

Overture

Man vs. the Universe—The match

Most of us live in bright-lit cities from where we cannot see the starry sky. But on our holidays we may still occasionally find ourselves outside on a very dark night, on a beach with no lights, in the middle of the sea, in a desert or on top of a mountain. Then, if the sky is clear, we will see with our naked eye that it is literally brimming with stars. And with even a small pair of binoculars, we will see the stars miraculously multiplying, whitening a sky that had seemed black.

Lie down on the ground and look up for a few quiet minutes. You will become conscious that the stars really do exist. They are not a figment of the imagination of astronomers and poets. They cannot be dismissed, however distant and unreachable they might be.

Today we know that these stars are more or less like our Sun. They appear smaller only because they are much further away.

You might try to imagine whether, like our Sun, they also have planets orbiting around them, and, if so, what they might be like. Then, inevitably, the question arises: is there life on these planets? At which point you have to ask yourselves: what would scare us most? To know that we are alone in the entire Universe? Or to know that there is someone else out there?

I have asked this question to hundreds, maybe thousands of people, of various walks of life and nationalities. I conduct show-of-hands polls in lectures and meetings. I ask my college students. I ask friends and acquaintances, or even people I meet for the first time. Nearly everyone has an answer. Everyone understands that *tertium non datur*

(either we are alone, or there is someone else); very few remain indifferent or refuse to express an opinion. And the overwhelming majority opinion is in favour of there being someone else out there.

The question, it must be stressed, does not specify exactly who—or what—the “someone else” would be. The people I have polled may imagine a vile bacterium, a disgusting spider, a sly monster spreading destruction, or a good fairy dispensing well-being and happiness. It does not matter—anything seems preferable to the angst of loneliness. We simply do not want to be on the only inhabited planet in our Universe.

The bad news, of course, is that we are not yet able to determine whether or not there is someone out there. We have yet to find evidence of life outside Earth, but on the other hand, we also cannot prove that it is not there.

Undeterred, we are still looking, with the best tools that modern astronomy can provide. In the last few years there has been important progress, both in observations and in theoretical studies. The feeling is that we are getting closer to a result. By “result” we mean primarily the discovery of some form of life beyond Earth. Many think that such a discovery would be the most extraordinary event in the history of mankind, so any claim would have to be very convincing. As Carl Sagan said, “extraordinary claims require extraordinary proofs”.

This book is written as homage to the majority of people who prefer that we are not alone in the universe. It is written because very recent scientific studies of the Universe, and of life, have delivered results which have changed the very way in which we look at the problem. They are worth recounting.

Another reason for writing this book is to remind readers that, as we look outwards, we should always be aware of our true place in the Universe. This is important because today’s culture, with its widespread ignorance of science, or rather of the history of science in the last four (or forty?) centuries, tends to revive anthropocentric irrationality.

As a light-hearted introduction to the discussion that follows about the origins of the Universe and of life on Earth, and perhaps outside Earth—that is the origin of man in the Universe—I am inserting here the broadcast of the second round of the “Anthropa Cup”, a football challenge of two games between the teams Dinamo Universal F.C.

and Man-Centred United, which I received in a zipped file from an anonymous source.

The anonymous source reminds us that the first round, played many centuries ago in the “Mediterranean” stadium, ended with a resounding 2–0 victory for Man-Centred United. The goals were scored by Aristotle and Ptolemy, the philosophers who place Man and Earth at the centre of the Solar System, therefore of the Universe. They were the forefathers of anthropocentrism, which allocates to man and his planet a special place in the universe.

The second round, naturally, is played in the “Universal” stadium. Here is the broadcast.

A huge crowd. Billions of stars and a billion of galaxies are silently cheering for Dinamo Universal, and also provide the lighting for the night game.

The rowdy Man-Centred supporters crowd the South Terrace with their collective trillions of brain cells (incredible as it may sound, each fan is endowed with a hundred billion), and there are also a bunch of hooligans dressed in the cardinal-red Man-Centred football shirt.

The starting whistle is around 500 AD. The Man-Centred game plan is immediately revealed: Aristotle and Plato, at centre field, emboldened by their initial strong advantage, are wasting time. They kick the ball round and have the Sun and all the planets turn around the Earth. But all of a sudden the Dinamo-Uni’s Polish stopper, a certain Kopernik, comes into action. Until now he has been an unknown semi-illegal immigrant in Italy, but a new graduate of Ferrara University. Kopernik takes possession of the ball. He kicks a deep ball which slices through the opponent’s defence. It is a revolutionary book (not for nothing called *De Revolutionibus Orbium Coelestium*), which in 1543 for the first time puts the Sun at the centre with the Earth rotating around it.

Kopernik’s pass is picked up by the legendary Galileo Galilei who plays with a small telescope stitched on his Dinamo United midnight-blue football shirt. Galileo substituted Giordano Bruno, sent off field by the referee in a burning lack of justice (the referee has a hard time running, as he has to pick up the heavy cassock that hides his shorts. . .).

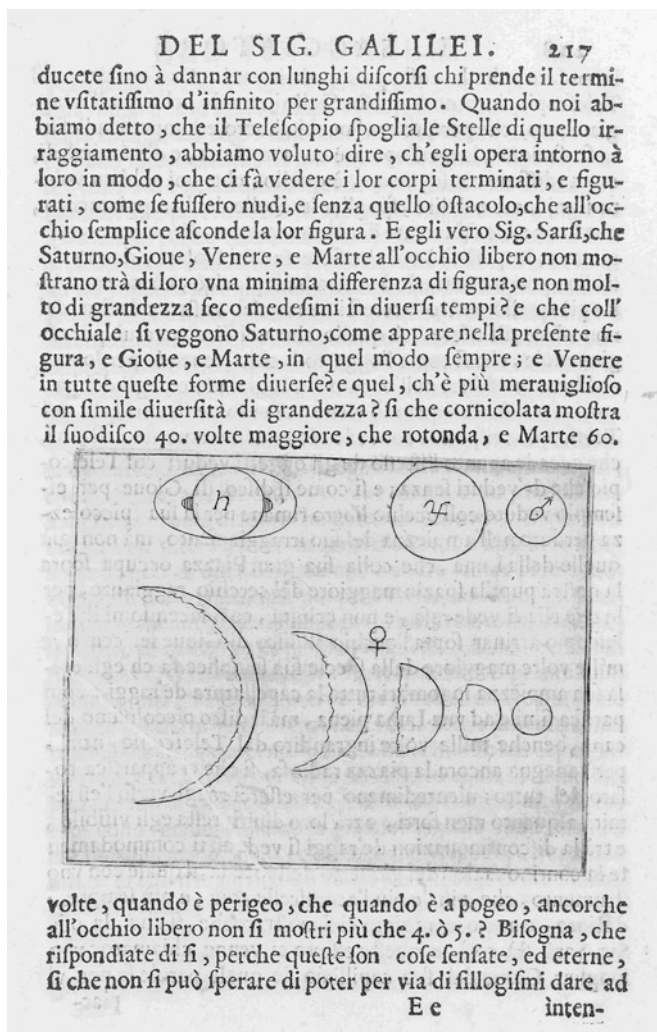


Fig. 1 At the bottom of the page from *Il saggiatore* (1623) the phases of Venus drawn by Galileo can be seen. This observation demonstrates that Venus orbits around the Sun; the planet appears to be “full” when it lies on the opposite side of the Sun in relation to the Earth. This image comes courtesy of the Photographic Archive of the Museo Galileo in Florence

Galileo pushes to the centre, holding on to his telescope and kicks into the net Kopernik’s brilliant pass by observing satellites around Jupiter and the phases of Venus. From now on the Earth is not at the centre of the solar system, and the planets are revolving around the

Sun. It is no longer a mere abstract mathematical theory which the Church had not even bothered to blacklist (it will do so only in 1616, after Galileo's score): now it is a safe and undisputable astronomical observation.

In spite of the frantic waving of the banner "Bellarmino, you take care of him" by the hooligans on the South Terrace, Galileo scores the first, awesome goal that marks Dinamo United's comeback.

In the ensuing scuffle in the goal zone, however, Galileo himself is cautioned by the referee. He is forced to chew and swallow the ball and even to say that he enjoyed it.

The game re-starts, but Galileo will never be the same. In the "After-Match Trial", which took place—admittedly with some delay—in 1984, Pope John Paul II had to admit that Galileo should not have been punished, and had not actually even committed a foul.

At the end of the first half—we are now in 1859—Dinamo Uni brings in a powerful English centre-forward, Charles Darwin, who, despite his advancing years, asserts himself on the Man-Centred half field. He is dressed as a monkey, but then throws his mask and displays the fish-creature from which we all descend. He scores!

Not only is man no longer at the physical centre of the universe, but also now we know that we only are a kind of evolved fish. The referee would like to disallow the goal, but cannot find in the regulations a ban specific about scoring while holding a fish.

Two-nil for Dinamo at the end of the first half. The Man-Centred team goes to the locker room with their heads down, followed by their cardinal red-clad masseurs offering incense as a pick-me-up.

The deciding second half starts around the mid-1900s. Dinamo United can now pick fresh talents from the newly available fields of nuclear and theoretical physics. One such talent is the classy English player Sir Fred Hoyle, even if bespectacled and a bit overweight. With his "theory of nucleosynthesis" he is building up a new offensive from centre field. Hoyle knows how the stars work and he understands why they burn. He barges into enemy territory wearing Mendeleev's table on his midnight-blue shirt (the referee is clueless as to what this table is, so he lets it be. . .). Then he points at the Table so as to let everyone know that he has discovered that the chemical elements are made by stars. From their own terraces the stars scream to the men on the south terrace: "Dust, you are all but our dust!" Hoyle is carried away by the excitement and he scores!

An important goal for Dinamo United. The matter from which man is made (and the Earth and everything else) comes from the Universe, and has really nothing special to it. The stars cheer, hugging themselves into spontaneous spirals. Three-nil. Things are looking bad for Man-Centred.

Last frantic minutes of the game, from 1990 to today. Astrophysics is now the breeding ground of fresh talents, so many that it is impossible to name them all. Dinamo Universal takes a two-pronged offensive: the composition of the universe matter and the planets surrounding other stars.

The new hires from the astronomy pool find out quickly that the matter that makes us (and all we see around us) is nothing but a pinch of salt in the soup of the universal matter. Most of the universe, precisely 96%, is made of matter or energy that we call “dark”, just to give it a name, but have nothing to do with ordinary matter. In other words, we belong to a trivial 4% of the universe.

Here is another great score against Man-Centred: not even our own matter is central in the universe. Four-nil.

The next offensive comes from a combined action of Dinamo’s two wing players: Earth Astronomer and Space Astronomer.

Many people had always believed that planets exist around other stars—from Giordano Bruno, the one of the scorching send off, to Giacomo Leopardi. But no one had ever seen one until 1995, when the first extra-solar system planet was spotted. Today we have counted nearly 1000 and within a few years, the count will be in the thousands. Planets, it turns out, are the norm, not the exception, around stars. Our own Solar System is just one of many, nothing special about it. Fifth goal for Dinamo Universal, and the referee blows the final whistle.

A resounding five-nil win, which crushes the 2-0 of the first round and decides the winner of the Anthropa Cup, which is delivered with great pomp to the victorious Dinamo.

Coach Universinho immediately brings in a huge steamroller which, in a theatrical gesture, flattens and destroys the cup. Farewell anthropocentrism.

The stars, planets and galaxies scream like crazy (some feel an obscure, indescribable, unknown presence in the air. . .). Some disrespectful voices scream: “Make Giordano Bruno a saint now”. They are soon quieted.

The referee responsible for Bruno's send-off and Galileo's heavy caution, not to mention the clumsy attempt to deny Darwin's goal, runs for the locker room and escapes through an underground tunnel dug under the river Tiber.

This is the commentary so far (thanks to the anonymous sender of the zipped file).

The rest is history, as they say. I will try to tell the story in a less frantic manner in the next chapters. I will cover the origin of the universe, of the stars and the galaxies, of the elements of which we are made and all the rest. I will also cover the birth of the planets and the molecules that float in space, by themselves or carried by interplanetary and interstellar rocks and ice balls.

Then I will talk about the new astronomy of the third millennium, that is, "contact astronomy" which started with meteorite collecting and today allows us to visit planets, comets and asteroids to have a taste of them in situ. There we find important molecules, "the bricks of life", amazingly similar to ours, arousing the suspicion that like atoms and molecules, we may also come from outside the Earth. So are we the real Martians?

Naturally the distance between "bricks" and "life" is enormous, and it is not resolved. A truck full of bricks is not enough to make a house. Life is a crucial step, still unknown, that so far defies everyone's understanding, a bit like the Big Bang genesis (although we now know quite well what happened after the Big Bang).

There is no scientific evidence that life comes from outside. However, I will also talk about "panspermia", that is the possibility that elementary forms of life survive in space by travelling between planets (someone has even suggested between stars), carried by Enterprise-class meteorites. No, we are not going to talk about the famous Star Trek Enterprise, nor the spaceship carrying the cute E.T. Let us use our imagination, but let us also try to stick to the facts. And on this note, if there really is someone out there, might they be trying to contact us? I will recount the half-century history of the SETI project, the search for extra-terrestrial intelligence. We have not found it yet; but, as I will explain, we ourselves are sending confusing messages into space, a sort of message-in-a-bottle inside what we will call the "Berlusconi Bubble" that now has engulfed thousands of stars.

We are the Martians

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