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Beyond the Earth: The Orbital Age

"Let us prepare ourselves to escape, to continue life and rebuild our cities on other planets: we shall not be long on this earth."

(Ray Bradbury to Oriana Fallaci)

The Gravity of Earth

The age of stellar orbits has its very origin in the problem of gravity. Gravity makes all things fall down to the ground as they are attracted by the earth and that means that man cannot take off from the ground out of his own force. Why then do the moon and the stars not fall down to the earth? It is because they are revolving around each other in elliptic or circular orbits. The fundamental principle on which this movement of planets is based is the law of attraction by gravity which is a universal law, i. e. it holds true for the entire universe. The fact that the planets Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto) do not crash into the sun but revolve around the sun in elliptic orbits, just as the moon does not fall down to the earth but revolves around it, is a result of gravity's forces of attraction, in accordance with a simple law discovered by Sir Isaac Newton (1642–1630): The attraction between two bodies is proportional to the product of their masses and inversely proportional to the square of their distance (1687). This means that the force of attraction between two bodies decreases with increasing distance and decreasing mass. The force of attraction by gravity keeps the movement of a planet circular, but what keeps the planet moving?

After an initial push (the Big Bang at the beginning of the expanding universe), it is the balance of centrifugal force and gravity. Centrifugal force alone would push an object in a circular movement towards the outside. By the way, centrifugal force increases with the radius and the mass of the object and with the number of revolutions it makes per second. After Johannes Kepler (1571–1630) had formulated the basic laws of planetary movement, i. e. that the planets revolve around the sun in elliptic orbits –the earth at a distance of 150 million kilometers—Newton could start to find out why this happens. The explanation for this "Mysterium Cosmographicum" (thus the title of Kepler's book published in 1597) could not be obtained by assuming a universe of spheres, cubes, pyramids, etc. but only by assuming the existence of a law of gravitation which would balance the centrifugal force. Calculation of the centrifugal force of a planet has been possible since Kepler discovered its distance to the sun, its orbit, time of revolution, etc. As soon as calculation of the centrifugal force of a planet was possible, we could also calculate the gravitational force, as it is known to be equal to the centrifugal force. On the basis of the law of gravitation planets and stars attract each other and in this way balance the escape force of the Big Bang which puts everything in motion. Just as the moons revolve around the planets, and the planets revolve around the sun, the stars revolve around the centre of the galaxy and the movement of galaxies themselves is also subject to gravitation. Therefore it is no surprise that Newton was the first to think of the possibility of sending an artificial satellite into orbit around the earth. From the above said it can be grasped that two important discoveries have radically changed man's conception of the earth: That earth is not only a stationary centre of movement in the Universe but that it is just one of several planets which move around the sun. (1543 "De Revolutionibus" by Nikolaus Copernicus 1473–1543).

The second is Newton's discovery that this movement is controlled by a universal law of gravitation.

Kepler's laws of planetary orbits were the basis for the discovery of the laws of gravitation. Both are the core of the orbital problem. It is therefore a beautiful arrangement that the first conference on the orbital age is held in Linz as the father of orbital thinking spent many years of his life in Linz. So, the

discoverer of the orbital laws is one of the founders of orbital thinking which attempts at reflecting the consequences of 3 scientific discoveries (of Copernicus, Kepler, Newton) which were the foundation of modern astronomy and have contributed to the development of manned space flight.

The movement of planets in (elliptic or circular) orbits on the basis of the laws of gravitation has triggered a powerful imagination, or, to put it more precisely, has triggered the desire to overcome gravitation, to be free from earth's gravity and to launch out into the cosmic choreography of planetary movement. The revolutionizing idea that the earth is in motion, that the earth is only a planet rotating around its own axis and moving along a given orbit, the idea that the entire universe consists but of planetary orbits, has created the desire to move into this planetary movement, to be an orbiter (an object revolving in an orbit). It had been soon discovered that the knowledge of the laws of fall and gravitation can be used not only for overcoming earth's gravity but also for creating and controlling such orbits. In these "human" orbits, man would, for the first time, be in a position to determine the size of an orbit and the duration an object is supposed to stay in a given orbit. Imagine a stone being thrown from an immensely high tower. Suppose we throw the stone horizontally into space and imagine there were no gravity and no atmospheric friction, the stone would fly into the infinity of the universe. However, the path of the stone is deflected by earth's gravity in accordance with Newton's law of gravitation. So the stone would land on the ground far away from the tower. However, if we launch the stone into the horizon with a certain machine power and up to a certain height, it may happen that the curve of the coming down of the stone becomes equal to the curve of the sphere of the earth. In that case, the stone would never reach the earth, because every time the path of the stone would deflect downwards, the surface of the earth would bend to the same degree. If, by virtue of the initial force, the stone has reached a certain height, and speed making the curvature of its fall equal to the curvature of the earth, it will never reach the earth and revolve around it as a satellite. Here we see how the falling movement of an object can become an orbital movement around the earth provided that the object receives a strong enough horizontal push/thrust (by rocket explosion). Here we see how the orbital movement is related to the laws of gravitation and centrifugal force. The horizontal velocity required for producing a curvature of fall equal to the curvature of the earth is some 5 miles per second. In this place, I would like to mention a forth precursor of orbital thinking: the discoverer of the laws of falling, Galileo Galilei (1564–1642).

The principle of launching a satellite into orbit with a rocket is the same as that applying to the before mentioned stone. The first explosion launches the rocket beyond the atmosphere, the second rocket explosion pushes the satellite into horizontal movement. Consequently, satellites are artificial, manmade planets which are brought into orbit by man. Their orbit, that is to say its size and duration, can be controlled by man. Man is also in a position to direct such a satellite–planet away from the earth and steer it onto a new orbit by means of further small explosions, in the same way as formerly a sailing ship was steered across the seas. With these artificial planets, man can travel through weightless space defying the earth's gravity. The Big Bang at the beginning of the Universe can be compared to a first rocket explosion. The Big Bang has put the planets in motion. The orbital character of this motion is a result of the laws of gravitation. Now we put our satellites in orbital motion by means of rocket explosions. We take off from the earth, we make use of the laws of gravitation in order to escape gravity, i. e. the force of the attraction of the earth. This conquest of the orbital sphere beyond the earth's gravity makes us understand that the earth herself is but a satellite. Man–controlled launching of satellites into orbit around the earth is a tremendous interference with natural orbits, with the order of nature, with the orbits of planets and stellar orbits. This is the case when artificial satellites quietly sail along between the balancing forces of attraction of the earth and the moon which prevent them from being diverted from their orbits.

Orbits determined by Man on which man–launched objects are moving constitute the beginning of a life in space, a life beyond the earth. This may be just as important as the beginning of life on earth some million years ago, because the beginning of the Orbital Age constitutes the beginning of the transfer of life from the earth into space and eventually into the cold black deserts of the universe. Who or what suggests that the surface of the planet earth must remain the only place for an expanding technological civilization? Who says this except the law of gravitation? For millions of years earth's gravity made us think that the surface of the earth was the only place to live. It was from the depths; of the earth that we dug up materials and pumped energy resources, not from the depths of space. Incredibly large spaces beyond the earth are opened up to human life by the new possibility of entering into stellar orbits, of dancing in the cosmic choreography as an artificial planet whose nucleus is a satellite. In this sense, the landing on the moon may be one of the most important events in the history of human life. In any case, it is a turning point, a fulfillment and a beginning, it means breaking with a pattern of thinking which was in operation for hundreds of thousands of years and with the way of life of a prisoner of the globe's gravity which controlled man's fate for millions of years.

The force of gravitation was the most elementary aspect of evolution on earth for billions of years. The living beings were tied to the earth with their feet downward, towards the centre of the planet. Breaking with this law, as was done by entering into the gravity–free orbital sphere, may have been the most important event in the history of mankind when seen under the above mentioned aspect. When the first vertebrates appeared 400 million years ago and fishes lived in the seas, when after millions of years the amphibia conquered dry land, when 50 million years ago the first primates appeared and when in the same period the continents started to drift and to separate, during all this time, life was tied to the earth. Even when the animals moved from their initial biotopes, from water onto the land and into the air, this process took millions of years. If we compare this to the 2000 years history of orbital awareness and to the 30 years history of space travel, this voyage away from the earth is not only incredibly accelerated in comparison to the movements on the earth (from the water into the air), it is also the natural continuation of the movement of man, of the ascent of living beings. The movements of the continents took millions of years, the movement beyond the continents took only 500 years for its realization. All life has taken place within the earth's atmosphere for 3 billion years. For 30 years, the experiment has been going on to carry or to launch life to space outside the earth's atmosphere. When a satellite is put into orbit this is an attempt to launch life to a place outside the earth. If we compare this function of a second in the life of the earth (and these 30 years really are not more) to the millions of years of evolution of life on earth, we have a motive for being optimistic and we can imagine what is going to happen in the millions of years to come ...

The Orbital View: Earth as the Third Planet

"I didn't grow up with the idea of drifting continents and sea floor spreadings, but I tell you when you look at the way the pieces of the northeastern portion of the African continent seem to fit together, separated by a narrow gulf, you could almost make a believer of anybody."

(Scientific astronaut and geologist Harrison H. Schmitt on his flight to the moon in 1972 to the ground crew at Houston.)

Setting out into the orbital sphere has changed our consciousness as well. Bearing in mind that upright carriage of man took same 400 million years of evolution and that Leonardo da Vinci's dream of flying, of leaving the earth was materialized within a few centuries, further bearing in mind that for millions of years life was tied to the earth and that for 30 years man, and with him life, has been able to detach from the earth, we are able to assess how new and revolutionary this experience and change of consciousness must be. It is probably so deep that we can hardly grasp it. The symposium on "The Orbital Age" makes a first at examining traces of this experience and change, because the orbital age is more than just a date and an image, it is also a consciousness. Space is a new but also our last frontier.

The very heart of this consciousness is also to be found in the problems of weight and gravitation, but much earlier than in the days of the before mentioned scientific precursors. The conquest of orbital space is the fulfillment of an old dream and desire which was formulated more than 2000 years ago, and this desire goes beyond space–flight dreams. Orbital expansion has two dimensions: One is directed forward, i. e. towards the new ocean of the solar system and the Milky Way; the other is directed backward, i. e. towards the earth itself.

From the orbital sphere I can look not only into the universe, which has always been possible from the earth, but—and this for the first time in the history of the earth and of mankind—I can also look onto the earth itself. The view of the planet earth from the orbital satellite, i. e. from the artificial planet, is the greatest, most beautiful and most important image mankind has ever produced. It is an image unimaginable for millions of years.

As I have said before, the voyage into the solar system and the look back to the earth are the two dimensions of the orbital revolution, of the orbital leap. In our opinion, the second dimension, the orbital look to the earth, seems to be the more important aspect. This orbital look to the earth, this viewpoint of the earth determines the orbital consciousness. The genuine father of this orbital consciousness is Archimedes (287–212 BC). It we can believe Pappus (Pappi Alexandrini collectionis quae supersunt, publ. T. Hultsch, VIII, p. 1060, Berlin, 1876–78), for it was in connection with his solution to the problem of how to move a given weight with a given force that Archimedes exclaimed the famous sentence: "Give me a place to stand on and I will move the earth"

This famous Archimedean 'place' is not a written statement. It is based on oral tradition. According to Plutarch, Archimedes is reported to have said to king Hieron that any given weight could be moved by a given force, and to have quoted as an example that if they gave him another earth he would change over to it and even move this earth. When Hieron, full of amazement, asked for a practical example, Archimedes put up a set of pulleys and while sitting far away from a heavily loaded ship easily moved it with his hands, although all the people of Syracuse together had not been able to move that ship. With the help of a mechanical invention (which included transmission of force and transfer of centres of gravity) Archimedes illustrated that the earth can be moved with little force from a point outside the earth. This point, place or space beyond the earth is the orbital point. With the conquest of the orbital sphere we have reached this Archimedean point beyond the earth. Will we move and change the earth accordingly? Is this 'point, place or space' the orbital place?

The Orbital Ocean and its Pioneers

"Space is the new ocean and this nation must sail upon it."

President John F. Kennedy

I say that the orbital age has a date and an image. The date is October 4th, 1957, when the Soviet Union launched the first man-made object into an orbit around the earth. This artificial moon was called Sputnik which in Russian is one of the many metaphors for the moon, namely "travelling companion" or "friendly wayfarer". This name was given following the advice of a Russian pioneer of space flight, Konstantin Tsiolkovsky (1857–1935). This date kind of officially marks the beginning of the orbital age. The image of the orbital age is the image of the landing on the moon in July 1969 by the American spacecraft Apollo 11. While watching the landing on TV, people could see the moon far away when looking out of their windows. The real moon was far away as always, but its image, its televised close up on the TV screen was very close. I saw two pictures of the same object at the same time: the real picture of the moon and the electronic image which made me kind of a guest on the surface of the moon. After that, the transmission of images which showed the view of the earth from the capsule of the spacecraft was the perfection of this first original image.

This orbital image of the planet earth, taken from the bull's eye of the new orbital ocean ship is the logo of space flight. The history of aviatics is an evolutionary interlink in escapism from the earth into orbital space which must at the same time be seen as a preliminary stage of space flight, therefore the reference to Leonardo da Vinci's dreams of flight machines.

The history of orbital space flight proper starts with Konstantin Tsiolkovsky (1857–1935). He published the first work on the use of rockets driven by liquid hydrogen and oxygen. In 1903, he described a space–habitat with artificial gravitation which would rotate by means of centrifugal force.

In 1923, Hermann Oberth published the famous book "Die Rakete zu den Planetenräumen" which also discussed propulsion problems and life in space.

J. Desmond Bernal (1901–1971), one of the founders of modern crystallography, published as a young lecturer at Cambridge the book "The World, the Flesh and the Devil" in which he predicted the emancipation of mankind from the earth. He emphatically praised the colonization of space, the restoration of the earth by emigration into space where people would live in hollowed asteroids with giant wings for collecting solar energy or on self-made artificial planets revolving around the sun. The self controlled evolution of mankind would find its perfection in a "weightless life".

At the same time, Robert Goddard (1882–1945) designed the first real liquid driven rocket. On March 16th, 1926, the first small rocket flew across a field in Massachusetts. A few years later, Wernher von Braun (1912–1977) was active in rocket research in Germany—for the purposes of war. Later he was to be the head of the team which in January 1958 launched the first American satellite into orbit, Explorer 1. In 1959, the famous physicist Freeman Dyson who is now at the Institute for advanced Study at Princeton, published his ideas on "The Greening of the Galaxis" and on the extension of human activity into space. The most spectacular concept is that of the Dyson–sphere, the idea of having a type of box around the sun, a type of spheric shell around the mother star. The shell would consist of a large number of artificial space cities, each of them having its own orbit.

The structure of this new and improved arrangement of planetary material, this artificial biosphere would for the first time use the entire radiation energy of the mother star. Dyson thinks that within a few thousand years the human population will be several million times larger than in the 20th century and that therefore searching for new space for living, new sources of energy and materials beyond our earth is our only option. Launching artificial satellites and space shuttles with giant solar cells is for him a first experiment in this direction of creating an inhabited Dyson–sphere. A former student of Dyson's who now is also professor of physics at Princeton, Gerald O'Neill has made the largest scientific efforts hitherto known for designing models of inhabitable space cities. His ideas have become known under the name of "The Princeton Prospectus". The decisive progress with regard to former models is that the building materials for these orbital habitats are not supposed to be brought from the earth but to be taken from the moon, i. e. from space itself, with the help of special machines. In August 1974, he first published his ideas in the British scientific magazine "Nature". In 1977 he published the book "The High Frontier" which brought him a large number of supporters. The idea of his space settlements, the creation of new land in the form of large habitats built with material from the moon and revolving around the sun should solve the problems on earth such as overpopulation, lack of energy resources, pollution, food shortage, climatic changes and limitation of economic growth. With the help of the chemical elements already present in space and with solar energy he thinks to be in a position to have even better conditions for industrial and agricultural growth as a result of the absence of friction and gravity. In this way the new space inhabitants would be independent of the earth. In honour of J. D. Bernal, he called the model of the first spheric settlement with some 50,000 inhabitants Bernal–Sphere. People would live within these spheres where the ground and the feet of inhabitants would be directed towards the outside, away from the Axis. When looking up they would not see the

stars in the sky but the other side of the settlement. To quote an example: If the earth were such an hollow sphere, North Americans would see Australia in the sky.

Therefore, in order to prevent the sense of isolation, claustrophobia, etc., later on and under the direction of the anthropologist Magorah from the University of Illinois a 'torus' was taken as a model of a habitat, since this, curved upwards, had a kind of built–in horizon. Skylab (1973) and Space Shuttle (1983) are the first cells of such habitats inhabitable by man. Compared with the first and only single orbiting around the earth of a satellite with a man on board, with Yuri Gagarin on April 12th, 1961, followed by three orbits with John Glenn in February 1962, the progress is immense, when, 20 years later, you see the astronauts in their spacecraft taking a bath, doing scientific work and keep–fit exercises, have a good meal, sleep in their own beds and stay in space for days. The spartanic period of space flight has already been left behind. Experimental missions have become operative probing missions which make use of the great possibilities of that huge realm beyond the earth. Space Shuffle is the first real "aerospace vehicle" for it is in its element in the air as well as in space. From the Space Shuttle orbital factories with orbital living quarters will develop. Within a few decades the Orbital Age will have taken shape, people will have started to work and to live in the orbital space.

These people can certainly be compared with those pioneers who sailed from England to America during the 17th century, or with those prehistoric people who made the South Pacific islands inhabitable. But these people will not use slaves, that is exploit people, to tackle initial difficulties. Their slaves will be the robots. Therefore robotics, computer and automata theory will number among the most important media after the laws of gravitation in the Orbital Age. Or will there be war between the masters of the space and its tenants in the Orbital Age?

The Orbital Consciousness

A comparison with the Pilgrim Fathers reminds us that the colonization of America did not take place without wars, that almost all human expansion had and has warlike character.

This corresponds with the fact that the NASA (National Aeronautics and Space Administration) is financed by the army and that US president Reagan turns space into a theater of war with his Strategic Defense Initiative SDI. The abysses in the concept of progress will not remain closed even in the orbital space.

All the more important is the second dimension of space travel, the orbital point of view of the earth itself, because from this viewing point the "earth as spaceship" (Buckminster Fuller) as an integrated whole becomes discernible for the first time. The promise to see the earth itself as a single nation, as United Earth, instead of United States of any nations, is like the promise of a coming golden age. This idea was first presented as planetary or global consciousness by psychedelic movements like Whole Earth Catalog and its effects still continue to be felt. See "The global brain. Speculations on the evolutionary leap to planetary consciousness" by Peter Russell (1983, Los Angeles). The orbital consciousness is not the same as the planetary or global consciousness, although, with its idea of the earth as an 'integrated whole' it is related to the unifying orbital point of view of the first attitude. But the 'orbital consciousness' is more complex, conscious also of the negative dialectics of man's idea of progress. Certainly, a united world is necessary and inevitable, and this exactly because we want to stay alive in a nuclear era. Social progress is possible, but only under the conditions of logic, diversity and heterogeneity. New thoughts, new forms of life, new views, deviating from tradition, on living with each other, on human relationships and our relation to the earth and the universe will become necessary and will have to be tolerated as a result of an adaptation which makes survival possible. But not only cultural diversity is absolutely necessary, we must also become aware that man himself is now able to control his genetic diversity since in 1965 Sol Spiegelman for the first time developed a living

unity (an active virus) from non–living material. Half in jest Spiegelman said: "When all ecological niches on the earth were occupied by DNA, the DNA had to invent man to explore the possibilities of extra–terrestrial life as a further place of replication". Thus, not the language is a virus (W. Burroughs) but man himself is the virus in space. Like up to now, man will continue to change genetically over hundred thousands of centuries and will continue changing genetically whether we want to or not. "Cloning" is thus the chance to control the direction of this evolution. Cloning will also help to make the universe inhabitable for man.

The Cloned Earth

The history of man's body
as the history of prothesis
converging with
the history of the earth
as the history of prothesis
The earth becomes man's body.

The tools and technical culture
originate from excavation (exterriorizations)
of man's body.
The tools and technical products
are replaceable limbs (prothethis) and complete the human organs:
motor—muscle
hand—hammer, lever
foot—wheel
eye—glasses, microscope, telescope, TV
ear –telephone, radio
memory—writing, photography, record
—computer
mother's womb—house, earth

The inherent quality of prothesis is the replacing
of natural organs by man–made
artificial auxiliary organs:
the technical forms of transformation of
the earth
as part of man's body.
Technique is the make–up of the earth.
The modelling of the body
leads to the technique of prothesis culture
of the cloned body.

Computational modelling and cloning
are the most advanced forms of prothesis
Man becomes the God of prothesis
a master over his body
over the earth and the universe.

The conquest of the universe
continues the exterritorization of the body.
Satellites and space ships are

not only exterritorizations of the body
but also exterritorizations of the earth.

The dwelling and energy sources
the organs and tools
of the earth are placed out into the universe.
The earth as man's womb is
exterritorized in space age.
Like the innermost of the earth
the subconscious of man
is also placed on the outside.
The earth becomes man's brain
of man the God of prothesis.
The earth becomes a kind of prothesis
a tool of man.

The Earth as Brainwork:
self–made reality
self–produced world.

The earth becomes man:
that is the goal of tools,
of prothesis and of technique.
Satellites are eyes, ears
and cameras of the human earth
of the human earth turned into man's body.
After the cloning of the body
the cloned earth follows.

Space ships are
the first cells of the cloned earth.
The mother ship and the master tape earth
will release innumerable copies
into the universe.
Just as every cell of an individual organism
with cloning can become the stomach of an
identical individual,
the earth can become stomach
of identical earth stars and earth cells.

In the space age
we replace parts of the earth
until the earth itself is replaced.
A replaceable cloned earth
is infinitely reproducible.
The earth is transformed
into an immortal gigantic prothesis.

The Orbital Accelation: Chronopolitics

The Egyptians built on their temples for thousands of years, the cathedrals still took hundreds of years to be completed, today, a museum or a church takes a few years at the most to be finished. This

acceleration in building has to do with a change which Paul Virilio called the change from geopolitics to chronopolitics. Terrorism is accelerated chronopolitics of war. But this acceleration also evokes a notion of a slow down. A slowed down fantasy is able to imagine that once more we will build for thousands of years on our cities, only this time in space. The orbital age is an age of acceleration. This acceleration affects almost all sectors of society such as transport, education, etc. Due to accelerated communication on the level of information as well as on the level of transport, our planet shrank. What in former times took months and weeks, namely to get from Europe to America or Asia, takes but a few hours today. Equally, the time that has to pass between important inventions gets always shorter. Take as an example the development from the transistor (1947) to the integrated circuit in 1960. We may say that the velocity of change in our present society increases exponentially. The velocity of this change is shown in the example of the intervals between the discovery of our technological means and their being put to physical use. In photography it took 112 years, with the telephone 56, with the radio 35, with radar still 15 years to put theoretical knowledge to physical use. In the case of the nuclear bomb it took only 6 years and in microelectronics this progress was achieved in 1.5 years. The same phenomenon is to be observed in the increase in population. It took up to the middle of the 19th century to reach the first billion of people on the earth. In 1930, only 80 years later, the world population had reached 2 billion. And only 30 years later, in 1960, we had already reached the third billion. And a mere 15 years later, in 1975, we had arrived at four billion. We have to expect that in 50 years we will number 8 billion people, which means that in the last 200 years the population of the earth will have multiplied by eight. The conflicts which will arise from this development within a nation, but also between nations and continents, can be foreseen. However, to consider this exponential growth as independent of the exponential growth of technology would mean to start from the wrong premises. The contrary is true.

In the context of this technological growth, this technological acceleration, computer culture plays a special role, because it is part of the third revolution in the field of communication, which constitutes the basis of the Orbital Age. The invention of writing about 5000 years ago was the first revolution in communication, because direct communication between persons, up to then the only way of communicating, could be left for the first time. By means of writing, distances in space and time could be overcome. Past events could be recorded and passed on to persons living in later times and elsewhere. Disembodied information could be moved around in time and space. The second revolution in communication was the invention of the printing machine about 500 years ago. What writing had done for individual communication, now became possible for mass communication. The printing machine introduced mass communication. The encoding of messages by electromagnetic fields, as it was introduced by the telephone about 150 years ago and which provided the basis for electronic processing of information by the computer, represents the third revolution in communication. The disembodiment of the message has now reached worldwide status. A network of computer terminals, telephones, telex systems, satellite TVs, etc. have created a new, orbital environment of information.