirty-eight, it may be, of somewhat striking physiognomy, hair and beard glistening black, and an irregular, high, white forehead; a remarkable head for height, but of short antero-posterior diameter. In a long, black, dripping mackintosh he was personally a remarkable figure, with a flavor of Munkacsy about him and a suggestion of the Parsee.

Our particular work that day was on the brittle old hip bone of a woman, bedridden for ten years, at the age of eighty-eight; a sad object lesson in itself. The compact osseous tissue had thinned to a perilous shell. Even the cancellous tissue had been much reduced by absorption; a mere old sham of a bone which the slightest fall or even misstep might break. Contrasted with the "control" bone from a young adult, it was indeed a pitiable earnest of the present fate of aging, dying man.

Our visitor who had been made welcome and invited to see the day's work, examined it with a certain interest, but an interest manifestly measured by a dominant idea of his own. This delimitation of his sympathy was presently made more apparent by a leading remark; and this proved the harbinger of a plenteous outpour of his opinions, which were evidently fervid convictions, hot from the man's heart.

"I grasp the central thought of your work here. I see the hope

you hold and the line of effort you are following," he exclaimed, at length. "But do you not perceive, can you not realize, that this conception of yours will never eventuate in what you hope for? That from its very nature it is un-moral and on a wrong course, and hence ought not to succeed?"

This question was put forth with a solemn frankness which fairly relieved it from any trace of rudeness; and the '87 Graduate replied, civilly and pleasantly, that we had not been much disturbed by such views or aspects of our inquiry.

The University Professor from beyond the Mississippi penetrated us with his earnest dark eyes in silence for a moment.

"Let me make plain to you the later, grander conception of Christianity, the Christ idea of self-sacrifice and service, which is the foundation and the basis of our new social science," he said, with zeal suddenly unchained.

"Your effort here aspires to the culture and perpetuation of self, to the preservation of individuality, to the apotheosis of separate human personality, the indefinite prolongation of individual life. But that is all wrong from the beginning. The idea is wrong at the outset. It is the road to Death, not to Life, that you are following with such a painstaking of research."

"How so?" queried the Casual Worker.

"Because it is a retrogression to self, a segregation and an isolation of life in self. Whereas the higher life, the only life worth living, is an abandonment of self, a living outside and beyond self, in the greater life of Humanity. There is no other real happiness save in that self-abandonment and self-surrender in the social life of the entire human race. We live and are immortal only as we throw our lives into the one great Life which lives on from century to century and from æon to æon. Individual, bodily life is valueless, worthless, Christless, save as it casts itself into the social life. Hence, he who would save his life by personal effort loses it utterly from the very nature of life's essence. All these separate struggling human efforts to amass personal wealth and achieve personal fame are on wrong courses and eventuate in sorrow and confusion. Such efforts carry the unhappy devotee of self farther and farther from the great, true Life of Man which ultimately is the Life of Deity. To live for self and lay up treasures, either on earth or some hoped-for heaven after death, *is to leave Life and die!* Those

who thus live for self-salvation and self-advancement are moral monsters who stray off far from Life and God. Their lives are hid not in God, but in dark holes of the earth, apart from Life. They become, in very truth, lost souls."

"But these are generalities," remarked the Casual Worker. "Your conception, to be fully clear to me, needs restriction to the every-day conditions of our lives. You assert that we are wholly wrong, at the outset. Now pray be a little more explicit. Do we understand you to say that there is no such thing as personal or individual immortality, that the hope of it and wish for it are improper and immoral?"

"I mean rather that such a wish is of the nature of a mistake, an effort in the wrong direction," replied Professor Hamline. "It is contrary to the moral order, an erratic aspiration which would bring no real happiness with it. That is not the way to live. Perpetuation of self is an anomaly of life, a contradiction of the very terms of life, a *reductio ad absurdam.*"

"But you speak of 'God,'" the '87 Graduate objected. "Under your last deduction, 'God,' if a living personality and a self, cannot be immortal."

"God is the Greater Life of all humanity, the Life of all terrestrial life, and not only of terrestrial life, but the Life of all life in the universe, of unnumbered globes and spheres in outer space, the Whole Life of the cosmos," rejoined the Socialist. "This grand life is infinitely higher in degree and in quality than the life of any organism, animal or human. This grander life is to the personal life of a man as the life of the entire brain, the intellect, is to the life of a single cell of the brain. It is something loftier, more intelligent, divine and omniscient, something to which the individual self-life could never attain in quality, even if it could prolong itself for a thousand years, or a million. You see now why I think you are going wrong. You see now what I mean by coming out of the self-life and rising into this grander life of all humanity. You see now why self-perpetuation, if possible, would be a mistake and an impropriety, a contradiction of the moral order, a failure to develop. It would be like the survival of some old reptilian type which in the natural progress of species should have become extinct. It would be retrogression, not progress."

"But what is your method, your formula, for entering into this

greater life, for leaving self behind and rising into the higher life of 'God,' as you describe it?" the Casual Worker asked.

"Simply to forget all personal cares, all worries and fears about self. Cease from self-consciousness and all selfish, personal plans and schemes, and with these will vanish envy, pique, resentment, hatred, grudges, desire for revenge, and also the fear of disease and death. All such miseries pertain wholly to self. As soon as you forget self these disappear from the intellect, and you are ready to rise to the higher life. With the effacement of egotism, moreover, sex-lust ceases to be felt, leaving in its place naught save a passional love for every other fellow-being."

"Even if it were possible to become thus self-forgetful and yet live, of what is one to think?" questioned the '87 Graduate. "For one must think of something, or become cataleptic.

"Enter without self-reserve into the life and interests of all men," replied the Socialist Professor, with enthusiasm. "Into our national life, let us say, into all the great social and public questions and enterprises of the times. Immerse yourself wholly in them. Work and *live* in them. Transfer your personal life from self into these currents of the national life. Throw your life into them. Life is an etheric current in the brain. Instead of allowing it to spend its force there, as a useless, tiresome *eddy of self,* direct it outward into the great attractive currents of all human life, or, as I said a moment ago, into the national life of these ninety millions of people in the United States.

"The moment you really succeed in doing that, in diverting your personal vital current out of your own confined organism into the great social current, you will experience a sudden thrill of the most exquisite happiness, a joy that you never felt before. You will then catch your first intimation of what the higher life is. As plainly as if God had spoken to you will the revelation what this new higher life is come to your mind and your heart. You will realize then how futile, meager and undesirable self-life is. You will see then what I mean when I tell you that a personal, self-immortality, either in the body or out of it, in some mythic 'heaven,' would be worthless, wrong, and immoral, a solecism, a retrogression, a reversion of the intellectual type. The moment you enter this grander life and feel the new joy and thrill of it, you will cease, as in the twinkling of an eye, to wish to live in any other

way. The desire of continued self-life will cease. You will no longer desire an immortality of self on earth, or in 'heaven,' for you will feel that you have found something better and nobler. This is strictly a physical process, the rising to a higher plane of mentality. Not all the treasures of earth nor the promises of 'heaven' would tempt you to go back, or accept immortal self-life. For you have been rescued from self, and you will feel and know, absolutely, that your 'soul' has, indeed, been saved. For the only 'hell' is the hell of self.

"And this," continued Professor Hamline, "this life in the common life is the Christ-life. This is the great truth which Jesus sought to teach humanity, the salvation of the human soul by self-renunciation and self-sacrifice, — a transfiguration as demonstrable even in terms of energy as is the transformation of heat into volts of electro-motive force. This great new idea was the corner-stone of Christianity. It is the keynote of modern socialism."

"And the human longing which we all feel for continued life, for immortal life, what of that?" queried the Casual Worker.

"It is but a spasm of *self;* it passes and ceases to be felt when once the self and self interests are thrown forward into the higher life," replied the Professor. "There can be no fear of death when self is renounced, no dread, no sting, for all these emotions spring from egotism, or egoism. Why, don't you see there is no longer a self to die, or to fear death for? You have passed from death unto life. You have already, before the cessation of the organic functions, entered immortal life as a part of the higher Life of Man. You have no longer anything to do with the thought of individual immortality, either in the body or as a disembodied soul. You are *saved* from that; for this is the real salvation of Christ, the transfer of the human soul or intellect from self into the greater, grander life of the universe. And when once we feel the thrill and the joy of entry into that grander life, we gladly abandon self-life and go to it, as to heaven."

"But this natural abhorrence of death, this dread of ceasing to live, is deeply implanted, at least in me," remarked the Casual Worker. "How shall I begin to abate it, or even to lessen it?"

"By love, just as Jesus taught; by love for all men, love for all one's fellow-beings, the passional giving of one's interests and efforts for their good. Jesus experienced all this. He opened the

way, and showed us how to leave self and the fear of death and rise into the heavenly life.

"And now can you not see that this enterprise of yours at this laboratory is retrogressive and reactionary? or in plainer language, that you are on the wrong track, and that your very success would defeat itself in the act of succeeding?"

"You put us on our defence," replied the '87 Graduate, laughing. "In reality this is the old question of individualism as against communism and pantheism. In India, thousands of years ago, they sought to work out this conception in Brahminism, and later in Buddhism, where the leading idea or tenet is escape from individual life into *nirvana,* the peace of universal life. I deem it quite possible to so train, discipline and school the mind and its emotions as to throw one's personal interests, hopes and fears from self to humanity as a whole. I think that it can, as you allege, be done to a considerable extent, and that a certain solace may be found in it. As a makeshift to assuage the personal fear and hardship of death, it may even be advisable, since it usually redounds to the public good. A person may meet death the more bravely for it, and even die happily in such disciplined self-surrender. To those who cannot achieve prolonged personal life it may even be an allowable solace. Temporarily allowable, I mean, for a few centuries or a few thousand years longer, but not ultimately, or as a final law of life."

"But it *is* a final law of life!" Professor Hamline interposed.

"On that point I differ from you, radically," replied the '87 Graduate. "I have no wish for an argument, however; discussions of individualism *versus* communism and pantheism always end weakly and wordily. But the facts from histology and biology are all for individualism and for that self-life which you so much decry. Not for a disproportionately selfish life, but for personal intellect and character. The grand science of physiology is a well-nigh perfect argument for individualism. The argument from the cell which you have brought forward, *i. e.,* the union of cell lives in a human intellect, as illustrating and proving your position, is, when understood, a complete refutation of that position. The evolution of life on the earth has been the development of *self,* from first to last. From unicellular life upward through metazoans to man, the aim and *motif* have been to give field for individuality

and personal self. Not only do the united brain cells live consentiently in order to utter a strong personal life, but by the very act of thus uniting, they have each been made stronger and more forceful as cell selves. There can be no general weakening of cell self without slackening and failure of the entire organic life.

"It is not otherwise with the life of a nation or of humanity in its relation to the life of each citizen, or human being. For what is the nation? What is this humanity into which you exhort us to throw ourselves and renounce self? What is it but a million or a billion of our personal individual selves? Nor is it, as you claim, a grander or higher life than that of the individual man or citizen. On the contrary, it is notorious that the character and morals of nations are never as high or lofty as the life and character of any good citizen. Every great nation of the earth to-day is living a life in its foreign and domestic policy such as any honest, educated man among us must despise and condemn. How, then, can we cast ourselves with full sympathy and veneration into that which is lower and baser?"

"To make it purer!" interjected the Socialist Professor.

"Oh, that indeed, but that is not the point here at issue," rejoined the '87 Graduate. "It is the question of a loftier, higher life. But a national life, or a life of all humanity, is an abstraction, at best.

"A nation exists only in the selves of its citizens. The best citizens of a nation, too, are always the men of strongest, staunchest self-life, who make their personality a dominant force in the nation and in the world, the men who from sheer force of self and personal character *break out of the common national* life and lead it upward to something better. What would the world be but for such men? And what are they but powerful eddies of personal self? Why, Professor, your argument for the abatement of self is contrary to the course of nature and matter. The sentient atoms unite in a cell which sets up at once a personal axis and could not live without one. The human organism is composed of cells, but each cell retains and maintains its personal self-axis. You could not have a human intellect without these millions of cell selves. If they were each to abandon self, there would be no personal human self. It is only by virtue of the component cell selves that the larger personal self of a human life comes into being. When you

strike at the principle of self, you unwittingly deal your ideal life of pan-humanity a mortal blow. You obliterate it at its source.

" Again, practically, as we now lead our imperfect lives, a young man must live shrewdly and diligently for self to earn a competence, make a home, select another, female self as a mate and bring other young selves into existence. To do this he is absolutely compelled to think for self and work for self and be very decently selfish. If he failed to do so, where would your ' grander life ' of humanity be in the course of thirty or forty years?

" More practically still, it seems to me that you ought heartily to endorse our idea of prolonging personal life, for if human beings did not die so constantly, after a brief lifetime, they would acquire greater stores of knowledge. Instead of being mainly lost by death, as now constantly occurs, there would be a conservation of knowledge and experience in the individual. Men would be wiser and live more correctly, and thus ' the higher, grander life of humanity,' on which you lay such stress, would be elevated and improved, since the ' Life of Man ' is but the sum of individual lives and its wisdom but the totality of human knowledge."

" Oh, but — you fail to grasp my idea! " exclaimed Professor Hamline. He began to elucidate again, but merely iterated his dominant idea, the idea of the Christ-life.

The '87 Graduate resumed confidently, and the argument would no doubt have lasted the day out and ended " weakly and wordily," but that our visitor's stay was limited by a railway time-table.

" If I had but the time! " he exclaimed, impulsively, at the door, " I would convince you; I am certain that I could. I utter a great world truth which must reach you in time."

" You have truth, no doubt, but don't think that you have all the truth," said the '87 Graduate. " Truth is like the universe, boundless, infinite."

" And thank you for coming! " exclaimed the Casual Worker. " Come again and have it out with us whenever you can. The truth is what we want here. Meantime, let us have an abounding charity and toleration one for another, for that is in the ' Christ-life,' too, is it not? "

So with a " charity " hand-shake all around we parted; yet the Professor went away with a baffled wrinkle in his brow, as of one reluctant to quit the field till he has silenced all his enemy's guns.

The ardor of combat still lingered in the '87 Graduate's eye, also.

"What a purist! What a stark, staring purist!" he exclaimed, as he watched the Professor striding rapidly down the misty path. "When one of these college professors sets up as a socialist, good-by to all moderation and common sense."

"But he has an idea," said the Casual Worker.

"An idea! yes; the idea of a termite communist, a beehive socialist."

"But who knows? Perhaps a white ant republic is the best that can be done by humanity on so hard and baffling a theater of life as this bleak old earth," remarked the Casual Worker, thoughtfully.

"What a lack of faith!" exclaimed the '87 Graduate, warming for battle again. "Why, every step in the progress of humanity has been due to the heroism or the hard work of the individual, the scholar, the statesman, the military chieftain, the artist, the scientist. Always to the single man, the individual, never to the herd of men. And this modern communistic effort, what is it? Rightly estimated, it is all for the individual, all to give the common man a better chance to live, develop, and enjoy his life than was possible under the old conditions. I boldly assert that modern socialism, altruism, communism, 'anarchism,' 'nihilism,' all are but the struggles of individualism for a higher recognition. It is a great spontaneous throe of humanity to give the obscure poor man fair play, to give the common individual an equal chance in the world. In one word, it is individualism."

A MERYCOLE

One who signs himself "A Good Catholic" has written in excellent spirit, to remonstrate against what he is led to term the bitterness expressed in *Salvation by Science* against the Romish Church.

I feel that this remonstrant misunderstands the Promethean Faith. It is not Christianity, its spirit, its good works, or its achievements in the past, of which Americans are doubtful for the future, but the insistence with which the Church of Rome teaches an outgrown dogmatism, forcing upon the mind of the child a catechism and ritual which the child has infallibly to reject and cast aside a few years later.

We deem this insistence dangerous to proper mental growth.

As illustrative in part of what is meant, allow me to relate the story of a curious occurrence at this laboratory.

The first autumnal chill of the advancing season had come to us that evening, Aug. 29; — for Maine verges northward under the Seven Plow-oxen. From over the hills and woods, White Mountainward, the wind puffed sturdily; the cold came with it, as it often comes here by the last night of summer.

The Casual Worker, who had been with us four days on this particular occasion, laid a fire in the laboratory fireplace, the first of the season. The '87 Graduate drew up a creaky old basket-bottomed rocking-chair, and raised his very American heels against the right jamb; the Neophyte hauled in an oak settee upon the left flank; and the Casual Worker lighted a cigar, in the middle background. From their general air, it was plain that there would be chat, argument, or agnosticism, as the case might be.

Peter Bubier, the chore boy, came in, fetching great sticks of four-foot wood for the fire from the shed, and unwittingly furnished the theme; for Peter was chewing his cud. He is a French

Canadian from the Three Rivers region, emigrant from a parish up the St. Maurice, but claims to hail from Three Rivers, for he does not wish his priest to learn of his whereabouts.

The trouble is about Peter's cud. We fancied at first that it was tobacco or spruce gum which he held so constantly in his mouth. The cud, however, proves to be something of a phenomenon; Peter actually raises and re-masticates a part of his food, — ruminates. In short, Peter is a merycole. Shall we call it *bovinthropy?* Is rumination in man a reversion of type, a freakish survival, or is it a still more freakish instance of nature's perverse imitativeness across the gulf of species? What is the true history of the vermiform appendix which has now fallen into the hands of surgery? A young surgeon who visits us here says that this antiquated appendix v. should be removed from each nursing infant, and save trouble in the adult; no aspect of the thymus gland discussion terrifies him. "It ought to be out," he asserts. He would like exceedingly to examine Peter's, and runs an inventory glance over him at times, the full significance of which Peter himself has no conception of, or we would not keep him long.

Peter is a sturdy, well-knit little dark fellow of twenty-four, pure French from the days of Roberval, scrubby, provincial French. He is alert, content, a good worker.

He fetches in the armful of four-foot wood; and the Neophyte, swinging aside for him to throw it in the wood box, says, "Well, Nebuchadnezzar, how does your old cud taste to-night? Sit down here, Peter, and tell us what the priest said to you."

"Said, ''Pit it,'" Peter replies, reluctantly.

"Spit it out?"

"*Oui, oui;* ''pit it.'"

But he will not sit down with us to talk about it.

"Dis is too hort here," he exclaims, pointing to the fire; it is but his excuse to get away. The truth is that Peter is afraid. We know the facts, however. The Canadian priest had overhauled Peter's nutritive habits and decided that they were unregenerate, anti-Catholic and subject to church authority. Man, redeemed from animalism and a candidate for salvation by grace of our Lord and Saviour, must have done with the cud business. With the weight of apostolic authority behind him, he directed Peter to repress his desire to raise the cud by all the force of his will and by prayer;

and if anything rose inadvertently, to eject it at once from his mouth.

And Peter "'pit it," and in consequence grew wondrous ill at ease; he could not sleep; he became thin and unwell. At length he ran away to Maine without the knowledge of his priest. But he was in fee of a sweetheart; and goaded by his fears of rivals, he contrived to write a letter to her wherein he acquainted her of his constancy and his present whereabouts, but enjoined strictest secrecy as to the latter.

The Acadian damsel replied, promising to be silent as the grave; but her priest who had heard that she had received a letter, wrung the entire matter from her at confessional, whereupon the girl wrote yet again to Peter asserting that she had told no one!

Hence on a day which he could not know, his priest wrote to a priest at Bangor enjoining Peter's reclamation to parochial authority, and the latter came to find him. For be it known that the French Canadian, coming into New England, was for a time in a condition not a little resembling that of a fugitive slave in the Northern States, before the days of John Brown.

"Ah, bitter irony of time, that Puritania should but too surely become a Romish province, and its soil groan under an ugly burden of Catholic church architecture!" the Neophyte exclaims.

It is too late; at least, our young associate says so. The mischief is already done, he asserts. That priceless freedom of thought which brought forth our national idea and founded the free public school is to be smothered by the Papist catechism. The Norland hill country which nurtured Websters and Sumners passes under the yoke of that church whose synonym is intellectual blight; that church which so jealously inoculates the tender mind of the child with doctrines which make a mental eunuch of him through life. The Neophyte really thinks so; and he adduces history and physiology in evidence.

In New England, of all lands, the mental condition of Spain, Italy and Mexico is to be reproduced. That very liberality and breadth of thought which inspired the framers of our national Constitution to make America the refuge of the oppressed everywhere, has proved our undoing; for the oppressed brought along with him the oppressor, enshrined in his bosom.

And now whitherward shall the lover of intellectual freedom

turn, to stand clear of the octopus clutch of that hierarchy and the fatal incubus of its indoctrination? To Australia? A century hence Anglo-Saxon Australia will eclipse America, — if only Australians are warned in time by the race catastrophe in America. Geographically America has shielded Australia and stood to it as the flood-gate and sluice-rack to divert the tides of emigration. Trebly fortunate in this, the progressive race may find on this last of earth's continents a field for its slower growth and larger development.

An English writer, the most remarkable literary light of this generation, who at one time made New England his *quasi* place of abode, has written not wisely nor well of the decadence of New England and the "going to seed" of Puritanism, having for his text and his illustration a rural county of our north country, to which as yet few aliens have penetrated. In the condition of life in that locality he believed that he saw the natural outcome of the Puritanic flight to America.

Strange that a man as acute of vision should have gone so far astray in his observation!

What he saw in that rustic county was but the graves of the Puritans. The Puritans, indeed, are no longer in New England. They migrated years ago; have been migrating for a century. First came the migration to Pennsylvania and Western New York; then to Ohio, Illinois, Wisconsin, Michigan, Iowa and Kansas, all of the corn and wheat States. For a century, the brightest, the strongest and the most energetic of New England's sons and daughters have taken their way westward. The only wonder is that anything remains over and above such an enormous depletion of the best blood, brain and muscle; that so much of intelligence and energy is left behind. Why, all the Midland States, as also Texas, California and Oregon, are but so many later New Englands. The leading spirits, the owners of property, the controlling and directing minds are nearly all New Englanders, or of New England parentage.

Pioneers from these six eastern Anglo-Saxon colonies carried the first germs of business enterprise and civil government to every new territory of the national domain. The extreme truth of the above assertion will prove a matter of astonishment to any one who will take the trouble to inform himself of both the early history and

present social and industrial condition of every State of the Republic, save eight of the Southern States; and since the abolition of slavery, these eight States are being revivified from the same fruitful source. It is not more than the truth, that the well-spring of the national life was from that one lonely colony on the Massachusetts coast, in 1620. Nor in the now known correlation of the physical and moral forces of man is this a fact to excite wonder. For what was the dominant idea of the New England colonist? Freedom of thought promoted by public instruction, and self-government based on such freedom. That was the Puritanic *idea;* and for the fostering of it there went self-denial, continence, temperance in all things, enforced with an austerity sterner than Cato's. Such an idea, thus fostered, could but prove a prevalent force in the world, a force that will be felt for a thousand years.

The Puritans still live in every State of the nation, and lend power and vigor to the national life, and will so live, even although the sterile soil of New England is populated by immigrant aliens, and desecrated by that paganized form of Christianity which the Puritans abhorred.

New England was the cradle of the nation's infancy; but now the child has grown and left it, and the old cradle is relegated to the barn for pups and kittens to nest in. It may not be worth while to grieve or indulge in sentiment over it, yet it once rocked a divine child. Let that only be remembered. Let it be as when we visit Greece, or the shrine of a hero of old. Ordure of degeneration will lie about; and as we pore, a vermin-infested beggar will whine, "I too am a Puritan! For the love of the Virgin, a few cents."

Such are the vaticinations of the Neophyte touching Romanism in America. On this woe he out-Cassandras Cassandra. His lament, however, is not common property with us.

But Peter caught sight of the Bangor priest coming to his boarding place one evening, and slipping out at a back door fled again far across the country and took service with us.

As we talked of these things before the first autumn fire that night, and predicted the future of this quarter of our common country, Peter sat on the door-step outside and chewed his cud. It may be partly fancy, but he really appears to lapse into an ox-like

mood as he ruminates; the calm of an internal pre-occupation takes possession of his brain. Otherwise his whole aspect, day by day, is one of settled, plaintive anxiety. His sweetheart and his priest lie heavy on his heart and lower its beating. Yet the dire corporeal stress of his outlawed cud is heavier still; and his life drags on, beset with miseries. He is happiest when ruminating, at least, calmest, a bovine calm.

Observation shows that he masticates at meals, as thoroughly as the average; and his teeth are excellent. Even after a breakfast of well-cooked oat-meal, he shows a tendency to raise particles, but not as much as after a dinner of meats, vegetables, green lettuce, etc., when for several hours subsequently, of an evening, Peter is busy, indeed. While hard at work sawing wood, or wheeling fuel into the shed, Peter rarely raises his cud, but on sitting to rest for a time will begin soon to do so, and munch away with apparent satisfaction, particularly when his breakfast has consisted of tough beef-steak. Nor is he apt to evince much appetite for his noon lunch if he has not had time during the morning to re-masticate his breakfast. Apparently, rumination is necessary to his physical well-being; and no doubt he was a sufferer in many ways not easily described, while attempting to break off the habit or function, by ejecting what rose to his mouth. It is not unlikely that his life might have paid the forfeit of a rigid adherence to the commands of his spiritual director; and that in a strictly literal sense, Peter had been obliged to choose between a continuation of his terrestrial life and the sacerdotal promise of a heavenly one.

In some way his priest again became aware of his whereabouts. Peter had been with us for no more than a month, when a very civil letter was received at the laboratory from a priest at a neighboring factory town, inquiring whether one Pierre Bubier, who was described with the accuracy of an anthropometric chart, was sojourning with us.

To this tentative missive, the Neophyte replied with the unwise warmth of youth, stating the facts, giving the physiological data of the case, pointing out the folly of interference with a function so deep-seated and requesting that the stress to which the poor fellow had been subjected should cease at once. In his ardor the Neophyte demanded that a promise to cover this latter request should be communicated through him to Peter.

In reply to this humane but indiscreet outburst, there was presently received as smooth a rejoinder as one would ever have expected from Machiavelli himself. In it showed forth that well-organized, long-perfected policy of dominating mankind which has been maturing for fifteen centuries. The promise, forsooth, was not forth-coming; and summed up, the letter was to the effect that the Holy Church, and not laymen, must decide by its canons all final questions of life and salvation.

We made merry with the Neophyte that evening, and put him in a state of mind so heated that he again replied to his canonical correspondent, avouching succinctly that if Peter were molested he would lodge a complaint against his persecutors and test the matter in the courts. An answer to this democratic ultimatum has not yet reached us.

COMMENT AND DISCUSSION

"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 that saves them, personally."

The above is quoted from a recent 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, and — like the above writer — are inclined to feel aggrieved unless it is furnished to them.

Scientific research does not undertake to furnish faiths-to-suit, or religions-to-please. That is the function of the paid priest. 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, false 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 insures a progressive growth of mind and

brain, with mental health and moral elevation. In good sooth, as a great Teacher once said, " The truth shall make you free," free of error, free of disease and pain, free of death. Death is that last enemy of life, which shall be destroyed in the future " Kingdom of God " on earth.

For truth is life, 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 invigorates and renews the mind. It brings joy and hope. It breaks the stasis of mortal selfishness. It clears the mental sky. It puts one in accord and in harmony with the steady beat and throb of the whole universe. It is the true elixir of life, the synonym of immortality.

Faith springs from the apprehension of truth. It is faith and hope which have pioneered all the great achievements of man in the past. Immortal life will not be achieved until the achievement becomes a Faith. Faith leads the way and centralizes effort.

In this respect *Salvation by Science* will not differ from the other great cults, or onward movements, of the human race. The ideo-volts of Faith are ever required to push them forward to attainment. It was so with early Christianity, Islam, Buddhism, and the lesser cults. Faith had first to be generated in the minds of men to stimulate them to work and fight.

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, sweet 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.

Another kindly critic, evidently a thoughtful mind, writes, " I admire your devotion to the ' Promethean Faith,' and I fully believe that good will come from all earnest efforts at research. But allow me to advise you (as a friend if you will permit me thus to style myself) to say nothing of the bearing of these researches on the doctrine of disembodied soul life. That doctrine is dear to the hearts of millions; and even if, as you believe, it is a delusion, no good can come from controverting it. You will but subject your-

self to bitter attacks and even to personal hostility, which will injure the Faith you are trying to teach, and lead thousands to reject it, without a hearing.

" You will deprive yourself of the sympathy and coöperation of thousands who would otherwise work with you. Among Christian people, generally, you will be shunned and ignored, instead of praised.

" My friend, the world, particularly the religious world, is not ready for this sterner feature of the ' Promethean Faith.' People still cling fondly to the doctrine of personal life after death. It is almost cruel to attack it; and, if you will pardon me for saying so, it is hardly courteous or in good taste.

" As your well-wisher, I counsel you seriously to avoid all reference to this part of ' the new Faith of Science.' Let that come in the future, if come it must. Break it gradually, graciously. Allow the world time to ponder the idea of self-salvation, first, and the grim alternative, later."

The above is manifestly the advice of a friend. It is gladly received and deeply appreciated, all the more that the subject is one which has been under consideration frequently for twenty years, even including the question of bad taste and rudeness to popular sensibility, which is not without its claim and weight.

In replying, it is well to call to mind that they who read *Salvation by Science* are not those who throng the nave of cathedrals and other places of public worship and adoration. That entire great class, composed largely of immigrant, indoctrinated minds, will never learn much of the Promethean Faith, and hence may be left out of the present consideration. By estimate, there are one million persons in America and in England, including one hundred and twenty thousands in Germany and France, to whose thoughtful attention and estimation *Salvation by Science* now bids fair to come. These are persons of education and varied attainments, often holding radical views and beliefs. In a word, they are people who think for themselves and are quite capable of forming opinions of their own on all subjects.

On maturest consideration, I do not believe that this class desires, or requires, to have the truths of nature half stated or disguised as something different, sugar-coated, or made into baby-pap. I take it for granted that these persons want to know all that is

known, and all that is probable, touching life and death; that they are ready to face the facts and act on them. I would deem myself guilty of a piece of impertinence if I assumed any other position toward them, and would expect to be laughed at. To pop one's self up on such a pedestal before an audience of educated people would be a piece of egotism, worthy only of ridicule.

The question touches deeper considerations. The plain fact is that Salvation by Science reverses supernaturalism in all its forms and tenets. It derives its present force in the world from the fact that supernatural salvation is now invalidated. What is more, the new faith cannot be properly and adequately stated without directly controverting the dogma of disembodied soul life after death.

If this earth is merely a species of green-house for propagating human " souls " and bringing them forward for early transplantation by death, to a distant " heaven," then the achievement of prolonged life is nonsense and contrary to the alleged " divine scheme " of things.

Natural salvation and supernatural salvation are diametrically opposed to each other. It comes to a question of veracity between them. The student has to decide for himself which he will accept as truth.

The matter goes even deeper. If supernatural salvation be the one true and only road to immortal life, then evolution is but a futile divarication of earthly life and the growth of scientific knowledge is scarcely worth while. That, in fact, is and always has been the church view of the matter.

There is still another consideration. The writer is one who has always felt that the discovery of truth carries with it the sacred obligation for utterance; that it is not to be sequestered, hoodwinked, nor hidden under a bushel. The negative view of disembodied spirit life is presented here in the interest of human progress; not in wantonness of giving pain, if pain is given, but in regret of it. Truth is a necessity to that progress.

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 ' Promethean Faith,' 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 obeah, 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; and the far outlook of such growth is "the spiritual calm and peace of the gods," happiness, immortal life.

"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 *Salvation by Science* (the Promethean Faith) 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.

The intent and purpose here has been to convey the idea that *Salvation by Science* is the belief which the most advanced scientific knowledge of our times not only teaches, but necessitates; that it is the faith which future, educated America will be compelled, logically, to adopt. On these grounds we are ready to array the facts and meet the counter argument — when it is really argument — of any opponent.

Since the first editions of *Salvation by Science* were published, a number of reviewers and critics have described it as " an attempt at a new religion," " a new cult of Nature," and, generally, as something newly devised.

It would have been better described as the oldest of all religions, the religion of cell life, the instinct-effort of the protozoon to save itself. Compared with this natural effort at salvation, on the part of the unicells of the ancient earth, the World's five great Creeds are as novelties of yesterday. A hundred millions of years ago, natural salvation was operative and prevalent; it is coeval with the earliest metazoons; the first cult of unicellular life; the " golden rule " of the cell. The golden rule of Christianity, indeed, is reflected upward from it, upward from this lowly sentiment for union and coöperation on the part of the component cell life of the body.

"An opponent," thus styling himself, asks, with a flavor of derision, "Do you actually believe that the protozoa, the unicellular 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 has any such position been 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.

It would neither add nor detract from our present estimate of the impersonality of cosmos, were we to learn that all the metazoons, including mankind, started from the accident of a few grains of sand falling foul of a cell, a hundred millions of years ago. We have given up the idea of design in Nature to that extent. Nature neither lets nor hinders; the liberty of cosmos can in no other way be conserved. Why speak of design? Nature needs not design.

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 *Natural Salvation.*

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

Professor Metchnikoff, of the Pasteur Institute, believes that "old age" is accelerated by the abnormal activity (phagocitosis) of the white corpuscles of the blood, which, after a manner, devour the cells of bone, muscle, brain, and other tissues. Experiments are now in progress at many European laboratories, bearing directly or indirectly on these theories. Facts of great interest have already been brought out.

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 Professor Metchnikoff's or Professor Loeb's views or beliefs are, touching immortal life for human beings, nor whether they believe their discoveries have any bearing on the subject.

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; and to me it seems only logical that theologian, priest and sectary should oppose scientific progress generally. 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 Catholicism in America seeks to accomplish. Its sustained struggle against popular education and the growth of knowledge here is one of the most instructive spectacles which the times present. 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. This is what the Christianity of Rome and of Constantinople have at times accomplished in Spain, in France, in Ireland, in Russia.

It is quite impossible to harmonize Judaism, 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. Moreover, between church doctrines and the science of our times, there is an issue raised, a crucial question, this: —

Is the human personality, the ego of a human life, detachable from the organism, capable of living on in the absence of that organism, or not? Church authority says yes, the growth of scientific knowledge, no. A grave question of veracity is thus raised. One or the other is radically wrong.

It is the realization of this *impasse* which accounts for the present attitude of the scientific world toward the church; the attitude of quiet tolerance, with a disinclination to discuss the matter; the realization that the church has its uses and is endeared to a large class of the population; the further realization that the regimen

it prescribes, is perhaps best for that class; and, finally, the thankless nature of the task of teaching truths which would be certain to be unpopular. Briefly, the biologist of to-day is shirking his duty as a teacher rather than incur odium and resentment.

" 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." Matter lives, that is, feels, and moves, because it feels. Indeed, there is no such thing as matter, in the former sense in which the word was used. Matter 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.

Every last corpuscle of matter is *alive,* in the sense that it may take its place and contribute its life to culminate with others in the life of a tree, or an animal. Each minute corpuscle is to itself a living, personal particle.

There are, therefore, no insentient forces; the universe moves because it lives, not lives because it moves insentiently. This latter doctrine had its day in a cumbrous philosophy and has passed to its bourne.

It is already apparent that the " atom," so called, is an organized life. All these " atoms " and " molecules " of our old-time chemistry are living creatures, often comparatively long-lived, even to a degree of immortality, yet still mortal and dissoluble under certain stress and duress of environment.

The point of this newer, better conception of nature is, that every corpuscle, " atom," or " molecule " is, in a lowly sense, a living thing, having what is to itself a sentient life.

A busy New York lawyer who still finds time to consider *res ultimas,* 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 in 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 some thing superadded 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.

A teacher of biology writes: —

"You speak of the 'personal axis' of life, the axis of self-consciousness in a cell, or in the human brain. What is meant by the term?"

This question is answered in part, at least, on preceding pages.

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 paradisation 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.

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 American 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. But my answer to this question would be, By bringing the theory and promise of the Promethean Faith to the attention of intelligent people who are beginning to think on these subjects. By suggestion of it to them. By a clear presentation of it. Thus leading them to think about it for themselves. It will then make its way in their minds by virtue of its own logical strength and the eternal truths of life on which it rests.

" 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,* or *per centum,* but improved and rounded out as to its entire interior organization. It is a case of fatting 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 in-

gested, 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 largely answered.

THE END.