ESSAY

SCIENCE

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MARINE LIFE

First Discourse

MICROBES

This ocean—this vast watery wilderness, which is the abode of death for mankind, which is the burial ground of hundreds upon hundreds of helpless drowned voyagers—is yet also the birthplace and playground of countless creatures! How trifling, how small, is the land in comparison to this watery world. Michelet says that upon this earth, water is the rule; dry land is but its exception. If this vast belt encircling the earth on every side, stretching from pole to pole, were to become dry, what a majestic, what a profound spectacle would unfold before our eyes—how many mountains, how many valleys, how many groves adorned with marine vegetation, how many creatures both minute and vast would fall within our sight. In this oceanic forest, how many creatures are racing about, swimming, hiding in the sand; some clinging to the flanks of vast mountains, some building their dwellings in caverns; here a great battle has broken out between two, there others have joined together in the play of affection. I cannot refrain from quoting here a hair-raising image that our celebrated poet Bihari Lal Chakravarti has given, in a passage describing the sea:

41

"The more I contemplate you in my heart,
The more I sink in the flood of wonder;
Upon so vast a form as this,
Who knows what vaster mystery lies concealed within.

42

If today that mighty sage should come,
And suddenly drain all the waters with a single sip;
What boundless, fathomless depth

Would appear before me all at once!

43

What terrible roaring would arise from a million creatures,
What violent writhing and thrashing;
As if the earth had suddenly split in two,
And all its living things had fallen within.

44

The whole universe would fill with tumult,
The world of the living and of the gods struck still with terror;
The sky torn by cries of anguish and lamentation,
As if the entire cosmos were violently churned.

45

I seem to stand upon some wondrous mountain,
Having climbed to its very highest peak;
Its sandy slope, from where my feet now rest,
Descends steadily downward and merges below.

46

The valley stretches, vast and fathomless, into nothingness,
As if countless demons within it
Were locked in furious tumult—a violent affair,
As though, grown desperate, they raged in battle.

47

Turn back from that path, O lovely Imagination—
Behold, the sorcerers are utterly distraught,
They perish, every one, upon this wilderness;

Does not your heart, seeing this, grow troubled?

48

Bring quickly that mighty mass of water,
Cover over this vast desert form,
Let nectar rain down upon them;
May the whole world grow cool in peace.'

From the smallest invisible microbe to the mighty whale, and from microscopic plants to the thousand-foot-long plant called Algae, all are nurtured within the womb of this ocean. As many creatures as exist within this oceanic womb, so many do not exist upon the land!

In the sea you will find a certain class of creatures of the most degraded order. They are but one step advanced beyond the vegetable kingdom. Their bodily apparatus is so rudimentary that they are not readily perceived as living beings at all. These have been established as the primal creation among earth's living forms. The older the earth grew, the more complex became the bodily nature of the creatures produced upon it, until at last the pinnacle of this progression came to rest in mankind. Some suppose that here the process has reached its end, that it will advance no further; but who can say that upon the dwelling-place of man another layer of soil shall not settle, and that upon the grave of human society another, more advanced being shall not arise? In the earth's earliest state, nothing existed save plants, and among these, the lowest forms of vegetation were born first.

If a certain quantity of water is left standing in a vessel in the open air, it will soon be seen that a most delicate film of yellow and green colour has formed upon its surface. Examined under the microscope, it will be seen that these are nothing other than thousands upon thousands of floating vegetable substances. After this, thousands of microbes will be observed, swimming about in groups, sustaining their life by feeding upon that vegetable matter. This vegetable substance, which we cannot perceive without the aid of the microscope, is perhaps to them a vast kingdom. Later, another group of microbes arises and attacks the first-born

microbes, devouring them. Thus first come plants, then plant-eating creatures, and after them, carnivorous beings.

It is exceedingly difficult to determine precisely where the vegetable kingdom ends and the animal kingdom begins. It has been observed that in the minute portions of algae, in plants of the Algae family, certain particular characteristics of animal life are present; it seems as though they possess organs of locomotion. By means of a fine, mobile filament that hangs from their body, they move about here and there, and observing this, one is led in every way to suppose that they move about of their own volition. Certain plant spores and the fecundating corpuscles of plants, while floating in water, wander about hither and thither much as lowly animals do, attempt to enter cavities, then withdraw again and once more dart towards them. In this way it appears, at least outwardly, that they possess the capacity for deliberate effort. If certain lowly marine organisms are compared with these, it becomes difficult to determine which are plants and which are animals.

The aforementioned lowly organisms are called, in European languages, "Zoophytes"—that is, plant-animals or vegetable-creatures. For many among them have an outward form resembling that of plants; branches extend from their bodies just as from plants, and some of their organs are coloured in various hues and resemble flowers in appearance. Corals, in particular, appear exactly like plants; their root-portion lies embedded in soil or rock, and branches extend from their stems, and their coloured organs at times take on precisely the form of flowers. Up until the eighteenth century, learned scholars regarded coral, without any doubt, as a plant; only recently has it been established to be an animal.

Do these lowliest of creatures possess intelligence or mental faculty? This is well-nigh impossible to determine. First, it has been established only with great difficulty whether they are plants or animals at all; to determine now whether they possess intelligence or mental faculty would doubtless require a long delay. Oysters, after all, remain fixed to a single rock from birth onward. Microbes too wander about, but only within the smallest bounded space. Amoebae, which change their shape a hundred times within a minute, are but living atoms. It goes without saying how difficult it is to determine whether these possess intelligence or mental faculty.

The skeletal structure of vegetable-creatures is exceedingly imperfect, their nervous apparatus utterly rudimentary. Most creatures of this class have no sensation other than touch—these are included among the very lowest order of the animal kingdom. Vegetable-creatures are divided into many species.

When Leeuwenhoek took his microscope and set about examining a single drop of sea-water, he discovered that within that one drop of water lay concealed an entire new world. Let us read a brief account of the inhabitants of that new realm.

Among the particular nature of the Rhizopoda, or "root-footed" creatures, there is no digestive apparatus; like aquatic plants, they possess a fine filament upon their bodies by which they move about, and they can extend and divide their own bodies into branches at will. At times it is observed that these branched limbs gradually contract and merge back into the body. It seems as though the creature is devouring its own body. Creatures of this kind also sustain life by clinging to the bodies of other creatures and organisms. Many species of Rhizopoda exist, of which the description of two or three is given here.

The bodies of the microbes called Amoebae are so transparent, so minute, that at times, even placed under the microscope, they cannot be found at all. What the structure of their bodies actually is cannot at all be conceived. Viewed under the microscope, they resemble a drop of water, but from moment to moment they assume so many varied shapes that their form cannot be fixed in any way. No digestive apparatus is visible in their bodies—how, then, do they sustain life? It has been established that they absorb food directly into their bodily substance. Under the microscope, portions of vegetable matter can occasionally be seen within their bodies. As they can extend and contract their bodies at will, they have considerable facility in mixing food with their substance. By extending their body over some particle of plant matter and then contracting again, it easily enters into the substance of their body.

There is another kind of creature of the aforementioned class called Foraminifera; they are nearly invisible to the eye, their size not exceeding two-hundredths of an inch, and yet, when one considers how great a work has been accomplished by these minute creatures, one cannot but be astonished. The crust of many regions

of the earth is formed of nothing but their bodies. In the youthful age of our planetary abode, these creatures probably inhabited the ocean in incalculable numbers. From the piled-up mass of their dead bodies, vast mountains have arisen and lifted their heads above the ocean's depths. If the sand of the sea is examined under the microscope, it will be seen that half of it consists of their hard shell-coverings. The great limestone mountains of Russia are formed of their remains. The mountain of chalk that stretches from Champagne in France to the middle of England is but a heap of these bodily deposits. The chalk of which nearly the entire land-mass of Paris is constructed is nothing but the aggregate of their bodies. Upon this aggregate of tiny creatures, how many revolts, how many upheavals, how much bloodshed has occurred, and shall occur yet again. Upon this aggregate of tiny creatures, civilization's loftiest palaces stand built. The truth of the matter is this: upon the piled-up dead remains of these minute organisms, another and higher kind of creature of this world disports itself!

D'Orbigny found four hundred and forty thousand shells of Foraminifera in three grams of sand. How many of their bodies have been employed in enlarging the very land-mass of the earth lies beyond the reach of imagination. By their accumulated mass, the harbour of Alexandria has gradually become filled up; by their accumulated mass, the shoreline of many places in the sea has been formed. Like coral and one or two other marine substances, they too have constructed many islands within the ocean. One cannot but marvel, considering how this substance, invisible to the eye, gradually fills the ocean's vast belly and, by degrees, forms islands and mountain-ranges.

Their bodies are made of jelly-like substance. Through the medium of their own shell-covering, they extend branched limbs, and by means of these limbs, they move about. These tiniest of limbs, moreover, contain a poisonous substance. It has been observed that when their poisonous limb touches creatures such as the Infusoria, the latter are instantly rendered motionless. In this manner they hunt their prey. These minute creatures are cruel carnivores, and they are, moreover, the terror of many microbes. They also invade their own miniature kingdoms of microbes, destroy them, and cause much havoc. Durjadin observed that they can, at will, form new limbs from their own bodies, and once these are no longer needed, merge them back again into their body. In these too, no digestive

apparatus has yet been observed. Their beautiful shell-coverings are of many kinds. Their species is determined according to the variations in their shell-coverings.

Let us say a word or two on the subject of the sea-creature called Noctiluca. Valmiki, in his description of the ocean, has written: "In places there are massive rocks. They are unfathomably deep. Fearsome pythons lie submerged within its depths; their bodies are luminous. Upon the ocean's breast, it is as though fine powder of fire has been scattered." Sailors of the present day also sometimes observe, while voyaging upon the sea, that the ocean's surface appears as though sprinkled with fiery dust. Struck by oars and stirred by the motion of waves, this luminosity increases further still. The entire sea appears to be one blazing conflagration. Sometimes, when the tide ebbs, it is seen as though fire has caught upon the flanks of mountains, upon the marine grasses, and upon the shoreline. What in Valmiki's time people took to be the body-light of pythons, scientists have discovered to be the phosphorescent light emitted from the bodies of countless tiny creatures. These creatures are called Noctiluca. On stormy, pitch-dark nights, scattered here and there by the silvery, foam-flecked, restless waves, this blazing radiance presents so beautiful a spectacle.

The Infusoria, like the Amoebae, dwell in every kind of water—clear or saline, cold or warm. Leeuwenhoek, the celebrated scientist of the seventeenth century, was their first discoverer; these ever-restless microbes are so minute that millions upon millions can dwell within a single drop of water. The Ganges gifts so many Infusoria to the sea each year that, gathered together, they would exceed six or seven times the volume of the Pyramids of Egypt. In desert regions, higher forms of life cannot survive, yet even there these creatures sustain life in countless numbers. In the depths of the ocean floor, deeper than the height of the earth's tallest mountains, these countless living particles dwell. Like man, these invisible microbes too form a part of this great universe. Remove these microbes from the world, and the world becomes deficient in one respect. There is no place where they do not exist. In the sea, in rivers, in ponds, even in the fluids within our own bodies, they move about. In many places, the strata of the earth, extending over vast distances, are formed of nothing but their bodies. It is by virtue of their remains that the fertilizing power of the silt on the banks of rivers such as the Ganges and the Nile arises. Their minute shell-coverings, becoming compacted, form a kind of stone. Geologists say that

many lofty mountains have been formed by them. From these smallest of the small—capable of dwelling by the millions in a drop of water—mountains have been built up in heaps.

These microbes dwell, some in water, some on damp rocks, some in the bodies of other creatures. Indeed, they have even been found in the milk of a woman's breast. If any reader wishes to view these microbes under the microscope, let him place some egg-white in a vessel of water and leave it in the open; upon adding phosphate or carbonate of soda, or nitrate, or oxalate of ammonia, these microbes will multiply with great rapidity.

Among these microbes there exists a distinction between male and female. But they also come into being through causes other than reproduction. If one of their countless companions is taken separately and examined under the microscope, it will be seen that the middle portion of its body is gradually growing thin, and gradually, in the lower region, certain locomotor filaments become visible. At length, this creature becomes entirely divided into two portions, and thus two creatures are born. The severed portion, too, is seen to develop a mouth and other organs. Among them, it is as though "the son is born from the self itself"—not so among humans. In this way, a single Infusoria which existed many ages ago may perhaps, in its divided fragments, continue on even to this day. It has been observed that within a month, two divided bodies of a microbe gave rise to 1,048,000 microbes. In 42 days, a single microbe's body gave birth to 13,640,000 microbes.

Upon the body of this exceedingly minute microbe, still smaller microbes move about; the body of the larger microbe serves as their dwelling and feeding-ground. The lifespan of these microbes is but a matter of hours. Yet a curious thing has been observed: if one carefully covers an Infusoria so that no air can reach it, then however long a time passes, the moment even a single drop of water touches its body, it will revive once more. In this way, this two-hour creature may lie dead for a hundred years and yet, in an instant, come back to life.

These microbes possess yet another marvellous property. Even if a portion of their body is severed, they do not die. The severed dead portion disappears, and the

living portion continues to move about quite as confidently as before, as though it had suffered no loss whatsoever—though it may perhaps have lost a sixteenth part of its former body.

If a feather moistened with ammonia is dipped into the drop of water in which these microbes swim, their movement instantly ceases. They continue to stir their limbs as if to move, but cannot move. Gradually their bodies begin to dissolve. But if good water is again supplied, their dissolution instantly ceases, and the remaining portion again swims about happily.

There is a kind of Infusoria found in the decaying bodies of plants or animals, but the moment other creatures occupy their place, they disappear—that is, other species devour them. And when that same matter has decayed to such an extent that no other creature can survive in it, they reappear. Leeuwenhoek observed these microbes even in the white substance found in teeth. They also dwell in the bodily fluids of many diseased creatures. There is a kind of Infusoria whose body is coiled like a screw. These spin at such an astonishing speed that the eye cannot follow them, and no reason can be conceived as to why they spin so fast. There is another kind of microbe whose body seems not to be its own. Creatures smaller than themselves pursue them relentlessly, and the moment they can seize them, mount upon their bodies, drain all their blood, and, remaining there, devour them entirely. Unlike lice or bedbugs, these are not satisfied with a mere pinch—they do not let go until all the food is exhausted. Nor is this the only torment these microbes suffer; another kind of microbe watches for them, and the moment they draw near, enters into the interior of their body. And within a short time, this creature sets up housekeeping within the poor victim's body, and eventually, together with its children and grandchildren, contentedly devours its body. As many as fifty of these tiniest microbes have been found within the body of a single microbe.

Bharati, Baishakh, 1285

THE ATTRIBUTION OF HUMANITY TO GODS

Herbert Spencer, in an essay entitled "The Use of Anthropomorphism" contained within his collected writings, has discussed the subject of attributing humanity to gods, on which topic we have certain observations to offer. First let us present what he says, then we shall express our own view.

Spencer says that whatever religious belief prevails in human society at any given time is, for that time, the most suitable of all. Many, upon hearing this, will perhaps be astonished, but upon reflection they will find proof of it.

Both the individual man and human society grow like a tree; there is nothing abrupt in their beginnings. If this is true, then it must be admitted that man's religious belief, like man's political and social institutions, changes and develops according to circumstance. In whatever age whatever form of religion is needed, that form of religion spontaneously arises. Let us explain at length why this is so.

It is generally acknowledged by all that, when we set about conceiving of God, we cannot help but attribute to Him our own nature. This is a law of our mind. In greater or lesser degree, this human tendency is observable in every religion. It is only when we see an excess of this tendency in some particular religion that revulsion arises within us. When we hear that in the religion of the Polynesian peoples, their gods devour the souls of the dead, or that the gods of the ancient Greeks left nothing undone from the eating of kinsmen's flesh to the vilest of sinful acts, an intense revulsion arises within our minds. But if we consider the matter with due reasoning, if we examine the mental state of the worshippers and the conditions of their time, we may understand that such a religion was indeed suited to that condition, and therefore not to be condemned.

For is it not true that only by fear of savage gods can savage men be kept within bounds—that the more untamed their nature, the more dreadful must be the terror of their governance, and that if the governance must be dreadful, must not the ruling deities also, in that same measure, be cruel and vengeful? Is it not to

their benefit that the treacherous, thieving, lying Hindus believe in a hell full of boiling oil and cauldrons? And is it not necessary, for the creation of such a hell, that there exist so cruel a deity—is that not why their gods take pleasure in witnessing the self-torture of ascetics?

Thus it is seen that, for savage men, a savage god is fitting. That we mould God after the image of our own nature is, for us, beneficial rather than harmful.

It has also been observed that when an attempt is made to forcibly establish, in some condition, a religion unsuited to that condition, it can gain no lasting foothold whatsoever. In uncivilized lands, Christianity is Christian in name only; the ancient religion of the uncivilized peoples continues to reign within it.

The above has presented Spencer's view; let us now state what we have to say.

Spencer's first argument is this: man worships God in his own image; therefore, just as man changes, so does God change accordingly. When men are wrathful, their gods too are wrathful; when men are compassionate, their gods too are compassionate; and so on. From this follows the conclusion that as long as a nation's conception of divine character or religion retains mention of contemptible conduct, it will be known that that nation's own nature is likewise contemptible.

Spencer's second argument is this: "As is the man, so precisely is the god suited to him." From this follows the conclusion that every religion is suited to its own particular devotees. For it has already been proven that man naturally moulds God after his own image; now, if it can also be proven that such a god is indeed truly suited to him, then it is proven that every nation's own religion is suited to that nation itself. It is necessary here also to explain what Spencer means by the "suitability" of religion. The suitability of religion consists in restraining men from wicked deeds.

Spencer's third argument is this: as long as an object retains its usefulness, so long can it endure, but no longer. Therefore, when the nature of a particular people undergoes change, their ancient religion becomes unsuited to them, and

consequently perishes of its own accord. If, before this happens, one attempts to propagate a new religion among them, it finds no place.

As for Spencer's claim that when men themselves are wrathful, their gods too become wrathful—that they attribute to their deities whatever vices they themselves possess—this is an utterly incomplete and defective argument. Were it the case that man conceives of God entirely and solely from within his own mind, with no connection whatsoever between the conception of God and the outer world, between it and our sensory perception, then Spencer's claim would be true. But this is not so. In the infancy of religion, men worship one or another portion of external nature as a deity. At that time, the sun, fire, wind—all are deities. If a devotee conceives of fire as cruel, this does not prove that his own nature, being cruel, has rendered his deity cruel as well; if someone conceives of the wind as irascible, one cannot infer from this that he himself is irascible in nature. When he sees before his own eyes that fire, spreading its thousand tongues, destroys huts, villages, and forests, he may easily think of fire as a cruel deity even though he himself may be compassionate. In the external world exist both pleasure and pain, both calamity and prosperity, both life and death; therefore, those who establish deities based upon the external world naturally come to conceive of certain deities as inherently cruel. Especially in an uncivilized state, danger lies at every step, death at every step; therefore, in that condition, the conception of merciless deities does not depend upon the mind alone. Thus, whether I myself am compassionate or cruel, as long as I regard the destructive power of fire as divine, so long shall I know it to be cruel. My own nature may change, but surely the nature of fire will not change on that account. Therefore, to infer man's base nature from the base nature attributed to gods does not hold true in every instance. Hundreds upon hundreds of proofs of this could be given from our own scriptures. All are aware of the account of Brahma's attachment to his own daughter. But such abominable conduct was never in practice among the Aryans; how, then, did so incongruous a conception arise in the hearts of the ancient Aryans?

It is stated in the Shatapatha Brahmana that Prajapati, beholding his own daughter—the Sky, or Ushas—became united with her. In the eyes of the gods, this conduct was sinful; therefore they declared, "He who commits such an act towards his own daughter and our sister commits sin—therefore let him be pierced." Rudra

pierced him. It appears to us that this is an allegory representing the attack of the dawn-mist upon Ushas. For in one passage of the Bhagavata Purana it is stated that, seeing their father's mind inclined towards unrighteousness, his sons the sages, placing Marichi at their head, rebuked him thus: "That you, without restraining yourself, have become enamoured of your own daughter—such a thing has never been done before, nor shall ever be done hereafter. O Lord of the World, for those glorious beings whose example mankind follows to attain liberation, such conduct is by no means to be praised!" Hearing his own children speak such words, Prajapati grew ashamed and cast off his body. That terrible body enveloped the directions in darkness, and this the sages know as the dark mist.

In the Bhagavata Purana, in place of Brahma's daughter Ushas, there stands Vani; we have combined the two accounts. From what has been quoted above, it will be seen that Brahma's sinful conduct has been expressed by the Aryans as utterly reprehensible. But whether reprehensible or not, they saw directly before them that the dawn-mist was forcibly enveloping the dawn—this was, to them, in the manner of a true event.

If, in Greek mythology, some deity is said to have devoured his own kinsman, is the reason for this that the Greeks were so uncivilized as to eat the flesh of kinsmen, or that they did not consider the eating of kinsman's flesh wrong? I once heard a riddle concerning night and dawn, which said that the mother, having given birth, devours her own child. Might not the above Greek tale be some such kind of allegory? If it is true that the Greeks did not eat their kinsmen and considered the eating of kinsmen a sin, then why did their gods develop a taste for kinsman's flesh? If you say that perhaps, in some uncivilized age, the Greeks once did devour their relatives to make them more thoroughly their own, and that this tale originated at that very time—then, when in their civilized state the Greeks' views and conduct on this matter changed, why did their belief not likewise change?

If men also attribute to their gods those actions which they themselves do not perform because they consider them contrary to nature, and which they regard as utterly reprehensible, then how can we say that they attribute only their own virtues and vices to their gods?

In attempting to prove that every religion is suited to its circumstances, Spencer says: "Is it not true that only by fear of savage gods can savage men be kept in check; that the more untamed their nature, the more terrible must their governing terror be; and if governance must be terrible, must not the governing deities also, in that same measure, be cruel and vindictive?" This statement of Spencer's, too, is not wholly true in every respect. There is a certain condition of religion in which the sole purpose of divine worship is to achieve some end, to escape from danger, or even to placate the inherently malevolent, violent tendencies of gods. "I am going to steal—I worshipped the deity; I am going to commit murder—I worshipped the deity; my purpose shall be accomplished." "An enemy nation has invaded—I worshipped the deity, I shall be delivered from calamity." "I worship Olabibi, Shitala, Manasa, and other deities, lest they do me harm." In such a condition, however terrible the deities may be, they are of no use whatsoever in curbing the vicious tendencies of their worshippers. Rather, they incite vice and abet wicked deeds. Does the worship of Kali, and the offering of human sacrifice to Kali, in any way diminish the violent tendencies of bandits? Do they not, rather, gain double strength for their wicked deeds from it? A bandit's nature may change owing to a hundred thousand other external causes, but if he continues, age after age, to worship Kali, his cruelty will increase rather than diminish. Then where is this curbing of the worshipper's untamed disposition that is supposed to arise from the deity being terrible? Rather, it gains further vigour. When society has attained a certain degree of advancement, when people have come to believe that the gods possess certain benevolent commandments, and that violating these will incur divine wrath, then Spencer's argument holds considerably true. But that condition is the fruit of much social advancement. Even now, hundreds upon hundreds of people may be seen on every side who worship gods solely for the sake of danger and prosperity—who worship deities in order to win an unjust lawsuit, in order to send an innocent person to prison—and who never once consider that they are praying for divine favour precisely in order to violate divine command. They never forget to worship their gods thrice daily, yet within those same twenty-four hours they commit hundreds of thousands of sinful acts without the slightest hesitation. If one flower is missing from their worship, if there is some slight deficiency, they become alarmed—yet they think nothing at all of doing wrong! What improvement in nature can possibly come from shedding blood before the deity and reciting mantras before the deity?

At this point Herbert Spencer has attempted a certain reconciliation. He says—

"Certainly, such conceptions as those of the Greeks, who ascribed to the personages of their Pantheon every vice, are repulsive enough. But… the question to be answered is, whether these beliefs were beneficent in their effects on those who held them."

In order to prove that these beliefs were truly beneficial to their worshippers, he states that the more untamed the nature of savages, the harsher must be their governance; and that if governance must be harsh, the governing deities too must, of necessity, be cruel and vindictive. He has mentioned only so much as is necessary for his argument, concealing the remaining part. Cruelty is not the only vice (Vice). A deity may not be cruel at all—but if a deity is a thievish rogue, if a deity is a lying coward, then I should like to know what benefit such a deity could possibly confer upon its worshipper! If the position is that all deities possess some utility, then what is our answer to this question? Reducing everything to its essence, it comes to this: according to Spencer's view, in the uncivilized state, only a cruel deity possesses utility. But, as we have said before, this too is not wholly true in every respect. There exists a condition of society in which, however cruel the deity may be, the untamed disposition of the worshippers continues to increase rather than diminish. If you say that at that time no religion other than their own could survive among them, and therefore that religion alone was possible for them and, in that sense, suited to them—then we ask, where is the sufficient proof of this? The single example that Spencer has cited does not seem to us sufficient. He says that Fijian converts to Christianity, in their penitence, cry out in anguish for a long time out of the soul's restlessness. At last, exhausted, they fall into a swoon; regaining consciousness, they again pray until they lose consciousness once more. Citing this incident, Spencer says that the Fijians are an utterly uncivilized people. They eat human flesh, kill children, offer human sacrifices. There is no trust even among members of the same family. They worship serpents. It is seen that, having become Christians, they have selected only the vengeance, eternal torment, and devil-lore of the Christian religion. This is why they cry out in fear. Their old serpent-worship has merely assumed the name of Christianity. This example above does not prove

in the least that converted Christians who have adopted a higher religion have made no progress whatsoever.

If one applies the argument that as long as a thing retains utility it can survive, but no longer, then whatever religion has survived in a given country must be suited to that country—on this point too, we have one or two things to say.

Human nature possesses both qualities: stability and changeability. It is not the case that change occurs solely in accordance with necessity. This is a law that holds true not merely in human nature but throughout the entire universe. From the Pliocene age down to the present day, the incomplete rudiment of a toe persists in the horse's foot, though it serves no purpose whatsoever—why, according to the law of utility, has it not disappeared? Male mammals too possess breasts, and even their "mammary glands" persist. Many will have heard that milk has appeared in the breasts of many men. There is no proof whatever that male creatures ever at any time suckled their young. If, from ancient times to the present, the male of the human species has never nursed offspring, why does this unnecessary organ continue to exist in the male body?

Professor Haeckel says that among living creatures there exist two kinds of tendencies: one centripetal, by which they preserve their hereditary characteristics; another centrifugal, by which they effect changes suited to external conditions. That is, unless placed in utterly adverse conditions, many unnecessary organs and appendages continue to persist. Let me quote what Professor Huxley has said in an essay entitled "The Genealogy of Animals":

"I think it must be admitted that the existence of an internal metamorphic tendency must be as distinctly recognized as that of an internal conservative tendency; and that the influence of conditions is mainly, if not wholly, the result of the extent to which they favour the one, or the other, of these tendencies."

This law holds true with respect to religion as well. If it be granted that, in the uncivilized state, terrifying hells such as the Kumbhipaka were naturally conceived precisely in order to restrain the untamed heart, it can still be asserted with certainty that as long as belief in that hell persists among a nation, it does not

necessarily follow that their uncivilized condition and untamed heart still persist. A belief, once formed under a particular circumstance, does not perish merely because that circumstance changes. In particular, there is no reason for belief in heaven and hell to perish quickly. No direct evidence is found against it—that is, no circumstance exists that is particularly adverse to that belief. Therefore, once a belief has taken root, there is no reason to shatter it and disbelieve it once more. Citing the mention of the Kumbhipaka and other hells described in our scriptures, Herbert Spencer has called Hindus treacherous, thieving, and lying. If this be so, then what might we not call the Christians! Our scriptures contain no eternal torment. Those who must believe in an eternal hell—one cannot help but wonder how fiendish their nature must become! The plain truth is that men do not view such beliefs through the lens of utility. If people believed by saying, "It has become necessary, therefore let us believe," and abandoned belief by saying, "The necessity has passed, therefore let us cease believing," everything would become exceedingly simple. Once a thing comes to be believed, that belief continues for a long time. Let me offer an example. In some kingdom, if there existed a custom whereby one person is punished for another's crime, who would not condemn such a custom? Such a form of justice does not accord with the sense of justice present within our hearts. Yet why do Christians cite the event of Christ's death for the sake of mankind as proof of God's very justice? How is it that they have, for eighteen hundred years, believed to be justice that which they themselves would never do, and which they would condemn were they to see another do it? How do petty superstitions continue to persist? Many Englishmen believe that if thirteen people dine at one table, one of them will die within the year; though they may many times have received direct evidence against it, why does the belief not disappear?

Finally, I ask: is there any real reason why so many harsh epithets have been applied to poor Hindus? Has Spencer, merely upon reading of the Kumbhipaka hell, concluded that Hindus are treacherous, thieving, and lying? Is this a known fact, on which no one could differ or disagree? Had he first proven that Hindus are indeed treacherous, thieving, and lying, and only then brought up the matter of the Kumbhipaka hell in support of his argument, this would have accorded properly with the rules of logic.

Spencer has said that Hindus have a harsh hell, therefore they must also have a cruel deity. What is the proof that their deities are cruel? Why, that their fakirs practise self-mortification. Deities who take pleasure in witnessing suffering must certainly be cruel. First, fakirs are not Hindus. Second, though it is true that many Hindus practise self-torture before deities (as, for instance, offering themselves as sacrifice before Tarakeshwar), this does not prove that their deity is cruel. Rather, the opposite is true. In our country there are many beggars who obtain alms through self-mortification. The reason for this is not that alms-givers, delighted at seeing suffering, reward the beggar for it. Indian beggars have such faith in mankind's intolerance of another's suffering that they torment themselves in order to obtain alms. The Hindu worshipper has precisely the same faith in the mercy of the deity. He knows that if he inflicts so much suffering upon himself, the Merciful One will surely be unable to bear it, and will surely come to fulfil his desire. If Spencer calls our ascetics fakirs, we may say in this regard that Western philosophers may perhaps not truly understand the inner meaning of what the ascetics, in subduing the body for the sake of the soul's advancement, willingly deprived themselves of worldly pleasure and comfort. On this point, Spencer's error runs deep. This error is not confined merely to what is expressed in this essay—Spencer has said precisely these same things in his treatise entitled Data of Ethics.

Bharati, Baishakh, 1289

SCIENTIFIC NEWS

We had always supposed that our own country held the world's record for mosquitoes—that cold countries knew no such plague. That notion is not correct. One would be astonished to hear of the abundance of mosquitoes in the cold, arctic region called Alaska. One writer has recorded that there, it is difficult even to hunt beasts and birds, for dense swarms of mosquitoes fly like clouds and obscure one's aim entirely. Sometimes mosquitoes there even kill dogs. A certain Mr. Swatka writes that he has heard of mosquitoes there killing even a large bear. When a bear wanders into a mosquito-infested marshy region, it stands and tries to fight off the swarm with its two paws, but the effort is in vain. Not a single scratch from its great claws touches the mosquitoes, and there is no way to catch hold of them either. At last, blinded by mosquito bites, the bear collapses and, unable to feed itself, dies. Nowhere else does the mosquito exercise such fearsome dominion as in the cold arctic regions. All who travel by ship to the polar regions know this well. Wherever the ship stops, swarms of mosquitoes come and attack the vessel, entering the sleeves of coats and drawing blood with terrible ferocity. Two brave men once disembarked from their ship to go hunting. One of them was a German soldier. This man had, during wartime, traversed France on horseback with great valour and encountered no danger whatsoever; yet here, plagued by mosquitoes, he fell from his horse and was left lame. Both horse and rider had grown so restless from the torment of mosquitoes that self-control had become impossible for either. This soldier, upon returning to the ship, related: "Mosquitoes enter one's very stomach; with each breath, mosquitoes enter the nose; one must spit them from the mouth continually." In that country, the mosquito plague is somewhat less severe in summer, because birds come and eat a great many of them. In our own country there are so many birds—yet mosquitoes are hardly scarce either.

It is a common belief that water does not permit fire to burn, but Mr. Baker has recently demonstrated through experiment that if any substance can be dried absolutely completely, it will no longer burn at all. Perfectly dry wood does not burn. But this is difficult to test, for watery matter exists on every side. Air contains water; gas contains water. It is difficult to eliminate water altogether. Experiments have shown that even highly combustible substances cannot burn without the

presence of watery matter. Thus it is seen that water actually assists in the process of combustion.

An estimate has been made of how much rifle ammunition is wasted in war. In the Franco-Prussian War, it was found that 1,300 bullets were expended to kill a single soldier. At the Battle of Solferino, 4,200 bullets were required to kill each soldier.

Many scholars conjecture that, like the sea, the earth's crust is also constantly undulating and shifting; that tides ebb and flow across its surface. Among the countries of the world most prone to such tremors, Japan holds a prominent place. There, tremors both small and great continually arise. In our own land there is not so much of this movement, but it is not entirely still either. Just as the water of the sea trembles when an oar is dipped into it, so does the ground tremble when carts and carriages pass along a road—everyone has observed this. European scientific scholars have recently begun experiments concerning these earth-tremors.

Most people, I believe, know that disguise is commonly practised among insects for purposes of hunting food and self-protection. Beyond this, many insects gain advantage in self-protection and food-gathering by bearing a natural resemblance in form to flowers, leaves, and the like. A blue butterfly was flitting from flower to flower in search of nectar. Amid a bouquet there appeared a flower somewhat withered; the moment the butterfly touched it with its proboscis, it was instantly caught. It was not a flower at all—it was a white spider. But it disguises itself in such a manner that it can easily be mistaken for a flower.

Just as a lizard's severed tail continues to twitch, so does a spider's severed leg continue to move. If an enemy seizes hold of its leg, the spider readily sacrifices attachment to the limb and lets it go. Even losing one or two legs causes them no great harm—they run off with ease.

Among gardeners in England there exists a saying that wherever the English marigold is planted, insects and pests do not come. A plant likely to be infested with pests can be protected by planting English marigolds around it. This can easily be verified by experiment.

The eminent scholar Mr. Tyler says that, upon examination, one can discern in the actions of plants a certain semblance of independent intelligence. A tree does not act merely as a lifeless mechanism—it acts, to some extent, as though guided by discernment and consideration. Mr. Tyler has been conducting experiments on this subject for many years. He says that when artificial obstacles are placed in their way, trees attempt, by various means, to overcome them, and even alter the arrangement of their branches to suit their own convenience. On this subject he has recently delivered a lecture, employing various other kinds of proof.

Along the coast of Travancore, at the ports of Narakal and Alleppey, the sea is exceptionally calm. Even when storms rage on every side, the peace of these two harbours remains undisturbed. There is a reason for this. In English, an old saying has long existed that pouring oil upon a troubled sea calms it. Many had considered this baseless. But it has recently been proven by experiment that pouring oil does indeed cause the waves to subside. Some time ago, a proposal was read advising that every ship carry a substantial quantity of oil, so that in stormy weather this oil might be poured gradually along both sides of the vessel. From the sea-bed near the ports of Narakal and Alleppey, petroleum oil continually rises up. There is a similar source of oil in the sea near the California coast. There too, the sea remains calm.

Among America's artisans and labourers, learning is widely cultivated, and for this reason, handiwork there is executed with exceptional finesse. In the United States there are two hundred twenty-five thousand eight hundred public schools—that is, one school for every two hundred people. In Massachusetts alone there are two thousand libraries—that is, one library for every eight hundred people. Many suppose that education impedes skill in craft, but this is a mistaken notion. Education aids every kind of work. One principal reason the Germans defeated the French in the Franco-Prussian War was that they were educated—for this reason, they had achieved greater proficiency in the use of weapons.

A French scholar named Carbonnier states that in a pool near the Ganges there is a species of exceedingly small fish that build nests in the water, much as birds do. These fish are extremely beautiful, coloured in various hues like the rainbow. They take a certain kind of plant in their mouths from within the water and place it upon

the surface; and so that it may not sink again, they release air from their mouths and float it upon bubbles. The next day, they fill up this plant-mass with bubbles and shape it into a round form. After the male fish enters within and cleans it, the female fish is called to lay her eggs there. Having laid her eggs, she departs, while the male fish tends the eggs. In this manner ten days pass. When the eggs hatch, the male enters the nest, punctures it, and releases some of the trapped bubbles. It then no longer remains round, but spreads out flat.

We ourselves dwell close by the Ganges, yet we do not properly know what fish this is. Do readers who live along the banks of the Ganges have any knowledge of this fish?

Balak, Ashwin-Kartik, 1292

THE SENSE OF MOTION DETECTION

In one section of our inner ear are three semicircular canals shaped like tiny eyes, whose particular function has not, to this day, been satisfactorily determined. Physiologists formerly supposed that they served to determine the direction of sound. But recently one or two scholars have established a quite different function for them.

They say that, up to now, no physiological explanation has been discovered for how we perceive motion. If a carriage moves along a straight, level road without any jolting whatsoever, we cannot tell that the carriage is moving at all—a sailing boat is an example of this. But if the carriage turns right or left, or stops, we know it instantly. According to these scholars, the aforementioned portion of the ear's apparatus is precisely the means by which we perceive such changes of motion. There is a certain disease in which the patient staggers while walking, falls to one side, and becomes unable to hear. It has been discovered through examination that this disorder of the semicircular canal is indeed the cause of their illness. If they cannot properly determine which direction, and to what degree, they are tilting, walking steadily inevitably becomes impossible for them. Everyone knows that an instrument for measuring the elevation and depression of ground is constructed by placing liquid within a glass tube; within our aforementioned ear-canal there likewise exists such a liquid substance, which, in all probability, changes position according to our changes of motion, thereby alerting our nerves, whereupon we too, accordingly, instantly proceed to balance the weight of our body.

WILLED DEATH

Our will does not hold sway over every organ of the body. Digestion, blood-circulation, and similar functions do not depend upon our volition. We can close our eyelids at will, but we cannot close our ears. Seals, when diving into water, can close their nostrils and ears at will. We too possess muscles capable of closing our nose and ears, but they have become largely useless—we can wrinkle our nose upon perceiving a foul odour, but we cannot close it. Yet occasionally certain people are found who can, with the ease of animals, wiggle their ears and move the skin of their scalp. Cattle can chew the cud, which is impossible for humans; yet many people can vomit at will with ease, having, by chance, acquired mastery over the muscles of the stomach. Everyone knows that we possess certain nerves that obey the commands of our will. The will decides to raise the hand, and instantly, through the nervous pathway, that command is issued to the muscles of the hand, and the hand rises. But, as stated above, the sway of this messenger of will does not extend everywhere in the body; by some accidental disruption in bodily constitution, this will-transmitting nerve may occasionally take up residence in an unaccustomed place, giving rise to extraordinary sensory powers in a person. Ordinarily, it is not within human capacity to arrest bodily processes at will. But an astonishing example of this is recorded in medical literature. A certain Colonel Townshend was able to die at will. At first the doctors did not believe this. They set about examining him. The Colonel lay down calmly on his back for some time. Gradually, before their very eyes, his pulse diminished, his heart's motion ceased; at last, no sign of life remained. The doctors grew alarmed. But after half an hour, his pulse gradually returned, his breathing resumed, and he began to speak. Medical science holds that, due to some abnormal cause, voluntary nervous control had come to be established over the muscles of his heart and lungs. But how life is preserved while bodily function is thus arrested for half an hour, who can say? Similar instances are said to have occasionally been found among yogis in our own country. But the difference between the yogi and the patient is this: the yogi has attained this capacity through spiritual discipline, whereas the patient has obtained this same result through an involuntary derangement of the bodily mechanism.

THE GLORY OF THE FEMALE SEX IN SPIDER SOCIETY

Regarding masculine prowess, there is simply no comparison between the female spider and the male spider. First, in size the female spider far exceeds the male; moreover, her power is far greater still. There is no limit to the torment she inflicts upon her husband—she beats and bites him until he is utterly worn out. Indeed, she often even kills and devours him; such a complete union of matrimony can scarcely be found, I suspect, in any society of higher-order creatures.

THE KICK OF THE OSTRICH

While building its nest, this vast desert-dwelling bird becomes exceedingly fierce. Upon seeing a human nearby, it charges and attacks, and, swinging its legs, delivers one tremendous kick. It is said that a single such kick has broken a horse's spine. Escaping this bird's attack by running is impossible—none can outpace it in speed. In such a situation, the only recourse is to lie face-down upon the ground and patiently endure its kick. One man, attacked by such a bird, forcibly held its neck bent down to the ground. By chance, the bird's kick landed upon its own bowed head, scattering its own brains, and the man escaped entirely unharmed.

Sadhana, Agrahayan, 1298

THE POWER OF LIFE

Whether we will it or not, the functioning of our bodies proceeds without pause; and we scarcely realize what vast energy is expended in this process.

Our heart is divided into four chambers. Of these, two chambers receive the blood entering from the body, while the other two contract like a blacksmith's bellows, driving blood throughout the entire body. Day and night, this labour knows no rest. This is no trivial task even for so small a muscular organ. Of the two blood-circulating chambers, the left chamber, with each contraction, propels four ounces of blood to a distance of nine feet. The right chamber is comparatively weaker, but it too must labour. In a healthy adult, the heart contracts 75 to 76 times per minute. Calculation shows that the energy expended by the heart in circulating blood over twenty-four hours would be sufficient to lift a weight of more than three thousand maunds (120 tons) to a height of one foot.

Just as the contraction and expansion of the heart proceeds without cessation, so too does breathing know no pause. Through this process, the chest continually rises and falls, and the ribs, muscles, and lungs are engaged in this ceaseless rising and falling. In twenty-four hours of rest, six hundred eighty-six thousand cubic inches of air pass through the lungs of an adult, and during exertion, this volume of air may increase to as much as one million five hundred sixty-eight thousand three hundred ninety cubic inches. Drawing in and expelling so much air is no small task. Moreover, the lungs and chest wall offer resistance to this air, and it is by the strength of the muscles that this resistance is overcome to accomplish the act of breathing. The energy expended by our respiratory muscles in twenty-four hours would be sufficient to lift a weight of more than two hundred maunds (21 tons) to a height of one foot.

Beyond this remain the labour of the brain, the labour of the digestive organs, and various other bodily processes; calculating all of these together, one sees what an enormous quantity of energy is expended even in complete idleness. We have examined here but a small fraction of the reckoning for a mere twenty-four hours.

If one were to consider the entire lifespan of a single human being, one would understand just how immeasurable is the power of life.

THE AUTHENTICITY OF GHOST STORIES

Sir Edmund Hornby was Chief Justice of the highest Consular Court of China and Japan. He has recorded a direct experience from his own life.

Whenever he wrote a judgment in some case, newspaper correspondents would come in the evening to collect that judgment and would publish it in the next day's paper. One day, having written such a judgment, he had left it with his butler; the arrangement was that when the correspondent came, the servant would hand him the judgment. The judge was asleep at night when he awoke, hearing a knock at his bedroom door. He understood that someone was standing outside, awaiting permission to enter the room; when he bade them enter, that same newspaper correspondent gravely entered the chamber and requested his judgment. Angered by this unauthorized entry into his very bedchamber, Hornby ordered him to obtain the judgment from the butler; yet the man continued to make his request again and again, just as before. Partly disturbed by his entreaties, partly fearing lest Lady Hornby be awakened, the judge did nothing further, but briefly recited aloud, word for word, the substance of his written judgment. The man took it down, and, begging pardon, departed. It was then half past one in the night. Not long after, Lady Hornby awoke, and her husband told her the whole occurrence. The next day, upon going to court, the judge received the news that this same correspondent had died between one and half past one the previous night, and that he had not left his house that night at all. The inquest determined heart disease to be the cause of his death.

When this tale was published in the Nineteenth Century magazine, it excited the greatest astonishment among the public. Especially since Mr. Hornby was a great judge of a great court—whose very profession it was to weigh with precision the truth or falsehood of evidence. And he himself had stated that he was, by generations of family tradition, a man of law, utterly devoid of imaginative fancy, and disbelieving in the supernatural.

Four months after this account was published in the paper, Mr. Balfour, editor of the North China Herald, offered the following rebuttal in the Nineteenth Century:

1. Mr. Hornby says that Lady Hornby was together with him at the time of the described incident. But at that time there existed no such person as Lady Hornby at all. For Mr. Hornby's first wife had died two years before the said incident, and he married his second wife four months after the incident.

2. Mr. Hornby mentions the examination of the corpse by an inquest, but upon inquiring of the examining Coroner himself, we learned that no inquest was ever held regarding the said corpse.

3. Mr. Hornby indicates the 28th of January, 1875, as the day of the publication of his judgment. But no judgment was published on that date in the court's gazette.

4. Hornby says that the correspondent died at one o'clock at night. This is untrue. His death occurred at eight or nine o'clock in the morning.

Against this rebuttal of Mr. Balfour's, Sir Hornby could say nothing at all; he was obliged, in a manner, to admit the whole of it.

After this, it becomes exceedingly difficult to remain free of doubt regarding the authenticity of testimony to supernatural occurrences.

THE HUMAN BODY

Those who have read the essay "Life and the Living" published in Sadhana will already have gained some inkling that the animal body is an assemblage of countless minute living cells. Reflecting carefully upon this fact, one is filled with wonder.

Scientific scholars say that wherever, in our bodies, the current of life flows, it is composed entirely of a jelly-like substance called protoplasm. Not merely the human body, but every living substance—plants and all else—possesses no vital force whatsoever apart from protoplasm.

Examining the human body under the microscope, it will be seen that this protoplasm, bound within exceedingly minute cells, is perpetually at work. In certain places, it has taken the form of fibres and formed our muscles and nerves. But it is these aforementioned cells that constitute the living, functioning substance of our body.

A mere particle of the vital substance called protoplasm, enclosed within a delicate membrane, forms a single cell. At the centre of every living cell lies a condensed point. These cells are so minute that their scale defies conception.

It is these very cells that are the labourers of our body, the citizens of our vital kingdom. It is they who are constructing our bones, expelling the body's waste matter, transforming into muscle tissue. The nerve cells are the capital city of the body. It is they who are engaged in such great tasks as the defence of the realm, the administration of law, and the like.

Among these there exists a division of labour; everything from the secretion of digestive juices in the alimentary canal to the formation of bone has been distributed among distinct, separate groups. One group scarcely interferes in the slightest with the work of another. Most of their functions are carried out almost independently, though they all acknowledge the brain and nerves as the governing authority.

If one considers how countless are the tasks performed by our body, and with what discipline this multitude of cells carries out these tasks, one cannot but marvel. Some are supplying saliva upon the tongue, some generating vapour to keep the eyeball moist, some manufacturing digestive juices in the stomach—and there are yet several thousand other tasks besides. The living cells of which the liver is composed perform only the thousand tasks of the liver, and nothing else whatsoever—such is the functional discipline of every cell belonging to a particular organ. The cells of which the brain is composed sit at the highest chamber of the body, ceaselessly engaged in affairs of state.

Thus, the human body is like a society. A confluence of countless citizens in unity. Just as an army is divided into various divisions—cavalry, infantry, and the like—and each division is itself a composite of many individuals, yet all together maintain an exceedingly cohesive unity, like one great living creature; some are dying, while new persons come to fill their places—the living body of man functions precisely in this manner. Each one of us is, alone, a thousand—indeed, far more than that.

DISEASE-ENEMIES AND THE BODY'S GUARDIAN ARMY

That water is as full of fish as land is of animals, and air likewise full of countless microbial seeds, is no novel notion in these present times. Everyone knows that mould arises in molasses and honey, that things left standing grow mildewed, that dead bodies rot—and that these very microbes are the cause. Wherever this microbial seed falls upon a suitable field, it swiftly attains maturity and begins to multiply. How minute these organisms are defies proper comprehension. One writer says that if arranged in a single layer over one square inch, the population of bacteria could be made to exceed the human population of London a hundredfold.

The celebrated French scholar Pasteur divided these microbes into two classes. One group he named aerobic, the other anaerobic. The aerobic organisms take birth upon the surface of dead bodies, causing them to putrefy, and gradually consume and destroy them by combustion; the anaerobic ones arise in the lower layers of decaying matter and continue to bring about its decomposition; they die the moment they are touched by pure oxygen vapour, and the surface-dwelling aerobes destroy them in turn. In this way, the two groups together continue to remove all dead matter from the earth. Were they not to exist, death would become immortal, and there would remain no place on earth's surface for one's foot to fall, so heaped would it be with undecayed corpses. In whatever regions of the earth these microbes have no activity, there exist no living creatures or plants whatsoever. Such places are either sandy deserts or endless fields of snow. There, dead bodies refuse in any way to decompose; without the aid of vultures, kites, or some providentially appointed carnivorous creature, there exists no other means of removing the dead in such places.

When, in France, at one time, a certain epidemic broke out among silkworms and began to severely damage the cultivation of silk, Pasteur, being especially entreated, set aside his other work and turned his attention to seeking a remedy for this disease of the silkworm. Pasteur was not a doctor, nor a biologist—his particular expertise lay in chemistry; how wine ferments and becomes spoiled—it was upon this inquiry that he had spent the greater part of his time; that he should

suddenly sit down to diagnose a disease of silkworms might seem, in a certain sense, an unauthorized intrusion into another's domain. And Pasteur himself hesitated somewhat, at first, to undertake this task. But how extraordinary—by means of the microscope, after some days of investigation, the great scholar came to see that just as microbes cause wine to ferment, so too are microbes the cause of the silkworm's disease. A unity emerged between the disease of wine and the disease of living creatures, and he was able to apply here the very line of inquiry he had earlier pursued elsewhere. Finally, following this thread, it was gradually discovered that many diseases of the living body are indeed caused by these very microbes. They are ceaselessly searching, like Saturn and Mars in their malignant aspects, for an opening by which to enter the body; the moment the rules of hygiene are violated, they seize that opportunity to take refuge in the body and begin to corrupt its fluids.

That there exists an invisible enemy without, there can be little doubt that there exists within us some measure of countermeasure against it as well. It has recently been discovered that just as there are enemies, so too are there internal guardians of ours. Something like guard-dogs. Both are utterly minute. We have compiled below some portions of the description given by Dr. Wilson on this subject.

Examined under a good microscope, blood appears colourless, like water. The reason for this is that, in truth, countless red corpuscles float upon a colourless fluid; to the naked eye, it is these floating red-coloured corpuscles that make blood appear red to us—without the aid of the microscope, we cannot perceive that colourless fluid at all. These red corpuscles of the blood have a particular function.

With every breath we draw in, these red corpuscles gather oxygen from the air we inhale, and carry to the lungs the poisonous vapour known as carbonic acid gas from the body's carbon, which we then expel with our exhaled breath.

The function of white corpuscles is of a different kind. Each of them is an extraordinarily minute living cell. Their size is one twenty-five-hundredth of an inch. In a previous issue of Sadhana, in the essay "Life and the Living," the account of the most primitive of living substances, called protoplasm, was described; these white corpuscles of the blood are precisely such protoplasmic cells. Though they dwell

within our bodies, they are nonetheless independent living organisms. These millions upon millions of streams of life wander about our bodies quite as they please; we have no control whatsoever over their movements. Often, as though at their own arbitrary will, they pierce through the walls of blood vessels and enter into the tissues of our body, emerging to roam about in various parts of the body.

Examined under the microscope, it is seen that, like amoebae and similar organisms, they continually change shape. And it has also been observed that when they find some particle of food, they attack it and set about digesting it in proper fashion. Observing precisely this capacity for feeding, scholars have given it the name "Phagocyte," that is, "devouring cell." Its other name is "Leucocyte," or white cell.

An example may be given of how voracious these are in feeding. Everyone knows that when a tadpole becomes a frog, its tail disappears. It has been observed under the microscope that white cells, leaving the blood vessels, occupy the tadpole's tail in great numbers and set about devouring it. The nerves and muscles there are torn to shreds and eaten. The inhabitants of the body, thus intent, can only leave the wretched, useless tail to survive so much longer. It is for this very reason that the tadpole's tail disappears upon reaching maturity.

Nor is the mere disposal of the body's unnecessary burden their only task. When any germ enters our body from without in the form of disease, these attack it and engage in a regular hand-to-hand battle. If the external invaders are victorious in this battle, we are overwhelmed by various maladies such as fever; but if our body's guardian army proves victorious, we are delivered from the disease.

I recall having read, in some other essay, that not only disease—whatever painful substance enters our body, these all-devouring cells attempt to attack and destroy it. If a speck of sand falls into the eye, these rush swiftly to eliminate it—the eye turns red with the mark of that struggle. If the body is somehow wounded, these soldier-corpuscles crowd in and turn that place red. Examining the pus of a wound, it can be seen that these are attacking the disease-germs from all sides and attempting to consume them.

In a healthy state of the body, I believe these white corpuscles naturally remain vigorous and can easily overcome disease-germs. But due to causes such as starvation, excessive exertion, indigestion, and the like, when the body is in a weakened state and these lack vigour, disease-germs such as malaria and cholera suddenly attack and overwhelm us.

However this may be, remembering that airborne living germs are ever seeking a suitable field for the production of disease-crops, none can remain ignorant of how absolutely essential it is, for our own good and that of our neighbours, to keep food, drink, and dwelling clean.

THE SUN AND MOON AT RISING AND SETTING

Why the sun and moon appear so much larger at the horizon during rising and setting was discussed to some extent in the Sadhana of the first year. One reader of Sadhana wrote to say that this always occurs on account of the refraction of the air. Regarding this, we present a summary of what is stated in Proctor and Ranyard's treatise entitled Old and New Astronomy.

Mr. Proctor has shown that the visible diameter of the sun, owing to the refraction of the air, diminishes considerably in the vertical direction, yet does not increase laterally. Indeed, the diameter of the moon diminishes both vertically and laterally.

Knowing that the detailed account of the causes underlying this phenomenon would prove complex and tiresome to many readers, we refrain from elaborating upon it here. Should readers wish, they may find the full account by consulting page 247 of the treatise we presently cite.

However this may be—through atmospheric refraction, the disc of the sun and moon appears smaller—so why, then, do we mistake them for larger?

Mr. Proctor says that the sky appears to our eyes as a spherical dome. The portion of this dome directly overhead seems to us less distant, while its boundary toward the horizon below seems considerably more distant. The reason for this is that, ordinarily, there exist no adequate means of measuring the height of the sky, but when we observe the sky merging with the horizon beyond houses, dwellings, human settlements, fields of grain, rivers, forests, and mountains, many objects are found by which to gauge its distance in that direction.

Thus, through lifelong habit, unknowingly, we regard the sky at the horizon as far more distant than the sky directly overhead.

Therefore, when we see the sun and moon touching the horizon at rising or setting, this same preconception leads us to judge them as comparatively far more distant;

and for this reason, we mentally enlarge them beyond what their diameter appears to be to the eye.

There exists an experimentally proven demonstration in favour of this. Draw a very large black letter on white paper and gaze at it for a considerable time. At last, when your eyes grow weary from staring, if you lift your gaze from the letter and look at the white portion of that paper, you will see there too a white letter corresponding to the black one. This is because, from prolonged staring, that letter has become imprinted upon the retina of the eye. But if, after gazing long at that letter, you suddenly cast your glance toward a distant wall, you will see a letter of exceedingly enormous size. Yet in actuality it is by no means larger than the letter written on the paper, for it is precisely that same letter which has been imprinted upon the retina. But multiplying it by the distance of the wall, we mentally enlarge it in accordance with our habitual preconception.

Often, seeing the sun or moon through mist, for this very same reason, its true visible size seems larger than its actual volume. For distant objects appear hazy, and hazy objects are mistaken for being more distant. The more distant something seems, the greater its volume will correspondingly appear. The author says that many have directly observed how a ship, seen through mist, appears extraordinarily large; but if measured for comparison by suitable instruments, it is found that there is scarcely the slightest difference between its size then and its size when the mist has cleared.

Through proper measurement, it has not been proven that the moon at the horizon is in any way larger than the moon at its zenith.

CHANGES CAUSED BY HABIT

Through habit, alterations may be effected in our limbs and organs. There is a great difference between the hand of the plough-bearing farmer and that of the pen-bearing gentleman. Everyone is aware of how small and deformed the feet of Chinese women become through artificial means.

But whether such changes, brought about by habit or artificial causes, are transmitted from generation to generation is a matter of current discussion among scientists.

Herbert Spencer says that perhaps, unless this is admitted, the doctrine of evolution remains incomplete. But the German scholar Weismann has proven, through abundant argument, example, and experiment, that novel bodily variations produced by habit are not transmitted through succeeding generations. The celebrated evolutionist Mr. Wallace also supports Weismann's position.

He says that if a young horse or dog of good breed becomes, for some reason, crippled or deficient in some limb, breeders of animals nonetheless keep it free for the purpose of reproduction. And its offspring are in no way inferior to their ancestors on this account.

Among ordinary people there also exists a belief that among craftsmen's classes such as weavers, descendants attain, without any instruction, the particular skill in work that arose from their ancestors' practice. Wallace says this is a delusion. For if this were true, then the offspring of a father of greater age would attain proportionately greater natural skill. In that case, the youngest sons would be the most accomplished. But there exists no proof of this whatsoever. The children of gifted persons do not become gifted—rather, examples of the opposite are found more frequently. Were this not so, then artistic skill and genius in the world would have continued to develop, generation upon generation, to an ever-greater degree.

But certain writers say that the appearance of certain particular new organs among special classes of creatures cannot be attributed to any other cause if one does not

consider it the result of long-accumulated habit. Take, for instance, horns. Those animals that habitually butted with their heads developed thickened skin on their foreheads, and their bones were pushed outward accordingly; that alteration, transmitted to their offspring, increased through habitual practice, and was transformed into horns of varied and curious form.

Wallace says there exists no proof whatsoever of this claim. In Darwin's own treatise it is seen that in certain countries, small elevations resembling tiny horns have been observed on the foreheads of horses. But among no breed of the ancient lineage of horses have horns ever been observed. Had horns existed, according to the laws of natural selection, it would have been most improbable for such a weapon of self-defence to have disappeared entirely. Therefore, this small "horn" of the horse is a novel development.

The porcupine's quills, the feathers of birds, and similar features—it cannot be said with certainty that these have arisen through particular habitual exertion.

It has been established through experiment that the sensitivity to touch is not uniform throughout every part of our body. What we cannot perceive at the middle of our back is easily perceived at the tip of our fingers. Herbert Spencer says the reason for this is chiefly that, since we touch and examine all objects primarily with our fingers, their tactile sensitivity has increased through habit, and this capacity has continued to be transmitted through successive generations. But on the back, the opposite is true.

Wallace says natural selection is the cause of this. Our survival depends considerably upon the sense of touch. Wherever on the body an injury does greater harm to life, that place possesses proportionately greater tactile sensitivity. The tactile sensitivity of the eye is greatest of all, and yet none could say that touching objects with the eyes is our most habitual practice. But if the eye is lost, sustaining life becomes exceedingly difficult; therefore, those creatures whose eyes are exceedingly sensitive to touch, capable of perceiving the slightest contact and becoming instantly alert to protect the eye, are precisely those that survive through natural selection. Many further examples of this kind have been demonstrated.

Thus, according to Wallace's view, the habitual practice of a trait has no efficacy whatsoever. Natural selection is its principal agent. That is: whatever offspring are, for some reason, born possessing some additional advantage over others survive victorious in life's struggle; the others cannot compete with them, and consequently perish. In this way, this new advantage, and the creature possessing it, become permanent. If, among hornless deer, through some obscure cause, a horned deer is born, then by the strength of its horns, it will be capable of gathering more food and of securing does to its liking. And the more that horned deer are born into its lineage, the more inevitable becomes the extinction of the hornless deer.

Thus, according to many present-day evolutionists, it is inborn advantages that become permanent in the animal kingdom, not advantages acquired through habit.

THE SPREAD OF CHOLERA

That India is the birthplace of cholera admits of very little doubt. In the year 1817, this terrible epidemic set forth from Bengal to conquer the world, and, crossing the Indus, the Euphrates, the Nile, the Danube, the Volga, and finally even the Saint Lawrence and Mississippi rivers of America, raised cries of lamentation in lands both near and far.

But by what path this disease travels—water, food, or air—has not yet been established beyond doubt. However, considerable evidence suggests that water is its most important vehicle. There is discussion on this subject in the New Review of May.

In 1849, when this epidemic broke out in London, the water of the Thames river was generally used there. The city's sewage flowed into this very river. At that time it was observed that the further downstream from the city the river water was drawn, the greater the number of deaths; and among those who used water from the comparatively less contaminated parts near the city, the death toll was correspondingly low.

In 1854, when the cholera epidemic occurred in London, another piece of evidence on this matter was obtained. Among the two water companies that supplied piped water in London, the Southwark and Vauxhall Company drew its water from the Thames near a sewage outlet in a place called Battersea. Whereas the Lambeth Water Company drew comparatively purer water from much further upstream. In various parts of London, the pipes of these two companies ran adjacently, side by side, in the same houses; and yet, comparing the death rates, it was found that among those who used the Southwark and Vauxhall Company's water, fifty-seven per thousand died, while among those who drank the Lambeth Company's water, only eleven per thousand died.

In 1854, cholera appeared in a small district of Soho, London, called Golden Square. A commission was convened to determine the cause, and they found that the people of that district drank water from a particular well. Through investigation,

they learned that, shortly before the outbreak of the epidemic, a local drain had become so decayed that sewage seeped through the soil and mixed with this water. Remarkably, right above the street where this well was located stood a distillery, and its workers did not drink that water—and not a single one of them contracted cholera.

In 1885, a coolie-ship named the Dorunda, having left England, took on coal at a port in Java about a month later. No cargo was loaded there; only fruit and vegetables were taken aboard for the first-class passengers. Distilled water had been used throughout the voyage, and no water had been taken from any port. After leaving port, cholera appeared aboard the ship. But none of the first-class passengers fell ill. They had eaten the fruits and vegetables, and had disembarked at the port to spend the night ashore. Some sand had been brought from the shore to clean the ship's deck. This sand, having been used in certain sections of the vessel for two days, had been discarded on account of its foul odour; the ship's crew believed that the seeds of cholera lay within that very sand. If this is indeed true, then in this instance water cannot be blamed. It must be inferred that the poison was absorbed into the body through inhalation from the sand.

The steamer England set out from Liverpool in 1866 and reached Halifax. Along the way, three hundred persons died of cholera. Upon reaching port, the pilot tied his boat alongside the ship and brought it to its appointed place. The pilot and his two companions never even set foot upon the ship. Yet two days later, the pilot himself was struck with cholera, and on the third day, one of his companions too was seized by the disease. At that time there was no cholera anywhere else in that region. Here too, nothing but the air can be held responsible.

In 1884, Mr. Koch established cholera as the action of a particular microbe upon the body. Though this view has not yet gained universal acceptance, it is nonetheless believed by the majority.

Many microbial seeds, remaining dry for long periods, revive again upon finding a favourable medium. But Mr. Koch's cholera microbes have not, to this day, been observed to produce seeds, and once dried, they die. If this is true, then living cholera microbes cannot, by resorting to dry receptacles such as dust, become

widely dispersed through the air in all directions. Water alone is their broad highway, and the cholera microbe is aquatic in nature.

ETHER

That ether is beyond the reach of touch, and offers no resistance whatsoever to the motion of matter, has been thoroughly investigated. For this reason, many educated persons, I believe, regard the existence of ether as a mere hypothetical conjecture. But ether is not beyond the reach of our senses—our perception of light and heat is itself its proof.

The matter, in brief, is this: on earth, light and heat are radiated chiefly from the sun. If any known substance exists in the sky between the earth and the sun, it is an exceedingly rarefied gas—sometimes in atomic form, sometimes gathered in small clusters; but between these there exists considerable separation. These disconnected particles are entirely unsuited for the task of transmitting light. In particular, the speed at which light travels cannot be sustained by the motion of any solid, liquid, or gaseous substance. Therefore, it undoubtedly has its own distinct vehicle. That it possesses such a vehicle cannot be denied, for it has been thoroughly proven that light rays are wave-like in their vibration, and that the timing of their motion is precisely determinable.

That action cannot occur through empty space unsupported by anything is an incontrovertible principle of science. Matter acts only upon substances contiguous to it. Force can traverse from one place to another only by means of some uninterrupted intervening medium. Between the earth and the sun there is not merely a relation of radiated light—there is also a bond of attraction. This attractive force is by no means small; the pull exerted could not be sustained even by seventeen feet's breadth of steel cable of a hundred trillion strands. Who or what is transmitting so vast and powerful a force? It is difficult even to separate a steel plate by applying considerable force; and yet it is known to all that the atoms of any substance whatsoever are not directly touching one another—there exist gaps between them, and it is in these very gaps that the universally pervading connecting substance called ether resides, binding together the unconnected clusters of atoms. This intermediate substance is indeed beyond the reach of touch, yet it possesses such a property that it can transmit the most powerful attraction.

It is not merely through the perception of light and heat alone that we sense the vibration of this ether. All those scientific instruments through which we gain knowledge of electric current are, as it were, instruments for gauging the pulse-beat of this universal ether. Even now, the speed and force of this light, this electricity, have not been determined; even now, its workings lie beyond the grasp of mechanical theory. In the present century, extensive information has been gathered concerning these matters. Many scholars hope that in some future century a definitive theory shall be established regarding this, and upon that theory a new foundation shall be laid for the whole of physical science. Vital force and mental force have likewise not yet fallen into the grasp of science, but the celebrated physicist Professor Oliver Lodge conjectures that, together with ether, these two shall also be grasped—that between them, perhaps, there exists some hidden connection.

SUBTERRANEAN WATER AND AIR-CURRENTS

When rainwater falls upon the earth's surface, a portion of it is absorbed and dried up by the soil, a portion evaporates into the air, and the remainder flows across the land's surface in the form of streams and rivers.

If the soil is somewhat compact, much of the water remains upon the surface, creating marshes, swamps, and the like.

The present essay concerns itself with that water which penetrates into the soil.

Some portion of this soil-absorbed water is drawn up by grass and the roots of trees, and that moisture escapes as vapour through the leaves. But the greater part of the water is stored in the depths through pores and fissures, and if the strata slope, this subterranean water likewise flows accordingly downward.

How the overlying current of water disappears when the soil strata are riddled with pores can be understood from the example of subterranean rivers such as at Phultu.

Exactly how far down into the soil the water above the earth trickles, and why it comes to a stop at some particular point, has not yet been satisfactorily determined. But it has been observed that upon descending some distance beneath the surface, one arrives at a completely water-saturated zone, where every pore of the soil, instead of containing air, is filled entirely with water.

Just as the water of the sea is level everywhere, so too does the water beneath the ground possess a certain level. What the level of the subterranean water is in any particular region can be understood simply by observing the water-level in the wells of that country.

This water flows ceaselessly, at a gentle pace, toward the sea or some nearby body of water, and depending upon the season, this water-level sometimes rises and sometimes falls.

The height of this subterranean water-level is determined, in different regions, according to the nature of the soil. In marshy areas, this water-level may perhaps be found just a few feet below the surface; in other places, this water-level becomes visible only several hundred feet below. In whatever region there exists, at whatever depth below the surface, an impermeable stratum of soil capable of retaining water, the subterranean water-level in that region is fixed at that particular depth.

This universal underground flow of water is by no means a trivial matter for mankind. By means of wells, ponds, springs, and the like, this very water quenches the thirst of most of humanity throughout the world—and it has, moreover, an intimate connection with the preservation of health.

As has already been said, depending upon the season, the level of this subterranean water rises and falls. And this rising and falling has a connection with the increase and decrease of certain particular diseases. Dr. Pettenkofer says that the higher the water-table rises, the more typhoid fever spreads. In his view, this occurs because the moisture of the ground assists in the propagation of disease-seeds.

Certain scholars indicate other causes. They say that when subterranean water rises to a point not far below the earth's surface, it can readily mix with much of the world's refuse.

An example of how this mixing occurs will make the matter clear. In village areas, where there exists no proper sewage arrangement as in cities, filthy matter often accumulates within numerous wells; when this rises to the surface, it becomes mixed with the excrement-laden soil, and that water, carrying disease-germs and contaminated matter, pollutes wells and ponds.

From this, readers will understand how much care is required to keep drinking water pure. Even if one does not directly foul the water of a reservoir by washing

clothes or bathing in it, there exists every possibility that the filth of nearby refuse may become mingled with the water.

It has sometimes been observed that this contamination affects a distant reservoir while leaving a nearer one unaffected. There is a reason for this. As stated earlier, subterranean water flows slowly toward the sea or some other nearby body of water. Wells situated upstream of a refuse-pit, though nearer, cannot be reached by contaminated matter flowing against the current, but with a favourable current, polluted matter may travel a great distance. Once the directional flow of subterranean water is determined, measures can be devised to prevent contamination of the water reservoir.

When water is drawn from a well in excessive quantity, that nearly-emptied well begins to draw water forcibly from all sides. At such times, as water is drawn from above, below, and from great distances, much contaminated matter may be carried along with it. In porous, sandy soil, the likelihood of such drawing-in is far greater than in impermeable ground. The seeds of contagious diseases such as cholera spread with great rapidity through such means in sandy soil.

Just as there exists a flow of water beneath the earth, so too does there exist a flow of air. This air-current is somewhat less in clayey soil and somewhat greater in porous, loose soil.

The proportion of carbonic acid gas present in the underground air-current ought to be considerably greater than that present in the air-current flowing above ground. This is because various animal and vegetable substances are mixed with the soil, and the carbon from these substances, combining with the oxygen of the air, produces carbonic acid; besides this, much decaying matter beneath the soil may itself give rise to carbonic acid gas.

The quantity of this carbonic acid gas also increases in accordance with the moisture and warmth of the soil. Experiments conducted in the city of Munich have shown that the proportion of carbonic acid in subterranean air rises to its highest level during the months of Ashadh and Shravan (mid-summer), and falls to its lowest during Magh-Phalgun (late winter).

It has also generally been observed that in loose, broken soil, carbonic acid is scarce, whereas in compact soil, into which air cannot easily penetrate, the proportion of carbonic acid is greater. In fallow land, carbonic acid is four times greater than in cultivated land. The reason for this is that soil in which air remains trapped accumulates a greater quantity of carbonic acid.

Just as there exists a current of subterranean water, so too has it been established through experiment that there exists a current of subterranean air. The rise and fall of our health depends considerably upon this circulation of air. For it has been observed that this air contains abundant quantities of carbonic acid and other contaminated gases. Moreover, disease-seeds present within the soil may, by means of this air-current, become disseminated in all directions.

There exists yet another major cause of air-circulation underground: the disparity in temperature between the atmospheric air and the subterranean air. This requires detailed discussion.

Soil is of various kinds, and not all soil is heated with equal ease. But water, more than any soil, becomes heated more slowly.

Whatever readily absorbs heat also readily releases heat. For this reason, water becomes heated more slowly than soil, and releases heat more slowly as well. Wet, damp soil does not readily absorb the heat of the sun. Similarly, it does not readily release it either; dry, sandy soil quickly grows hot, and just as quickly cools again.

The effect of the earth's heat is not confined merely to the earth itself. It has its influence upon the temperature of the atmosphere as well. It is generally held that dry air readily allows radiated heat to pass through, whereas moist air absorbs that heat in considerable quantity. Completely dry air is nowhere to be found in nature; for this reason, all air is heated both by the sun's warmth and by the heat radiated from the earth. As far as can be determined through experiment, it appears that the temperature of air is regulated more by the earth's temperature than by direct solar heat. Upon contact with warm ground, the lower layer of air first becomes heated and expands, and rises upward; the comparatively cooler air above

descends and absorbs the earth's warmth—thus, in this manner, the entire body of air becomes heated. Everyone knows that the air at very high altitudes is considerably colder than the air near the earth's surface.

From this it may be understood that the temperature of the soil and the temperature of the air are not identical—and, generally, the soil's temperature is greater.

Soil is not a good conductor of heat; for this reason, the heat of the surface layer of soil is delayed in reaching the lower layers. It is for this very reason that in summer, when the earth's surface grows hot, the lower layers remain comparatively cool; and in winter, when the surface temperature of the earth diminishes, that coldness is delayed in reaching the lower layers—and thus, in winter, the soil at lower depths remains warmer than the soil at the surface. It is stated in the aphorisms of Chanakya that well-water is warm in winter and cool in summer. According to the principle described above, the cause of this is not difficult to determine.

In summer, as the earth's surface becomes more heated than the subterranean depths, the air surrounding the ground tends to move downward toward the lower strata, and in winter the opposite occurs. If a room is made extremely hot by fire, and if the floor is not properly sealed, the local subterranean gas tends to become suspended and rise within that room—of this, much evidence has been obtained.

Not long ago, the streets of Dublin were paved with stone. Since then, the incidence of typhoid fever there has considerably increased. The reason is that subterranean air can no longer escape through the paved roadway, and instead escapes through unsealed flooring. In this way, contaminated vapour accumulates within dwellings.

It has even been observed that, during periods of extreme cold, when frost forms on roads and pathways, the escaping gas from gas-pipes beneath the road, finding no outlet through the road itself, begins to escape within houses—and thus many have fallen into critical condition from inhaling this poisonous air.

However this may be, from this essay readers will understand that our health depends considerably upon subterranean water and air. Care ought to be taken to ensure that no contaminated matter accumulates anywhere near a water reservoir. And it is particularly essential to seal properly the floors of rooms and the surrounding areas of houses for some distance, so as to block the passage of contaminated vapour-laden air from below.

Sadhana, Ashwin-Kartik, 1301