

# Oroboros 25 years - since 1992



**2017**  
**O2k-FluoRespirometer**

**Two in one**  
**O2k-Series H**



**2004-2014**

**OROBOROS INSTRUMENTS**  
high-resolution respirometry

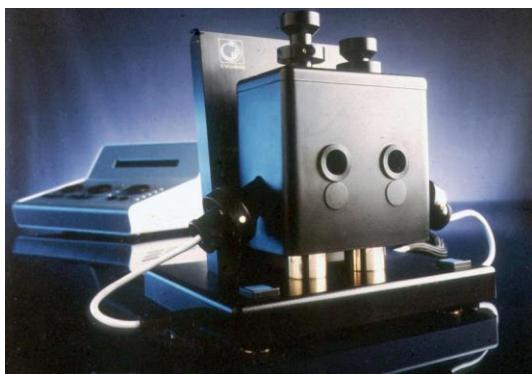
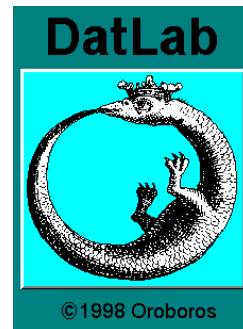
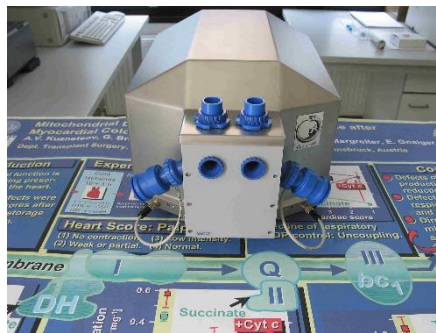
**Oxygraph-2k**



**2002 O2k-Series A**  
**Oroboros and WGT**

**Oxygraph-2k**

**www.orooboros.at**



DR. ERICH GNÄGER BIOENERGETICS AND BIOMEDICAL INSTRUMENTS  
CYCLOBIOS

**1992-2002**  
Anton Paar, Graz



**OROBOROS**  
BIOENERGETICS AND  
BIOMEDICAL INSTRUMENTS

# Oroboros 25 years

**Programme 2017-12-12**

The Oroboros team welcomes you at our special celebration

**Filou, Stiftgasse 12, Innsbruck**

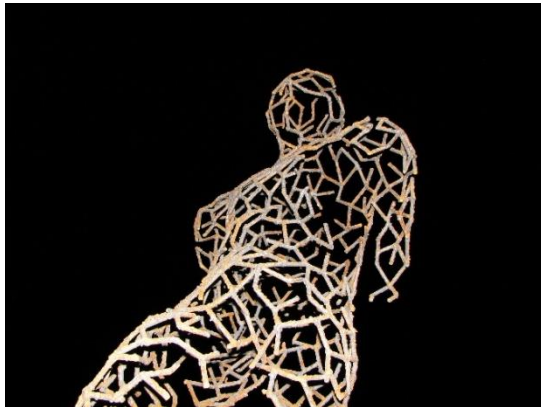
18:18 Xmas *Glühwein* at Filou



*Glühbirnen*  
Winfried Platzgummer

19:19 Oroboros team birthdays

**20:00 Percussion by Engelbert Gagl** – serial music  
with bronze art by Richard Agreiter



**20:20 Oroboros 25:**

**Science with thoughts**



24:00 Midnight special



# Oroboros 25 years



## 2017-12-12 Science with thoughts

MiPart by Odra Noel and selected pictures

**Nietzsche F (1886) Die fröhliche Wissenschaft.** Nicol Verlag. ~ *Leben - das heißt für uns, alles, was wir sind, beständig in Licht und Flamme zu verwandeln.* ~

*Die Feder kritzelt: Hölle das!*

*Bin ich verdammt zum Kritzelnmüssen? -*

*So greif' ich kühn zum Tintenfaß*

*Und schreib' mit dicken Tintenflüssen.*

*Wie läuft das hin, so voll, so breit!*

*Wie glückt mir alles, wie ich's treibe!*

*Zwar fehlt der Schrift die Deutlichkeit -*

*Was tut's? Wer liest denn, was ich schreibe?*

*Es ist als ob wir eine unaufhaltsam rollende Maschine im Kopfe herumtrügen, welche selbst unter den ungünstigsten Umständen noch arbeitet. ~ Das Tempo bedeutet nämlich unter den Kräften der Entwicklung bei Völkern ebensoviel wie bei der Musik; für unseren Fall ist durchaus ein Andante der Entwicklung notwendig, als das Tempo eines leidenschaftlichen und langsamen Geistes. ~ Wie? Das letzte Ziel der Wissenschaft sei, dem Menschen möglichst viel Lust und möglichst wenig Unlust zu schaffen? Wie, wenn nun Lust und Unlust so mit einem Stricke zusammengeknüpft wären, daß, wer möglichst viel von der einen haben will, auch möglichst viel von der anderen haben muß ..? .. Vielleicht ist sie [die Wissenschaft] jetzt noch bekannter wegen ihrer Kraft, den Menschen um seine Freuden zu bringen und ihn kälter, statuenhafter, stoischer zu machen. Aber sie könnte auch noch als die große Schmerzbringerin entdeckt werden - und dann würde vielleicht zugleich ihre Gegenkraft entdeckt sein, ihr ungeheures Vermögen, neue Sternennwelten der Freude aufleuchten zu lassen! ~*

***Es liegt ein tiefes und gründliches Glück darin, daß die Wissenschaft Dinge ermittelt, die standhalten und die immer wieder den Grund zu neuen Ermittlungen abgeben: - es könnte ja anders sein!*** ~ O diese Menschen von ehedem haben verstanden zu träumen und hatten nicht erst nötig, einzuschlafen! ~ .. wir müssen unserer Torheit ab und zu froh werden, um unserer Weisheit froh bleiben zu können! ~ Ein einziger freudloser Mensch genügt schon, um einem ganzen Hausstande dauernden Mißmut und trüben Himmel zu machen; und nur durch ein Wunder geschieht es, daß dieser eine fehlt! ~ Das Glück ist lange nicht eine so ansteckende Krankheit - woher kommt das? ~ Seinem Charakter "Stil geben" - eine große und seltene Kunst! ~ Wer mit sich unzufrieden ist, ist fortwährend bereit, sich dafür zu rächen. ~ Es will mir scheinen, daß vom Schmerze und Unglück immer übertrieben geredet werde, wie als ob es eine Sache der guten Lebensart sei, hier zu übertreiben. ~ Man schämt sich jetzt schon der Ruhe: das lange Nachsinnen macht beinahe Gewissensbisse. .. die eigentliche Tugend ist jetzt, etwas in weniger Zeit zu tun als ein anderer. ~ Ehemals wollte man sich einen Ruf machen: das genügt jetzt nicht mehr, da der Markt zu groß geworden ist, - es muß ein Geschrei sein. ~ Ich will sie das lehren, was jetzt so wenige verstehen und jene Prediger des Mitleidens am wenigsten: - die Mitfreude!

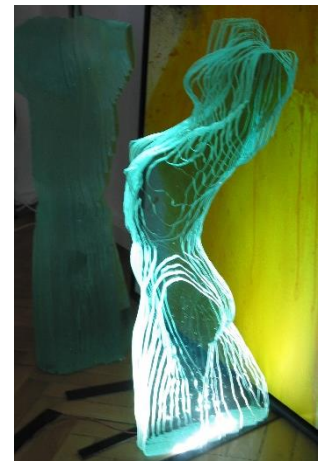


**Schrödinger E (1944) Was ist Leben? Die lebende Zelle mit den Augen des Physikers betrachtet.** (1. Ausgabe. What is life?

Cambridge Univ Press) Piper Verlag München (15. Auflage 2017).

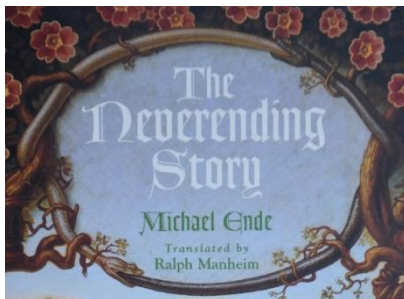
*~ To put it briefly, we witness the event that existing order displays the power of maintaining itself and of producing orderly events. That sounds plausible enough, though in finding it plausible we, no doubt, draw on experience concerning social organization and other events which involve the activity of organisms. And so it might seem that something like a vicious circle is implied. - [a dragon biting its tail, the Oroboros\*]*

\* Gnaiger E (1994) Negative entropy for living systems: controversy between Nobel Laureates Schrödinger, Pauling and Perutz. In: What is Controlling Life? (Gnaiger E, Gellerich FN, Wyss M, eds) Modern Trends in BioThermoKinetics 3. Innsbruck Univ Press: 62-70.



**Hofstadter DR (1979) Gödel, Escher, Bach: An eternal golden braid. A metaphorical fugue on minds and machines in the spirit of Lewis Carroll / Ein endloses geflochtenes Band.** ~ *'Lady Lovelace, no less than Babbage, was profoundly aware that with the invention of the Analytical Engine, mankind was flirting with mechanized intelligence - particularly if the Engine were capable of "eating its own tail" (the way Babbage described the Strange Loop created when a machine reaches in and alters its own stored program). In an 1842 memoir, she wrote that the A.E. "might act upon other things besides number". While Babbage dreamt of creating a chess or tic-tac-toe automaton, she suggested that his Engine, with pitches and harmonies coded into its spinning cylinders, "might compose elaborate and scientific pieces of music of any degree of complexity or extent.*

M. C. Escher: Dragon (wood-engraving, 1952). 'However much this dragon tries to be spatial, he remains completely flat. Two incisions are made in the paper on which he is printed. Then it is folded in such a way as to leave two square openings. But this dragon is an obstinate beast, and in spite of his two dimensions he persists in assuming that he has three; so he sticks his head through one of the holes and his tail through the other.'

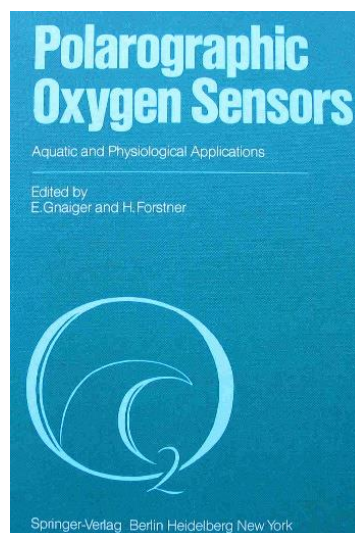


**Ende M (1979) Die unendliche Geschichte. / The neverending story.** Firebird (translation 1983). ~ .. *two snakes, one light and one dark. They were biting each other's tail, so forming an oval. ~ Only the right name gives beings and things their reality, .. A wrong name makes everything unreal. That's what lies do. ~ What has always happened will happen once again.*

**Willem Retze Talsma (1980) Die Wiedergeburt der Klassiker. Anleitung zur Entmechanisierung der Musik. –**

Rebirth of Classics. A guide to the de-mechanisation of music. Wort und Welt Verlag Innsbruck. ~ *The industrial human – surrounded by dead mechanical motions – does not understand music from the pre-industrial age anymore. More precisely, this means that in today's life we do not possess the understanding of classic natural beat and tempo. ... Nowadays, metre is mostly imposed upon us and not one's own choice, and tempo is an occasion to show off technical-mechanical skills. For the pre-industrial human, the word beat or metre had a completely different meaning: it stood for a quasi natural order of things that one readily submitted to. The motion of a tree, the waves of the ocean, the change of seasons: All these ordered movements and rhythms are the key to really understanding early music.*

**McDougall C (2009) Born to run: The hidden tribe, the ultra-runners and the greatest race the world has ever seen. / Ein vergessenes Volk und das Geheimnis der besten und glücklichsten Läufer der Welt.** Profile Books London.



**Lane N (2002) Oxygen: The molecule that made the world.** Oxford Univ Press. ~ *Oxygen defies easy classification. Ever since it was discovered in the 1770s, its properties and chemistry have been squabbled over by scholars and charlatans alike. The controversy persists today. Oxygen is hailed as the Elixir of Life, a wonder tonic, a cure for ageing, a beauty treatment and a potent medical therapy. It is also purported to be a fire hazard and a dangerous poison that will kill us in the end. The popular health press is contradictory. Inhaling pure oxygen in cosmopolitan 'oxygen bars' and health clinics is said to work wonders, yet the opposite, 'high-altitude therapy', is claimed to eliminate superfluous oxygen, conferring the health benefits of austerity. So-called 'active' oxygen treatments, meaning ozone and hydrogen peroxide, are touted as miraculous scourges, or as cures for cancer; yet at the same time we are told that the secret of a long life is to eat plenty of antioxidants, to protect us against the very same 'active' forms of oxygen. Oxygen seems to attract nonsense and misinformation like a magnet.*





**Lane N (2005) Power, sex, suicide: Mitochondria and the meaning of life.** Oxford University Press. ~ *Mitochondria are a badly kept secret. Many people have heard of them for one reason or another. In newspapers and some textbooks, they are summarily described as the 'powerhouses' of life – tiny power generators inside living cells that produce virtually all the energy we need to live. There are usually hundreds or thousands of them in a single cell, where they use oxygen to burn up food. They are so small that one billion of them would fit comfortably in a grain of sand. The evolution of mitochondria fitted life with a turbo-charged engine, revved up and ready for use at any time. All animals, the most slothful included, contain at least some mitochondria. Even sessile plants and algae use them to augment the quiet bum of solar energy in photosynthesis.*

**Coopersmith J (2010) Energy, the subtle concept.** Oxford Univ Press. ~ *Also the historical sequence of events is surprising. The steam age was well under way - steam locomotives pulling trains and steam engines powering industry - decades before 'energy' had been discovered and its conservation stated as the First Law of Thermodynamics. ~ The idea of a perpetually acting device appears to have originated in India, where a perpetually rotating wheel had religious significance, symbolizing eternal cycles such as the cycle of reincarnation (wheel symbols often appear in Indian temples). ~*



*Newton's Second Law of Motion: The alteration of motion is ever proportional to the **motive force** impressed; and is made in the direction of the right line in which that force is impressed. - 'Alteration of motion' was ambiguous. It meant 'rate of alteration of motion' - or acceleration. ~ In the Newtonian [force] view, an isolated body is the centre of attention and we track its twists and turns, its accelerations and decelerations, as it moves along its path and encounters the slings and arrows (the external forces) of fortune. In the energy view to come, a system is examined in its entirety and we look at the interplay between the various bodies within this system and within a certain time interval or cycle. ~ .. **new concepts in physics are only forged when experiment, mathematics, and the ideas themselves all move forward together. Now we see that yet another factor that is important - technology.** ~ Daniel Bernoulli: One can sometimes substitute the modern word 'energy' for the old term 'live force' in his work without disturbing the meaning. ~ In the birth of a new concept, as with the birth of a child, there is usually an interim period during which an appropriate name must be found. In the memoir Helmholtz used only the term 'force', sometimes in the old Newtonian way but usually in the new way, meaning 'energy'. It is invariably clear from the context which meaning is intended; thus 'forces of attraction and repulsion' (force means force) and 'the principle of the conservation of force' and 'force equivalent' (force means energy). The term 'energy' was introduced by Thomson in 1852 and Helmholtz very much approved.*

**Schatz G (2011) Feuersucher. Die Jagd nach dem Geheimnis der Lebensenergie.** Wiley-VCH Verlag, Verlag Neue Zürcher Zeitung. ~ *This retrospective recounts the hunt for the mechanism of mitochondrial ATP synthesis, the early days of research on mitochondrial formation, and some of the colorful personalities dominating these often dramatic and emotional efforts. The narrative is set against the backdrop of postwar Austria and Germany and the stream of young scientists who had to leave their countries to receive postdoctoral training abroad. Many of them—including the author—chose the laboratory of a scientist their country had expelled a few decades before. The article concludes with some thoughts on the uniqueness of U.S. research universities and a brief account of the struggles to revive science in Europe.*



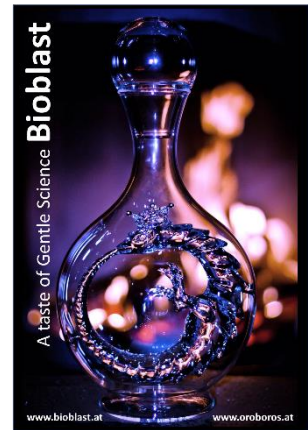
**Kahneman D (2011) Thinking, fast and slow.** Penguin Books. /

**Schnelles Denken, langsames Denken.** Penguin Verlag. ~ ..

*Familiarity is not easily distinguished from truth. ~ Contrary to the rules of philosophers of science, who advice testing hypotheses by trying to refute them, people (and scientists, quite often) seek data that are likely to be compatible with the beliefs they currently hold. ~ The confidence that individuals have in their beliefs depends mostly on the quality of the story they can tell about what they see, even if they see little. ~ .. sustaining doubt is harder work than sliding into certainty. .. we are prone to exaggerate the consistency and coherence of what we see. .. it will produce a representation of reality that makes too much sense.*

*~ To think clearly about the future, we need to clean up the language that we use in labeling the beliefs we had in the past. ~ We know that people can maintain an unshakable faith in any proposition, however absurd, when they are sustained by a community of like-minded believers. ~ Once you understand the main conclusion, it seems it was always obvious. ~ Because optimistic bias can be both a blessing and a risk, you should be both happy and wary if you are temperamentally optimistic. ~ The easiest way to increase happiness is to control your use of time. Can you find more time to do the things you enjoy doing?*

*..*



**Silver N (2012) The signal and the noise. The art and science of prediction.** Penguin Press. ~ *We*

*focus on those signals that tell a story about the world as we would like it to be, not how it really is. ~ .. a certain amount of immersion in a topic will provide disproportionately more insight than an executive summary. ~ Our brains, wired to detect patterns, are always looking for a signal, when instead we should appreciate how noisy the data is. ~ What happens in systems with noisy data and underdeveloped theory is a two-step process. First, people start to mistake the noise for a signal. Second, this noise pollutes journals, blogs, and news accounts with false alarms,*

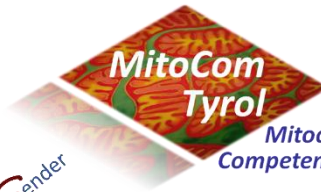
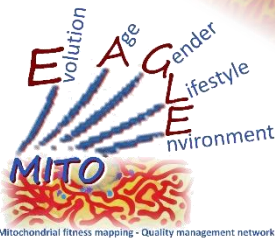
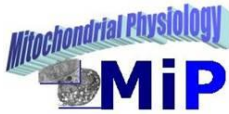
*undermining good science and setting back our ability to understand how the system really works. ~ Most of the data is just noise, as most of the universe is filled with empty space. ~ **If you're using a biased instrument, it doesn't matter how many measurements you take – you're aiming at the wrong target.***



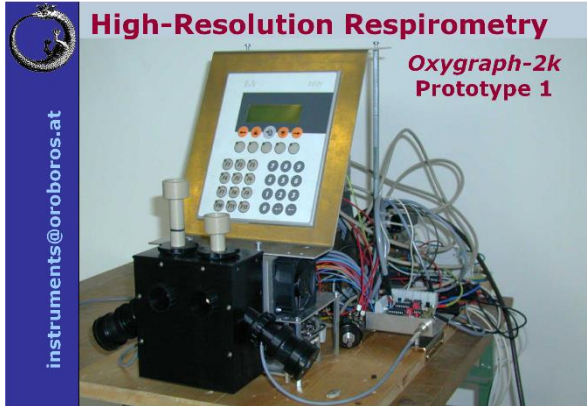
**Perteck D (2017) Das Buch Ouroboros. Gesammelte Legenden von Zauberern und Dämonen.** Books on Demand Norderstedt.







Mitochondrial Competence



**High-Resolution Respirometry**

Oxygraph-2k  
Prototype 1

instruments@oroboros.at



www.oroboros.at

**O2k-Fluorometer**

**Light in the Powerhouse of the Cell**

Explore the Power of Life with the world's most powerful respirometer for cellular and mitochondrial research, combining

- Oxygen consumption • ROS production
- Mitochondrial membrane potential
- ATP production • Ca<sup>2+</sup>

**Workshop on High-Resolution Respirometry Austria, 9-12 September 2003**

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**O2k Protocols**

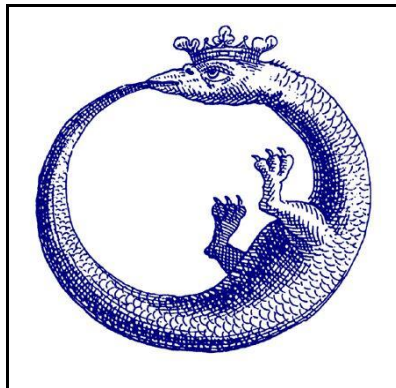
**Oxygraph-2k**

The world-wide standard for studies of mitochondrial physiology and pathology



## FEEDING ON NEGATIVE ENTROPY?

The dragon forming a cycle, feeding on its own tail - in alchemy, the Oroboros is an emblem of the eternal, cyclic nature of the universe, combining idea and action, efficiency and power. The Oroboros is grasping the whole by the conception of the opposite, the divine process of creation and the evil back-lash of destruction. In thermodynamics, the alchemist's search for the eternal Unity has been continued in the many efforts to construct a machine operating at 100% efficiency, the Perpetuum



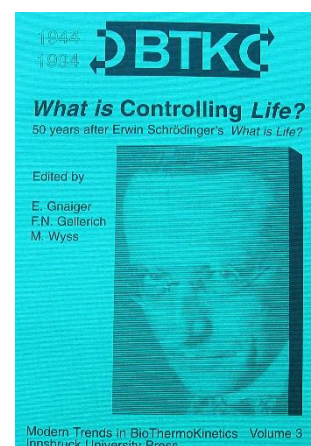
Mobile. 100% efficiency is the prerequisite for a truly cyclic nature of energy flux through the biosphere. The notion of the arrow of time, introduced by the Second Law of thermodynamics, replaces the quest for 100% efficiency by the pursuit of a balanced management of the resources of energy and time. Such optimization of efficient material recycling and balanced resource utilization is a vital responsibility of modern society for the protection of local and global ecological systems.

The Oroboros is one of the rare universal examples where feeding on external negative entropy,  $d_e S/dt$ , is not true, as shown by the feedback loop and the system boundaries. In terms of ergodynamics, at any rate, Oroboros is the fine state of non-thermodynamic equilibrium.

From: Abraham Eleazar, 1760: *Uraltes chymisches Werk*.  
2nd ed., Leipzig

Gnaiger E, Gellerich FN, Wyss M (1994) *What is controlling life? 50 years after Erwin Schrödinger's What is life? Modern trends in BiothermoKinetics 3*, Innsbruck Univ Press:336 pp.

[http://wiki.oroboros.at/index.php/Gnaiger\\_1994\\_BTK](http://wiki.oroboros.at/index.php/Gnaiger_1994_BTK)



— OROBOROS® Cooperation and Feedback in Science —