parts of the earlier books of the Bible of the historical value which was generally attributed to them by our forefathers. The story of the Creation in Genesis, unless we play fast and loose either with words or with science, cannot be brought into harmony with what we have learned from geology. Its ethnological statements are imperfect, if not sometimes inaccurate. The stories of the Flood and of the Tower of Babel are incredible in their present form. Some historical element may underlie many of the traditions in the first eleven chapters of that book, but this we cannot hope to recover."

But Huxley was not content to deny any authority to the Scriptural basis of most of the religions of Europe and America. He denied that there was any means of knowing what the future had in store. He did not deny that there was a heaven or a hell; he did not deny that in a future world man might continue in a sublimated state, and might be punished for his misdeeds or rewarded for the good deeds he had performed and for good thoughts on earth. He did not venture to express any opinion on the subject for the reason that he had no data to base an opinion upon. He called himself an agnostic and the attitude he assumed was agnosticism.

This term agnostic, we are told by Mr. R. H. Hutton, was suggested by Prof. Huxley at a party held previous to the formation of the now defunct Metaphysical Society, at Mr. James Knowles' house on Clapham Common, one evening in 1869, and was suggested by St. Paul's mention of the altar to the unknown God—'Ἀγνώστῳ θεῳ.

But Huxley has explained that he assumed this term in contradistinction to the gnostic of old. The gnostic claimed to know what in the nature of things is unknowable, and as Huxley found himself with an exactly opposite mental status, he coined a word to express that antithetical state—agnostic.

I have done all I conceive to be necessary in giving this statement of Huxley's attitude. Whether he was right or wrong, each one must judge for himself or herself. Believing as he did, on a bed of prolonged illness he resignedly awaited the inevitable, and desired that his sentiments reflected in verse by his wife should be engraved on his tomb.

"And if there be no meeting past the grave,
If all is darkness, silence, yet 'tis rest.
Be not afraid, ye waiting hearts that weep
For God 'still giveth his beloved sleep,'
And if an endless sleep he wills—so best."

THEO. GILL.

CERTITUDES AND ILLUSIONS.

CHUAR'S ILLUSION.

IN the fall of 1880 I was encamped on the Kaibab plateau at the edge of the forest above the canyon gorge of a little stream. White men and Indians composed the party with me. Our task was to make a trail down this side canyon into the depths of the Grand Canyon of the Colorado. While in camp after the day's work was done, both Indians and white men engaged in throwing stones across the little canyon, which was many hundreds of feet in depth. The distance from the brink of the wall on which we were camped to the brink of the opposite wall seemed not very great, yet no man could throw a stone across the chasm, though Chuar, the Indian chief, could strike the opposite wall very near its brink. The stones thrown by others fell into the depths of the canyon. I discussed these feats with Chuar and led him on to an explanation of gravity. Now Chuar believed that he could throw a stone much farther along the level of the plateau than over the canyon. His first illusion was thus one very common among mountain travelers—an underestimate of the distance of towering and massive rocks when the eye has no intervening objects to divide the space into parts as measures of the whole.

I did not venture to correct Chuar's judgment, but simply sought to discover his method of reasoning. As our conversation proceeded he explained to me that the stone could not go far over the canyon, for it was so deep that it would make the stone fall before reaching the opposite bank; and he explained to me with great care that the hollow or empty space pulled the stone down. He discoursed on this point at length, and illustrated it in many ways: "If you stand on the edge of the cliff you are likely to fall; the hollow pulls you down, so that you are compelled to brace yourself against the force and lean back. Any one can make such an experiment and see that the void pulls him down. If you climb a tree the higher you reach the harder the pull; if you are at the very top of a tall pine you must cling with your might lest the void below pull you off."

Thus my dusky philosopher interpreted a subjective fear of falling as an objective force; but more, he reified void and imputed to it the force of pull. I afterward found these ideas common among other wise men of the dusky race, and once held a similar conversation with an Indian of the Wintun on Mount Shasta, the sheen of whose snow-clad summit seems almost to merge into the firmament. On these dizzy heights my Wintun friend expounded the same philosophy of gravity.

Now in the language of Chuar's people, a wise man is said to be a traveler, for such is the metaphor by which they express great wisdom, as they suppose that a man must learn by journeying much. So in the moonlight of the last evening's sojourn in the camp on the brink of the canyon, I told Chuar that he was a great traveler, and that I knew of two other great travelers among the white men of the East, one by the name of Hegel and another by the name of Spencer, and that I should ever remember these three wise men, Chuar, Hegel and Spencer, who spoke like words of wisdom, for it passed through my mind that all three of these philosophers had reified void and founded a philosophy thereon.

In the history of philosophy an illusion is discovered concerning matter and each of the constituents or categories of matter, which are number, extension, motion, duration and judgment; and as bodies are related elements of matter, relation itself comes to be the object of illusion. Matter is the substrate of all bodies; bodies thus have a substrate, and the illusion of matter arises from supposing that matter, which is the substrate, has also its substrate, which is sometimes called essence. Classes are orders of number; the illusion of number relates to class or kind, and this is also usually called essence. Extensions combined have figure and structure, which produce form, and the illusion of extension is an illusion in relation to forms which are derived from extensions, and is called space. Motions through collisions are forces, and the illusion relating to motion is also called force. Duration is persistence and change, which give rise to time, and the illusion of duration is called time. Judgment is consciousness and inference, which give rise to comprehension of ideas, and the illusion of idea is called ghost. Bodies are related to one another, hence numbers, extensions, motions, durations and judgments are related. Certain of the relations of these things are called cause, and the illusion of relation also is called cause.

Now it must be clearly understood that the terms substrate, essence, space, force, time, ghost and cause refer sometimes to real things, as when properly used in science, and sometimes to illusions, when they are improperly used, as they often are in metaphysics; but usually the word ghost is now used only in reference to an illusion,

and this is the sole case where we have a term for an illusion which is commonly understood in that sense, but the term spirit is used in both senses, for the certitude and for the illusion.

The seven illusions here enumerated are perhaps the most fundamental and far-reaching of the vast multitude of illusions which appear in the history of error. The words substrate, essence, space, force, time, ghost and cause are terms of universal use and their synonyms appear in all civilized languages, and perhaps in all lower languages. They have always stood for certitudes and illusions; here they require definitions both as certitudes and as illusions, in so far as we are able to define them.

SUBSTRATE.

Substrate is matter, matter is the substrate of all bodies. Essence is any collocation of units into a unit of a higher order which makes it a kind or one of a class. Space is any extension or any collocation of extensions; force is any collocation of motions that are related by collisions; time is any duration or collocation of durations; mind or spirit or ghost is any cognition or collocation of cognitions; cause is any related antecedent or collocation of such antecedents of a change. Such are the fundamental meanings of the words when used to designate realities. We shall hereafter see what they mean when they are used to designate illusions. Matter is the substrate of body and has no substrate for itself. All matter has four factors or constituents, number, extension, motion and duration, and some matter at least has a fifth factor, namely judgment. Matter is not a substrate for these factors, but exists in these constituents which are never dissociated, but constitute matter, or are the moments of matter; and this matter is the substrate of all bodies.

ESSENCE.

The term essence as used in philosophy is employed in a double manner and is thus often ambiguous. It is sometimes used as a synonym for substrate of matter, at other times it is used to designate the occult substrate of class. In this latter sense it is here used. Essence, then, is the number essential to make an order or kind of a class. As the whole number is essential, every one is essential; they are severally and conjointly essential, so that it is possible correctly to speak of them all as being essential and to speak of every one severally as being essential. All of the particles which make up a body are conjointly and severally essential to that body, and the essence of a body is the hierarchy of particles of which it is composed. The term essence, therefore, is a general term or pronoun for all collocations of number, and its special meaning is derived from the context. As an illusion, essence is the name of an unknown something which produces a kind or class, and is a property of an unknown or unknowable substrate of matter.

If, as the chemist believes, with much good reason, the ultimate chemical particles are alike, they are alike only in number, extension, motion and duration; they are unlike in association, position, direction or motion and the duration of association, so that likeness and unlikeness is inherent in matter itself. In bodies innumerable combinations of number, extension, motion and duration are found, and out of these are developed innumerable likenesses and unlikenesses, so that one body is like another in many respects and unlike that other in many other respects. The science of classification takes these likenesses and unlikenesses and discovers degrees among them which are of profound importance in the study of the world, and upon which a large share of knowledge rests. All knowledge does not rest upon likeness and unlikeness; but like-

ness is founded upon number, and men have discovered that what is true of a body is true of any other body of like kind, under the axiom that whatever is true of anything is true of its identity in so far only as it is a constant property or an absolute, and not in so far as it is a variable or relative. These are all simple, self-evident propositions, but in the compounding and recompounding of matter it is not always possible to disentangle the constants from the variables. Men lost in the meaning of words, forever wandering in linguistic jungles, have engaged in discussions about essences and have at last reified the word as something which is not number associated with extension, motion and duration, but as some occult existence unknown and unknowable, which gives to bodies their likeness or unlikeness. Having reached the conclusion that matter is something more than its constituents, with an occult, unknown and unknowable substrate, they take the next step that the essence of class or likeness and unlikeness exists not in the fundamental properties of body or the fundamental constituents of matter, but in their substrate.

All known things are classified either properly or improperly. The characters upon which they are classed are thus innumerable. These characters which constitute class are all the bodies embraced in the class and all the properties embraced in all the bodies of the class. The term essence, then, used in this sense, means all of these things. Therefore it is a general name for everything in the universe, but obtaining its particular meaning in any case by the context. What is the meaning of the word *this?* It may be applied to any constituent of matter, to matter itself, to any body or to any property, relation or quality in the material world, and to any idea in the mental world, and its meaning is derived from the context; it has no definite meaning in itself. *Essence*, as a word used by philosophers, is a pronoun of like character without specific meaning, and attains its specific meaning only by the context; it has one meaning at one time, and another at another, and thus it seems to be illusive. As the substrate of matter, a reified nothing, is entertained in the minds of some as an entity, so some thinkers make essence a property of this substrate—a nonenity of a nonenity. Chuar, Hegel and Spencer reason in this manner. Essence as connoting the essential characters of a class is a word the meaning of which scientific men clearly understand; it is never ambiguous, although naturalists may sometimes disagree about the essentiality of a particular character, but the essence of which the philosopher thinks is nonexistent, the opinions of the three wise men to the contrary notwithstanding.

SPACE.

The word space is the pronoun of all extensions, figures and structures of extensions in the multitudinous bodies of the world. There are many extensions, and every known body is a constituent of some other body, and this synthesis may be continued until the mind is lost in immensity. The space occupied by a body is its extension in structure and figure. This desk before me has extension, or we say that it occupies space; the space which it occupies is its extension, from which it excludes other bodies. Remove the furniture from the room, it is said to be empty, yet it is full of air; remove the air from the room, yet it is full of ether; remove the ether, may be, we know not, all is removed; then the wall encloses void—nothing—but the walls of the room yet have extension, and we can measure this by measuring the walls, but void cannot be measured; there is nothing to be measured. Thus it is that space is the pronoun of all dimensions of all bodies, severally and conjointly, and as they are variable, space seems to be illusive, and it comes

at last in the minds of careless thinkers to mean something more than extension, an unknown and unknowable thing that, like essence, belongs to the unknown and unknowable substrate of matter. The word is useful when its use is understood as a pronoun or general word whose meaning is given by the context.

FORCE.

Force is the pronoun for combinations of motion. It thus may be applied to numerous things now existing, or which have existed in the past or may exist in the future. It is the general word for all collisions and all combinations of collisions; collisions of particles of ether in light and heat, collisions of particles of air in sound, collisions of particles of water in stress, collisions of particles of matter in all solids exhibited in the structure and strength of those materials. It thus stands for the action of two or more bodies as they come in collision, and thus influence each other's motions. It is not an occult, unknown or unknowable something which belongs to an occult, unknown and unknowable substrate. The term has no particular or determined meaning in itself, but derives its meaning from the context. It is a word of universal use, whose meaning must be determined by its application; it is the general term or pronoun to denote any or all actions and reactions.

TIME.

Time is the pronoun of all durations. It means any duration to which the term is applied, all durations or any collocation of durations the mind may entertain. When reified it comes to be thought of as applying to an existence independent of the things which have duration. Then time, like essence, space and force, becomes a property of the substrate of matter, an illusion about an illusion.

GHOST.

Spirit is a general term or pronoun for all judgments in the infinite variety of sensations, perceptions, understandings, acceptions and reflections. It is a name for all ideation. It is known to us only in its association or connection with the universal constituents of matter, which are number, extension, motion and duration. There is no spirit which is not a unity of many and one. There is no spirit which has not force. There is no spirit which has not duration; in so far all are agreed; and it is here affirmed that there is no spirit which has not extension, for without extension all the other constituents would vanish, become nothing, absolutely unimaginable or unthinkable. When spirit is considered to be something which is not number or many in one, which has not extension with figure and structure without force, or the power of action and reaction and without duration as persistence or persistence and change, that is, without time, it becomes a nonentity, a nothing, and it is then an illusion and is usually called ghost.

CAUSE.

We use the word cause as we use the words *this* and *that*, as a general term or pronoun for anything that stands in relation to any other thing in the production of a change. The multitudinous bodies and particles of the universe coöperate with one another in the production of changes. The condition before a particular change is considered in respect to the condition after the change, and the condition which coöperated in the production of the change, is called a cause, and the condition after the change is called an effect. It is thus that the term cause may be applied to any body, to any property, or to any relation; it is a term for any of these things, any collocation of these things or any part of these things, and just what its meaning may be can be discovered

only by the context in which the word is used. In the multitude of bodies, properties and relations which coöperate in the production of the change whose result is called an effect, we may stop to consider any one and call that the cause. Failing to appreciate the variable significance of the word, men are led into the illusion that there is some entity, some separate existence called cause.

Metaphorically, essence is sometimes used for space, sometimes for force, sometimes for time, sometimes for spirit, and sometimes for cause, and interchangeably all of these terms may be used as metaphors for one another.

Thus it is that we have a family of chimeras in substrate, essence, space, force, time, ghost and cause that are not bodies or the properties of bodies, but things nonexistent—mysteries that are at the foundation of all philosophies of the unknowable and all philosophies of the contradictory, and the ground of all antinomies. They constitute the substrate, the essence, the space, the time, the cause of the philosophies of the three wise men, Chuar, Hegel and Spencer.

We shall hereafter see more clearly how these illusions have been developed and how other illusions have gathered about them. Here we simply call attention to the fundamental illusions to indicate somewhat the purposes of this argument.

It is within the experience of every human being, and has been through all generations, that man is forever discovering number, extension, motion, duration and judgment. He learns something of number in infancy and adds to his knowledge daily and extends his knowledge to an indefinite multiplicity. He adds to his knowledge the extension of one body and another still embodied in a higher order; and thus his knowledge of extension increases to an indefinite extent. He is forever discovering new motions and new combinations of motions as forces and finds that he is able thus to add more and more of like motions and forces to his knowledge. Ever he is discovering durations – the durations of coëxistent things and the durations of past things, extending to high antiquity, and he prophesies durations to come, and many do come, until his mind is led into the illimitable future. Mind is then trained by constant experience to expect a further enlargement of knowledge and to consider the possibilities into which it may expand, until it dwells upon endless number, endless extension, endless force, endless duration. Man contemplates multiples and submultiples of the things of which he already has knowledge, and then invents implements of research by which submultiples are discovered, and other implements by which multiples in higher orders are discovered. Finding that he has explored but a small part of the universe, and that within the universe wherever bodies are to be met they have been resolved into numbers, extensions, motions and durations, he grasps the idea of infinity not as something other than that of which he knows, but as more of that which he best knows. The experience of men through countless generations has organized the concepts of number, extension, motion and duration as the universal factors of matter, and never has any mind discovered any other things saving only those which are included in the terms of mind. Of matter without mind, man has absolutely no vestige of knowledge which is not included under the terms number, extension, motion and duration. These terms absorb them all. Therefore matter is number, extension, motion and duration, and at least some matter has judgment.

The mind discovers another factor or category in the universe—judgment, which develops into cognition of the constituents of matter, of their relations, and also a cogni-

tion of cognitions and the relations of cognitions. It is thus that the universe is resolved into material elements and judgments, the five things best known, and science in dealing with the universe explains them by resolving them into these best known things. Science does not lead to mystery, but to knowledge, and the mind rests satisfied with the knowledge thus gained when the analysis is complete—when any newly discovered body is resolved into its constituents or any new idea into its judgments.

Concepts of number, extension, motion, duration and judgment are developed by all minds; from that of the lowest animal to that of the highest human genius. Through the evolution of animal life, these concepts have been growing as they have been inherited down the stream of time in the flood of generations. It is thus that an experience has been developed, combined with the experience of all the generations of life for all the time of life, so that it is impossible to expunge from human mind these five concepts. They can never be cancelled while sanity remains. Things having something more than number, extension, motion, duration and judgment cannot even be invented; it is not possible for the human mind to conceive anything else, but semblances of such ideas may be produced by mummification of language.

Ideas are expressed in words which are symbols, and the word may be divested of all meaning in terms of number, extension, motion, duration and judgment and still remain, and it may be claimed that it still means something unknown and unknowable; this is the origin of reification. There are many things unknown at one stage of experience which are known at another, so man comes to believe in the unknown by constant daily experience; but has by further converse with the universe known things previously unknown, and they invariably become known in terms of number, extension, motion, duration and judgment, and are found to be only combinations of these things. It is thus that something unknown may be imagined, but something unknowable cannot be imagined.

No man imagines reified substrate, reified essence, reified space, reified force, reified time, reified ghost, or reified cause. Words are blank checks on the bank of thought, to be filled with meaning by the past and future earnings of the intellect. But these words are coin signs of the unknowable and no one can acquire the currency for which they call.

Things little known are named and man speculates about these little known things and erroneously imputes properties or attributes to them until he comes to think of their possessing such unknown and mistaken attributes. At last he discovers the facts; then all that he discovers is expressed in the terms of number, extension motion, duration and cognition. Still the word for the little known thing may remain to express something unknown and mystical, and by simple and easily understood processes he reifies what is not, and reasons in terms which have no meaning as used by him. Terms thus used without meaning are terms of reification.

Such terms and such methods of reasoning become very dear to those immersed in thaumaturgy and who love the wonderful and cling to the mysterious, and, in the revelry developed by the hashish of mystery, the pure water of truth is insipid. The dream of intellectual intoxication seems more real and more worthy of the human mind than the simple truths discovered by science. There is a fascination in mystery and there has ever been a school of intellects delighting to revel therein, and yet, in the grand aggregate, there is a spirit of sanity extant among mankind which loves the true and simple.

Often the eloquence of the dreamer has even subverted the sanity of science, and clear-headed, simple-minded scientific men have been willing to affirm that science deals with trivialities, and that only metaphysics deals with the profound and significant things of the universe. In a late great text-book on physics, which is a science of simple certitudes, it is affirmed:

To us the question, *What is matter?*—What is, assuming it to have a real existence outside ourselves, the essential basis of the phenomena with which we may as physicists make ourselves acquainted?—appears absolutely insoluble. Even if we become perfectly and certainly acquainted with the intimate structure of what we call Matter, we would but have made a further step in the study of its properties; and as physicists we are forced to say that while somewhat has been learned as to the properties of Matter, its essential nature is quite unknown to us.

As though its properties did not constitute its essential nature.

So, under the spell of metaphysics, the physicist turns from his spectroscope to exclaim that all his researches may be dealing with phantasms.

Science deals with realities. These are bodies with their properties. All the facts embraced in this vast field of research are expressed in terms of number, extension, motion, duration and judgment; no other terms are needed and no other terms are coined, but by a process well known in philology as a disease of language, sometimes these terms lapse into meanings which connote illusions. The human intellect is of such a nature that it has notions or ideas which may be certitudes or illusions. All the processes of reasoning, including sensation and perception, proceed by inference; the inference may be correct or erroneous, and certitudes are reached by verifying opinions. This is the sole and only process of gaining certitudes. The certitudes are truths which properly represent noumena, the illusions are errors which misrepresent noumena. All knowledge is the knowledge of noumena, and all illusion is erroneous opinion about noumena. The human mind knows nothing but realities and deals with nothing but realities, but in this dealing with the realities—the noumena of the universe—it reaches some conclusions that are correct and others that are incorrect. The correct conclusions are certitudes about realities; the incorrect conclusions are illusions about realities. Science is the name which mankind has agreed to call this knowledge of realities, and error is the name which mankind has agreed to give to all illusions. Thus it is that certitudes are directly founded upon realities; and illusions as they are always about realities, are thus indirectly, though incorrectly, founded upon realities, but certitudes and illusions alike all refer to realities. In this sense then it may be stated that all error as well as knowledge testifies to reality, and that all our knowledge is certitude based upon reality, and that illusions would not be possible were there not realities about which inferences are made.

Known realities are those about which mankind has knowledge; unknown things are those things about which man has not yet attained knowledge. Scientific research is the endeavor to increase knowledge, and its methods are observation, experience and verification. Illusions are erroneous inferences in relation to known things. All certitudes are described in terms of number, extension, motion, duration and judgment; nothing else has yet been discovered and nothing else can be discovered with the faculties with which man is possessed.

In the material world we have no knowledge of something which is not a unity of itself or a unity of a plurality; of something which is not an extension of figure or an

extension of figure and structure; of something which has not motion or a combination of motions as force; of something which has not duration as persistence or duration with persistence and change.

In the mental world we have no knowledge of something which is not a judgment of consciousness and inference; of a judgment which is not a judgment of a body with number, extension, motion and duration. Every notion of something in the material world devoid of one or more of the constituents of matter is an illusion; every notion of something in the spiritual world devoid of the factors of matter and judgment is an illusion. These are the propositions to be explained and demonstrated.

In the following chapters an attempt will be made to show that we know much about matter, and although we do not know all, all we know is about matter in its categories of number, extension, motion, duration and judgment, or that we know of matter in its four categories and that we know of mind in the categories of judgment, but always this mind is associated with matter. In doing this we shall endeavor to discriminate between the certitudes and illusions current in human opinion.

In the intoxication of illusion facts seem cold and colorless, and the wrapt dreamer imagines that he dwells in a realm above science—in a world which as he thinks absorbs truth as the ocean the shower, and transforms it into a flood of philosophy. Feverish dreams are supposed to be glimpses of the unknown and unknowable, and the highest and dearest aspiration is to be absorbed in this sea of speculation. Nothing is worthy of contemplation but the mysterious. Yet the simple and the true remain. The history of science is the history of the discovery of the simple and the true; in its progress illusions are dispelled and certitudes remain.

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*NOTES ON THE DENSITY AND TEMPERATURE OF THE WATERS OF THE GULF OF MEXICO AND GULF STREAM.**

IT is estimated that the evaporation in the Gulf of Mexico amounts to about 60 inches a year, thus diminishing the amount of water in the Gulf 1.54 cubic miles per day. The evaporation is greatest in the central parts of the Gulf, following a line from east to west and approximately coinciding with the line of mean maximum of atmospheric pressure.

Precipitation, on the other hand, is greatest in the southwestern and northeastern parts of the Gulf, and least in the area intervening between the sandy plains of Yucatan and the arid regions of southern Texas and northern Mexico. By computation we find it to reach 32.7 inches annually, which is about 55 per centum of the evaporation, and it increases the waters of the Gulf by 0.84 cubic miles per day.

The water supply is further increased by river discharges, which amount to about 0.68 cubic miles per day; nearly 70 per centum of this volume being furnished by the Mississippi River. It will be seen that precipitation and river discharges feed the gulf by nearly the same amounts, but the effect produced by those feeders sinks into insignificance when compared with that produced by the inflowing current of the Yucatan Channel, which, according to a calculation from Lieut. Pillsbury's current observations, hurls the enormous quantity of 652 cubic miles of water per day into the Gulf, which quantity by itself would suffice to raise the level of the entire Gulf $5\frac{3}{4}$ feet within that space of time.

The Gulf stream carries off only about two-thirds of the water that is added to the volume of the Gulf in the manner indicated above, and evaporation being power-

* Abstract of a paper read to the Philosophical Society of Washington, by permission of the Superintendent of the U. S. Coast and Geodetic Survey.