

# Unity of the Universe —A Classic of Science

*Cosmography*

*COSMOS: A Sketch of a Physical Description of the Universe. By Alexander von Humboldt. Translated from the German by E. C. Otté. London, 1849.*

IT remains to be considered whether, by the operation of thought, we may hope to reduce the immense diversity of phenomena comprised by the Cosmos to the unity of a principle and the evidence afforded by rational truths. In the present state of empirical knowledge, we can scarcely flatter ourselves with such a hope. Experimental sciences, based on the observation of the external world, cannot aspire to completeness; the nature of things, and the imperfection of our organs, are alike opposed to it. We shall never succeed in exhausting the immeasurable riches of nature; and no generation of men will ever have cause to boast of having comprehended the total aggregation of phenomena. It is only by distributing them into groups, that we have been able, in the case of a few, to discover the empire of certain natural laws, grand and simple as nature itself. The extent of this empire will no doubt increase in proportion as physical sciences are more perfectly developed. Striking proofs of this advancement have been made manifest in our own day, in the phenomena of electro-magnetism, the propagation of luminous waves and radiating heat. In the same manner, the fruitful doctrine of evolution shows us how, in organic development, all that is formed is sketched out beforehand, and how the tissues of vegetable and animal matter uniformly arise from the multiplication and transformation of cells.

The generalization of laws, which being at first bounded by narrow limits, had been applied solely to isolated groups of phenomena, acquires in time more marked gradations, and gains in extent and certainty, as long as the process of reasoning is applied strictly to analogous phenomena; but as soon as dynamical views prove insufficient where the specific properties and heterogeneous nature of matter come into play, it is to be feared that

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**Alexander von Humboldt was an early popularizer of science. He brought new discoveries in geology into harmony with the better known sciences and presented science as a whole to "the intelligent layman" in his lectures and books. Behind the barrier of stilted Mid-Victorianese we can still make out the broad panorama of the field of science which he spread out before his contemporaries.**

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by persisting in the pursuit of laws we may find our course suddenly arrested by an impassable chasm. The principle of unity is lost sight of, and the guiding clue is rent asunder whenever any specific and peculiar kind of action manifests itself amid the active forces of nature. The law of equivalents and the numerical proportions of composition, so happily recognized by modern chemists, and proclaimed under the ancient form of atomic symbols, still remains isolated and independent of mathematical laws of motion and gravitation.

Those productions of nature which are objects of direct observation may be logically distributed in classes, orders and families. This form of distribution undoubtedly shed some light on descriptive natural history, but the study of organized bodies, considered in their linear connection, although it may impart a greater degree of unity and simplicity to the distribution of groups, cannot rise to the height of a classification based on one sole principle of composition and internal organization. As different gradations are presented by the laws of nature according to the extent of the horizon, or the limits of the phenomena to be considered, so there are likewise differently graduated phases in the investigation of the external world. Empiricism originates in isolated views, which are subsequently grouped according to their analogy or dissimilarity. To direct observation succeeds, although long afterwards, the wish to prosecute experiments,—that is to say, to evoke phenomena under different determined conditions. The rational experimentalist does not proceed at hazard, but

acts under the guidance of hypotheses, founded on a half indistinct and more or less just intuition of the connection existing among natural objects or forces. That which has been conquered by observation or by means of experiments, leads, by analysis and induction, to the discovery of empirical laws. These are the phases in human intellect that have marked the different epochs in the life of nations; and by means of which that great mass of facts has been accumulated which constitutes at the present day the solid basis of the natural sciences.

Two forms of abstraction conjointly regulate our knowledge, namely, relations of quantity, comprising ideas of number and size, and relations of quality, embracing the consideration of the specific properties and the heterogeneous nature of matter. The former, as being more accessible to the exercise of thought, appertains to mathematics, the latter, from its apparent mysteries and greater difficulties, falls under the domain of the chemical sciences. In order to submit phenomena to calculation, recourse is had to a hypothetical construction of matter, by a combination of molecules and atoms, whose number, form, position, and polarity determine, modify, or vary phenomena.

The mythical ideas long entertained of the imponderable substances and vital forces peculiar to each mode of organization, have complicated our views generally, and shed an uncertain light on the path we ought to pursue.

The most various forms of intuition have thus, age after age, aided in augmenting the prodigious mass of empirical knowledge, which in our own day has been enlarged with ever increasing rapidity. The investigating spirit of man strives from time to time, with varying success, to break through those ancient forms and symbols invented, to subject rebellious matter to rules of mechanical construction.

We are still very far from the time when it will be possible for us to reduce, by the operation of thought,

all that we perceive by the senses, to the unity of a rational principle. It may even be doubted if such a victory could ever be achieved in the field of natural philosophy. The complication of phenomena, and the vast extent of the Cosmos, would seem to oppose such a result; but even a partial solution of the problem,—the tendency towards a comprehension of the phenomena of the universe,—will not the less remain the eternal and sublime aim of every investigation of nature.

In conformity with the character of my former writings, as well as with the labours in which I have been engaged during my scientific career, in measurements, experiments, and the investigation of facts, I limit myself to the domain of empirical ideas.

The exposition of mutually connected facts does not exclude the classification of phenomena according to their rational connection, the generalization of many specialities in the great mass of observations, or the attempt to discover laws. Conceptions of the universe solely based upon reason and the principles of speculative philosophy, would no doubt assign a still more exalted aim to the science of the Cosmos. I am far from blaming the efforts of others solely because their success has hitherto remained very doubtful. Contrary to the wishes and counsels of those profound and powerful thinkers, who have given new life to speculations which were already familiar to the ancients, systems of natural philosophy have in our own country for some time past turned aside the minds of men from the graver study of mathematical and physical science. The abuse of better powers which has led many of our noble but ill-judging youth into the saturnalia of a purely ideal science of nature has been signalled by the intoxication of pretended conquests, by a novel and fantastically symbolical phraseology, and by a predilection for the formula of a scholastic rationalism, more contracted in its views than any known to the middle ages. I use the expression "abuse of better powers," because superior intellects devoted to philosophical pursuits and experimental sciences have remained strangers to these saturnalia. The results yielded by an earnest investigation in the path of experiment, cannot be at variance with a true philosophy of nature. If there be any contradiction, the fault must lie either in the un-

soundness of speculation, or in the exaggerated pretensions of empiricism, which thinks that more is proved by experiment than is actually derivable from it.

External nature may be opposed to the intellectual world, as if the latter were not comprised within the limits of the former; or nature may be opposed to art when the latter is defined as a manifestation of the intellectual power of man; but these contrasts, which we find reflected in the most cultivated languages, must



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not lead us to separate the sphere of nature from that of mind, since such a separation would reduce the physical science of the world to a mere aggregation of empirical specialities. Science does not present itself to man, until mind conquers matter, in striving to subject the result of experimental investigation to rational combinations. Science is the labour of mind applied to nature, but the external world has no real existence for us beyond the image reflected within ourselves through the medium of the senses. As intelligence and forms of speech, thought and its verbal symbols, are united by secret and indissoluble links, so does the external world blend almost unconsciously to ourselves with our ideas and feelings. "External phenomena," says Hegel in

his *Philosophy of History*, "are in some degree translated in our inner representations." The objective world, conceived and reflected within us by thought, is subjected to the eternal and necessary conditions of our intellectual being. The activity of the mind exercises itself on the elements furnished to it by the perceptions of the senses. Thus in the early ages of mankind there manifests itself in the simple intuition of natural facts, and in the efforts made to comprehend them, the germ of the philosophy of nature. These ideal tendencies vary, and are more or less powerful, according to the individual characteristics and moral dispositions of nations, and to the degrees of their mental culture, whether attained amid scenes of nature that excite or chill the imagination. . . .

It cannot be denied, that in this process of thought the results of experience have had to contend with many disadvantages; we must not therefore be surprised if in the perpetual vicissitude of theoretical views, as is ingeniously expressed by the author of Giordano Bruno, "most men see nothing in philosophy but a succession of passing meteors, whilst even the grander forms in which she has revealed herself share the fate of comets, bodies that do not rank in popular opinion amongst the eternal and permanent works of nature, but are regarded as mere fugitive apparitions of igneous vapour." We would here remark that the abuse of thought and the false track it too often pursues, ought not to sanction an opinion derogatory to intellect, which would imply that the domain of mind is essentially a world of vague fantastic illusions, and that the treasures accumulated by laborious observations in philosophy are powers hostile to its own empire. It does not become the spirit which characterises the present age, distrustfully to reject every generalization of views, and every attempt to examine into the nature of things by the process of reason and induction. It would be a denial of the dignity of human nature and the relative importance of the faculties with which we are endowed, were we to condemn at one time austere reason engaged in investigating causes and their mutual connections, and at another that exercise of the imagination which prompts and excites discoveries by its creative powers.