The ontological status of western science and medicine

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ABSTRACT

This paper traces the revolutionary changes that have transformed the ontological status of western physics and biology over the last thirty years, so as to show in detail how they have moved towards the perspective of the Vedic sciences. From this it appears that Ayurveda's more holistic approach is no longer in opposition to the views of physics and biology. In physics, experimental verification of phenomena associated with quantum correlations have forced scientists to accept that the macroscopic world is not strongly objective: traditional western scientific ontology stands rejected. One consequence is that the world is not necessarily reductionist i.e. based solely on the properties of its tiniest constituents. In biology, the 1930's discovery of homeostasis has reached a natural climax: the feedback instabilities, identified by Norbert Wiener as inevitably accompanying control processes, are now recognized to be states of optimal regulation, where organisms centre their function. The non-reductive properties of these states clearly distinguish the theory of control from previous physical theories; they now occupy the centre-stage of life. Possibly against expectation, their non-reductive nature makes their physics holistic: western biology seems to have broken free of reductionist physics. When Ayurveda and bioscience are compared in light of these little appreciated advances in fundamental science, the supposed differences between them are vastly reduced – they practically dissolve. Instead of being poles apart, the ontologies of western science and Ayurveda seem to have become almost identical.

Key Words: Criticality, holistic biology, holistic physics, ontology, quantum reality

INTRODUCTION

The previous issue of J-AIM contains an article by Jayakrishna Nayak[1] concerning differences in approach and outlook between Ayurveda and modern science. In his analysis, Nayak pays particular attention to science's reductionist perspective that was dominant in the mid-20th century, contrasting it with the more holistic world-view of the Vedic sciences in general and Ayurveda in particular. This approach, however, needs to be augmented by radical changes in the foundations of both physics and biology that have taken place in recent decades. These revolutionary changes seem to have brought the world view of modern science more in tune with that of Ayurveda. When taken into account, comparisons of Vedic sciences with modern science reach different conclusions, as this article attempts to describe.

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Physics, for example, now denies that the nature of the universe is purely objective, as outlined in the next section. [2] As further described, this has strong implications for the concept of reductionism: that all phenomena can be understood in terms of the smallest identifiable components of matter. Reductionism finds its origin in objective reality, and denial of the latter greatly weakens its status. Reductionism has been further weakened by the mathematical physics of regulation and control, as described in the third section.

In biology and medicine, the reductionist approach is implemented by taking the analysis of structures and their component subunits as fundamental. This is now giving way to analyzing life and health in terms of feedback structures regulating complex systems.[3] The fourth and fifth sections trace the story leading to life now being thought to optimize its function by centring its function on feedback instabilities. For these, their physics is non-reductive, and tiny influences, such as those of quantum correlations, can play identifiable roles.

Having summarized these truly revolutionary developments, this article suggests that, as a result, the gap between science and Ayurveda has narrowed to the extent that science no longer opposes Ayurveda's perspective, but actually supports it.

QUANTUM PHYSICS QUESTIONS REALITY

Scientists tend to regard physics as the science, from which our understanding of what is fundamental in the universe should ultimately be derived. On a microscopic level, the most fundamental theory in physics is quantum theory, with all its various forms in subatomic and elementary particle physics, such as quantum field theory, unified field theory and string theory. It is necessarily to this field of physics that science looks for its understanding of the nature of the reality in which we live.

Quantum theory has many highly unusual properties that have, over the years, stirred debate and controversy before they were properly experimentally verified. Quite startling was its prediction of persistent correlations between different quanta and quantum systems. Such correlations can bind two quantum systems into a functional whole, despite their being separated by macroscopic distances. They begin to atrophy the idea at the heart of reductionism and classical science in general that objects exist independently of each other.

Recognizing that these predictions would destroy the very heart of the traditional scientific outlook, Einstein protested strongly against them, publishing a famous paper with colleagues Podolsky and Rosen, known as the EPR Paradox.[4] Despite being counter to Einstein's intuition about the nature of reality, numerous experiments have shown that quantum theory's predictions stand: on this matter, Einstein was wrong.

Quantum correlations exist, even between well separated macroscopic systems. The scientific community has had to swallow the bitter pill they represent: for the most part they have done so stoically and silently. One physicist, however, has made much of the consequences, and shown that quantum correlations destroy one of science's most treasured prejudices – that the reality we live in is 'objective' i.e. made up of independently existing objects.[2]

It is easy to demonstrate a simple proof that quantum correlations mean that this is not the case. Just tear a piece of paper in half! The original supposed 'object' is now two 'objects'. The question is, 'Do these have absolutely independent existences?' Clearly we assume so, and to all intents and purposes the pieces of paper behave as if they do. But philosophically, the assumption of the independent existence of an object from all others around it is stronger – it demands an absolutely independent existence for each apparently separate 'object'.

Quantum correlations deny this: according to quantum theory, atoms that were adjacent in the piece of paper before being torn apart would have been correlated, and effects of those correlations will persist despite the separation. Such correlations only become significant when the piece of paper has been torn in two so many times that it is on the scale of molecules and atoms. These, however, were present at a microscopic level all the time, and, having once been contiguous, such objects retain some measure of correlation. As quantum entities, they can never become 'independent objects'. Conclusion: the idea that reality is purely objective is no longer valid; Objective Reality must be jettisoned.[2]

In that case, what form of reality is valid? D'Espagnat has carefully not committed himself, only stating that it must be 'veiled',[2] since its nature is hidden by the macroscopic world. For Vedic science, the proof that the reality of the world of physics is not objective is extremely important, since it opens the possibility that modern science may be more in agreement with the reality proposed by the Vedic sciences. Indeed, Capra has already pointed out that certain equations in elementary particle physics – the so-called 'bootstrap equations' – mean that reductionism is not properly realised even in this most fundamental area of physics,[5] while Hagelin[6] suggests that unified field theories are a means of realizing Advaita, the idea that all diversity springs from a non-dual underlying unity.

The idea that an overall unity is creation's source, so that diversification the fundamental process, is completely opposite to the idea that fundamentally different objects form the source, and that their aggregation in different combinations is the fundamental way that differences arise. Reductionism is again denied.

As regards understanding quantum theory and its correlations, it turns out that among the Ayurveda-related systems, the Samkhya system of Vedic philosophy is most helpful.[7] Samkhya holds that the world of experience has two levels, manifest and unmanifest. The macroscopic world of sense perception is manifest, while the quantum world that underlies and controls it is unmanifest.[7] The manifest world's appearance is maintained from the quantum level by information production; consequently, it is only an information field, with its self-consistency guaranteed by the very correlations that Einstein vilified. As Samkhya is one of Ayurveda's padartha (conceptual foundations), this represents a first direct vindication of Ayurveda's perspective on the world around us.

THE PHYSICS OF REGULATION AND CONTROL – CYBERNETICS

Another fundamental area of physics where reductionism has been brought into question is the theory of control, 'Cybernetics', introduced by M.I.T. mathematician, Norbert Wiener, in his revolutionary book of that title.[8] The technicalities of Wiener's work meant that physical science was totally transformed. His new kind of equations, 'integro-differential equations', behaved completely differently from the previous equations, 'differential equations', used to describe laws of physics. While the latter imply complete reductionism, the former contain mathematical 'singularities' describing places where the system becomes physically unstable and reductionism breaks down, as we describe below. The 'singularities' in the maths are a new element, giving the theory completely new characteristics. The new characteristics carry over into biology and medicine, and ultimately biomedicine's relationship to Ayurveda, so their importance lies in being able to trace them to their source in Wiener's well known work.

The physics of feedback singularities is also highly unusual. Macroscopic correlations bind the system into a whole; different states cannot be separated; the system cannot be reduced to independent interacting states. Furthermore, the physics looks the same whatever scale of length is chosen: it 'scales'. For these two reasons, the physics of feedback singularities cannot be considered reductive; rather, it is non-reductive, and in this sense holistic. While these points may seem distantly removed from biology and medicine, the two sections that follow show how feedback singularities assume central roles in biological regulation, and present a key to understanding Ayurveda's concept of 'perfect health'. The fact that the physics of the singularities is non-reductive, as indicated above, is therefore a point of central importance to secure the rigor of the logic behind the paper's conclusions.

While physics and chemistry have largely avoided using Wiener's concepts to describe their basic laws, biology, which partly provided the stimulus for his work, is unable to avoid the concepts of feedback and regulation that he popularized. This is because no biological system can function unless it is carefully regulated, and no regulation is possible without feedback: to regulate a process in an intelligent way, information about system output has to be 'fed back' into it. Examples are use of a thermometer to regulate heat input into a system, or looking through the sight of a weapon to detect deviations from a target, and correct the aim. In both cases adjustments are made based on the information obtained, creating a loop of information.

Such feedback loops introduce a radically different element into the world of physical theory, for they bind a system into a functional whole. Although a system may consist of separated entities that make it superficially look reductive, the physics of feedback introduces a holistic element into its function that effectively destroys its reductive properties. Clearly this fact carries over directly in biological regulation.

Nowhere is the destruction of reductive properties seen more clearly than at a 'feedback instability'. Such instabilities are commonplace. Everyone has heard a public address system begin to shriek, and the person with the amplifier be asked to turn down the amplification level. Once that is done, the system again behaves properly. The level of amplification is measured by the 'gain' round a feedback loop – equal to ratio of the signal amplitudes on successive passes round the loop. As long as this is less than one, the system is stable, but when it is more than one, the shriek is generated. The instability point is when the gain is exactly one, the shriek is almost, but not quite, expressed. It is at the limit of stability, the so-called 'Edge of Chaos'.[3]

As a feedback instability is approached, a system develops long-range correlations, which mean that distant points become correlated with each other. At the instability point itself, the 'correlation length' becomes infinite, it is said to diverge. With its correlations encompassing the entire system, no single element of the system can be considered isolated; its behaviour is not separate from, or independent of, any other point. There is a thus special sense in which the entire system begins to function as a whole: at feedback instabilities, system properties become holistic. Because feedback instabilities are now recognized to be central to biological regulation, this has important consequences for our understanding of biological systems, as explained in the next section. It also has vital consequences for Ayurveda. In Ayurveda, the state of 'perfect health' is known as Samatwa. [9] To be properly realized, it has to be located at such a feedback instability – a highly complex, multidimensional instability at that.

BIOMEDICAL SCIENCE

In biosciences, a slow but steady revolution has been taking place over the last 80 years, since the time when homeostatic mechanisms began to be elucidated. These were partly what led Wiener to develop his mathematical theory of regulation, but the major outcome for biology was the development of 'Systems Theory' by Ludwig von Bertalanffy[10] and others. Systems theory was the result of applying the idea that a system with feedback loops necessary for self-regulation develops its own integrity, and can therefore be considered a valid entity in its own right. The integral wholeness of the system is guaranteed by feedback.

Homeostasis means that an organism's regulated properties assume values independent of the environment, instead of being part of smoothly varying environmental variations governed by the normal differential equations of theoretical physics. This independence is what makes the functional wholeness of a living organism non-reductive: it has developed an emergent property of its own, which cannot be reduced to local properties of a smoothly varying structure dependent purely on local interactions.

Regulation thus means that biology is not subservient to the assumed implications of classical physics. An organism's ability to regulate its internal environment, homeostasis, is a defining feature of living organisms – of life itself. Feedback and control are thus acknowledged to be at the heart of biology. As hinted above, this has consequences for biology at least as startling as the consequences of D'Espagnat's work for physics, if not more so.

The implications of regulation reach their climax in modern complexity biology.[3] Here, not just homeostasis and feedback are recognized as central to life, but the physical locations from which organisms prefer to operate their regulatory systems are found to be the feedback instability points discussed above. This is because feedback instabilities are places where the gain round a feedback loop attains its maximum value consonant with stability; locating the operating centre of regulation at a feedback instability maximizes sensitivity of response. Due to the instability, moreover, the same response never occurs twice. Such flexible responses are of considerable advantage to a population of organisms – they increase the chance of an appropriate response being made in previously unencountered situations. For these two reasons, establishing its location of regulation at feedback instabilities endows an organism with significant competitive advantage.

As stated above however, at instabilities the mathematical and physical consequences of feedback take extreme forms. These turn out to be of most consequence to Ayurveda.

HOLISTIC BIOPHYSICS: VERIFICATION AND IMPLICATIONS

Western science does not yet seem to have caught up with the philosophical implications of this aspect of modern complexity biology. Yet a large body of experiment bears witness to it. The entire phenomenon of heart rate variability[11,12] is built round feedback instability. Only because of the instability can heart rates vary as much as they do. Other physiological systems obey similar kinds of law.[13] Because of the holistic properties of the physics of regulation at the instability points, the whole structure of regulation becomes more holistic than the feedback loops alone implied: at the heart of life is a structure of regulation that endows biophysics with an holistic structure.

The essence of life is thus transformed from being anatomical, reductive and purely objective to being based on non-reductive states that concern function rather than structure. Whereas the former vision of life is based on things that are manifest, visible through microscopes of various kinds, and subject to material analysis, like chemical sequencing, the new vision of life concerns things that cannot be directly seen, and are on the surface of things, unmanifest. Who can see function directly? Let alone its regulation?

Determining function of an anatomical feature may require considerable investigation. More subtle are the regulatory processes and sensitivities by which function operates in the real world. All this is well understood, yet biomedical science still behaves as if anatomy and its associated, reductive, 'objective reality' were the major defining features of life. Systems theory's implications have only recently begun to be explored, some 50 years after the fact, and even then in an inappropriate fashion – because the microscopic level is being considered first. As for the deep philosophical lessons behind heart rate variability, and, more generally, fractal physiology, little of their fragrance seems to have touched the biomedical fraternity.

IMPLICATIONS FOR AYURVEDA

Careful 'Decoding Ayurveda',[14] and elucidating the meaning of its various fundamental concepts, leads to the conclusion that they concern regulation of fundamental systems properties of the organism. Tridosha and the various subdoshas are responsible for all physiological function, starting with the fundamental systems functions, Input/Output, Turnover and Storage,[15] and the major organ subsystems, respectively. The implications are that they regulate these functions, as can be justified by careful analysis of both texts and functions.[14]

In contrast to bioscience, Ayurveda thus sets regulation at the heart of its analysis of life. When it states that health is a state where doshas and dhatus are in balance, it is pointing to states of optimal regulation[14] – the very state of criticality, proposed by modern complexity biology, and exemplified by heart rate variability.

Through recent and ongoing developments, modern bioscience has thus come to be far more in tune with Ayurveda, than scientists might have expected. The physics of variability of regulation has brought about a convergence between Ayurveda and modern biology. No longer are the two poles apart. The holistic form of the physics of feedback singularities has brought them into an apparently unanticipated harmony.

I say 'apparently unanticipated', because in my personal view, the Vedic sciences in general, and Ayurveda in particular, though constructed from a radically different perspective, are in advance of the modern sciences. They can therefore be used to gain clues as to how to make advances in modern science: Ayurveda shows that regulation of whole organism functions is fundamental, and that the hierarchy of regulation it implies spells out the biological history of changes in regulation. By adopting these clues and making the correct advances, modern sciences can be brought into harmony with Vedic sciences. Samkhya's use to understand quantum theory in physics, and the connections between 'perfect health' and fractal physiological regulation, embodied in feedback instabilities, are examples of how this vision is working out.

CONCLUSIONS

Ontological issues have previously been used to provide challenges to Ayurveda and place its holistic structure in some metaphorical outer darkness. Now they are dissolving. Work on criticality and complexity biology over the last quarter century has erased the boundaries. Ayurveda's metaphysics is no longer at odds with modern bioscience. It can 'come in from the cold'. The right perspective can even make it seem mainstream.

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