euresis journal

euresis
Association for the Promotion of the Scientific Endeavour

Volume 1
Summer 2011

journal homepage
www.euresisjournal.org

The event of discovery

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Discovery in science may come about through many different routes. Most commonly, discovery consists in the unraveling of the physical laws of nature and of the fundamental mechanisms continuously at play in physical systems – galaxies, oceans, or cells. In other cases it involves the acquired awareness of a unique event in natural history, such as the discovery of the K-T impact, or of the path of migration of ancient hominids. And we also call discovery the invention of a novel technological approach, by which a new combination of known physical processes enables new and potentially useful functions.

The paths leading to discovery may also be vastly different depending on situations and disciplines. A discovery may be the result of a long and patient search focused on a well defined hypothesis, pursued by a large number of researchers, sometimes across generations. By contrast, other discoveries happen suddenly, as the fruit of chance, or even as the benign consequence of an accidental error. Moreover, it is not unusual that researchers aiming their inquiry at a given direction end up by discovering something completely different: from Christopher Columbus onward, plenty of episodes show how sailing in a predefined direction may lead in unknown territory – a place not necessarily less interesting than the one initially pursued.

The various facets of discovery are so different from one another that the very attempt to sustain a focused discussion on the topic represents in itself a challenge. This challenge was taken up by a Symposium held in the Republic of San Marino in August 2009 under the title The Event of Discovery, organized by Euresis and supported by the John Templeton Foundation. The papers presented in this first issue of the Euresis Journal represent original contributions by distinguished scientists and scholars of different disciplines, reflecting on their experience of discovery. As in previous editions, the 2009 San Marino Symposium was held in the wider context of the Rimini Meeting for Friendship amongst People, featuring the theme Knowledge is Always an Event. The four-hundredth anniversary of Galileo's first observations of celestial objects with his refracting telescope in 1609 provided an ideal occasion for an open-minded, multi-disciplinary discussion on the subject. The passionate

and friendly atmosphere of the Rimini Meeting extended to the San Marino workshop thus facilitating a personal and free exchange of ideas and insight. The whole richness of such a living event can not be properly put into words, yet the papers presented in this issue represent an attempt to fix a trace of it.

The speakers in the San Marino Symposium were invited to express their views based on their own personal experience of discovery – be it a major achievement or simply a breakthrough in ordinary scientific work – rather than on abstract reasoning. From the speakers' contributions, as well as from the rich and exciting discussions that ensued, a number of aspects common to the different kinds of discoveries could be identified. Here we briefly outline some of the topics emerged during those discussions.

First of all, it appeared that discoveries always carry along a sense of surprise. This holds, of course, for the most unexpected, unpredictable findings – such as Fleming's famous discovery of Penicillin in 1928 or the serendipitous detection of the cosmic microwave background by Penzias and Wilson in 1965. But a dimension of surprise, though with a different flavor, is also present in the case of a strong confirmation of a theory – as in the case, for example, of the confirmation of general relativity by Eddington's observations during the 1919 solar eclipse. Every discovery in science has the characteristics of an event, in that it necessarily introduces in our understanding, at some level, a sparkle of genuine novelty that can't be reduced to any previously established knowledge or definition.

Not any new scientific advancement, however, can be called a discovery. A discovery is such if it unveils something significant. So, what are the criteria by which we regard a given scientific issue as significant or important compared to others? There are of course technological innovations, whose importance is measured by their potential utility for human beings. But in natural sciences, we seem to inevitably weight the importance of new knowledge insofar as it is able to shed new light on some fundamental issue. It is interesting to inspect the topics regarded today as "fundamental" in science. A short list would include extra-solar planets, origin of life on Earth, life in the universe, the nature of consciousness, origin and destiny of the universe, the nature of the intimate structure of matter, entanglement and the quantum world, grand-unification. All together, this list suggests that the focus of scientific interest, which identifies the territory of "discovery", is related – directly or indirectly – to ultimate questions: what is life, where do we come from, what are we made of, what is the destiny of all things?

Furthermore, the experience of discovery turns out to be a deeply satisfying one. This is not obvious, and it is interesting to ask why. The kind of human gratification that one experiences in a discovery somehow seems disproportionately large compared to the content of the discovery itself. This may be a reflection of the fact that a scientific discovery testifies something greater than just the new finding it brings in: every discovery, be it minor

or major, points to the evidence of an orderly structure deeply rooted in the physical world and, at the same time, to the exceeding richness of such world. Thus in the experience of discovery, nature becomes more familiar to us not only for the newness of detail that we come to learn in that specific case, but because we gain a more profound awareness of nature's coherence, unity and copiousness.

Not only a discovery in science reveals the internal coherence of the cosmos, it also highlights the remarkable correspondence between such orderly structure and the cognitive capability of our own mind. The very fact that scientific discoveries are possible to us human beings is far-from-obvious, as it has been pointed out by several great scientists.

> *"The most incomprehensible thing about the universe is the fact that it is comprehensible" (A. Einstein)[1]*
> *"The miracle of the appropriateness of the language of mathematics for the formulation of the laws of physics is a wonderful gift which we neither understand nor deserve. We should be grateful for it and hope that it will remain valid in future research and that it will extend, for better or for worse, to our pleasure even though perhaps also to our bafflement, to wide branches of learning." (P.E. Wigner)[2]*

In this respect, discovery is the continuous manifestation of the intelligible character of nature. This realization, much debated in the San Marino Symposium, opens up a number of fascinating questions, which by their own nature point beyond science itself. What is the significance of such correspondence between our reason and the structure of the universe? What is this situation telling us about the nature and origin of the physical reality and of the human mind? What are the implications for the issue of purpose in the universe?

The significance of a particular discovery, however small, goes beyond the physical phenomenon being studied, as it represents a remarkable sign of the meaning of reality as a whole. In such a broader perspective, science appears to share the joy of discovery with other manifestations of the human quest for truth, such as arts and philosophy: here too, it happens that the deep nature of things appears to unfold, revealing new facets of reality which may then become stable elements contributing to our vision of the world. In any field or discipline, discoveries are events of universal significance, even though the protagonists involved are generally one or few individuals: but this is perhaps just a corollary of the irrepressible aspiration to unity and completeness that makes us humans.

References

1. Albert Einstein, "Physics and Reality" in Journal of the Franklin Institute (March 1936).
2. Eugene P. Wigner, "The Unreasonable Effectiveness of Mathematics in the Natural Sciences", in Communications on Pure and Applied Mathematics 13, no. 1 (1960): 3, 7, 14.

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