

Form of Motion of Matter — A Kaleidoscope of Physics in Life

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Introduction

The subject of physics is well known to be dealing with the kind and types of energies, their conservation, manifestations, inter-conversion and interactions with matter belonging to both the animate and the inanimate world. And all activities of human beings; be it related to manufacture, trade, transport, commerce, business, management of resources, agricultural production and his personal existence are basically nothing more than the flow and conversion of energy and interactions with matter of various kinds. Therefore, whether we are aware of this fact or not, appreciate it or do not appreciate, like this reality or do not like it, consciously try to understand its meaning, reality and significance or unconsciously ignore it, the laws of physics, physical forces and energies, operate as the undercurrent behind all material creation, manifestation, activities, existence and even in destruction not only on the Earth but in the entire universe. It is therefore imperative that as an educated and enlightened citizen of a modern civilized scientific and technologically advanced world, irrespective of our physical location on the Earth, religious faith at birth, colour of the skin, kind of human race, physical conditions of living, chosen career for education and profession for livelihood, each one of us must be educated and knowledgeable about the basic laws of physics, not necessarily in details but at least in their physical significance and more particularly about the various forms of energy and their intertwined flow. All the money we exchange in whatever currency, grocery we buy, services we purchase and management of resources we practice, are in fact the price that we pay for a bundle of energy as an economic barter deal. And this realization,

knowledge, understanding and education as a 'primer' must begin from childhood at home and the primary schools in general. Therefore both the parents at home and teachers in schools at all levels and in all streams of our education (*e.g. science, technical, engineering, medical, agriculture and even social sciences and management etc.*) owe special responsibility in educating the young generations. The situation is quite analogous to the almost compulsive training, literacy and education in using computers today. Non familiarity with computers in the twenty first century has become akin to a stigma of illiteracy. So is the case with the knowledge in physics and physical forces and energies which concern us almost every moment of our healthy existence on the Earth. In fact every one of the living creature on the Earth is immersed in an ocean of energy of various kinds and respond to a multitude of them mentally, spiritually, physiologically, biochemically, physically, and mechanically. This fact is also true in case of plants, insects, microorganisms and aquatic life forms. All forms of sciences developed by human mind are therefore nothing more than attempts to systematically study the interactions of living creatures to the stimulus of various forms and kinds of energies. Therefore, it is essential that a basic minimum knowledge in physics must be delivered and made to understand by all means before individual subjects are formally taught. There is no doubt that training for logical thinking and reasoning in sincerely learning physics goes a long way beyond academics, in building a scientifically oriented, educated, thoughtful, sagacious, judicious and a genuinely open unbiased society as a long term objective for any self respecting sovereign nation. This is also necessary and helpful in eradicating several of our age-old social prejudices and miss-beliefs,

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superstitions, blind faiths, sense-less gory rituals of animal and human sacrifices in the name of religion and faiths, black magic, false sense of pseudo supremacy and honour killing for its sake and such other malaise, commonly prevalent amongst all religious faiths, communities, casts and creeds and deliberately perpetuated by the vested groups and touts in the name of rituals, traditions and culture to trap gullible individuals. It is the ignorance, fear about the unknown and lack of scientific (physics) education about the invisible world that perpetuates unscientific, illogical and at times cruel practices amongst all sections of population, literates, illiterates and the unthoughtful educated-illiterates. This may be exemplified from the still prevalent practice of attributing the cause for outbreak of epidemic viral diseases such as chickenpox and smallpox to the curse of female deities (DEVIS) in India. A properly trained and educated physicist of conviction instantly perceives the interflow of energies in a given situation and in most certain cases arrives at a very logical, scientific and reasonable understanding. In short, logic, unbiased reasoning, scientific tests, experimental demonstration, critical analysis and open mind to accept new knowledge must prevail over all other stray considerations. And the best mental training in doing so is certainly received in honestly learning physics and mathematics with eagerness. A notable example demonstrating truth about such a connection can be cited here from the personal memoirs of the former President of India Dr. A.P.J. Abdul Kalam, who clearly mentions that despite the society in Rameshwaram where he lived, being highly stratified into orthodox groups, he never felt differences because of social rebels in his Science (Physics) Teacher Mr. Sivasubramaniam Iyer and some others who not only defied all prevalent norms with a candid determination to change the social system and frequently invited young Abdul Kalam over lunch and dinner to his house as a personal example for others to emulate. Human history is replete with examples where only scientists and scientifically oriented individuals have been instrumental in changing the traditional mindset of the generations and bring about radical social reforms. Incorrect, illogical and unreasonable and unscientific

practices of any kind (religious, cult, faith or tradition etc) on whatever pretext, if once allowed to gain ground and perpetuate in society, it would take centuries and even millennium to get rid of their nuisance and malaise. The eradication of the 'Sati-Pratha' self or forced immolation of the wife of a deceased husband is an example of this kind. The recent spurt in the incidences of 'honour killings' for various reasons being reported in the media these days is another social malaise of this kind that needs to be dealt with heavy hand. And reasons for all such gory practices are surely the lack of modern scientific education, mind set and un-reasonable blind-faith. There is therefore no substitute to rigorously spreading, promoting, encouraging, learning and teaching of physics and related physical sciences for building an objective, rational, judicious and progressive society. It is unfortunate, that our scientific and academic bodies should not be in a position to initiate studies on such subjects as 'Family Gotras' traditionally held close to the hearts by people in almost all the states in the country to look into the scientific basis, their relation (if any) to the human blood groups, genetic basis and significance for marriages of individuals born within and between different 'Gotras' and continued relevance in the twenty-first century. This is particularly urgent in view of sporadic violence, murders and crimes being done and innocent lives are cruelly terminated. India has resolved earlier a contentious issue of 52 different calendar systems prevalent in the country and being religiously adhered to by various communities, in evolving a National Calendar through consensus. A similar approach needs to be adopted for the problem of 'Gotras' and various other orthodox problems that plague the social cause and lives in this country. It would be ridiculous to leave them just as such to the prevalent blind faith or social beliefs and not attempting to find or prove a scientific basis in them. I am sure, I am liable to be questioned-How learning physics and social problems described above have anything in common? And with all sincerity and conviction, I admit that there is not only connection but all our problems originate from non compliance and non-subordination to the natural laws that govern our very existence on the Earth.

How Physics is Integral to Education and Life

Under the present scenario, lessons in physics and mathematics should be made mandatory for the students of all biological sciences and particularly in agricultural sciences because they are directly and primarily concerned with the use of natural solar energy in terms of photosynthesis and the yields of plant and agricultural produce. All the efforts, indulged into, by the agricultural scientists in breeding and hybridization of new crop plant varieties for increased or optimized yields are, in fact directed towards efficient harnessing and utilization of solar energy under normal or specific environmental conditions from various locations. A critical scientific look at the crop breeding programs pursued by the agricultural crop breeders will reveal that the measures adopted by them are indeed directed to bringing about necessary changes in the existing varieties in terms of increased biomass production, qualitative and quantitative changes in protein, carbohydrate and sugar syntheses and other associated changes besides appealing colour, shape and size, taste, cooking qualities, economic production, resistance to pests and diseases, partitioning of harnessed solar energy for auto-synthesis of insect toxins (Bt.) for self protection by the crop plants and for enhanced post harvest shelf life. And all these involve complex dynamics of energy harnessing, transportation, biosyntheses and storage of molecules within plant cells to produce what we call the crop yield. Such changes are mediated through changes incorporated into the DNA sequence of the concerned crop plant-cell using several well known conventional and modern molecular genetics techniques. Complexities arise because most of the characters of crop plants are controlled by multiple genes and their sequential locations on the DNA molecular strand. Understanding of the energy basis of nature and of the physical processes that are involved for maximizing energy harnessing in any of the physical, physiological, biochemical, metabolic and biosynthetic processes is therefore essential to modulate, regulate and engineer crop plants suitable for new requirements and demands. No wonder, crop plant breeding is not an isolated

enterprise but an activity that needs considerable inputs from physics and physical sciences (Meteorology, Soil Physics, and Agronomy that is intimately related to micrometeorology and various kinds of 'morphogenetic energy fields'). And such conscious integration of different disciplines was one of the main reasons indeed for the success of the All India Coordinated Crop Improvement Projects launched by the Indian Council of Agricultural Research (ICAR) in the early sixties that led to the first green revolution.

Reasons for Location Specificity of Crop Plant Species and Varieties

Rupert Sheldrake, the well known biologist has recently come out with his path breaking 'New Science of Life' the role of physical forces and morphogenetic fields in what is called the morphogenesis of organic molecules and forms within living organisms. Several reports of studies conducted by the NASA-USA also corroborate the fact that radiations, electrically charged plasma, coronal mass ejections, solar flares etc from the Sun and outer galaxy affect the geomagnetic fields on the earth and life forms in both positive and negative ways. And it is time; investigations on the components of such morphogenetic fields are intensified. Perhaps, Physics departments in agricultural research institutions can take a lead. There appears great potential in this area of research as much of the problems of photosensitivity and location specificity in some cash crops such as cotton, durum and dicoccum wheat, spices from tropical humid climatic locations, alfonso mangoes from Ratnagiri, citrus and oranges from Vidarbha region of Maharashtra, coconut plantations along sea coastal regions etc and the crypto-biological aspects of insect-pest proliferation despite huge loads of insecticide and pesticide applications over the years, can be possibly linked to the presence of strong or weak morphogenetic fields at various locations. Recently, Huge Lovel* an organic and biodynamic pioneer, who developed a devise called 'Quantum Field Broadcaster' combining principles of quantum physics, biochemistry and the mind / body link, demonstrated the use of his stationary self driven devise that induces self-reinforcing, resonant fractal patterns, like

homeopathic potencies, directly into the life energy fields of soil and atmosphere. It not only improves the patterns of lime in the soil related to mineral release, nitrogen fixation, digestion and providing nutrients to plants, it also works with the atmospheric patterns of silica related to photosynthesis, blossoming, fruiting and ripening. Healthy lime and silica patterns are also believed to have the potential to change rainfall patterns and restore health to barren lands. Another classic and yet baffling example of how possibly, morpnic / morphogenetic fields modified by the presence of soluble and other impurities in water from any location on the earth affect the shape, size, symmetry and purity of snow, ice and water crystals formed from that water has been clearly demonstrated. And such snow and water crystals have also been reported to be responding to mental energies and human emotions through morpnic resonance. This seems logical because water constitutes over 90% of human, insect, animal and plant body masses.

This paper advocates the need for reorienting and strengthening teaching of physics in schools, colleges, engineering, medical and agricultural universities and in management oriented academic institutions for overall comprehension of the complex problems in a holistic way and more than this; to empower our young graduates and post graduates in tackling challenging problems of enhanced food production and food security for the billions living on the earth or mass-production of consumer goods for human comfort and necessities. Physics is not a 'subject for study' for a university degree but a 'religion by itself' and a philosophy for life and our existence on the Earth. Almost all the so erroneously called 'religious texts' of ancient Indian history e.g.; Vedas, Upanishads and Geeta are indeed scientific treatises. It is our negligence in learning the Sanskrit language that has alienated us from the science (as modern as we can think of) contained in them. Late Dr. M.R. Guney, a Nuclear Physicist from the Bhabha Atomic Research Centre has clearly brought out the scientific aspect of the Geeta in his book in Marathi- 'Dnyaneshwari che Bhava-vishwa' (*The Emotional World of Dnyaneshwari – a treatise on Geeta in Marathi written by Sant Dnyaneshwar about 700 years ago*).

Form of Motion of Matter

The Concept of "Basic Forms of Motion" embraces an extremely wide domain of phenomena into which the whole of nature can be broken down and to which, all natural sciences including all processes constituting the structural elements and interactions taking place in them are included.

Form of motion is;

1. Associated with a definite type of matter,
2. Have qualitative features of a certain family of phenomena or motions distinguishing it from other such family,
3. Related to internal structure of the material entity,
4. Related to the type of interaction between the elements constituting the given entity and its structure,

Interrelation of traditionally classified sciences, reflect the interrelation of forms of motion, and consequently the forms of energies, extending to the basic fundamental concepts of each science. For Physics, this fundamental concept is "Nature, Kind and Form of Energy" for Chemistry it is "Chemical Element" for Biology, the concept of "Species" or may be "DNA / RNA". Any quantitative research based on mathematical logic not only changes the quality but even the scales of accuracy for a meaningful comprehension of the phenomena / problem under investigation, its practical utility and for evolving or converting the results into practical technologies. Physics provides the necessary theoretical and experimental approach and mathematics, the necessary logic for quantitative measurements. Several examples of the intertwining of the conclusions of different sciences can be seen, not only in the development of the sciences called geology, geochemistry, geophysics, cosmology and astronomy but even in the biological sciences such as genetics, biophysics, biochemistry, physiology, molecular biology / genetics and biotechnology. For example, to study the upper part of the earth's crust, cooperation between ancient geology, geophysics and geochemistry has been established. But, to probe the deeper layers of the crust, specially the mantle and the core,

geological methods prove ineffective and physics, astrophysics / stellar physics, astronomy, geophysics and geochemistry come to the fore. Geophysics provides information on density, elasticity, viscosity, electrical and magnetic properties, heat flow from the interior to the earth's surface and information regarding thermal history of the earth in general. Physics provides theoretical and experimental data regarding the properties of matter at high pressures and temperatures to validate geophysical conclusions. Whereas, astronomy, astrophysics provides information concerning the distribution of mass within the earth, mechanical properties of the globe as a whole, its gravitational field, changes in the latitudes due to the shifting of the magnetic poles and fluctuations in the spatial orientation of the earth's axis of rotation and cosmogonic theories about the origin of the earth, the solar system and individual planets of the solar system. The interactions, mutual understanding and appreciation between specialists working in narrow areas of their individual specialty grows on the strength of increased use of quantitative analysis, analytical tools and holistic approaches from multidisciplinary angles.

It is known and well established that chemical, physical, mechanical and biological processes taking place on the earth have contributed to the evolution of a large number of transitory boundary sciences. The totality of all such sciences can be represented in the following table;

Astromechanics Geomechanics Biomechanics

Astrophysics Geophysics Biophysics

Astrochemistry Geochemistry Biochemistry

The two other transitional sciences between physics and chemistry include 'physical chemistry' and 'chemical physics'.

The horizontal rows and vertical columns in the above table exhibit the deepest and the most intrinsic relationship links respectively amongst themselves. However, in considering the interrelation of sciences, it should be borne in mind that each science has its specific method of research, tools, theories and relationship with each other, their subject matter, its common origin and

scale and magnitude of the forces and energies involved. Therefore, overall comprehension can never be achieved without the broadest utilization of the knowledge of physics, chemistry, mathematics and modern engineering and it would be futile to expect worthwhile contribution without inputs from these disciplines and knowledge about the interactions of matter with various form and kinds of energies.

Experiments conducted in changing the conventionally traditional sequence in the order of teaching biology-chemistry-physics in schools to physics—chemistry and then biology, has lead to a significant logical flow of conceptual understanding amongst students from physics to chemistry to biology, better mathematical reinforcement, increased appreciation and enrollment of students to physics courses, enhanced curiosity and scientific literacy besides compulsive urge to understand physical sciences. As biology and agriculture continue to become more and more sophisticated and knowledge intensive subjects with the wide scale use and applications of such physical tools as X-Ray diffractometer, transmission and scanning electron microscopes, scanning tunneling electron microscope and atomic force microscope, confocal microscope, nuclear magnetic resonance spectrometers, nuclear techniques, mass spectrometer, chromatography techniques, electrophoreses, computers, computing technologies, information theories and technology, mathematical and computer modeling, statistical theories and satellite borne and ground based remote sensing, there is a growing demand for human resource equipped with knowledge and comprehension of physics, mathematics and chemistry for better understanding the concepts in biological sciences. The important role of physics and physical laws as the under-current of all agricultural activities from sowing and germination of seeds to the harvest, storage, appropriate packing material, transportation, distribution and hygienically safe disposal still continue to be ignored, unsolicited and seldom appreciated in full measure, despite several serious instances of sporadic and epidemic spread of crop diseases, insect-pest infestations arising out of unsafe storage and distribution of

agricultural produce in public for human consumption. The role of physical conditions and environment for prolific growth of pathogenic micro flora over agricultural produce during storage and transportation is very much appreciated but never practically enforced in all seriousness as mandatory regulatory conditions.

Very few of our mushrooming 'Central and State Agricultural Universities' have established strong groups or programs in teaching and research in physics and physical sciences in relation to the requirements and demands of hygienic storage, processing, packaging, sanitization, transportation and distribution of our innumerable agricultural, horticultural, floricultural and even forest-related products. The present complacent situation needs to be changed at the earliest. The emphasis should be on generation of knowledge in a holistic way rather than setting boundaries limited to disciplines or sub-disciplines. All existing agricultural universities and other agricultural research institutions in the country must evolve a mechanism to workout problems in a multi-disciplinary action plan. This would not only end the isolation of our exclusively established 'Agricultural University' system from basic scientific disciplines but help in raising standards of teaching, research, education, human resource and technology development.

Challenging job opportunities can be created for physicists, willing to make career in the field of agriculture, where their knowledge can be gainfully employed to advantage. These include areas of growing crops under low input conditions of water, fertilizers and chemicals, high and low altitude and gravity conditions, agricultural meteorology, defining conditions of crop production under fluctuating climatic and global warming scenario, food processing, preservation, storage and technology, precision agriculture, grade and quality evaluation of agricultural produce, quality certification, molecular genomics, bio-molecular identification, isolation, purification, characterization, structure determination, preservation, storage and search for applications in other areas. All these may require readjustments / reorientation of certain existing sections under related disciplines and faculties for focused priorities.

Any talk of intellectual property right protection, preservation and conservation of crop, insect, forest flora and fauna, aquatic and marine biodiversity and such related issues without physical, genetic and bio-molecular characterization will receive little or no consideration and credibility. We need to establish strong schools and create infrastructure for education and training of human resource for jobs in these prime areas that require greater understanding of physics, physical laws, their limits, range and mode of operation on a war footing. In fact, time is running out and in the event of further neglect, a disaster unimaginable may befall. All these activities demand induction and recruitment of individuals who are capable, eager and willing to excel and perform with utmost honesty and sincerity. Quality science and related services can certainly be achieved through open competition and not through restrictive reserved pastures. There is still time for our exclusive agricultural universities to rectify the situation. It must be realized that all the best known institutes of technology and engineering in the world are also very strong centers of teaching, training, research and developments in physics, chemistry, mathematics and biological sciences. Recent developments in our Indian Institutes of Technology embarking on introducing medical, and medical technology courses is a step in the right direction. If agriculture constitutes a holistic technology for optimizing and maximizing crop productivity, there is full justification to strengthen strong teaching, training and research programs in basic disciplines in agricultural universities. Without them, I am afraid; there may be little hope for any meaningful significant contribution coming forth.

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