

Chapter 1

Introduction

The question we wish to address concerns one of the most rewarding scientific and cultural activities that are possible at present. The frontier of science and the humanities is the exciting territory we begin to step on in the following pages. The fast development of technology has allowed us to address the issue of a possible “second Genesis”, interpreted as the emergence of biological complexity elsewhere in the universe.

The reader is advised to refer especially to the following entries in the Glossary: Astrobiology, Biomarker, Biota, Galileo, Galileo mission, Newton, Prime Mover, Ptolemy, Raphael, Sagan, Second Genesis and Stanze della Segnatura.

1.1 An outline of the book

The question of intelligibility of nature has been a challenge in different fields of knowledge. One major aspect of the intelligibility of nature is the study of the origin, evolution, distribution and destiny of life in the universe, a scientific area that is known collectively as a single discipline: astrobiology.

Although this new science is far from reaching its maturity, it lies squarely within the frontiers of traditional research. Some of the deepest questions raised within astrobiology lie close to those raised within the humanities. From the point of view of philosophy and theology, it is conceivable to view conventional science as one aspect of a wider empiricism that would take into account such facts as the intelligibility of the universe. Some humanists feel that it is possible that a search for a rich empiricism could bring within human rationalization what lies beyond the scientific approach¹. Since time immemorial humans have asked themselves whether we are alone in the universe on this “pale blue dot” (to borrow Carl Sagan’s inspired description of the Earth²). Indeed, our planet can be conceived merely as a “dot”, since it is circling around a common star that belongs to a common galaxy, in a universe that many scientists believe (right or wrong) to be one out of many universes. This is the central problem of astrobiology, namely to investigate whether life on Earth is but one example of a ubiquitous phenomenon.

However, metaphysics is the philosophical study to determine meaning, structure, and principles. Although this study is popularly conceived as referring to anything excessively subtle and highly theoretical, and although it has been the

subject of many criticisms, it is presented by metaphysicians as the most fundamental and most comprehensive of inquiries, inasmuch as it is concerned with reality as a whole. Quite distinct in its nature, but equally profound is astrobiology³. Such an enquiry, which is the main objective of our research, is discussed at some length in this book.

Nevertheless, to paraphrase Sir Isaac Newton, we cannot avoid the feeling that our achievements in science are like having found small pebbles on an immense beach that represents knowledge. This is unavoidable since, in the tradition championed by Galileo, progress in science is a slow, serious and steady academic pursuit that encourages falsification by new experiments and repeatable observations. In other words, since Galileo science is strictly constrained by what can be verified by experiment, or careful repeatable observations, as in the case of astronomy. We feel deeply the need to encourage a dialogue between science and religion. Most of the pointless controversy that we are unfortunately experiencing at the present time can and should be avoided. Such an objective for a new book is possible, since science has well-defined frontiers within human culture. Similarly, faith does not have any need to justify itself in scientific terms, especially the most cherished values that religions have identified since the beginning of human reasoning. Yet, the depth of the questions in astrobiology should be the source of a fruitful dialogue with other sectors of the humanities, including theology.

1.2 The target audience of the book

We aim our writing at a level that will involve any reader who may be interested in the position of humans in nature, independent of whether the reader is more familiar with the humanities, or with science. In the process of writing such a book we had to combine different fields of knowledge, while retaining our objective of addressing a wide variety of educated people who, we hope, will find it engaging reading. The multidisciplinary nature of the question of intelligibility of nature forces upon us difficult areas that lie at the frontier of science and the humanities.

1.3 A second “Genesis”

The possibility of a second “Genesis”, namely the emergence of life beyond the Earth, will inevitably present us with significant challenges arising from the ever-increasing pace of the exploration of the Solar System and, more generally, from the rapid progress of the space sciences. There is a compelling motivation for a careful discussion of the frontier of science and the humanities. Widespread general misunderstandings of the topics we have attempted to cover should be

addressed seriously by practicing scientists. At present, even at the level of the school curricula much confusion arises due to a misconception of the real limits of science and the humanities. Indeed, science is an activity that is essentially experimental and supported by a reasonable theoretical background that is often presented in detailed mathematical language that is not easily understood by everyone. We have made a serious effort to avoid demanding from the reader detailed knowledge of science, philosophy, or theology. It is difficult for single individuals, either scientists, or humanists, to be able to approach reliably all aspects of contemporary culture. But it is nevertheless desirable to take additional modest steps in this challenging direction. Some experience in all aspects of culture is essential for a constructive, comprehensive and interdisciplinary discussion that dare to consider the implications of science in religion; for a mutual understanding, yet another book on the popularization of science is justified.

1.4 Three stepping-stones towards the intelligibility of nature

An old Chinese proverb states that a picture says more than a thousand words. The High-Renaissance-21st century image associated with this book summarizes adequately the main thrust of its subject matter. Raphael Sanzio (1509-1511) decorated the Room of the Signatura in the Palace of the Vatican. His painting of the “Prime Mover” is on a ceiling panel. The image represents the vision of the astronomers of the Middle Ages. The spirit of Ptolemaic cosmology and Christianity were being brought into harmony. Raphael aimed to reflect the interest of the Pope’s library on the science of the early 16th century. The impact of the Copernican revolution was still ahead in the future, almost 30 years after the fresco of the Prime Mover had been completed. With Digges and Bruno a new cosmology was formulated and represented a first stepping-stone along the path towards the intelligibility of nature. We shall return to this topic in Sec. 5.5.

Charles Darwin placed a second stepping-stone firmly along the path towards the intelligibility of nature. In terms of evolution, it is comprehensible (in scientific terms) that a dolphin-sized brain of one of our ancestors (*Homo habilis*) should be able to grow in a geologic instant of time to the large sized brain of present-day humans⁴, who are able to reflect on the question: *Are we alone in the universe?*

A Prime Mover is a concept introduced from Aristotelian cosmology in the Ptolemaic cosmos. He was capable of triggering the initial, eternal rotation at constant angular velocity of the outermost crystalline sphere of Heavens that lied even beyond the “Sixth Heaven”, referred to in Dante’s *Divina Commedia*⁵ (cf., Secs. 2.3 and 5.2). The same poetic imagery may be used for explaining the possibility of searching for a second Genesis. Today we have to return to the Sixth Heaven (Jupiter’s orbit), where the Prime Mover would be needed to call our

attention to one Jovian satellite (Europa) that was going to be discovered by Galileo Galilei 100 years after Raphael completed his masterpiece. Europa's full view is shown on the book cover. It is underneath the Prime Mover. The image of the satellite was taken early in the Galileo mission. The center of the disk is near the Europan equator. Jupiter would be towards the left. The satellite's orbital motion is approximately away from the reader⁶. Europa is one of the targets of the current research of the author and of so many other scientists and engineers (cf., Chapter 12). The irrepressible excitement that this satellite generates on us is due to the possibility of there being a second Genesis underneath its icy surface, where we shall see later on, there may lie an ocean of liquid water (Sec. 12.4). The biota that we have conjectured to exist on Europa is only microbial, the lowest stage in the evolution towards intelligent behavior^{7,8}. But instrumentation now at the stage of development^{9,10} would be capable of detecting the "footprints of life" (biomarkers). We can conceive that within our lifetime we may lay a third stepping-stone firmly along the path towards the intelligibility of nature. The main themes of this book are firstly, to consider the possibility of identifying a second Genesis, either on Europa or elsewhere, and secondly, to review some of the implications on the humanities of such a phenomenal achievement.

1.5 Recommendations to the reader

Reading the book will require some effort. To facilitate this pleasant task we have provided a very lengthy, easily readable *Glossary and Short Biographies*. With over 200 entries, this part of the book forms the "backbone" of the text. We have made a special effort to introduce each chapter with an advice to read a few entries from the Glossary. This preliminary effort will reward the reader with a wider appreciation of the given chapter. The suggested entries will be an introduction, not only to especially relevant terms, or short biographical notes, but at the same time the reader will find that the Glossary is a rich repertoire of knowledge that is accessed by noticing that there are certain words highlighted in italics. In each entry these highlighted words refer to other significant entries in the Glossary. According to the time the reader devotes to this exercise, he will have the opportunity of gradually extending his appreciation of the various themes that are relevant for better appreciation of *A Second Genesis*. The detailed index with almost 800 entries can be used in conjunction with the study of the Glossary. The Index provides additional references to other sections of the book, in which certain terms are discussed. Another opportunity for a deeper understanding of the text lies in the detailed Bibliography. It contains about 400 publications. Most entries are original works, but many of them do not require excessive acquaintance with the specific cultural area that happens to be most familiar to a given reader.