Chapter 2
The Position of Man in the Cosmos

Bernulf Kanitscheider

Abstract The centrality of man in the universe has a long history, stretching from ancient times to modern cosmology. Stepwise man's homestead has been displaced to a typical, inconspicuous location in space. Today there is not the slightest evidence for the existence of distinguished places at all within an isotropic and homogeneous universe.

2.1 Historical Precursors

The place of man in the universe has been a matter of debate since Stoic times, but as late as the period of Copernicus it grew to be a really terrifying subject of anthropological thinking (Rossi 1972). The geocentric Aristotelian world possessed a natural place for dynamic movements; accordingly everybody tends in a natural way to reach the center of the physical space, which is at the same time the center of the universe, which in turn includes the core of the earth. But due to the growing discoveries of renaissance astronomy the earth-centered approach could no longer be upheld. The displacement of the cosmic center occurred step by step, but before the advent of relativistic cosmology it seemed self-evident to everybody that the universe ought to have a focal point somewhere and a peripheral region. In view of that, Copernicus shifted the cosmic center to the sun as the origin of the reference system of astronomical description, thereby simplifying enormously the older system of epicycle–excenter–equant geometry of Ptolemy. The idea of a central place and a spatial boundary remained an unavoidable detail of the "constructions of the heavens". Astronomers and cosmologists tried to identify the central system of the world, even if it were only a mathematical point in the depth of cosmic space. At the end of the eighteenth century, Sir William Herschel moved the imaginary center

B. Kanitscheider (✉)
Zentrum für Philosophie und Grundlagen der Wissenschaft, Universität Gießen,
35394 Gießen, Germany
e-mail: bernulf.kanitscheider@phil.uni-giessen.de

U.J. Frey et al. (eds.), *Homo Novus – A Human Without Illusions*,
The Frontiers Collection, DOI 10.1007/978-3-642-12142-5_2,

to the core of our galaxy. But it couldn't stay there very long. The fundamental question at his time was the position of the entire Milky Way. Does it comprise the whole matter content of the universe or did Kant's speculation point in the right direction, that the universe contains many nebulae like our own? This was difficult to decide in those days. The uniqueness and the centrality of our mother galaxy grounded on the deceptive evidence that the nebulae were distributed well away from the disk of our galaxy on account of a fog that veils the innermost part of the disk. The extragalactic position was proved first for the Andromeda nebula by Heber Curtis, who showed that this system of stars is situated well outside our Milky Way by exploiting variable stars such as novae that change their intrinsic brightness in a well known way. In establishing that Andromeda is of comparable size to our galaxy he undermined the idea of the central position of the Milky Way. In the following era it was Edwin Hubble who corroborated by the method of Cepheid variable stars, using their period—luminosity relation, that in accord with Kant's supposition, our galaxy is only one medium-sized system within a huge entirety without any sign of specialness. Up to 1922 our sun was thought to be in a central position within the Milky Way but this location was overthrown by Harlow Shapley, who demonstrated that our Star is situated at a typical eccentric point a distance of 30,000 light years from the innermost part of our galaxy. The ultimate remainder of the former central position was the atypically large extension of the Milky Way, measuring tenfold that of a typical system of stars. The mistake was discovered by Walter Baade in 1952. He revealed that when using the method of measuring distances by Cepheid variables by the period—luminosity relation one has to distinguish between two types of variable stars and that therefore the intergalactic distance scale should be enlarged by a factor of 10. As a consequence our Milky Way ceased to be a giant system among its neighbors. Baade's discovery erased the ultimate vestiges of a privileged status of the cosmic home of man. To put the historical development in a nutshell: "Copernicus dethroned the earth, Shapley the sun and Baade the Milky Way. Since the local group of galaxies is a comparatively small cluster, the geocentric picture of the universe is completely discredited" (Sciama 1959, p. 62).

2.2 The Standard Concordance Model

Modern cosmology is based on Einstein's theory of gravitation, a theory in which gravity is treated as a trait of the metrical geometry of space-time. The field equations of gravity cannot be solved without the introduction of initial and boundary conditions. The most straightforward subclass of all space-times that are ruled by the Einstein equations is the set of isotropic and homogeneous world-models. In memory of their discoverers they are called Friedmann–Lemaitre–Robertson–Walker space-times or FLRW worlds. FLRW space-times comply with the constraints of isotropy and homogeneity; there are no distinguished directions or specially favored locations in these space-times. Most of them are expanding time-varying models in which curvature depends on the cosmic time parameter. Observation leads unequivocally to an isotropic distribution of matter and radiation. Local irregularities set aside, beyond 100 Mpc (megaparsec) galaxies are scattered evenly throughout 3-space up to the horizon. Radio astronomers have found that the very distant radio sources are distributed isotropically around us. The same is true for radiation, for example, the X-ray background and, foremost, the cosmic microwave relic radiation—the remnant of the fireball state, which today, after having expanded adiabatically for 15×10^9 years, has a measured temperature T of 2.9 K—show the same feature. Recent measurements reveal that the isotropy of the 3 K radiation amounts to about 1 part in 100,000, $\Delta T/T \leq 10^{-5}$. Although local isotropy (the rotational symmetry of light coming from distant galaxies around our special point of observation) is now well established, we cannot test empirically the homogeneity of space, because as observers we are bound to our terrestrial location. We cannot explore the vastness of space in order to assess the homogeneity of 3-space. It is a well-known theorem of differential geometry (Walker 1944) that exact spherical symmetry around any point entails that the universe is spatially homogeneous. Such a space-time admits a six-parameter group of isometries. Its surfaces of transitivity are space-like three-surfaces of constant curvature (Hawking and Ellis 1973, p. 135). In more colloquial terms: any point of 3-space in a homogeneous universe is physically equivalent to any other point on the same surface. Or, in phenomenological language, it is the impossibility of telling where one lives in a homogeneous universe. Since a uniform space has neither a boundary nor focal point, the very concept of place is inapplicable. A voyage to a far distant spiral galaxy would bring about no change in the overall appearance of the sky. Therefore it is prohibited to state that we look up to a world of stars from nowhere.

In order to fill the gap between local and global isotropy we need a bridging law. The customary procedure is to make use of the so-called Copernican principle. There are several formulations; an outstanding one has been stated in terms of the likelihood that man has a special privileged location in the universe. Hermann Bondi (Bondi 1968, p. 13) put it like this: "The Earth is not in a central, specially favoured position." The name of this principle is certainly a misnomer, since Copernicus, as mentioned above, believed that the sun occupies the central place in the universe. Nevertheless he initiated the tendency to displace the apparent focal point of the whole system of stars to the rim of the arrangement. Accordingly we have to realize that we are living on a medium-sized planet revolving around a normal main sequence star that is located on the edge of an average spiral galaxy, which in turn is a member of a local group of galaxies. If we recognize that there is not the slightest indication of a special position of our homestead, we can use without further ado the Copernican principle in order to pass from local to global isotropy, which in turn entails homogeneity. This is the received view of current cosmology. We should remark, however, that in 1978, now almost forgotten, Ellis, Maartens and Nel (Ellis et al. 1978) showed that the observed galactic redshift and the cosmic microwave background radiation (CBR) can be explained by a static spherically symmetric (SSS) model that contains two centers, a naked singularity, which in distinction to the big bang singularity continually interacts with the universe, and a cool center, in whose vicinity we are living, embedded in our galaxy. In this inhomogeneous SSS model the cosmological redshifts of the galaxies are interpreted as gravitational redshifts and the CBR as originating from hot gas near the naked singularity located at the second center of the universe. Although the inhomogeneous SSS model should not be taken as a realistic one, since it violates the cosmic censorship hypothesis (the conjecture, surmised by Roger Penrose, which states that black holes are always surrounded by an event horizon so that no outgoing causal effects can leave the singularity) and moreover does not provide a good fit to the magnitude—redshift relation (m, z), it points plainly to the necessity to take cognizance of the hidden selection effects. There is no need to assume that somebody has centered the universe to our advantage but it seems obvious that life would most favorably exist near the cool center of the universe and not in the vicinity of the hot radiating singularity. This corresponds to the obvious selection effect in a FLRW world, where nobody surmises the existence of life a short time after the big bang singularity. Temporal and spatial problems are mirror images of each other, in a FLRW world the initial singularity generates, probably by the process of inflation, the homogeneity of our observable universe; in an inhomogeneous SSS world the condition of static governs the overall structure.

The many advantages of dealing with time-like homogeneous hypersurfaces with constant curvature should not be overlooked. This high symmetry makes cosmology a much easier task in comparison with a highly inhomogeneous and irregular distribution of matter, which in turn would engender a complicated space time of variable curvature. A universe containing one or many special locations each with distinct properties of the pertinent matter could not be dealt with in a comprehensive way. The customary inference from a significant sample to the global matter distribution in space-time would be an invalid conclusion. Today we are convinced that the uniform distribution of galaxies stretches even beyond the event horizon and even if the global topology of 3-space is noncompact. It is not a matter of speculative physics that space is infinite and rather uniformly filled with galactic matter, it is rather the other way round, flat infinite models fit the astrophysical data much better than models with spatial curvature, hierarchical self-similar structure, or multiply connected topologies. The cosmic microwave background depends in a sensitive way on the model assumptions and this fireball remnant is only concordant with an infinite homogeneous flat expanding universe. Unsurprisingly matter distribution is quite irregular on a local scale, as we can observe in our planetary system and even on a galactic level. If, however, we move outwards towards the edge of the observable universe ($R \approx 10^{27}$ m) then the relative fluctuations shrink as $\Delta M/M \approx 10^{-5}$. What is more, there is no doubt that the homogeneity of the universe extends even beyond the observable realm (Tegmark 2003). From a theoretical point of view this uniformity seems to be startling, because Einstein's field equations do not demand anything like homogeneity in the distribution of matter and radiation, not even constant curvature for 3-space is required, and least of all flatness. Besides the mentioned Robertson–Walker spaces there exists a large class of solutions in which the requirement of isotropy is dropped but spatial homogeneity is retained. Even absolute rotation and shear of matter could be included in the field equations of gravitation. The more general Raychaudhury equations replace in this case the Friedmann equations. It might be of some interest that recently José Senovilla from the Universidad de Salamanca has discovered an exact solution of an inhomogeneous world that avoids the initial singularity, specifying a space-time that is regular from infinity to infinity (Senovilla 1990). In the meantime it has been shown that the solution is really geodesically complete and singularity-free. It satisfies the stronger energy and causality conditions such as global hyperbolicity, causal symmetry, and causal stability (Cinea et al. 2004). Anyway it seems to be clear that within the boundary of classical relativity there is ample scope for a cosmic past without breakdown of physically regular conditions.

2.3 Speculative Hypotheses on the High Energy Realm

Recently the entire debate on privileged locations received a new twist in relation to the concept of a *multiverse* that grows out of the high-level unified field theories. Unification has been a major aim of theoretical physics since the misty past. The Ionian dream has been a major attraction of theoretical physics since J.C. Maxwell unified electricity and magnetism with the stunning result of the wave theory of light. The replacement of Galilei symmetry group by the Lorentz group, which led to special relativity, amalgamated space and time in an intricate manner. With the advent of quantum mechanics the gauge group took up the role of a unifying instrument to bring about the standard model of elementary particle interaction. Electroweak theory in combination with quantum chromodynamics (QCD) gave rise to the standard model of elementary particle physics. The combination of electroweak theory and QCD was based mainly on similarity of mathematical structure; a lot of parameter values, especially the masses of leptons and quarks, were left as undetermined contingent empirical data. It could not be deduced from first principles that there have to be exactly three generations of leptons and quarks. On the other hand there were hints that such a grand unified theory (GUT) is not based on mere speculation. Although of very different strength on ordinary scales, these two forces seem to converge to a common power at higher energies. Concerning this meeting point of the running coupling constants of strong, weak, and electromagnetic interactions there is a powerful argument for superstring unification, because only with the inclusion of supersymmetry do the three coupling constants meet at exactly one point, with temperatures of 10^{28} K that prevailed 10^{-39} s after the Big Bang (Penrose 2005, p. 876).

Physical progress is propagated by the free parameters that remain unexplained by simpler theories; these contingent elements call for a justification of their numerical values. This was the leading motivation behind the construction of string theories. In the end, physicists discovered a growing number of solutions expressing local minima of energy, vacuum states that correspond to possible stable or metastable universes. Estimates of the number of these vacua reached the hair-raising number of 10^{500}. L. Susskind coined the name "string landscape" with a glance at biochemistry with its vast number of configurations. In some sense the original intention to minimize the contingent parameters had not been fulfilled, since although the theory was able to include gravity in a unified description it led to a proliferation of worlds instead of explaining the contingent parameter values of our distinctive world. With some repugnance physicists concede that we have to include environmental parameters in the scientific approach in order to come to grips with the gigantic number of vacua. Steven Weinberg (Weinberg 2005), by no means a promulgator of anthropocentric epistemology, concedes:

> The larger the possible values of physical parameters provided by the string landscape, the more string theory legitimates anthropic reasoning as a new basis for physical theories: Any scientists who study nature must live in a part of the landscape where physical parameters take values suitable for the appearance of life and its evolution into scientists.

What can now be concluded for the position of man within this huge array of worlds, most of which will not contain any life similar to ourselves? The first observation will be that the concept of position within an ensemble of worlds does not have any well-defined meaning, since the members of this set are not aligned in a spatial arrangement. As we have already seen, within an infinite single universe the very concept of position collapses; this is even more the case within an ensemble of worlds that do not have any common space-time or any causal connections whatsoever between them.

2.4 The Challenge of Quantum Cosmology

The very notion of a multiverse is a concept laden with enigmas and conundrums. It has a smell of metaphysics of those hoary days of yore. A deeply convinced logical empiricist of the days of the Vienna Circle would well-nigh reject any physical significance of an assertion belonging to a world besides our own. Nevertheless, the criterion of meaning has been liberated since the times of the founding fathers of scientific philosophy and science itself reintroduced this ancient idea into current discussion. With the advent of quantum cosmology it sounds less strange than before that our universe grew out of a primordial quantum configuration that engendered many other space-time regions as well. Andrei Linde's scenario of chaotic inflation gave rise to a somewhat more concrete picture, which delivered a dynamic underpinning of the idea of many worlds. Historically the proposal goes back to Leibniz, who introduced the expression of "possible world" in the metaphysical context of the theodicy problem. However, physics is not interested in the set of logically possible, that is noncontradictory, worlds but in the narrower concept of the really existing worlds. Conceptual problems arise at the very beginning in regard to the size of the class: Is the set infinite, which characters and peculiarities do the others have, and how will we gain knowledge of these other systems of total reality? Once more we are confronted with the mind-boggling concept of infinity but this time on a higher level. The very enticement to include this ancient, strange-sounding notion in the realm of scientific thinking had been that it seems to be the only logically coherent way to avoid a supernatural explanation of the fine-tuning of the cosmic parameters, elementary particle masses, and coupling constants anyway. There is no doubt that a cognizable universe permits only a rather narrow margin on these control parameters; the universe could have been only slightly different without denying the existence of observers. But within science there is no place for goal-directed teleological thinking. Why should a material universe be tailor-made for habitation, why are the initial conditions obliged to arrange themselves in a deliberate way that points to the evolution of man? (For a more elaborate criticism of the various types of anthropic principles see: Kanitscheider 1993.) The very occurrence of prescriptive terms in formulations of the strong anthropic principle disqualifies it as an assertion of a physical lawful.

At the moment there are only two ways to break the deadlock of explaining the contingencies of a welcoming and habitable universe: A deduction of all fundamental parameters and life-sustaining constants from first law-like principles or to treat these casual environmental elements as pointing to a hidden selection effect generated by our special membership within the ultimate ensemble of worlds, the multiverse. The first option has its shining example in the inflationary scenario, because it offers answers to a number of serious open questions of the standard FLRW big bang model. Instead of stipulating the constraints on the field equation of gravitation in order to get the homogeneity and isotropy of space-time, with only one further assumption of a scalar field at very early times it is possible to get a causal explanation as to *why* physical space has this peculiar feature. The dynamical process of exponential expansion led to a smoothing out of all possible earlier irregularities. The striking advantage of the inflation assumption, and what takes away the impression of an ad hoc postulation, lies in the simultaneous explanation of the horizon, the flatness, and the monopole problem.

2.5 The Intricacies of Infinity

The core of the problem of the position of man's homestead within the whole of reality is connected with the question of a physical infinity. The concept of infinity is laden with a host of harsh prejudices; the ancients were skeptical about anything that has no boundary. In medieval times infinity always had metaphysical overtones, since it was connected with the numinous and the supernatural. Scientists were suspicious because it transcends the empirically accessible. Ever since it has been argued that there are two types of infinity, a qualitative one that comprises perfection and self-sufficiency and which is more or less appropriate in the realm of metaphysics, and a quantitative one to be applied in mathematics. It must be recognized, however, that the defenders of the woolly concept of infinite qualities never came to grips with the vague semantics of that term. Therefore it can be argued that mathematics has for the first time cleared up the fuzzy connotations of the intuitive concept of infinity. But even within the territory of mathematics there had been age long quarrels on two types of infinity, the potential und the actual one. Aristotle tries to clarify in which sense an infinity can exist and in which not.

> On the other hand it is clear that, if an infinite does not exist at all, many impossibilities arise: time will have some beginning and end, magnitudes will not be divisible into magnitudes, and number will not be infinite. If therefore, when the case has been set out as above, neither

view appears to be admissible, we need an arbitrator; clearly there is a sense in which the infinite exists and another sense in which it does not.

Being means either being potentially, or being actually, and the infinite is possible by way of addition as well as by way of division. Now [. . .] magnitude is never actually infinite, but by the way of division [. . .] the alternative that remains therefore is that the infinite exists potentially. (Aristotle, Phys. III 6. 206a9) (Heath 1970)

Aristotle's conceptual distinction and argumentation became the received view on the two kinds of infinity, the potential or conceptual infinite as a necessary tool for analyzing mathematical problems, and the actual or concrete completed infinity in physical reality. The main objection to the latter was that it cannot have a determinate size, an infinite body or system of objects being a contradictory predication. In modern times David Hilbert reiterated this position. In his seminal paper on infinity (Hilbert 1925) Hilbert referred to the then prevailing opinion in cosmology of a curved elliptical metric that led to an unlimited but finite 3-space without boundary. But since his times the customary view in cosmology has changed definitely. Hilbert's main endeavor didn't concern cosmology but was intended to cope with the critics of the intuitionism of the School of Brouwer, who aimed to destroy the transfinite set theory of Cantor and his followers. Hilbert's movement to metamathematics in order to establish finite axiomatization of the whole edifice of mathematics takes the actual infinite as an idea without semantic reference. The doubts concerning a realized actual infinity have prevailed up to now and seem to be defended with the same empirically narrow minded arguments. In the influential paper of Stöger, Ellis, and Kirchner we encounter, for example, the opinion that Euclidean geometry will never be descriptive in physical cosmology, because these spatial sections are of indefinite extension.

In geometry we assume space extends forever in Euclidean geometry and [the same is true] in many cosmological models, but we can never *prove* that any realised 3-space in the real universe continues in this way—it is an untestable concept, and the real spatial geometry of the universe is almost certainly not Euclidean. Thus infinite Euclidean space as such is an abstraction that is almost certainly never realised in physical practice. (Stöger et al. 2004)

But here we encounter the old misunderstandings of logical empiricism, according to which every logical consequence of a physical theory has to be directly testable. It remains to be seen whether a theory that refers to an actual infinite space or a time coordinate that extends without limits to the past and the future can be tested, but it does not need to be the very consequence of infinity: It has to be controlled in regard to any of its empirical predictions. Only if the theory does not offer any contact with empirical reality at all can it be judged as metaphysical, superfluous, and cognitively worthless. As far as it concerns the position of man within an infinite Euclidean geometry, there is surely not the slightest possibility of a central position and even the rim is not defined because there are no distinguished directions. Jacque Monod judged the position of man with the famous words, in his book *Le hazard et la nécessité*: "L'homme sait maintenant que, comme un Tzigane, il est en marge de l'univers où il doit vivre. Univers sourd à sa musique, indifférent à ses espoirs comme à ses souffrances ou à ses crimes."[1] We can however strengthen these words, noticing that within an infinite universe there is no "marge" because there is no boundary and therefore we have neither a distinguished nor a peripheral position at all in a 3-space of indefinite extension.

2.6 Taming the Unfathomable

The problem iterates if we ascend from a single infinite universe to an ensemble of worlds, each of which can be thought of as finite or even infinite, but there is a difference: A universe can be thought of as a single causally connected space-time, where every subsystem can be conjoined by a time-like or null curve. A realized infinite ensemble of worlds does not necessarily have to be a causally linked system, although it might have a common origin, as e.g. within the chaotic inflationary scenario. Therefore the question of testability arises in an even more maddening manner. There can be neither direct nor indirect currents of information in order to gain some knowledge of these hidden worlds. The only way left is to specify the explanatory power of the many worlds assumption against some concurrent hypotheses. Stöger, Ellis, and Kirchner point out that some unsymmetrical generic worlds might need an unlimited amount of information in order to specify their initial and boundary conditions due to their field-like matter content, not every world being symmetric like FRW models. Within the ensemble there will be highly unsymmetrical worlds whose information content cannot be regarded as algorithmically compressible. But surely there is no need to postulate an ensemble of worlds that is so large that it comprises everything that can possibly happen, which means it is not logically contradictory. It suffices to hypothesize that the set is big enough to fulfill its explanatory function with regard to the otherwise unfathomable contingent traits of our visible universe. Unquestionably, within the approach of many worlds around the corner there lurks the problem of a slippery slope or runaway ontology, especially if we think of the continuum problem. How can we restrict the possible uncountable infinite set that pops up if we do not put a ceiling on the huge manifold of other worlds? Above that there is some quarrel over the size of infinity in physics. It is rather striking that none of our physical theories trespasses the cardinality of the real-number system. As Roger Penrose has argued, although the family of all real-number-valued functions on a space with points of the complex continuum $\mathbf{C}$ is indeed $2^{\mathbf{C}}$ and therefore larger than $\mathbf{C}$, the set of the continuous functions on $\mathbf{C}$ are only $\mathbf{C}$ in number (Penrose 2005, p. 378). A feasible procedure may be that we start with a set somewhat larger than surmised and then restrict it until we arrive at a minimum stage that suffices for our aim of explanation. Anyway the smallest set of possible worlds will do in accordance with Occam's principle of parsimony. But how large is the indispensable set of worlds compatible with the

[1] Man now knows that he lives, like a gypsy, at the edge of the universe. A universe that is deaf to his music and as indifferent to his hopes as it is to his sufferings or his crimes.

astrophysical data today? According to current methodology we have to accept the existence of objects that cannot be seen but deliver a coherent conceptual scheme for understanding visible things. Ships that disappear beyond the horizon do not vanish from existence, even for those who cannot follow them. Galaxies that drifted over the lookout limit did not change as material systems; they have the same ontological standing despite the fact that they do not have the same epistemological status. The most distant objects we can be aware of are at a distance of 14 billion light years away, it is the light from the hot initial state of our universe; the objects that sent us their radiation from the rim of the visible universe have in the meantime reached a distance of 40 billion light years, far beyond the cosmic horizon. Therefore, even if we only acknowledge our unique world with its matter content we have to admit a part of space beyond any possibility of visibility. With respect to immediate observability there is no difference in principle between the far away parts of our Euclidean universe and any member of a set of worlds in a multiverse. The only question is what will be gained for our cognition by introducing such an ensemble. How can we avoid too much metaphysical excess baggage? One of the strongest defenders of various levels of reality, each consisting of many worlds, is Max Tegmark (Tegmark 2003). He correctly argues that even at the basic stage the concordance model that fits every type of empirical facts decomposes into a host of different causally detached parts. What is more, spatial infinity is a generic prediction of the inflationary scenario that is able to explain certain contingent riddles of the standard model, such as the absence of monopoles, the causal puzzle, and the flatness puzzle (Weinberg 2005, p. 202). Tegmark's strongest argument consists in the fact that finite alternatives to infinite Euclidean spaces are inconsistent with the cosmic microwave background; compact, hierarchical, or otherwise multiply connected topologies cannot be integrated into the temperature distribution of the CBR. Furthermore, CBR and galaxy distribution suggest strongly a tendency to uniformity as we approach the edge of our observable universe. Within this level of existence the generic laws of physics will be the same, but there will be most likely a random distribution of initial conditions, since quantum processes were responsible for generating density fluctuations within the primordial inflation epoch. One of the staggering consequences of this multiple-world structure in which almost everything that is possible will occur somewhere in a remote corner of the whole being is the existence of a double. At a distance of $10^{10^{29}}$ m we have to admit an identical copy of ourselves, which has the same experiences, observing a Hubble volume with the same stars and galaxies (Tegmark 2003, p. 4).

2.7 Conclusion

All these cosmological facts having been considered, which conclusion can we arrive at concerning the place of man in an ensemble of worlds, be it countably infinite or uncountably large? What does it mean for our self-esteem, already pretty shaken by the offences of men's vanity from Copernicus to Freud? Should we be enjoyed or annoyed by our twin in another Hubble volume of our infinite universe at $10^{10^{29}}$ m distance? How do we rate infinity itself as the global environment?

Most people I asked, in order to get some psychological reaction, were not amused, either by an infinite multiversum or by a countable infinity of duplicates thinking the same ideas, playing the same music, or climbing the same peak over there. That means obviously that identity and unique existence seem to be a highly estimated value for mankind. But obviously the huge extension destroys the illusion of the uniqueness of existence too. Spatial infinity, be it on the level of a single space-time or an ensemble of worlds, reinforces the impression of being lost somewhere in the middle of nowhere that horrified the poets of the sixteenth century when they acknowledged that the medieval celestial spheres could not be upheld any longer within a heliocentric planetary system surrounded by an unfathomable array of stars. Already at the dawn of cosmological infinity John Donne confesses in his *Anatomy of the World* (1611):

So did the world from the first hour decay,
That evening was beginning of the day,
And now the springs and summers which we see,
Like sons of women after fifty be.
And new philosophy calls all in doubt,
The element of fire is quite put out,
The sun is lost, and th'earth, and no man's wit
Can well direct him where to look for it.
And freely men confess that this world's spent,
When in the planets and the firmament
They seek so many new; they see that this
Is crumbled out again to his atomies.
Tis all in pieces, all coherence gone.
All just supply and all Relation.

The case has strengthened since the time of Renaissance astronomy. What about the "coherence" John Donne alluded to? While there are possible space-time routes that could eventually lead from one Hubble volume to another, e.g., if cosmic expansion decelerates, there is no causal connection on the higher levels of cosmic manifoldness. According to Andrei Linde's scenario of chaotic inflation we have to surmise an infinite number of worlds with the same fundamental equations but different physical constants and dissimilar dimensionality. Evidently there remains some feeble law such as coherence, since there is a common origin of the space-times that afterwards are separated by superluminal velocities and aren't connectible by causal time-like lines. Apparently coherence crumbles in a piecemeal way, the causal bonds of the pertaining parts of reality getting weaker with every level of the multiverse. Shall we therefore break down in tears, being contrite due to the disintegration of reality? I surmise this to be a matter of personal temperament.

References

Bondi H (1968) *Cosmology*, 2nd ed. Cambridge University Press, Cambridge, MA

Cinea FJ, Fernández-Jambrina L, Senovilla JMM (2004) A singularity-free space-time. http://arxiv.org/abs/gr-qc/0403075. Accessed 10 August 2009

Ellis GFR, Maartens R, Nel SD (1978) The expansion of the universe. Monthly Notices of the Royal Astronomical Society 184:439–465

Hawking SW, Ellis GFR (1973) *The Large Scale Structure of Space-Time*. Cambridge University Press, Cambridge, MA

Heath T (1970) *Mathematics in Aristotle*. Oxford University Press, Oxford

Hilbert D (1925) Über das Unendliche. Mathematische Annalen 95:161–190

Kanitscheider B (1993) Anthropic arguments—Are they really explanations? In: Bertola F, Curi U (eds) *The Anthropic Principle*. Cambridge University Press, Cambridge, MA

Penrose R (2005) *The Road to Reality*. Random House, New York, NY

Rossi P (1972) Nobility of man and plurality of worlds. In: Debus AG (ed) *Science, Medicine and Society in the Renaissance*. Heinemann, London

Sciama DW (1959) *The Unity of the Universe*. Faber and Faber, London

Senovilla JMM (1990) New class of inhomogeneous cosmological perfect-fluid solutions without big-bang singularity. Physical Review Letters 64:2219–2221

Stöger WR, Ellis GFR, Kirchner U (2004) Multiverses and cosmology: philosophical issues. http://arxiv.org/abs/astro-ph/0407329. Accessed 10 August 2009

Tegmark M (2003) Parallel universes. http://arxiv.org/abs/astro-ph/0302131. Accessed 10 August 2009

Walker AG (1944) Completely symmetric spaces. Journal of the London Mathematical Society 19:219–226

Weinberg S (2005) Living in the multiverse. http://arxiv.org/abs/hep-th/0511037. Accessed 10 August 2009

http://www.springer.com/978-3-642-12141-8

Homo Novus - A Human Without Illusions
Frey, U.; Störmer, C.; Willführ, K.P. (Eds.)
2010, XIV, 291 p., Hardcover
ISBN: 978-3-642-12141-8