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PHYSICS AND NATURAL HISTORY

by

Francis G. Nagasaka
Faculty of Foreign Languages
Nanzan University
Nagoya, JAPAN

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1. Science and Pseudo-metaphysics

Some time ago, in an interview for a Japanese popular science magazine, James D. Watson made a remark to the effect that after twenty years there will be no biologist but only molecular biologists and, for example, morphology will be reduced to the studies of DNA[1]. Perhaps it is everyone's belief that in the coming twenty years molecular biology, and accordingly, its applications in so many fields, will make a stupendous progress. Nevertheless, it is also everyone's knowledge that even in the future society ethology and ecology will never fade away but probably will play even more important roles, notwithstanding the trmendous progress molecular biology might make. Therefore, what Watson meant was tantamount to the assertion that, even if those branches of biology continue to contribute very significantly to the welfare of human ~~beings~~ race, the specialists in these fields will not be given prestigeous positions in the scientific community, or simply those branches will not be regarded as really scientific disciplines, perhaps only auxiliary science at best. The situation is somewhat similar to those which existed between pure and applied mathematics and science and technology upto the earlier part of the twentieth century. Watson is not a philosopher of science, and probably he does not bother himself to ask such a question as what qualicications are required for systematic intellectual activities being called scientific.

So it is not fair to capitalize Watson's more or less casual remark made in the course of interview by a journalist, but I think at least this much can be asserted: Watson believes that, if utility of those and other branches of biology should be admitted, molecular biology would be situated at their root, namely it will account for the findings in those branches and will direct what researches and how they are to be carried out in the respective fields. Clearly Watson is not concerned about the practical effectiveness of these disicplines, but rather considers the matter from epistemological viewpoint, tacitly assuming a distinction between basic principles and derived knowledge, which is similar to the Galilean distinction between primary and secondary qualities. It may not be so strong an assertion as it sounds, but only a sort of working hypothesis which is by no means uncommon in the process of scientific theory formation. Nevertheless, it indicates a view which is quite pervasive in the modern mind. Because the remark is casual, all the more it reveals a candid image he has about the world and science. What really matters is this image. It matters because it is pervasive, and because that sort of working hypotheses is the commonest in contemporary science: the conception that macroscopic phenomena, for instance, could be accounted for by means of microscopic science entirely. Notice that there is no theory worked out which connects up the two kinds really satisfactorily. There is no quantum theory of macroscopic phenomena in general.[2] The so-called quantum mechanical effects on the macroscopic level are those anomalies for which theories of classical physics have failed to provide satisfactory explanations. So the working hypotheses are hypothetical in the sense that they do not belong to the theory concerned, but one has to note that they have often been extremely effective in the process of theory formation, though there are many which have come to be abandoned in later periods: we may cite the conception of aether in the formation of electro-magnetic theory as a most outstanding example. Any theory of science may be said hypothetical in the sense that it may be superseded by a certain ~~certain~~ better theory. But it is an important characteristic of scientific theory that it is well elucidated and articulated, while the so-called working hypothesis lacks this fundamental characteristic. Of course there have been all sorts of working hypotheses proposed; most of them are with quite limited scopes, but some are so basic that the feasibility of the whole theory may hinge on validity of the working hypothesis in question. Clearly those examples referred to in the above belong to the latter class.

As will be expounded later, scientific theories are always constructed upon the basis of certain metaphysical presuppositions. But the distinction between the metaphysical presuppositions and working hypotheses of the second type is subtle, for both play essential roles in scientific theory formation, and yet neither belong to those theories. But there is a fundamental distinction between the two: we must distinguish between the concept of <u>aether</u> and that of <u>matter</u>; clearly the latter is more basic than the former, and even after the former concept was totally abandoned, we have never dispensed with the concept of matter, though certain drastic modifications had to be ~~made~~ introduced to the concept. But the msot important distinction between metaphysics and pseudo-metaphysics is that, while the latter is ~~implied~~ asserted by a working hypothesis concerned only with certain scientific theories, the former is expected to ~~be concerned with everything~~ provide ~~a~~ a universal foundation for existence. We may say metaphysics is open, whereas pseudo-metaphysics is closed.

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What I like to point out concerning Watson's remark is simply as follows: Since the distinction between the two notions metaphysics and pseudo-metaphysics is so subtle, that the demarcation of the two ~~are~~ has often been obliterated, and as a consequence, people have endowed, say inadvertently, the status of metaphysics to the working hypotheses or pseudo-metaphysics tacitly propounded. I think that this is exactly what Watson did by making the remark, casual as it was. The upshot of this is that metaphysics upon which scientific theories have been constructed and which would make possible to understand them from more general viewpoint would be dispelled and ~~the~~ a certain sort of psedudo-metaphysics would take over its place, and, as a consequence, they deprive people of metaphysical mind. Whitehead called perhaps the most outstandig case of this kind "Scientific materialism"[3]:

"There persists ...throughout the whole period the fixed scientific cosmology which presupposes the ultimate fact of an irreducible brute matter, or material, spread throughout space in a flux of configurations. In itself such a material is senseless, valueless, purposeless...It is this assumption that I call 'scientific materialism'."[5] ~~The~~ A pseudo-metaphysical notion is an assumption, since there is no factual evidence nor theoretical ground to support it. It is not metaphysics, for it is closed; it is neither well articulated nor there ~~is~~ are arguments for defending the thesis. This is exactly the situation that the development of science brought forth to the modern mind. The pseudo-metaphysics goes beyond the scope of science itself: being metaphysical, naturally it tends to exclude other kinds of metaphysical thinking, and being scientific, it tends to create a more or less materialistic, namely, senseless, valueless, purposeless mentality. But the pseudo-metaphysics does not necessarily lead to, say, spiritual anarchy: we cannot see things without feelings, we cannot live and act without sense of value and purpose. It is impossible that our daily experiences should be totally devoid of these elements. So, more often than not the pseudo-metaphysics is supplemented more or less by certain metaphysical conceptions, perhaps with sacrifice of consistency, and thus ~~the~~ requirement for complete rationality ~~is~~ ~~generally~~ has often to be abandoned. And as a consequence, trust in rationalism has been greatly dissipated. It seems that recent controversial arguments concerning the rationality of science is at least in part derived from ~~the~~ this situation.[5] This is at least one aspect of the crisis we are now experiencing.[6] But is it really possible to stop and reverse the gradual shift to spiritual anarchism which, we observe, has become accelerated especially in the latter half of the twentieth century? So this is the nature of the scientific crisis ~~of science~~, which has induced the spiritual crisis the twentieth century is experiencing, and I think this is also the gist of what Husserl called "the crisis of sciences" which represents the life crisis of Europe.[7] Husserl asserts: "the whole worldview of modern men was exclusively determined by the positive science and left blinded by the 'prosperity' it brought about," and by that "exclusivenes" Husserl meant that men had been led to turn away indifferently from the problem which is vitally significant to the true humanity.[8] In the fifty odd years after the first paper of the series was published, the crisis nevertheless has become more acute and pressing, and we are still searching for the remedy.

2. Physics and the Seventeenth Century Scientific Revolution

The term "scientific revolution" was employed by Butterfield in the Origins of Modern Science and became commonly used subsequently,[9] though the idea itself had been forwarded by Whitehead much earlier.[10] But I think the expression "scientific revolution" is quite misleading. It was only in the latter part of the nineteenth century that such terms as "science" and "physics" came into common use in the meaning as is now ~~employed~~ used. Before that time "philosophy" was the term generally employed. But even though the term "chemical philosophy" was commonly used in the seventeenth century, we cannot find any drastic progress in this field during that period. Thus the sort of intellectual enterprizes which are generally categorized as science mostly emerged in the course of the nineteenth century, and acquired much wider scope and greater impact on the society only in the present century. The only exception is physics whose beginning may be dated in 1687 when the first edition of <u>Philosophia naturalis principia mathematica</u> was published, though its revolutionary significance had not been appreciated until more than one hundred years after its publication. On the other hand, however, the interval of one hundred years which required for the full acceptance of the <u>Principia</u> shows most eloquently the profound depth of the revolution resulting from the thought which was initiated by Newton.

Furthermore, if we take a glance at the history of investigations achieved in such fields as chemical process, biology, and medicine in the seventeenth and eighteenth centuries, we find at once the presence of mechanistic views in these fields. Whether they might be due to the Cartesian or the Newtonian mechanistic view, it is quite apparent that the superiority of the Newtonian philosophy of nature inspired and prompted these investigations to gradually form scientific disciplines in later years. The influence of physics on other disciplines became more manifest as time developed. Including Watson's remark, we find here the source of all sorts of physicalism and their justification. I think at least this much can be asserted: every scientific discipline contains some elements of the method of physics in an essential way. Thus, if we are to understand the nature of the scientific crisis and to find some way not to fall into the pitfall of spiritual anarchism, it is at least necessary to understand the nature of physics and its philosophical implications, including both metaphysical presuppositions and psudo-metaphysical assertions.

3. Precursers of the Newtonian Revolution

Science, physics in particular, is a product of the Western civilization, or more precisely of the European civilization. Like so many other things in Europe, physics emerged out of the legacy of the views and intellectual habits the ancient Greeks held which were transmitted to the Christian Europe mainly by way of the Aribian civilization. But the integration of the Greek thought and the Christian tradition was by no means easy. The first integration was attempted by the Church Fathers, in which Platonic and Neoplatonic understandings and interpretadisputes.[13] Concerning the second problem Galileo adopted the latter view, while Kepler adopted the former view, but concerning the first problem the both chose the former position.

The difference of attitude toward the Paduan disputes between Kepler and Galileo is not only most interesting in itself but made both of them real precursers of Newton, since the Newtonian philosophy of nature involves in an essential way the synthesis of the two opposing positions.

Before discussing the significance of the Keplerian conception of nature, it may be necessary to touch briefly on the history of astronomy. Greek astronomy was born in the Pythagorean school in the fifth century B.C. It is believed that "the Pythagoreans were the first to call the world cosmos (implying that it is a well-ordered and harmonious system) and to say that the earth is round."[14] It was the conception of the universe ascribed to Philolaus which provided the solid ground for the later astronomy and cosmology to the time of Descartes and Newton: the earth is a sphere which is tiny in comparison with the dimension of the universe and of comparable size with the moon and the planets; the moon shines because it reflects light it received from the central fire (later from the sun); light of celestial region is of the same nature as we observe on the earth; no divine or supernatural intervention should be required to account for the celestial motion.

One must note that this conception was necessary not only for theory construction but for accurate observations, and thus for mathematical representations of the celestial phenomena. What we observe of stars is that we see the stars in such and such directions. Those directions are given interpretations such that they correspond to the positions of stars in motion only if we have such theories as orbits of stars together with the notion of spherical shape of earth, only then those directions have meaning and become data upon which astronomical theories are to be constructed. It was those theories that were called "phenomena."[15]

Plato and Aristotle differed in ascribing causes to the phenomena. Whereas Plato searched for mathematically ideal formulation, Aristotle was not satisfied only with the formal cause. Instead, he demanded physical explanation for the celestial motion. The expression "saving the phenomena" was coined in the Platonic vein, but later it lost its original significance and meant merely more accurate mathematical analysis of the phenomena which would make precise predictions of the location of stars possible. "It is the business of physical inquiry to consider the substance of the heaven and the stars, their force and quality, their coming into being and their destruction, nay, it is in a position even to prove the facts about their size, shape, and arrangement; astronomy, on the other hand, does not attempt to speak of anything of this kind, but proves the arrangement of the heavenly bodies by considerations based on the view that the heaven is a real *kosmos*, and further, it tells us of the shape and size and distances of the earth, sun, and moon, and of eclipses and conjunctions of the stars, as well as the quality and extent of their movements." This is the passage of Simplicius' *Commentary on Aristotle's Physics* translated by T.L. Heath.[16] Thus astronomy was a branch of mathematics sharply distingusished from cosmology. So in astronomy any theory was regarded as a hypothesis and acceptable as long as it gives an accurate account of the phenomena.

Mathematically speaking, the geocentric and heliocentric systems are equivalent, and the problem itself lost its original significance after the Newtonian revolution with the supposition of endlessly extended universe. In this regard Copernicus did not accomplish anything significant, except that his theory gave a more simplified and coherent mathematical system. But he called hismself a Pythagorean, and he wanted to transform astronomy from a mere instrument to save the phenomena to *cosmology* in the Pythagorean spirit. His *Revolutionibus* was written in the current of revival of Neoplatonism which contained strong Pythagorean element.[17]

As is well known, Kepler was a devout Pythagorean, so was Galileo, though somewhat in a different sense. Both of them believed that the principles, or the essence of the universe must be mathematical. They accepted Copernicus because they believed in his Pythagorianism. This meant an emergence of new cosmology, which is totally different from the Aristotelian physics. Being a Pythagorean, Copernicus could not tolerate any incoherencies which could be found in the Ptolemaic system, notably the infamous "punctum aequans." This is the restoration of astronomy to the original Platonic conception. Burtt stated: "The transformation to the new world view, for him, was nothing but a mathematical reduction, under the encouragement of the renewed Platonism of the day, of a complex geometrical labyrinth into a <u>beautifully simple</u> and harmonious system."[18]

Among Renaissance philosophers probably Nicholas of Cusa was the most prominent figure in this vein. As is well known, he asserted the conception of infinite universe. Clearly without his contribution and the subsequent development of his thought the Newtonian philosophy would have been impossible. But Koyrè pointed out "he never affirms the infinity of the world (as Descartes mistakenly assumed him to do) but always calls it 'interminate' and opposes its limitlessness to the positive infinity of God."[19] So, if Koyrè is right, then it was Descartes who established the notion of "infinity" of the created world and introduced the notion into mathematics as positive entity. Kepler as well as St. Thomas would have rejected the idea.[20]

Kepler, being Pythagorean, naturally defended the idea of cosmos, and Koyrė asserts that the transition was "From Closed World to the Infinite Universe."[21]

There is no question that Galileo contributed to this transition decisively, not because he accepted the notion of infinite universe, but because he was a Platonist and believed that "the Great Book of Nature is written in the language of mathematics." Burtt commented on this famous passage: "Galileo is continually astonished at the marvellous manner in which natural happenings follow the principles of geometry, and his favorite answer to the objection that mathematical demonstrations are abstract and possesss no necessary applicability to the physical world, is to proceed to further geometrical demonstrations, in the hope that they will become their own proof to all unprejudiced minds."[22] Galileo was a Platonist, but at the same time he was also an Aristotelian belonging to the Paduan school. This somewhat contradictory attitude toward the Nature was exactly what Burtt pointed out with abundant evidence in the Discorsi and the Dialogo. So Burtt made a further remark: "It is abundantly apparent, however, from the whole of Galileo's achievements and interests, that he never seriously entertained the possible extreme of this mathematical apriorism."[23] Galileo sought the forms of the facts he observed. Since the form is reality in the Platonic sense, the fact is its representation, so the latter has to obey the laws of mathematics. This is a sort of mathematical aprionism, and I do not think Burtt was mistaken because of the qualification, "possible extreme." It is due to this kind of apriorism that Galileo could assert the possibility of linear, uniform motion in vacuum, though we shall never observe such motion on the earth.[24] Perhaps we should regard the Galilean conception of "New Science" as a development of the Paduan critical Aristotelianism.[25] Thus Galileo made critical studies of problems raised by Aristotle such as natural (fall) and projectile motion. This is what Kepler never attempted. Furthermore, Galileo was not satisfied with the formal cause alone but the efficient cause of motion, namely force, was also considered. Unlike the cosmology of Copernicus and Kepler, Galileo's was basically physical. His attempt to explain the phenomena of tide by means of motion of the earth is a good illustration of the nature of his cosmology. Thus his concept of motion was not limited to so-called locomotion, but motions in quantity and quality had to be considered. If the world should be expressed in the language of mathematics, and only such knowledge should be regarded as true, then the distinction between primary and secondary qualities had to be introduced, which would enable us to distinguish objective knowledge from subjective knowledge. This distinction is clearly a legacy of ancient Greek thought; distinctions between _episteme_ and _doxa_ and between

<u>theory</u> and <u>practice</u>. However, the Galilean interpretation of these conceptions was quite different from the original. The concept of Nature had been well established by this time: it is an object, great as it is, in contradistinction to human beings, while Greek "physis" never had the connotation of object; ~~it~~ the latter had multiple meanings such as underlying principle, reality, and inherent cause which gives rise to all the mutations, ~~but~~ and yet it never meant "things generated by <u>physis</u>" nor "cosmos": "physis" was opposed , as in Plato, to "nomos" and also, as in Aristotle, to "techne", and all these connotations of "physis" were transplanted in the Latin "natura" through Plato and Aristotle, and other ancient authors[26]; furthermore, in the Christian Europe "natural" was opposed to "supernatural." The original complexity of the meaning of "natura" and its further development in the Renaissance and subsequent eras ~~was~~ were all manifest in the writings of Galileo, Kepler, Descartes, and Newton. Thus I maintain that this coneptual development has a vital importance in the formation of the Newtonian philosophy of nature.

4. Characteristics of the Newtonian Revolution.

The principal aim of the <u>Principia</u> was to derive the Kepler's Laws from more fundamental principles in the manner that geometrical theorems are derived from the axioms and postulates together with definitions. Since Kepl~~a~~er's laws were expressed in mathematical terms and formulas, the Newtonian fundamental principles, i.e., laws of motion and the principles of universal gravitation, must assume mathematical forms. Throughout the First and Second Books of <u>Principia</u> Newton discussed only "motions of bodies", and not Nature. We find only in the Third Book discussions concerning celestial phenomena, but in the theorems 20, 24, 36, and 37 of the Book such terrestrial phenomena as tide also were discussed. So in Newton the distinction of sublunar and superlunar worlds was completely lifted: This is a clear articulation of the conception that the whole univers is subsumed under the same principles, which is a development and elucidation of the Galilean idea, namely, here is only one world, objective, mathematical, and mechanical.

Like Galileo, Newton was in the vein of the Aristotelian heritage. His problem was to discuss "motion" or "change" in the Aristotelian sense. He had to attain the cause of motion, but his principles which would make knowledge "episteme" was not limited to the immutable formal cause, but the causes which would make the motion possible. According to Aristotle, "Motion, we say, is the fulfilment of the movable in so far as it is movable. Each kind of motion, therefore, necessarily involves the presence of the things that are capable of that motion."[27]

What are movable in the Newtonian philosophy are bodies, which are substrata of the motion. The attributes of bodies are extension and quantity of matter, and the latter corresponds further to the Aristotelian material cause which made the Newtonian philosophy radically different from the Cartesian metaphysics of res extensa and res cogitans. Clearly extension is the form of matter, so matter is also substance and it is the position of matter that changes. Thus the Newtonian conception of body is very much parallarel to the Aristotelian hylomorphyism, though the difference is quite obvious: "position" is an accident in the Newtonian matter whose attribute is its density, so matter is measured by quantity. Thus "the quntity of matter is the measure of the same, arising from its density and bulk conjointly."[28]

Therefore, bodies of which the world consists are determined by the form and quantity of matter. Thus matter is the substance of the (msterial) bodies, or beings, and it is characterized by its qunantity alone, and it is the immutable substratum of motion; though bodies may change their forms and positions, the total quantity of matter will remain constant; though it is movable in the sense of locomotion, its attributes are density and extension which are represented in terms of mathematical entities, i.e, figures and numbers, and no other qualities but mobility and impenetrability are ascribed to matter. Therefore the Newtonian matter is an actual entity in contradistinction to the Aristotelian (primary) matter which is pure potentiality. So matter is substance and subsratum, it would not undergo any *motion* unless it is acted upon by external force, keeping its *state of motion* or *state of rest*.[29] So matter does not possess by *nature* the ability of motion. This passiveness of matter is one of the outstanding characteristics of the Newtonian philosophy of nature. Gravity which originally was internal ability of ~~a~~ motion (natural fall) had to be amended so that a falling body is acted on and be "gravitated" by an external agent, and the agent is another body: the gravitating power inherent in matter is the feature of the Principle of Universal Gravitation.

On the other hand, however, Newton was cautious in making metaphysical commitment: "We know the properties of things from phenomena, and from the properties we infer that the things themselves exist: but we do not have any more idea of substances than a blind man has of colours."[30] Here we may think Newton is a precursor of Kant. But Newton always tried to evade metaphysical questions. We find the famous passage of General Scholium of the Principia: "and I frame no hypothesis; for whatever is not deduced from the phenomena is to be called hypothesis, and hypotheses, whether metaphysical or physical, of occult qualities or mechanical, have no place in experimental philosophy. In this philosophy particular propositions are inferred from the phenomena and afterward rendered general by induction. Thus it was that the impenetrability, the mobility, and the impulsive force of bodies, and the laws of motion and of gravitation, were discovered. And to us it is enough that gravity does really exist and act according to the laws which have explained, and abundantly serves to account for all the motions of the celestial bodies and of our sea."

Thus as the Newtonian philosophy superseded the Cartesian metaphysics, all the metaphysical presuppositions of the former on which those discoveries were based receded into oblivion, and as a consequence the <u>scientific</u> materialism emerged subsequently.

In the above and in the preceding section, I have tried to expound the extremely complex philosophical situations which contributed essentially to the emergence of the Newtonian philosophy: it was a great philosophical revolution, but it was founded upon and derived from the Western tradition which contained so many philososphical ramifications, and the latter were so interwoven that more or less dialectic evolution of thought took place in the history of the Western civilization. Mathematization of the world was possible only on the Pythagorean and Platonic conception, which established the idea that mathematics is the form or cause of the world, or cosmology. It was pointed out by Leclerc, "this (Newtonian) metaphysical conception of nature was new, but the ontology which it entailed was not; it was the Neoplatonic ontology which had been revived in the antecedent two centuries....It had been maintained in the Neoplatonism prior to the seventeenth century that soul alone is incomposite, and thus 'being'; nature or physical, on the contrary, as composite of soul and matter, is in becoming. In this respect the new doctrine of the seventeenth century is fundamentally divergent from the antecedent one. For matter, qua 'matter', is incomposite, and thus in itself changeless, which meant....matter had....to be accepted as 'being' according to the Neoplatonic criterion."[31]

What Leclerc pointed out indicates another peculiar feature of the Newtonian revolution: numerous factors contributed essentially to its fermentation; those factors are not necessarily coherent, but often paradoxical, and thus could imply so many types of cosmology. Therefore, the Newtonian philosophy is just one type, but unprecedented peculiar type of cosmology: a mathematical world to which the Euclidean geometry is validly applied, and which is mechanical so that the laws of motion may hold exactly, and yet which contains <u>incomposite</u> matter as constituent of the world; it is thus changeless in itself, and no quality but only quantity is ascribed to it. The world is completely objective or theoretical in the Aristotelean sense of the word so that it has nothing to do with human practice and value; it lacks purpose, for everything should be determined by the initial conditions in the past, and though it was created by God, the existence of human beings is accidental. What I said in the above does not belong to Newton himself entirely, but from his philosophy one could draw these conclusions, unless it is supplemented by certain metaphysics which has the power to endow sense, value, and purpose. "Man, as per se soul or mind, is in nature by reason of of the soul's connection the body, but man is not <u>of</u> nature, with the body, but man is not <u>of</u> nature, i.e. man is not part of material nature."[32] This pecuriarity has been unnoticed perhaps due to the great success of the Newtonian philosophy, and it has often been called a great synthesis. I readily admit it was a synthesis but not without some reservation: it was new, and contains so many elements but, nevertheless it was a unified system comparable to that of the Eucleidean geometry. And yet, I am inclined to say it has elements of <u>syncretism</u> which, we find, had not been uncommon in the history of the Western philosophy and theology before Newton. The history of physics provides abundant evidence that the great synthesis is just a matter of appearance. I maintain that its greatness was in its potentiality for so many ramifications in the subsequent eras: thermodynamics with its statistical formulation could not be subsumed under the Newtonian principles: fluid mechanics and theoies of metals would not constitute one system by the Newtonian mechanics; electomagnetism is a sort of an annex to it. This system of physics is a compound construction, which contains so many elements, but without the Newtonian philosophy of nature the great system of physics would never have existed.

Apparently Newton was not a metaphysician, and we should not expect to find or fabricate any coherent metaphysics which might be contained in his philosophy of nature. He was a religious person, and being a sort of Unitarian, he denounced at least implicitly traditional doctrines of Angrican (and naturally Roman Catholic) Church. To him his cosmology and faith were sufficent to dispense with metaphysics. But when the Roman Catholic Church canonized St. Thomas Aquinas and called him *doctor angelicus*, metaphysics was officially acknowledged as *ancilla thologiae*, i.e. indispensable learning for the Catholic faith. So such philosophy as Newton's would not be conceived in the mind faithful to the doctrines of the Catholic Church. Nevertheless Newton admitted the constant, perpetual presence of providence of God whose existence thus could be known through the philosophy of nature. In this regard Newton could be said to have inherited the Christian tradition ascribed to St. Augustin's "Book of Nature".

After physics emerged out of the Newtonian philosophy of nature, its basic concepts have undergone so many changes in the last two hundred years. Nevertheless its fundamental way of seeing the world has remained unaltered, and as a consequence this view has had great impacts on other fields of intellectual inquiries, and as a consequence, the inherent pseudo-metaphysics strengthened and broadened the scope of the view immensely. In spite of the changes and modifications introduced into its basic concepts such as mass and spatio-temporal framework, it continued to retain its most fundamental peculiarities: being mathematical, the category of quality has no place in physics. Secondly, it has been theoretical, that is, it is always a system in which all the results of observations must be deduced from the fundamental principles, though it happened that new principles were added and the scope of old principles was made restricted, and the explanatory model of the Principia, i.e. by means of certain substrata, is still used. Thirdly, it has always been thoroughly objective, and as a consequnce, human existence could not play roles in an essential way in the theoretical system. Fourthly, certain entities have been introduced to be immutable substrata in the processes concerned. Thus mathematically, the notions of invariance and conservation have come to play vital roles in the processes of theory formation. I contend that the permeation and domination of basic views of physics are the fundamental characterisics of modern science, and I maintain that the root of modern scientific crisis is here.

4. Physics and Natural History

Probably the term "natural history" came to be commonly used in the medieval Europe through the influence of Pliny the Elder's Naturalis Historia, for this encyclopedic work had been the greatest source of knowledge and one of the earliest classical works known in the medieval West until the learning in the Arabian civilization was introduced in the twelfth century.

Even in the European tradtion, natural history has had an entirely different path from the development process of physics. It consists of accumulation of knowledge of things which exist by their nature. It served as a bridge through which man could communicate with those things. In the Western tradition natural history has been regarded as a branch of science, and contemporary ecology, ethology, morphology, etc. have been taken as a kind of its ramifications. Clearly the world conceived by natural history is not senseless, valueless, nor purposeless, for things are taken in their entireties, and human presence is essential in that Nature; birth, growth, and death are not necessarily limited to living things. Nevertheless, in the West even natural history could not be exempted from the Greek tradition nor from physics, and was tinted with elements of objectivism.

But when the Christian faith prevailed, the great universe was viewed with awe, and one felt the hand of God in everything therein. Pascal remarked in his Pensèes, "The eternal silence of the universe makes me afraid." Pascal was by no means exceptional, and the saint who preached to birds was never mocked at but revered. So in a Benedictine monastery, there was no conflict between studying and praying; both were acts of faith and devotion. The Romantic reaction of Wordsworth, as Whitehead so called, as well as Transcendentalism of Emerson may be regarded as the remnants of the past era. "...the narrow and efficient scheme of scientific concepts .....was the product of a mentality which found the Augustinian theology extremely congenial. The Protestant Calvinism and the Catholic Jansenism exhibited man as helpless to co-operate Irresistible Grace: the contemporary scheme of science exhibited man as helpless to co-operate with the irresitible mechanism of nature."[33] The narrowness means lack of metaphysics and spirituality, and it is very paradoxical that this situation resulted from Neoplatonic rationalism and the doctrines of extreme piety and total submission to God's Will.

In the above I used "natural history" in the broadest sense of the word, and it is my contention that it consists of accumulation of our daily dealings with natural world, and our comprehension of the natural world constitutes the natural history, which contains man and his experience in an essential way. Experience is not mere perception, but more human life itself, which does not contain even the distinction between subject and object, for it is a theoretical entity which was introduced in the process of theorization.

If natural history is understood this way, then a particular type of natural history, and also metaphysics and spirituality will be found in every human culture, for as far as human beings are intellectual, it ineviably contains such elements as how to live in it and with it, and how to live together: thus human experiences are never deprived of sense, value, and purpose.

We have seen that the restoration of natural history is vital in avoiding the catastrophy of scientific crisis. But now the influence of science and technology permeates almost every culture, and their confrontation with the traditional metaphysics and spirituality seems unavoidable. As has been witnessed in Japan, any culture other than the West would be more vulnerable in the scientific crisis than the West itself, for science and technology emerged out of the Western tradition and the tie which connects the former with the latter is not entirely lost, while in other cultures such tie is not present. When Japan started to accept the Western civilization some one hundred years ago, "Japanese mind, Western ingenuity" (wagon yohsai, in japanese), was a very popular slogan, but contrary to the expectation, so much of traditional culture has been lost, or mixed up with the Western elements in the past hundred years, and now most Japanese do not know which is which.

The concept of Nature may illustrate the point. The term "nature" was translated into Japanese perhaps in 1880s, or very early part of Meiji period.[34] The translation was "shizen"

自然. But the term itself is old, and Japanese learned these chinese characters from Taoism literatures,(though Japanese learned chinese philosophy mainly through Confucian literature) and it had been pronounced as "jinen" until the translation dispelled the traditional meanings, but it had been pronounced also as "shizen" even before it came to be used as a translation of "nature," but with a different cannotation. Apparently the translators understood the meaning of nature coincides with that of "jinen". Clearly they did not conceive Nature as something objective. The traditional meanings of "jinen" are quite diversified. Nevertheless, most of Japanese intellectuals knew those diverse meanings quite well, since they were familiar with Chinese classics, including those of Buddhism, ~~and~~ as well as numerous Japanese interpretations of these literature~~s~~, and an ancient conception which was also represented by the same Chinese characters 自然. But the Japanese pronunciation of the term in the last meaning was "onozukara" which meant <u>by itself</u> or <u>of itself</u>, and this is the most basic meaning of Japanese conception of nature. This word can be found in the oldest Jpanese literature where the influence of Chinese philosophy was almost negligible but some minor elments of Taoism.[35] The concept might be traced back at least to the fifth century, and associated with ancient Shintoism.[36]

This conception represents the attitude of ancient Japanese toward <u>nature</u>: it contained the conception of a whole in an essential way, where the separation of man and nature did not exist; one should not take it for a form of animism (though the animistic interpretation is always possible where any close association between nature and man exists); it is the conception of nature that everything grows of itself, and so does man, and thus to be "onozukara" was the norm and aim of human life, which includes everything man does and creats, that is, the whole culture. Naturally it had very significant influence on the interpretations of Chinese classics and Buddhism which came to be introdeced into Japan in later periods, and the abundant evidence found in the Japanese classical literature shows the vastness and depth of influence. The conception provided the foundation for such original authors as Motoori Norinaga, Andoh Shoeki and Ishida Baigan, later in the Edo period.

On the other hand, "onozukara" is very close to the Greek conception *physis*, which also has the connotation of "of itself" and "by itself", and like "onozukara", was always used as adjective and adverb. But "onozukara" does not imply the opposi- between *physis* and *nomos*; since the notion of transcedental God was absent in Japanese tradition, naturally it did not contain the cannotation of object, and one must note that it was an adjective or adverb which modifies some sort of *becoming*, and the concept of substance was entirely absent in Japanese philosophy of nature or metaphysics from which the world of immutable mass and empty space was totally alien.

Since every natural process was thought to occur naturally or "onozukara", it had somewhat a status of common and unifying principle. There is a striking similarity between the conception of process of Whitehead and, the ancient Japanese conception of nature, though naive and totally unsophistcated it was. There is no ditinction between technee and physis either. "Onozukara" was an ideal that Japanese tried to achieve in arts, not only in fine arts but such arts as architecture, No-play, tea ceremony, and flower arrangement. We could find abundant evidence of its essential influence in the formation of Japanese mind; in philosophy, in religion, in ethical and esthetic thinking.

There is no space to spend so much to expound the conception as desired. Last but not least I maintain that most of contemporary Japanese do not know what "jinen" and "onozukara" used to mean and that only their remnants remain in Japanese thouhgt, even among the most sophistcated circles. Similar situations exist with respect to other numerous conceptions: in the above I have touched upon the notion of religion in the contemporary Japanese thought. I maintain that this kind of situation, which is perhaps unparalleled in other civilizations, makes more difficult for Japanese to comprehend the meaning of the pressing but puzzling plight brought about by the scientific crisis, for they have not acquired the Western tradition in the real sense of the word, with its depth and scope. Thus the problem of East-West perspective is, I believe a really serious issue Japanese have to cope with in the age of sceince and technology.

NOTES

1. Watson, 1987, 17.
2. Attempts to integrate the hypothses of this kind into the theories often, if not always, lead to contradictory conclusions, as is best exemplified by the quantum theory of measurement. See Nagasaka, 1983.
3. Whitehead, 1950, 25ff.
4. ibid. 25. Italics are mine.
5. This view coincides with that Husserl advocated in Husserl, 1954.
6. Rationality of scientific theories has been questioned, and criticized. See for example Kuhn, 1970, and Feyerabend, 1975.
7. Husserl, 1954, Chapt. 1.
8. ibid. 3. The translation is mine.
9. Butterfield, 1962
10. Whitehead, 1950, especially Chapt. 1.
11. Concerning the issue and its relation with scientific thought, see for example Dijsterhuis, 1961, 160ff.

12 Nature is a translation off "physis", which was used only as adjective or adverb, but it has another meaning as the objec-

tive world. This dual meaning played important role in the development of the European thoght.

13. See for example Randall, 1940.
14. Sarton, 1960, 287.
15. N.R. Hanson propounded an assertion that all observed data are <u>theory laden</u> (Hanson, 1958). If we see a shining object in certain direction, in order that we may say it is a star, it is necessary that the sameness of the shining object through time must have been established. But the sameness of the object is not enough for our seeing may constitute data of astronomy: so many presuppositions and theories must have been established so that our observations may have certain meanings.
16. Cohen and Drabkin, 1958, 90.
17. See for example Burtt, 1932, 40ff.
18. Burtt, 1932,44.
19. Koyrè, 1965, 197.
20. ibid., 196.
21. Koyrè, 1957.
22. Burtt, 1932, 64.
23. ibid., 66.
24. See for example Koyrè,1943.
25. See for example McMullin, 1967, 15.
26. See for example Plato, <u>Laws</u>,889B; Aristotle, <u>Physics</u>,192b ff.

27. Aristotle, Physics, 251a, 9f.

28. Newton, Principia, Definition I.

29. See Koyrè, 1965, 9f.

30. Hall & Hall, 1962, 360. This passage is found in the MS. Add. 3965, a draft of the Scholium Generale of the Principia, though it is omitted in the published edition.

31. Leclerc, 1984, 20.

32. ibid., 5.

33. Whitehead, 1950, 10, 106.

34. Yanagibu, 1977, especially Chapts. 1, 2, 3.

35. See for example Fukunaga, 1987.

36. Shintoism cannot adequately be classified as a religion. The latter concept had never existed in Japanese tradition until it was translated as "shuhkyoh", which had had a meaning somewhat similar to religious dogmas in English. However, now the "shuhkyoh" is a well established word among Japanese, but the word involves ievitable ambiguities and vagueness, and this situation, I believe, has given rise to considerable confusions when religious matter is discussed. In the Christian tradition the term "Religion" designated christianity, and when this is used a cateogorical term, it seems that still it retains the Christian element quite significantly, and I maintain that this situation makes understanding the Japasnese tradition considerably

difficult not only for non-Japanese, but for Japanese as well.

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