ISSA Proceedings 2002 – The Need For A New Rationality

1. Introduction

Looking for a new rationality is a relatively recently started activity in philosophy concerning mostly philosophy of science. It is certainly connected to the developments in the most contemporary natural science in the last decades of XX century. We are going to present some arguments that favour the new approach to rationality. Some philosophers of science, methodologists and scientists have been singled out as the most active proponents of the need to change the basics of rationality. For instance, Ilya Prigogine has entitled the introduction to his recent book "A New Rationality?" (Prigogine 1997). There is a symptomatic question mark at the end of this title as we can see. Prigogine is really quite justified to doubt, whether we have the real need to speak about a new rationality. However, the question mark rather stands for the question, whether the changes are deep enough for speaking about a new rationality than for the doubt, whether the essence of rationality is changing at all. We necessarily have to take a look into the traditional conception of rationality in order to discuss, if a principal alteration of the meaning of the term has really become necessary.

Nicholas Maxwell has put forward another serious challenge to classical rationality by arguing for a new conception of science (Maxwell 1998). In order to succeed in his task, Maxwell asks openly for a new rationality, claiming that classical science is not rational in the genuine sense of the concept. Discussing the claims of Prigogine and Maxwell we try to find out, whether they are asking for the same kind or different kinds of new rationality. In the closing section of the paper, we shall argue that temperate rationalism of William Newton-Smith is not really a new approach to rationality in science, but just an indication of one possible direction out of the outworn classical frames.

2. Understanding of Rationality in Classical Science

The concept of rationality plays the central role in all human activity, not just science. "In its primary sense, rationality is a normative concept that philosophers have generally tried to characterize in such a way that, for any action, belief, or

desire, if it is rational we ought to choose it" ("The Cambridge Dictionary of Philosophy" 1999: 772). This is a pleasantly general formulation of the concept and cannot ask for any alteration. However, it does not give any clue, how to differentiate between rational, non-rational and irrational behaviour. We shall consider non-rational to be the opposite of rational. Irrational is not an issue here, as it is a principally different kind of human reasoning compared to rational. People, especially philosophers, are sometimes irrational on purpose, not by the reason that they are not capable of being rational. It does hardly make any sense, however, to be non-rational on purpose (If not a joke is performed, of course).

We can try to be somewhat more explicit than in the first definition of rationality, saying that: "To give a rational explanation of an action Φ done by A is to show that on the basis of *A's* beliefs A did what he thought was most likely to realize his goals" (Newton-Smith 1996: 270-271). In this minimal sense, the majority of aim-oriented human actions are rational. Therefore, there need not be a unique way of acting rationally in a certain situation. However, a definite goal has to be achieved or approached at least. Otherwise, it would not be classical rationality that we are dealing with. We may sometimes fail to act in the rational way for the simple reason that we just cannot recognize it among the several choices available. Such failure does not turn us into non-rational or irrational creatures.
In spite of the general meaning of rationality as a whole, there are good reasons to think that focusing on rationality in science would be a reasonable plan for us here. In that case we have to restrict ourselves to the requirement that the goal in question be scientific. Let us just assume for the sake of brevity, however, that we are able to decide about the scientific nature of the goal in the intuitive manner.
It is the classical Newtonian science where the concept of rationality has been established most clearly. Specifying the concept of classical science is not an issue for us here. Still, some brief explanation is very much in place. By classical science we shall understand the approach to science, which is based on a definite method called scientific and which Nicholas Maxwell has named standard empiricism (Maxwell 1998). René Thom has probably meant the same while speaking about positivist-pragmatist approach to science (Thom 1990). Maxwell states that: "Standard empiricism (SE), remember, is the doctrine that in science no substantial thesis about the world can be accepted as a permanent part of scientific knowledge *independent of the evidence*, and certainly not *in violation of the evidence*" (Maxwell 1998: 37). SE is certainly an aim-oriented activity. By and large, it has been very successful in achieving its aims. The aims, however, are

often narrow and isolated from each other. Their achieving does not contribute to making the world comprehensible. Classical science has been successful just in producing evidence for the support of its narrow specific claims. Evidence necessarily has to be produced in the rational way, *i.e.*, there has to be a definite method for producing the evidence, which has to be applied for many times by different agents. Most important, these attempts must yield analogous results.
The common perception is that there can be an excuse for non-rational action anywhere except science. As far as irrational is concerned, however, it seems that it may have a place in science. It is just non-rational that doesn't. Irrational, just like rational, is connected solely to human beings and does occur in conjunction with rational. The stress in science, however, clearly lies on the rational and it is non-rational that has to be avoided as carefully as possible.
Today, scientists themselves have started to think in a manner, which is hardly compatible to the traditional rationalist one. Philosophers of science, on the other hand, seem to be more interested in the rationality of scientific change rather than science itself. Of course, one may claim that there is no difference as permanent change is going on for all the time. Before continuing, we have to specify our understanding of rationality in the classical sense in a greater detail.

The classical understanding of rationality means that there exists a model of rationality, which can be applied by all reasonable people and repeatedly so. Behaviour that goes contrary to the model's suggestions cannot be called rational. Normally, rational means in accordance with the rules of classical (Platonic) mathematics, laws of classical logic and statistics. Such approach works well in the situations, where the result aimed for is calculable. If this is the case, the central feature of classical rationality emerges in a natural way. It is the requirement that all rational agents should obtain the same result if dealing with the same problem. Some reasonable error is permitted of course. Otherwise, there would be no rationality in natural science. It could occur only in mathematics and logic. We can see that the possibility of repetition becomes a very crucial issue. Rationality in the classical sense cannot be attributed to a unique act at all. The rational result necessarily has to be reproduced for several times, as a unique act of behaviour may come out as rational by chance. This is one of the main reasons of the importance of reversibility in classical science.
We get a somewhat different picture in the case of Karl Popper's critical rationalism. Sir Karl uses to equate the rational attitude and the critical attitude (Popper 1995: 16). Therefore, there is a strange discrepancy between classical

and critical rationality. The first seems to apply to the situations, where there is nothing to criticise. At least in the case if we don't want to apply the Cartesian malicious deceiver against the whole human understanding of mathematics. Critical rationalism, however, seems to apply in the situations, where classical rationality does not apply anyway. Certainly, the case is not that simple. The Popperian conception of critical rationalism leads us towards the new rationality we are striving for, but itself still remains in the frames of classical science. Popper himself was obviously more interested in careful demarcation of classical science from any other intellectual activity than changing its essence. Critical rationalism was meant to be a tool for achieving this goal. Its central feature is casting doubt on any human intellectual achievement if possible. Normally, it is possible, if we deal with reality, not with mathematics. However, possible does not mean reasonable. Therefore, critical rationalism is not ideally rational in the classical sense and can be applied to any kind of reasoning, both scientific and non-scientific. Besides, Popper considered any activity that is in accordance with the classical criteria scientific. Thus, it would be somewhat awkward to take his attitude as an example of the new rationality we are looking for. Below, we shall give some explicit reasons, why this is impossible.

3. Science as a Tool for Prediction

From now on we shall focus on the rationality of research in natural science, which is certainly the foundation for both of our key authors mentioned above, Prigogine and Maxwell. Let us keep in mind the crucial role of the question of reversibility. The latter has been an absolutely necessary condition of experimenting in natural science in the classical sense. In the most contemporary natural science, however, we have to abandon this condition. Why does such change take place? In order to answer this question, we have to address the problem of the aim of science.

The understanding of the aim of science by different authors differs in many respects. There is a consensus, however, in the point that science should be an effective tool for predicting future events in its field of concern. Seen from this angle, we might say that in the case of rational action we necessarily predict correctly. We make mistakes in predictions only if something non-rational has been executed. Such reasoning works in a determinist world. As we don't know, whether the world is determinist or not, we have to prepare for a more sophisticated argumentation here. As the dilemma of determinism suggests, humans have the ability to choose freely between alternative possibilities of

acting (Popper 1982: xix). Unfortunately, we don't know, whether we really do choose freely. However, it is certainly pleasant to believe that we do.

Still, if we don't believe in determinism, then we have to admit that some events happen by chance. This means that they cannot be predicted in principle, as a predicted chance is not a chance any more. Most that we can predict in this sense is just the general possibility of chance. Therefore, an essentially new approach to rationality seems to have become inevitable. Statistics has to be brought into the picture. But this is not enough. The concept of an event becomes crucial in analysing the development of any system.

Still, the basics of the new rationality cannot be too different from the classical ones as we intend to remain inside the frames of science after all. Therefore, predictability still remains the main goal. But the requirement that different agents working with the same problem should always get the same result has to be dropped. The same applies to the requirement of repetition of experiments. In a certain sense, a successful prediction becomes a unique phenomenon. Still, some regularity has to be observable between the unique events. Here we enter the realm of attractors. Some other contemporary keywords have become very important too, *i.e.*, irreversibility, initial conditions and indeterminism of course. We shall address these issues below in context with the views of our key authors.

4. New Rationality in the Sense of Prigogine

Let us take a fresh start in order to present an intelligible insight into the new rationality. The new rationality is about the world as it is, the classical one being mostly about science itself. In the objective reality we normally deal with systems, which consist of particles. The number of particles in a system is often arbitrarily large. The particles are in incessant mutual impact. Such situation, which is the real one, leaves the Laplacean demon helpless. The latter, if it could exist, would be a perfectly rational creature in the classical sense. In the new sense of the term, the demon would fail inevitably by a simple reason. It is just impossible to describe the current state of things in the world with infinite precision. In fact, there is no current state at all, but rather a permanent becoming.

Bringing the Laplacean demon into the picture is a risky undertaking. We face the danger of confusing determinism with predictability. The inability to predict does not necessarily mean that the system we are dealing with is indeterminist. On the one hand, we just need not have enough information to present a correct prediction. For instance, our knowledge may be limited to the macroscopic level. The system under study may be perfectly determinist, but for finding this out, we

may need access to the microscopic level. On the other hand, systems that are determinist, but exhibit unpredictable behaviour, exist. This has been proved a couple of decades ago already. The latter is an important fact for us. It means that the inability to predict cannot really be equated with not being rational. However, we must be aware of our inability and in the best case, know the reasons for it. This is an important step towards the new rationality.

It has often been stated that the failings of prediction are due to our inability to know the initial conditions of a process precisely enough. To be more precise, it is not even a question of knowledge or measurement, but rather of representation. No intelligence, neither natural nor artificial, can consider infinite decimal fractions. Some approximation is always necessary. As we know from the butterfly effect of Lorentz, for instance, approximation does not necessarily approximate, but can yield quite different outcome. Does it mean then that we can never be really rational? It is hardly a sufficient reason for giving up the whole idea of rationality altogether. Fortunately, while dealing with large systems in the sense that the volume in which the system is located is big enough for the surface effects to be ignored, we have to deal rather with ensembles than with individual particles. In such case the concept of initial conditions has a different meaning. Actually, there are no initial conditions, as any condition is the result of a historical development, is in becoming (Näpinen, Müürsepp 2002).
Both Prigogine and Maxwell agree in sharing the common ancestors, the pre-Socratics. Prigogine also includes the name of Epicurus to the list of his most important forefathers. The pre-Socratics, with Heraclitus at the head, praised the eternal motion stressing that nothing is ever at rest. It is his approach that puts the world into permanent becoming denying being at the same time. Epicurus stands out for having introduced the crucial idea of the *clinamen*, the basis of chance. A very important component of the foundation of the new rationality, however, was not produced in the Ancient times. It is the evolutionary view of the *physis*, of the whole material world. Charles Darwin is certainly responsible for the evolutionary approach in natural science. It was Ludwig Boltzmann, however, who took the crucial turn in physics. “From today’s vantage point, Boltzmann’s need to choose between his conviction that physics had to understand becoming, and his loyalty to its traditional role, seems particularly poignant” (Prigogine 1997: 21). The situation Boltzmann was facing prevented him from taking full advantage of the idea of irreversibility and introducing the arrow of time permanently. In the case Boltzmann had taken full account of these concepts, the

new rationality should be started with him.
The undisputed merit of both Darwin and Boltzmann is the replacement of the study of "individuals" with the study of populations. "Exactly as biological evolution cannot be defined at the level of individuals, the flow of time is also a global property" (Prigogine 1997: 20). As we know, Darwin's theory has enjoyed lasting success and remains the basis for our understanding of life. "On the other hand, Boltzmann's interpretation of irreversibility succumbed to its critics, and he was gradually forced to retreat" (Prigogine 1997: 21).

Now, let us get closer to the idea of new rationality keeping the focus on Prigogine and turning to Maxwell later. In the eyes of the former, it is mostly the idea of irreversibility that plays the crucial role in making the world comprehensible. Putting the *arrow of time* into the centre of our picture of the world has enabled to view our surroundings in a new way. Certainly, this move is in full accord with our everyday life, as we can never accomplish two things in exactly the same way twice. Most probably, the common sense perception was also the basis of understanding for the pre-Socratics.
In general, irreversibility is based on the distinction between past and future. Prigogine considers the latter a *primitive concept* in the sense of Niels Bohr (Prigogine 1980: 213). This concept precedes scientific research in a certain sense. In scientific research we prefer to speak about irreversibility. However, irreversibility on the macroscopic level is obvious. It is the idea of microscopic irreversibility that has initiated the search for a new rationality. "From the methodological point of view, the large Poincaré systems used in the theory of microscopic irreversibility (which is in the stage of development) can be interpreted as mathematical models which grasp the *time-oriented* aspects of the real (irreversible, chance, instable and so on) world" (Näpinen, Müürsepp 2002).
Now, what about the concept of science? Isn't it so that the narrowly aim-oriented classical science owes its success just to the definite method that is strongly based on the possibility to repeat an experiment? Let us remember at this point that the new rationality implies that all processes that can be studied are necessarily irreversible. This means that strictly speaking, not a single experiment can ever be repeated. Every phenomenon is absolutely unique.
What to do in such situation? Is a science that lacks the possibility to repeat experiments science any more? Strictly speaking, we do not need to drop any other traditional requirement of scientific research, except reversibility. Even the task to predict is still in place. However, the essence of prediction has to change.

We cannot hope of being able to predict events as such. We can rather predict courses of processes and even those with significant limitations. The most crucial limitation concerns reaching the next bifurcation point where the course of the process under study may change significantly. "… we can never determine when the next bifurcation will arise" (Toffler quoted in Prigogine 1984: xxxii).
To sum up with, a rational agent in the sense of Prigogine is an individual, who is able to recognize periods in the course of a system's development, when principal changes can occur (strongly non-equilibrium conditions) and can act during these periods in a way that brings her closer to achieving the goals she is striving for. The rational agent is well aware that any move she makes, either in scientific research or everyday life is unique and its immediate consequences have to be faced. It is never possible to foresee all possible consequences of any act. The latter applies to the results of scientific research as well.

5. New Rationality in the Sense of Maxwell

It seems that rationality becomes equated with comprehensibility for Maxwell, who holds that if standard empiricism is accepted, the achievements of modern science become incomprehensible and science itself becomes irrational (Maxwell 1998: 36). We can make the universe comprehensible only if we act rationally. Thus, Maxwell denies the rationality of classical science, an enterprise, which is normally taken as the model area for rationality. Self-evidently, science is taken as a whole here. The meaning of rationality is connected with the problem of understanding the world as a whole. Therefore, the suggested reformation of science would have fruitful consequences not just for science, but for all inquiry and for all life, i.e., personal, social, cultural, global contexts (Maxwell 1998: 25-26). As it is widely accepted, rationality, in the narrow sense of the term, works well in classical science. The general methodological approach to classical science has culminated with the principle of demarcation, which excludes metaphysical ideas from science by the reason that they are not empirically testable. This approach forms the basis for classical rationality. Aim-oriented empiricism advocated by Maxwell, however, by contrast to standard empiricism, insists that metaphysical ideas – rival conjectures as to how the universe may be comprehensible – form a vital, integral part of the intellectual domain of science (Maxwell 1998: 27). It may be that the traditional metaphysics is still not the one that we need for making the world comprehensible. Why then was it excluded from science with such determination for more than a century? We are face to face with a very complicated question – what would be the correct (in the

scientific sense) metaphysics? We should speak about a metaphysical approach, of course, as metaphysics is metaphysics. There cannot be several different metaphysics in principle.

Ideas belonging to the philosophy of science concerning the aim and essence of science also form an integral part of science for Maxwell. The latter position becomes the most rational attitude in the context of aim-oriented empiricism, which is a philosophy of science itself. Philosophers of science have been working inside the frames of standard empiricism for a long time. “In doing this they have sought to justify the unjustifiable, defend a conception of science which, if honestly put into scientific practice, would bring scientific progress to an instant standstill” (Maxwell 1998: 33).

We have seen that Maxwell and Prigogine are applying quite different terminology. Still, our claim is that they are basically speaking about the same thing or at least the same situation in contemporary science. For instance, Maxwell turns to the limitations on the predictions, if we assume that there exists a true theory of everything, T. It is very likely that we will be able to solve only few very simple equations of T exactly. It may even be that no equations at all can be solved exactly (Maxwell 1998: 33). Although Maxwell is correct in presenting this opinion, it is not clear, whether he has understood the reasons why we cannot obtain exact solutions any more. It is very clear, however, that Maxwell attributes the limitations of the predictive power of T in practice to the impossibility of obtaining precise knowledge of the initial physical state of any physical system (Maxwell 1998: 34). He has not understood that the question is not that of precision. There just does not exist any initial system. The situation is at least as hopeless in the case of non-physical systems, i.e., human experience, human consciousness, meaning.

It is obvious that Maxwell has started to call standard empiricism irrational by the same (or at least very similar) reasons Prigogine is looking for a new rationality. The latter, in addition to his criticism, has proposed a qualitatively new approach to science. Maxwell has proposed his new approach too, calling it aim-oriented empiricism. But is it qualitatively new? Maxwell has called aim-oriented empiricism *the key to scientific progress*. A vital feature of scientific rationality has been a kind of positive feedback between improving knowledge and improving knowledge about how to improve knowledge (Maxwell 1998: 17). Maxwell suggests that it would be more appropriate to speak about positive

feedback between improving knowledge and improving *aims* and methods: “A basic fixed aim of science (fixed for the time being at least) is to discover in what precise way the universe is comprehensible, it being presumed that it is comprehensible in some way or other” (Maxwell 1998: 18). In this light, the feature of science that accounts for the name *aim*-oriented empiricism is the following: “The more or less specific (and highly problematic) aim and methods of science evolve with evolving knowledge within the framework of a (more or less) fixed aim for science and fixed metamethodological methods” (Maxwell 1998: 18). These quotes testify, however, that Maxwell is looking for a new rationality inside the frames of the classical approach, bringing in (meta)methodological and metaphysical ideas. This claim is strengthened by the fact that Maxwell considers Einstein having worked in accordance with aim-oriented empiricism. Now it is very clear that the new rationality of Maxwell and of Prigogine are different. The latter can never call Einstein’s thinking rational in the novel sense, as the creator of relativity theories did not recognize the irreversible flow of time, as it is well known. In this sense, Einstein’s attitude was as bad as could be, because he even called time an illusion. For Prigogine, time is probably the most real quality of all. It is true, that Einstein did put forward scientific hypotheses, which could also be viewed as methodological principles. However, it was just introducing methodology into scientific research. This is a move that generally has not been rejected even by Karl Popper. Certainly, Einstein produces a deeper understanding than regular standard empiricism does. But it is obvious that the problems Einstein was dealing with were not accessible by the classical methods at all. Einstein was just pushed to the edge of standard empiricism. He never showed up real wish to get out of it.

Maxwell’s search for a new rationality has not been entirely successful. His aim-oriented empiricism succeeds in providing a somewhat deeper understanding than standard empiricism does. It is certainly not an irrational activity. But in the light of the most contemporary research methodology based on irreversibility, it is still rather quite non-rational than rational. Especially, when compared to the approach of Prigogine.

6. Temperate Rationalism of Newton-Smith, a Possible Solution?

Could it be that we just have to belittle the requirements for rationality for achieving our goals, namely for presenting an understanding of rationality, which is in accord with the latest developments in natural science? In order to answer this question, we have to make it clear, what a temperate rationalism could mean.

We are in possession of one outspoken form of temperate rationalism. It says that temperate rationalism offers a dynamic theory of science (Newton-Smith 1996: 270). This means that failure to make progress in science leads us not just to test different theories, but also to investigate the effects of altering the list of controlling factors. This in turn, may lead to improve our beliefs about the world by improving the ways we come to decide between theories (Newton-Smith 1996: 270).
Thus, by introducing temperate rationalism, William Newton-Smith certainly adds a new straw to the classical understanding of rationality in science, which has been dominant even in the postpositivist philosophy of science. The latter, however, still remains a firm basis of his argumentation. It should also be stressed that the primary interest of Newton-Smith is the rationality of scientific change studied in the wake of Kuhn and Lakatos. Our main interest here, however, is not necessarily connected to ongoing global change in science. We are rather focusing on the rationality of acting while engaged in scientific research.

"If the temperate rationalist finds that the real reason why a scientist believes that one theory is better than another is not that he has good reasons (on his own terms), but that believing this serves some non-scientific interest, he will seek a sociological explanation" (Newton-Smith 1996: 271-272). This claim is in accord with the aspirations of Prigogine and Maxwell discussed above. In some sense, they both are probably temperate rationalists. But they certainly try to go further. At least Maxwell rather stresses strengthening the idea of rationality than loosening it. There is nothing wrong with this. But the strengthening has to be accomplished at a new level. Prigogine has achieved this level. It is probably not the case with Maxwell and certainly not with Newton-Smith. In the case of Prigogine the social and cultural aspects play important roles. The role of the individual researchers has become crucial in his approach. In addition a whole new network of key terms that characterize the approach of Prigogine has been set up and elaborated. This network is the basis for the new rationality in the sense of Prigogine.

In conclusion, temperate rationalism of Newton-Smith is not an appropriate candidate for the role of the new rationality. It is a step in the right direction. It breaks out of the narrow borders of rationality set in classical science, but still remains on the same platform not making the crucial leap that has been executed wholly by Prigogine and partly by Maxwell. Unfortunately, Newton-Smith has just

tried to loosen the frames of classical scientific rationality grounding his arguments on the postpositivist tradition in the philosophy of science. He has accomplished his task successfully. However, this is not the new rationality we are looking for.

7. Conclusion

In the light of the most contemporary developments of natural scientific research we can say that the traditional understanding of rationality, which is well furnished for testing classical science, is not applicable in the new conditions. Today, we have to recognize the principal irreversibility of all ongoing processes. Therefore, the requirement of repeatability of experiments can no longer be applied. *The arrow of time* has been introduced permanently into the research of nature (In social research it is present anyway.) There are no initial conditions for any process. Any condition has its history. The determinist view on the world has to be dropped. The Laplacean demon is helpless in the world full of systems consisting of infinite number of particles. Chance governs, but not in a random way. There are certain patterns of development, which are followed in the case some definite conditions are present. Classical laws of physics have to be replaced by the laws of chaos. This is the situation, where rationality acquires a new meaning. Let us emphasize, however, that this concerns rationality of science. Rationality as preferred human behaviour has retained its general significance.

REFERENCES

Audi, R. (Ed.) (1999). *The Cambridge Dictionary of Philosophy*. Second Edition. Cambridge: Cambridge University Press.

Maxwell, N. (1998). The Comprehensibility of the Universe. Oxford: Clarendon Press.

Newton-Smith, W.H. (1996). *The Rationality of Science*. London and New York: Routledge.

Näpinen, L. & Müürsepp, P. (2002). The concept of chaos in contemporary science: on Jean Bricmont's critique of Ilya Prigogine's ideas. *Foundations of Science* (forthcoming).

Popper, K. (1982). *The Open Universe: An Argument for Indeterminism*. Cambridge: Routledge.

Popper, K. (1995). *The Logic of Scientific Discovery*. London and New York: Routledge.

Prigogine, I. (1980). *From Being to Becoming: Time and Complexity in the*

Physical Sciences. San Francisco: W. H. Freeman & Co.
Prigogine, I. (1997). *The End of Certainty*. New York, London, Toronto, Sydney, Singapore: The Free Press.
Thom, R. (1990). *Semio Physics: A Sketch*. Redwood City, California; Menlo Park, California; Reading, Massachusetts; New York; Amsterdam; Don Mills, Ontario; Sydney; Bonn; Madrid; Singapore; Tokyo; San Juan; Wokingham, United Kingdom: Addison-Wesley Publishing Company, Inc.
Toffler, A. (1984). Foreword: science and change. In: I. Prigogine & I. Stengers, *Order Out of Chaos: Man's New Dialogue with Nature* (pp. xvii-xxxii), Toronto, New York, London, Sydney: Bantam Books.