Participating in the World: Research and Education in a Changing Society*

Diederik Aerts

Center Leo Apostel.
Brussels Free University,
Brussels, Belgium.
diraerts@vub.ac.be

> Break the pattern that connects the subject matter and you destroy all quality
>
> Gregory Bateson in "Mind and Nature".

> Intelligence is what one uses when one does not know what to do.
>
> Jean Piaget in "La psychologie de l'intelligence".

> Ideas, concepts and theories are the stuff that constituts our reflection, and its reflection has a powerful influence on the world.
>
> David Bohm in "Unfolding meaning: a weekend of dialogue with David Bohm".

The garden of Academe has many parts. Some are demanding, inhabited by strictly selected flowers, fruit bushes and domestic animals, surrounded

*Published as: Aerts, D., 1999, "Experiencing the world: research and education in a changing society", in *Science, Technology and Social Change*, eds. Aerts, D., Gutwirth, S., Smets, S. and Van Langehove, L., Kluwer Academic, Dordrecht.

by paths and fences in geometric patterns. This part is closely controlled by the gardeners. Other areas of the garden are less structured and merge almost unnoticeably into the surrounding inaccessible and unknown wilderness. Dandelions and forget-me-nots blossom there, and a squirrel runs past with a piece of bread it has nabbed from the bird-table in the marked off area.

One sunny day sometime in the twenty-first century — or much later, but let's hope it's not too much later — a teacher and his students were walking along a path that runs through the wide grassy field. They stopped at one of the lovely spots where the grass was soft and inviting, and lay down.

The teacher intended to tell them a story about the twentieth century, more particularly about the way research and education were organised then. He looked around at his students, who had settled down comfortably in the afternoon sun, which was already beginning to fade.

1 Observation and Participation

"You already know that the twentieth century was in many areas a turning point leading to the society we now live in," he said. "You will remember how the participatory evolution that started then made concrete many old humanist ideas, which had already repeatedly been expressed in earlier times, in the form of movements that are now fully active. We have often talked about this in previous gatherings. It is impossible to consider the changes in forms of education and research independently from this overall transformation, and for that reason I would like to talk to you about it in that context."

Ernest asked, "Was twentieth-century education and research still largely dominated by the 'observational' paradigm, about which we have spoken so many times?"

"One might put it like that," replied the teacher. "You will remember that the 'observational' paradigm was based on the notion that it was 'possible' and 'desirable' to use a model of the world, built on the basis of observation, for the 'organisation' of the world. In the context of this 'observational' paradigm almost no account was taken of the essential 'participation' of the 'perceiver' in the construction of the world. The 'perceiver' was considered to be an 'observer', and this had all kinds of consequences, about which we have already spoken in earlier gatherings. The changes that took place in the organisation of education and research are perhaps the

best example of this transition from an 'observationally' organised society to a 'participatory' one."

"So how was education organised in the twentieth century," asked Sonia.

"The structure of education was 'in practice' based largely on the observational paradigm. It was assumed that 'observational knowledge' of reality, the knowledge acquired by way of a purely observational model, could be passed on to others by means of 'lessons', which the teacher presented to a group of students. The main activities expected from the students were listening and understanding. This 'observational' preconception regarding the nature of reality was illustrated very well by the ritual that went with the way of transferring knowledge used in education. The one who 'knows', the teacher, stood in front of the class with his face, the symbol of the explicit nature of the knowledge, towards the group of 'non-knowers', the students, who listened and tried to understand."

"What a remarkable situation," said Jan. "Had they not yet understood that genuine knowledge can only be acquired by experiencing the world?"

"Yes, they had already understood that for a long time," answered the teacher, "and that's why I said that this was the way knowledge was still transferred 'in practice'. Many of the thinkers in this field, some long before the twentieth century, had already claimed that a participatory form of teaching was much better, the student acquiring knowledge and learning about the world from his own experience. So over the years educational reforms tried to change the normal practice of education into a more participatory form. Again and again these fine plans were watered down into an observationally structured pattern. The reason for this was the presence of a highly social and cognitive 'observational paradigm' which exercised its power in a subtle and mysterious way."

"So were none of these attempts to change to a participatory form of education successful?" asked Jonito.

"It was not quite that extreme," said the teacher. "Several people, who argued very energetically for a participatory educational system, and had the necessary charisma to enthuse the followers they needed, did succeed in propagating alternative forms of education. But it can be said that these attempts remained marginal until the end of the twentieth century."

"Can you give us a few examples?" asked Ernest.

"Well, there have been regular attempts throughout the western world to renew education," replied the teacher. "I shall give you a few examples. In this country, Ovide Decroly [1] proposed ideas that came very close to a participatory form of education. He saw the students' active participation in the process of education as pivotal. In 1901 he founded a small school

in Brussels for mentally handicapped children, and later put this form of education into practice in his 'Ecole pour la vie par la vie'. Decroly's ideas had a great influence on the renewed Belgian syllabus in 1936.

In the United States the philosopher and educationalist John Dewey [5] had a great influence on the renewal of education. In 1894 he founded a school of education at the University of Chicago and attached a training school to it. Even then he already wanted explicitly to consider the school as a social community in which the students and teachers worked together on projects and whose primary intention was to teach students 'to live'. It was he more than anyone else who pointed out the shortcomings of the prevailing educational system.

In 1907, in Italy, Maria Montessori [9] took under her wing a group of children from the poorest districts of Rome, founding 'la Casa dei Bambini', a small school where she tried out her educational method. This was based on the central idea that a child develops itself, as long as one provides an environment that encourages action. When she was older, Maria Montessori transferred her activities to the Netherlands, where a number of small schools applying her method survived.

At about the same time in France, Celestin Freinet [12] was also at work. He propagated an educational system that emphasised educational tools and resources. These were partly designed by the students themselves in order to stimulate participation and creativity.

There are other examples too [15, 16], and generally speaking one can say that all these attempts to renew education aimed to develop and open up the student as a person in the best possible way."

"But didn't any of them succeed in actually changing traditional education?" asked Sonia.

"No," replied the teacher, "the time was not yet ripe. These attempts took place in a society which was itself organised primarily in accordance with the observational paradigm, so they were like drops in the ocean. What also contributed to the failure of these personal initiatives was that they were often too strongly linked to certain strange and specific philosophical views held by their charismatic initiators."

The teacher paused for a moment. The sun had in the meantime disappeared behind the tall poplars lining the field. It was a warm day and the coolness of the shade was pleasant. He then continued.

"Fundamental changes such as the transition from an observational to a participatory world view take a long time and are associated with extremely complex upheavals. An interesting study could in fact be made of humanity's slow settling into the observational paradigm, for a large part due to a

few significant but personal aspects of the human situation, such as the fact that at a certain moment 'the eye' became the most important of the human senses [17]. We now know that from the seventeenth century the observational paradigm was taken in crescendo to a peak [18].

"What happened then, when this reinforced the observational paradigm like that?" asked Jonito.

"Cogito ergo sum," said the teacher emphatically.

"Descartes [19, 20, 21]," responded Jonito and Ernest in unison.

"That's right," continued the teacher, "René Descartes was a great mathematician and hugely fascinated by the axiomatic method, which had also produced profound and far-reaching results for the Greek mathematicians. He proposed this mathematical method, which developed theorems out of basic principles, as the method which should also be used for the philosophical study of the world. According to him, the senses were to be fundamentally distrusted in their observational capability [22], and he proposed that only what we see 'clearly and distinctly' is 'true'. This meant that the criterion for truth was shifted to the thinking. According to Descartes, animals were pure automatons, whereas when man was created, two dissimilar substances, matter and consciousness, were merged."

"Surely it is not possible that one thinker, even if it was Descartes, could have disseminated this sort of idea as a view of the world," said Jan.

"That would indeed have been impossible," answered the teacher. "One should not see these proposals by Descartes as the contemplation's of one isolated individual. They are the result of an attempt to fit the convictions current at that time into the framework of the observational paradigm, which was already a dormant but powerful presence. Descartes made a synthesis of the general thinking from his surroundings, and the explicit step towards the dualism of mind and matter was a normalisation of man as he then was — this was a world view. This dualism had far-reaching consequences, especially when it turned out to be fruitful, and was overwhelmingly confirmed by Isaac Newton's miraculous findings [23]. Newton's mechanics describes nature with fantastic accuracy as a great mechanical play of forces and interacting material entities. The 'perceiver' of this nature, who was reduced in Descartes' principles to the reasoning part of the human mind, is a 'photographic observer'. At the same time, Newton devised geometric optics as a theory of light, which emerges as a medium the material reality projects onto the retina of the human eye just as in a 'camera obscura'. The human mind remained in its inner theatre [24] and observed this reality."

"But it must have been clear to everyone even at that time that there was not only observation, but also human action with its effects on nature,"

commented Ernest.

"That's right," continued the teacher, "but human actions and experiences were conceived as mental, and spontaneous, results of reasoning. Physical phenomena and natural processes were mechanical, repetitive and predictable and linked only to matter, which itself was passive and inert. No one denied that humans acted in this natural world and that the face of nature was changed by collective human activity. But the scale and significance of these influences could be minimised and were not essentially linked to natural events. Nature was not conceived as an ecological network of biological systems in which living humans were only an added influence, and in this way human activity appeared not to have a significant influence on the workings of nature. Nature was considered rather to be the scenery in which the human drama was acted out, scenery which was not in any essential way involved in the play."

"Is it true that as a result of this, education also started to streamline itself within this observational view of the world?" asked Ernest.

2 Education

"Well," said the teacher, "the evolution of education in the Western world has been influenced by many aspects of society. There have, over the centuries, always been pressure groups of various sorts that have wanted to make their mark on education in one way or another. I would like to distinguish between two main trends with respect to the aspect we intend to consider. Insofar as education remained 'personal' and was 'specifically goal-oriented', it largely evaded the influence of the already latent observational paradigm. In ancient times, in Mesopotamia and Egypt, for example, there was a sort of apprentice system under which every official trained his successor. It was the good training of the apprentice that was of prime importance, and not the subject matter presented. [25]."

"I understand," said Jan, "insofar as they concentrated efficiently on a concrete goal, and the teacher also remained directly involved in the apprentice's actual practical application of the subject matter, he had to apply a participatory form of education."

"That's right," said the teacher, "education that was aimed directly at practical application, and that was generally the case in later ages too, has never suffered too much from the observational paradigm. The Greeks were in fact the first to introduce a different form of education, in which the subject matter to be taught became an important entity in itself. For instance,

they made a distinction between the human sciences and the natural sciences. And that was where the influence of the observational paradigm first made itself felt, by more emphasis being put on the subject matter, and so the idea crept in, inspired by the observational paradigm, that it should be possible to present this subject matter to the student separate from the practical application, from mind to mind.

"Did that have consequences for the structure of education itself?" asked Jonito.

"Yes, it did," answered the teacher, "there is only any point in considering dividing this matter into different 'subjects' when the accent is put on the subject matter and not so much on the actual skills a student learns and has to be able to apply, and this is what happened in the case of the Greeks. This system was later adopted by the Romans, under the name of the seven liberal arts [26], grammar, rhetoric, dialectic, arithmetic, geometry, astrology and music. This was the birth of the division into different disciplines, which were later greatly extended and diversified [27]. The advantage of the separation of these disciplines was that specialisation and deeper study of a narrow aspect of reality was able to develop: the same advantages are still present today in the various aspects of science. But it also contained a great danger: the idea grew that reality itself, as well as human action within that reality, could be compartmentalised in accordance with the example of these disciplines. The presence of the observational paradigm meant that this danger was hardly recognised, since a purely observational picture of reality can indeed, without danger, be split into fragments."

"Whereas every genuinely relevant project in the world needs a multiplicity of these disciplines together," said Jan.

"Yes," replied the teacher, "there is actually a second division that had already taken place at that time, and which was the consequence of class distinctions in Greek and Roman society. The philosophers, the military and the manual workers were three distinct classes, each of which received its own education and training. This division formed the origin of what was later to become higher, secondary and primary education. The Greeks also introduced the principle of selection, which determined which sort of education one was suited to. But education was not yet compulsory and was left to private individuals, usually professional teachers."

"I suppose the private way it was organised and its non-compulsory nature made it impossible to deviate too far from the original aim," said Jonito.

"That's true," continued the teacher, "and although those two aspects had a very negative influence on the democratic aspect of education — only a

certain elite took part in it — they provided a protection against too great a deviation away from the needs of the student towards the importance of the subject matter. The observational paradigm's total hold on the education system could however only take place after the appearance of the 'modern' world view, after the seventeenth century."

"Was that because it was from then that the idea of seeing education purely as a transfer of subject matter, from the teacher's mind to those of his students, became predominant?" asked Sonia.

"Yes, that's right," replied the teacher, "between the Greek-Roman and the late modern era education was immersed in a completely new sphere of influence: Christendom's urge to convert. It was at that time aimed at a very broad section of the population, since the church wanted to disseminate its world view as widely as possible, but this once again made it very goal-oriented. The subject matter was extremely limited: singing, acquaintance with The Lord's Prayer, the credo, the Ten Commandments, the Ave Maria and the Sacraments. In a certain sense this period was an interruption of the evolution set in motion by the Greeks and Romans. After Newton's discoveries, differential and integral calculus and the blossoming of physics, the enormous increase in 'observational knowledge' about the world meant that subject matter gradually expanded. Individual education was increasingly being replaced by a classical system. School reports made their appearance, with marks for behaviour and progress. Entrance and end-of-year exams were introduced. The subject matter, which was to a great extent based on observational knowledge, now really became the focal point. In this way the observational paradigm took firm hold of the whole process [28]."

"I understand," said Jan, "it was probably the 'modern' convictions in which man is considered primarily and almost exclusively a reasonable being, and nature as an organised whole, that have determined the ritual of education as you have already described it."

"Quite right," said the teacher, "from the seventeenth century there was a gradual decline in the importance of the old liberal arts, whose very nature meant that they were still fully involved with direct human interaction with the world. They were replaced by subject areas inspired by the new natural philosophical knowledge of the world, structured as part of Newton's observational paradigm."

"Surely the Newtonian theories of reality reached their peak in the second half of the nineteenth century," remarked Jan. "The development of the theory of relativity and quantum mechanics in the early twentieth century put a final end to the possibility of an observational world view in physics."

"Yes, you are right," replied the teacher. "As we all know, it is mainly

quantum mechanics that has demonstrated that reality is not 'observational', but is fundamentally 'participatory' in nature [29]. However, there is always a long delay in the penetration of such fundamental insights into other areas of the world. That is why these insights only very slowly entered general thinking, and it has taken until the beginning of the twenty-first century for them to become fully integrated."

"Surely one does not need to understand quantum mechanics to see that reality is such that you can do no other than participate in it?" commented Jan, "one knows that simply by looking at the phenomena closest to us."

"Yes," answered the teacher, "all the studies of what were then called human sciences showed up this participatory aspect in a very convincing way, but at that time it was generally thought that this was simply an aspect of 'complexity', but not a fundamental aspect. Since the observational world view had since the seventeenth century been supplied with its material mainly by the findings of the exact sciences, its shortcomings, as were identified by those same exact sciences, played a defining role in setting the definitive change in motion. And after all, one must not forget that most of the twentieth century was characterised by a fierce struggle between the scientists who were still trying to keep quantum mechanics within the realm of the observational world view, and those who were convinced of its fundamentally participatory content [36]. As a physical theory, quantum mechanics displayed so many oddities that many interpretations were possible. It was the first time in history that a theory made so many predictions that went directly against the obvious notions of the then dominant world view."

"How was this argument then ultimately settled to the advantage of a participatory world view," asked Sonia.

3 The Role of the Sciences

"It was necessary to wait until the closing decades of the twentieth century," replied the teacher, "when it became technically possible to carry out experiments that could directly test the nature of reality as predicted in quantum mechanics. At a certain moment the theoretical thinking on the question of whether reality is fundamentally participatory crystallised round the violation or not of a certain mathematical inequality called the Bell-inequality after its discoverer [41]."

"What do you mean?" asked Jonito, "Was it possible, by testing this Bell-inequality, to determine whether the micro world is participatory or

not?"

"One might put it like that," replied the teacher. "If the Bell-inequality was violated by the experiments, it supplied empirical proof of the participatory nature of the micro-world."

"And what was the result of the experiments?" asked Sonia.

"All the experiments, spread over almost a decade, violated the inequality, as had been predicted by quantum mechanics [46]," replied the teacher. "This result was that much more convincing because it was known that experimental errors would always lead to a smaller violation of the Bell-inequality, which demonstrated that the violation achieved could not be the result of experimental inaccuracy. For the vast majority of theoretical physicists this meant the dice had been cast."

"Was anything also learnt about the nature of the participatory aspect of the quantum world?" asked Jonito.

"Yes, it was," answered the teacher. "While these new experiments gave a definite answer to the philosophical question just mentioned, they also led to a completely new experimental area. At the end of the twentieth century man was capable of carrying out interferometry experiments with atoms. This meant there was no more doubt about the fact that the typical quantum mechanical properties are also present in atoms and molecules and even in larger material structures. The nature of the quantum mechanical situation became increasingly clear. It was during that period that man actually started to understand that two aspects are present in every perception: a process of 'observation', which leads to the discovery of a reality already present, and a process of 'creation', which leads to the construction of a new piece of reality."

"But that seems obvious to me," said Jan, "those two aspects, discovery and creation, are present in everything we do."

"Considered like that, this realisation is not so revolutionary," answered the teacher. "All human interactions with the world are acquainted with these two aspects, discovery and creation. What was spectacular about the quantum mechanic discovery had to do with the fact that 'perception' in itself, even so-called 'photographic' and 'observational' perception, contains a fundamental creative aspect."

"What do you mean by that?" asked Ernest, "give us an example."

The teacher considered for a moment and looked at the setting sun. He continued, "A photon that leaves the sun first travels through a non-spatial reality, then to be dragged into space, as it were, when it is perceived by our eye. While the photon is between the sun and our eye, it is in a non-spatial state, and is nowhere is space. It has only linked a number of spatial regions

to it, into which it can, with a particular degree of probability, be dragged. This phenomenon of 'non- locality' was verified experimentally during the last decades of the twentieth century. And all quantum entities spend a large part of their 'being' in these non-spatial states."

"But what were they able to learn from this about the universal participatory nature of reality?" asked Jonito.

"Well, that step was certainly not an obvious one," answered the teacher. "In fact it is not the case that the fundamentally participatory nature of reality as a whole could be deduced from the findings of quantum mechanics. On the contrary, some thinkers, even including Niels Bohr, dealt too lightly with the subject of the participatory nature of the micro-world. This meant they often achieved the reverse, and in fact only harmed the breakthrough of participatory thinking. In general, these thinkers' arguments and motives were based on vague analogies and it was clear that their intentions were guided by a romantic desire rather than a deep scientific understanding. This movement, sometimes referred to as the New Age, saw to it that participatory thinking was pushed to the fringe for the umpteenth time [47]."

"Would it not be possible to say that those thinkers were in fact aware of the participatory shortcomings of our society and so just sought help in the prestige of physics in order to bring charges against it?" asked Sonia.

"Yes, that's right," replied the teacher, "that seems to me the right analysis of this over enthusiastic and inaccurate use of the findings of quantum mechanics. But the effect achieved was not very positive, since this ill-considered approach gave the opponents of the participatory paradigm the perfect opportunity to make everything look ridiculous [48]."

"So when did the participatory world view have its breakthrough from the scientific area to the other areas of reality?" asked Ernest.

"Well," replied the teacher, "during the twentieth century there was a preparation for the breakthrough of the participatory world view, fuelled from various directions. I am thinking of the evolution, in cybernetics, to what was called second-level cybernetics, in which explicit account was taken of the fact that the builder of a formal model has to be incorporated into the theory [49, 50, 51, 52, 53, 54, 55]. In biology, new theories cleared the way for a participatory view of life. For example, the theories of Humberto Maturana and Francisco Varela on the concept of autopoiesis, in which a fundamental option was taken to consider the interaction of a living being, animal or human, with the outside world as 'observational' and 'creative' at the same time. They pointed out that reality is formed in part during the process of perception [56, 57, 58, 59]. These new insights also made their appearance in twentieth-century sociology [60, 61, 62, 63, 64], and psychology evolved

more and more towards a study in which 'human interaction events' were considered as basic entities [65, 66]."

"So ultimately the discoveries of quantum mechanics did not contribute that much to the change of paradigm," commented Sonia.

"Changes of paradigm always take place in a very complex and uncontrollable way, as a result of the combination of all sorts of forces and trends," replied the teacher, "and the influence of the discoveries made in quantum mechanics should not be underestimated. At a crucial moment in human history, they silenced those thinkers who claimed that the whole of reality could be described within the observational paradigm in a way that presented no problems. This has also made them a constant stimulus in the quests for participatory models in other disciplines. Even so, it was easy to stick to an interpretation in which only the quantum particle itself was considered a very unusual little entity with obviously non-local behaviour, whereas macroscopic matter, while composed of tiny quantum entities, avoided this strange behaviour and could thereby be described in the observational paradigm. The question of whether quantum properties can be transferred to the macroscopic world was a disputed point between scientists until late in the twentieth century."

"And what turned out to be the answer?" asked Jonito.

"Well," replied the teacher, "as often happens, the answer to this question came from an unexpected source. On the basis of a reductionist line of thought, which is in fact by definition deeply rooted in the observational paradigm, some scientists wanted to demonstrate that the discoveries of quantum mechanics had some influence on macroscopic reality, by starting from the basic idea that macroscopic matter is built up of quantum entities. In this way the question was raised whether quantum effects play a part in the material processes in the brain, and various arguments for and against formed the object of discussion [67]. Later however, it turned out that this was only one of the trails connecting the nature of the macro-world with that of the micro-world. A new light was shed on this question from a completely different angle not connected to reductionist thinking. It was discovered that some fundamental mathematical structures used in quantum mechanics, such as the probability model, were found in situations in the macroscopic reality where the interaction between the perceiver and the perceived is fundamental."

"What situations do you mean?" asked Ernest.

"Well," replied the teacher, "at the end of the twentieth century it had already been demonstrated that the probability model that describes the situation in a poll, where questions are asked whose asking may help deter-

mine the opinion of the respondent, is not a classic probability model, but a quantum probability model [68]."

"I see what you mean," said Jonito. "It was an isomorphism at the level of the operational structures, such as the probability model, that demonstrated that the participatory nature of the macro-world was equivalent to that of the micro-world."

"That's right," replied the teacher. "The nature of the interaction between the perceiver and the perceived determines the participatory nature of the situation. If this interaction comes close to pure observation, as is the case when a photo of a macroscopic object is taken, then the observational paradigm more or less holds good. If this interaction is far from being an observation, which is the case when taking a photo of a microscopic object — an example from the micro-world - and when carrying out a poll — an example from the macro-world, then the observational paradigm does not hold good at all. This insight makes it clear that the observational describes a limited situation that is only valid in exceptional circumstances, but that the general situation, both microscopic and macroscopic, is participatory."

"We have always spoken about participatory realisation in the sciences: physics, biology, cybernetics, sociology and psychology," said Jan, "but in the same way, as you told us, that it was not Descartes and Newton's theories themselves that reinforced the observational paradigm in the seventeenth century, nor can it have been these new scientific theories that led the transition to a participatory world view. What else happened?"

"Very well observed," replied the teacher. "Just as Descartes formalised what was evident in his age, one can also say that, in symbiosis with a moment in time that was gradually turning towards the participatory, researchers in the twentieth century received attention mainly for these aspects. The observational paradigm was in fact still a very strong presence, and one can even clearly identify the way it vigorously flared up anew in the second half of the twentieth century. The fashion of the 'sciences of chaos and complexity' dominated the eighties and nineties, and this vision once more tried to put forward the notion that reality is a great machine, that functions undisturbed beyond the reach of the participator. The nuance that was now introduced was that the machine is very complex, so complex that in principle it is impossible to distil a 'workable deterministic model' from it. But according to this theory, everything remained at bottom mechanical and determinist. As if all the lessons learnt from quantum mechanics had been forgotten." [69]

"Even so, the discoveries made by the 'science of chaos and complexity' are still important," said Jan.

"That's true," answered the teacher, "the concrete discoveries of that sort of science are still very important, but now they are set in the framework of the participatory paradigm, and that completely changes their significance. We now know that there were technical reasons why, at the end of the twentieth century, quantum mechanics could not be integrated into studies of complexity. These technical shortcomings in quantum formalism were solved during the closing decade of the century, leaving the way open for a general participatory vision [73]. That was a very fascinating period, which we must talk about in more detail at another time. What I would mainly like to emphasise now, however, and this is also an answer to Jan's question, is the fact that it was a participatory crisis on a world-wide scale that finally set the things in motion that led to the situation we know now."

"What do you mean by a participation crisis on a world-wide scale?" asked Sonia.

The teacher took a deep breath and started on the most exciting part of his story.

4 The Political Participation Crisis

"The two rival political systems of the twentieth century both met their downfall because they were not structured in a participatory way," said the teacher. "Centralised socialism, with its aim of global implementation of a well and honestly organised society for everyone, could not function because it was based entirely on the observational paradigm. In this political philosophy it was thought that it would be possible to organise the world on the basis of knowledge of the world and man. It was forgotten that the participation of man means the world is constantly changing, so that only long-outdated models could be achieved. We now know that the stabilising forces needed for an honest and just world can never be fitted into an observational state structure because the observational forces are only linked to a small part of the movement and the change. Other participatory aspects can only find their stability in ethical, moral and fundamentally relational forces and these cannot be organised in a centralised political way. When institutionalised socialism went under, and the world was awash with the philosophy of the free market and the consequent capitalism, which displayed a greater degree of flexibility when it came to organisation, mankind was faced with a fundamental and very tangible participatory deficit. Unemployment was the 'insoluble' evil of the last decades of the twentieth century. The free market and capitalism just did not succeed in letting everyone par-

ticipate in the world. The failure was that much greater since it was clear that there was no shortage of work. Never before had there been such a need for people who would give their all. But where there was a great need for workers, there was no possibility of letting them work, because there were no funds for that much-needed work." [77]

"A very strange situation," Sonia remarked. "If there was so much work, and if the thinkers of the time understood that, I cannot understand why society did not succeed in seeing to it that the people could do that work. What went wrong, and what hindered that?"

"The situation was so distressing that it is hard for us to understand nowadays. More than three quarters of the world's population lived in miserable conditions: hunger, inadequate hygiene, disease, social disintegration, alienation and marginalisation, and the causes were known. And more especially, there was potentially an enormous number of people who would have liked nothing better to work on the solution to such obvious problems. But this could not be organised within the prevailing political and economic system."

"Surely that was a sign of decadence?" asked Jonito.

"That is sometimes claimed," said the teacher, "but I do not believe that was the cause. The twentieth-century society succeeded without the slightest problem in putting teams of highly-trained engineers to work perfecting usually senseless parts of often senseless electronic apparatus, by which I am not claiming that all engineers were working like that. There was also a large number, at that time too, who occupied themselves with very important and relevant matters. However, the first criterion was not importance and relevance, but the possibility of bringing products onto the market in order to keep the capitalist cycle of buying and selling in motion. During a particular phase of the industrial revolution, the beginning of the twentieth century, this expansion of the market had in fact led to genuine employment and thereby an improvement in the situation of the working population. However it soon became clear that this period was no more than a short transitional one. In the end, the capitalist production system did not need so many people and, since profits were the main aim, tried to manage with ever fewer. That is why, after this initial period of industrialisation, unemployment irrevocably struck. At the end of the twentieth century every developed country was struggling with unemployment of more than fifteen percent. In a country like ours, hundreds of thousands of people in their prime were excluded from 'participating in' the world. And this while there was so much interesting work for them to do in the world. I recently read a detailed report on the research situation at the universities. The researchers had a

tremendous amount of work to put forward, and they did this in the form of projects. In general they submitted projects whereby they requested a sum of money for the equipment costs, another sum for the running costs, and a third sum, always much bigger than the other two, for the employment of young researchers in the project. The report shows clearly how again and again the projects allowed were only granted subsidies for equipment and running costs. There was sufficient work, and the value of the work was acknowledged, but resources were hardly ever found to put young people to work."

"But why did those people keep on tolerating a situation like that, and why was there no revolt?" asked Jan. "A thing like that would no longer be possible nowadays."

"Well once, when unemployment struck for the first time, in nineteen seventy-five, many thinkers predicted that the situation would become untenable if it were not quickly solved. But that turned out not to be the case. Unemployment, and the marginalisation of the unemployed, grew steadily, but instead of rebellious reactions, it was passiveness and a general feeling of impotence that set in, which was reinforced even more by the automatic relief provided for the unemployed by the social security system. At that time there was a underlying anxiety and bitterness prevalent among the population which we can hardly imagine today. One of the causes of this was the way the generations of the time were led into the culture by the school system."

The teacher smiled when he saw the astonished looks on his students' faces. He was pleased to have succeeded in returning to the actual subject of today's meeting by way of the major problems of the twentieth century. He continued his story self-confidently.

"We have until now said little about the implicit influence of an observational school system on the students' world view. As a consequence of this system there arose among the students a great alienation and a dangerous division between explicit and official knowledge and implicit and personal knowledge of the world. And in fact they were repeatedly put in a situation where the knowledge and learning about the world was passed on to them observationally by an authority. They were offered it on a plate as if that official and explicit knowledge would not come bubbling up out of themselves. This meant that it was essentially foreign to them. As well as this, outside the school, in their contacts with the outside world, they underwent a normal process of acquiring knowledge, starting from their own experience and participatory knowledge and learning. But this participatory knowledge

and learning was often contrary to what was shown them at school, because it came into being in a completely different way."

"I can see the problem now," commented Jan. "Since they experienced these two completely different introductions to the world, it seemed as if they had to choose one or the other, and it appeared there was only a choice between the 'official', which was also what society accepted, and which presupposed an acquisition of knowledge and learning that originated from an authority in a purely cognitive way, and the non-official, which was socially subversive and which allowed the acquisition of knowledge and learning out of individual experience."

"A remarkable situation," said Sonia, "it seems like a state of universal schizophrenia."

"So at that time, those who opted for the subversive will have been better off," commented Ernest.

"Yes, but they were probably frustrated because they had failed in the official system," said Jonito.

The teacher was delighted with the dynamism that had arisen among his students, and continued, "The constant experience of the twentieth-century education system brought about a pattern of habit among the people that made it very difficult for them to hold their own against the problems that presented themselves. At school 'one did not participate in very much'. By starting from the observational paradigm and by structuring the transfer of knowledge in schools in accordance with this paradigm, one largely cuts the students off from the possibility of 'participating in ' things."

"In that situation they could certainly only have expected that in the case of big problems like unemployment, a cognitive solution would in one way or another be supplied to them by the government," said Jan.

"But that could not really happen," added Jonito, "because such big problems could not be solved within the 'observational' paradigm."

"I am beginning to understand how important the transition to a participatory educational system was," Sonia remarked. "Not only did it improve the educational system by offering a better method of transferring knowledge, but it created completely new generations of young people who carried within them the essential forces to enable a participatory society to be formed."

"That was indeed the greatest merit of the change in the educational system," agreed the teacher.

"I can now understand our last conversation much better," said Ernest, "when you told us about the necessity of the binding force of 'trust' in the maintenance of the participatory society we now live in. By bringing things

out so that one 'participates in' them, you involve those who participate, with their entire being."

"So was it the power of 'trust' that had become so weak in the twentieth century?" asked Sonia.

"Yes," replied the teacher, "the catastrophic result of the observational paradigm, and its consequence, the conviction that knowledge of the world would make it possible to base a society on immutable outside-in knowledge, elaborated into laws and regulations, was the loss of the binding force of trust. The strangest thing is that the evolution of the loss of trust was not identified as such by twentieth-century thinkers. They referred to a general loss of 'values', but did not see this as a process driven by the observational paradigm, but rather as the effect of a general decadence resulting from prosperity."

"Whereas it is clear, after all, that when all you expect from the people in a society is duties defined within the observational paradigm, in regulations and laws, and that from childhood on, they will never have been able to learn how the dynamics of 'trust' work," said Jan.

"Yes, that's right," said Sonia, "all they will watch for is whether they have fulfilled the objective criteria of the observational model, and imagine that that's the end of it. Whereas the real organisation of a participatory society rests mainly on the dynamics of trust. And it is only the experience of organising concrete projects, as is now happening all the time in our educational system, that can show how incredibly powerful that dynamic is."

"The dynamics of trust was also known beyond the official sphere," the teacher pointed out, "in what one did with one's real friends apart from the explicit circuit, and this meant it was identified rather as subversive, or at least not officially usable. Although the loss of values, including trust, was felt very intensely at the end of the twentieth century, there was, almost as a reaction, one might say, an ever increasing mania for observational control and regulation, and people who protested found themselves in more and more trouble."

"I understand," said Jonito, "people thought they could compensate for the vanishing binding forces, such as the dynamics of trust, by displaying greater efficiency in the purely observational world view."

"Yes, yes, I see what you mean," added Jan. " Let me put it by means of an example. One might think of the relationship of trust between people. If this relationship disappeared it was thought that one could replace it by a highly complex description of the possibilities for relationships between these two people within an observational world view, and one tried to make

explicit the rules and regulations to which they had to keep within this relationship. As if the observational bond could replace all other bonds."

"Now I can see the connection with what you told us about the rise of the fashion for the 'science of chaos and complexity'," remarked Jonito. "There too a new attempt was made to ignore the fundamentally participatory nature of reality, which in fact had already been demonstrated by quantum mechanics, and to veil these effects with the enormous complexity of a non-participatory theory."

"You have all made very good comments," answered the teacher. "If we analyse what happened afterwards, and consider the participatory society we now live in, we are forced to come to the conclusion that, however much this loss of 'values' was observed, the remedies proposed were often still from within the observational paradigm. It was frequently believed that the ethical values that were lost, and whose loss was greatly mourned, could be regained in a purely observational framework of laws and regulations."

"It had not yet been fully understood that the ethical binding forces, necessary to the stability of a participatory society, can only be created and maintained by the force of experience," said Jan.

"It's true that one should allow the children and, later, the young people to 'experience at first hand' how pleasurable and satisfying it is to live in a group where there is trust, honesty, respect, love, affection and tolerance, and how the presence of these binding forces forms absolutely no threat to freedom, but on the contrary, allows much greater freedom," said Sonia.

The teacher is pleased with these insights, which have never been so clear to him either, "It's true that only a true change could turn the tide, by the creation, for the youngest children, of an introduction into our society which was based on experience. That only became possible after the intrinsic participatory nature of reality had fully penetrated into the consciousness of a large number of people."

The group became silent, and Jan, Sonia, Ernest and Jonito looked at the sun, which by now was going down behind the poplars.

5 Research

Jonito asked, "Today's topic of discussion was research and education in the twentieth century. We have now got a fairly detailed picture of how education was organised. To what lines of force was research subject at that time?"

The teacher hesitated for a moment as to how he would commence an

explanation of research, because that was a much more complex matter. Jan stood up, with a questioning look in his eyes.

"Sorry to interrupt, but is anyone thirsty," he said, "I'll just go to the Culture Café with Ernest to fetch something."

"Good idea," said Ernest.

They all nodded in agreement. Jan looked round the circle and took their orders — coffee for Sonia and Ernest, a Coke for Jonito and a beer for Jan and the teacher.

Jan and Ernest went off towards the high poplars. The teacher and his students sat sunk in thought. The sun was still shining between the poplars and cast long shadows of the small group over the grass.

When Jan and Ernest returned the teacher started his explanation of research.

"Research is a highly complex undertaking, whose possibly most intrinsic interaction may occur between 'reality' and 'human action, construction and participation'. It is essentially an adventure and a voyage of discovery, but it is equally a project and creation of new territory [78]. Most fundamental research takes place in universities, and since the subjects studied are divided into specialities at these universities, research is also organised into various disciplines. This fragmentation of disciplines and subjects would not have been a problem if it was a sign of an essential and fruitful specialisation, arising from a core of common problems and methods, so that every specialised research study remained an integral part of the large overall project. But in many cases the opposite was true: the observational paradigm meant that people were not aware what the consequences were of isolating a problem from its context. In this way the sub-disciplines studied were themselves responsible for an almost haphazard growth of methods and areas of interest [79].

"I can understand how fragmentation must have harmed the dynamics of research, when it was not connected to an overall, meaningful project [80, 81]," said Jan. "The original 'experience' was reduced to the role of a small unwitting link in the whole."

"Yes," said Sonia, "something Like Charlie Chaplin's 'Modern Times', but in the science business. Each scientist carries out a small part of an already fragmented piece of research, without ever having the opportunity to survey the whole of the field he is working in."

"That's right," said the teacher, "Chaplin's famous film, showing the worker as a cog in the production process, was, for the beginning of the twentieth century, a visionary work. At a later date, specialisation and division into disciplines brought about a more fundamental sort of 'Mod-

ern Times'. It was only at the end of the twentieth century that attempts at cross-disciplinary research were given solid foundations. That most certainly also had to do with the moment of change towards a participatory society. Even so, research had to some extent been able to avoid too direct an influence from the observational paradigm until well into the twentieth century, although it was fundamentally linked to the major trends in society. The reason was that it took place mainly at the universities, and they had remained highly independent institutions, ivory towers, screened from certain directive influences from outside. They were still operating according to principles that were actually medieval, and in that way they understood the observational paradigm in a very special way. On the one hand they were the greatest victims of this, something that could be seen in the 'scientifically-based' prejudices regarding certain new insights, and on the other they also partially avoided it, unconsciously, since the academic freedom of the professors was given high priority, which meant that individual professors could nevertheless take account of a wide range of both participatory and observational forces in connection with their actions and decisions."

"Was education at the universities carried out in a different way, then?" asked Jonito.

"Not really, but in part, yes," answered the teacher. "Education there was largely ex cathedra, in the form of the same ritual as in schools, with the professor at the front, passing on his knowledge of the world to his students. But there were a few aspects that fundamentally changed the situation. For example, the students were not obliged to attend the lessons, and it was not unusual for a professor to meet certain students for the first time at the exams. This meant university education was more a sort of project in which the students were able to participate, in exchange for recognition or, at a later date, a degree. But to a great extent they were able to decide for themselves how they would participate."

"That meant that university education was indeed more participatory," remarked Jan, "although the form of participation was very much defined by the observational paradigm."

"Yes, but professors often broke with this form on their own initiative," answered the teacher, "by attaching most importance to the student's initiative and own work, for example. The tradition of the oral exam also allowed the whole system to escape to some extent from the observational paradigm. After all, in the best of circumstances this exam was a conversation with the professor, who then made a decision on the ripeness of the student in question, taking into account an extremely wide range of evaluation criteria

which he was able to determine himself. Oddly enough, these aspects of university education, which made it superior to non-university education, were broken off in the middle of the twentieth century. This was caused partly by an increase in the number of students, so that the oral exam had become purely a test of part of the syllabus offered. But this loss was mainly a consequence of the increasing demand for 'objectivity' within the observational paradigm, which was very much on the rise in the mid-twentieth century. That was the same evolution as we had already identified before - the attempt to back up all relationships, including that of professor and student, by an explicit observational description, in order then to take this description as the basis for the evaluation of the student."

"So did the university world come from the Middle Ages and fall totally, unexpectedly and abruptly into the clutches of the observational paradigm?" asked Sonia.

"You could put it like that," answered the teacher, "the consequences of this abrupt transition were actually even more disadvantageous for research. Whereas previously researchers at the universities had been fairly unimpeded and free in determining the object of their research, in the second half of the twentieth century they were seized by a veritable flood of observational control and regulation. Researchers were asked to stipulate as clearly as possible what research they would be carrying out and how, and that usually four or five years in advance."

"That seems like a real contradiction," said Jan, "how can one describe in advance what one is going to find. If that were the case no more research would be needed."

"Yes, creativity was replaced by innovation," replied the teacher, "and in that situation the observational paradigm struck in a way that backfired on it. It assumed not only that the world could be known without taking the knower into account, but also that the research process, the essential and intrinsic participation of the researcher, could be known and described as part of the project before the research itself had taken place. Genuine researchers were faced with an impossible and highly contradictory task. And it was compulsory, since the projects were actually selected by the quality of the description of the research process. It is now hard to believe that things could ever have gone so far."

"It is truly incredible," said Jonito. "If one considers the history of research it is surely clear that not one of the great researchers would have been able to describe the research process before he had made his discovery."

"Isaac Newton would not have found it easy to mould the discovery of classical mechanics into any such project plan," said Sonia.

"And how would James Clerk Maxwell have managed to describe the process of constructing the laws of electromagnetics before they were complete?" added Jonito.

"It's certain that no one would have discovered quantum mechanics," Jan threw in, "since Louis de Broglie would not have been able to explain anything except that he was driven by a strange intuition that made him want to try out the wave behaviour of subatomic particles, without having the slightest idea of what would emerge from it."

"The same applies to Erwin Schrödinger," said Jonito. "Searching for a comparison in movement, playing along on De Broglie's intuition, and trying out anything he could, almost at random, guided only by a vaguely outlined mathematical intuition."

"And it was even more so in the case of Werner Heisenberg," said Jan, "when he tried to frame the chaos of spectral data in a consistent whole, thereby introducing non-commutative calculus into physics, without himself being anywhere near conscious of it, which was, rather by chance, later identified by his friend Max Born as matrix calculus, and which formed the basis of modern quantum mechanics."

"Or how would the poor Sigmund Freud and Charles Darwin have got funding for their research?" asked Sonia.

The teacher was completely overwhelmed by the indignant examples being rattled off, "You are right," he said, "we can now hardly believe how those poor researchers were pestered in the second half of the twentieth century. But that's how it was. And it was not actually limited to this demand for an observational description of the research process. The increase in the demand for observational objectification resulted in frequent evaluations of the researchers themselves. They had to submit a detailed file on the research they had carried out and the research they planned for the future, to a committee of scientists who then tried to determine whether the research was worthwhile, purely on the basis of quantitative observational data. The result of this was that brilliant researchers sometimes lost a great deal of time occupying themselves with files and project descriptions."

"But that must also have had consequences for the nature of the research itself," said Jonito.

"That will certainly have been the case," said Sonia. "Research in which one could more or less describe the process probably had a greater chance of being subsidised. The result of that line was probably that research became increasingly 'applied' and short-term."

"That was in fact the case," said the teacher. "Excellent researchers frequently went around with extremely important projects in their heads,

often concerning stable long-term solutions to major problems, which they knew very well would never be financed."

"So that was a second, more fundamental way the observational paradigm made its own impotence clear," commented Ernest. "The major problems were known, but could not be worked on."

"In terms of content, that was indeed one of the most dramatic consequences," replied the teacher. "The only minor remedy to this pernicious line of force came from the skill of certain researchers who succeeded in working on long-term projects by way of short-term proposals. But that demanded a great deal of energy and only a limited number of researchers succeeded in it."

"I suspect that the policy-making bodies that applied these guidelines were not aware of the fact that they were in fact acting within the observational paradigm," said Jan. "What was their official motivation for this pressure and demand for observational objectification?"

"They didn't know," answered the teacher. "It must be said that they imposed these evaluations with the best intentions. There was a scarcity of funds, which had to be distributed among the researchers, and the intention was to make this distribution as honest and fair as possible. The conviction was that the only way of achieving this was to subject the researchers and their projects to an observational evaluation, as objective as possible, which is where the observational paradigm struck home."

"But if funds were scarce," said Sonia, "surely they should somehow have introduced criteria by which means they could be distributed?"

The teacher looked at his students questioningly.

"Why are research funds not scarce for us, nowadays?" he asked rhetorically.

"Yes, of course," said Sonia, "the scarcity of funds was naturally one of the first consequences of the observational paradigm. Researchers in the twentieth century participated in a piece of the world for which the then prevailing political and economic system had no normal reward at hand."

"I suspect that the scarcity of funds for research was only a minor aspect of the large participatory aspect you were just talking about," said Ernest.

"That's right," said the teacher, "scarcity of funds and unemployment were two sides of the same problem. Although society was caught irrevocably in the trap of the observational paradigm, twentieth-century people were still living, feeling people. They knew very well in their hearts what was important. They wanted to work on a better and more just world. They wanted to 'participate in' the world. That was also the reason why there was so much willingness to work in those areas of reality where it was possible

to work in such a way, such as health care, poverty issues, social exclusion, ecology, tolerance or, in short, human well-being in general. But it was precisely this enormous supply of work that could not be integrated into the society of the day. The lack of resources for the organisation of this enormous quantity of work was called a 'scarcity of resources'. There was essentially no scarcity of resources at all, there was only the impossibility of deploying the resources in the places where people so much wanted to work, based on their sense of general values, which they had not yet lost. Research was one of those areas. Even at that time in the twentieth century, many people were convinced that it was a very important and essential human activity, directly linked to man's chances of survival as an entity in reality, but even so, researchers always had to acquire those so essential funds from a kitty that was far too small. This problem was completely impossible to solve within the capitalist system, since only the actions of people oriented towards the manufacture of saleable products were raised out of this domain of scarcity and unemployment."

"Oh yes, I see," said Jan, "the scarcity and unemployment were symptoms of the same participatory deficit you were talking about."

"And these could be removed at the same time by making the transition to a participatory society," added Sonia.

"A society towards which we are now increasingly evolving and in which everyone, on the basis of their individuality, will from childhood be voluntarily involved in the project of the world," continued Jan.

"Well, we should not be too optimistic about our present society," warned the teacher. "A lot of things go wrong here too, and that will always remain so. But we can in any case say that people today have been able to discover at first hand how satisfying it is to be fundamentally involved from the very beginning with the ins and outs of the world, in all its beauty and drama, and also to bear the responsibility for it. We have fortunately also understood that this situation of fundamental participation and involvement cannot be maintained by an observational paradigm, but can only be nurtured through our children's fresh and free experience."

"And how did this change come about?" asked Jonito.

6 The New Educational Methods

"It was not an abrupt and revolutionary occurrence, but small-scale, dogged work in the shadows." answered the teacher. "There are so many small steps and aspects that it's hardly possible to identify them all, even now in

hindsight."

"Can't you give us a few examples?" asked Ernest.

"Well," continued the teacher, "I find one of the most striking aspects to be the quiet revolution in primary education. At the end of the twentieth century there arose throughout the western world small-scale attempts to change that part of the educational system. This new sort of education was called 'method education'. A totally new form was installed in this sector of education, instead of the old ritual, which was entirely a reflection of the observational paradigm. Pupils from three to twelve years were divided into three groups called 'social groups'. The first social group contained the infants, the second the pupils of the former first, second and third years, and the third the pupils from the fourth, fifth and sixth years. Each social group was supervised by two teachers. In these social groups, knowledge and skills regarding the world were no longer passed on to the pupils from the point of view of the observational world view. The pupils worked on concrete projects co-ordinated by the teachers, so that they were able to master knowledge and skills regarding the world step by step, on the basis of their own experience [82, 83, 84, 85, 86]."

"Yes, that was a step in the right direction," said Sonia. "Though it is extremely surprising that this change started in primary education."

"That was because this new form of education was driven mainly by discontent with the traditional educational system," answered the teacher. "Among a small but enterprising group of teachers there prevailed a great indignation about the way children became victims in traditional education."

"And without its being generally realised," said Jonito, "this new form of education brought about a much greater change than first imagined because it broke fundamentally with the observational paradigm."

"It meant that from a very early age, children were able to experience how pleasant it is to work in a group on a common project, and how in theory everyone was able to acquire a natural place within such a project," continued Jan.

"And in that way it solved the problem of unemployment and scarcity in the schools," continued the teacher.

"What do you mean by that?" asked Jonito.

"Well," replied the teacher, "the way we analysed the problem of unemployment and scarcity in our previous reflections allows us to easily identify these faults in the traditional observational education system too. Those who, for whatever reason, were not able to grasp what was offered within the observational paradigm were unemployed and sat wasting their time at their desks. And for this same group the traditional system suffered from a

fundamental, insoluble scarcity."

"I see what you mean now," said Jonito, "and this unemployment and scarcity were eradicated by the new educational system, because there everyone was able to find their place in every project."

"There remained of course the general problem of finding the resources for every individual project itself," continued the teacher, "as will always be the case, even in a society organised along participatory lines. But this lack of resources only led to the limitation of certain aspects of the project itself, and never to the exclusion of a particular group of workers. Finding and creating these resources was in fact an essential part of the project itself, as is the case now too, in our participatory society."

"When were these new schools opened?" asked Sonia.

"Small schools which partly used this method were already opening by the end of the nineteenth century, but they remained on the fringes and were often stuck fast in an over-rigid blind application of the teachings of their founders. The first school with social groups within the official Flemish community educational system opened in Koningshooikt, a borough of Lier, in 1992 and three years later there were already eleven all over Flanders. The parents sensed that this initiative was a major change of direction, and there were immediately waiting lists for all such schools, which thereby heralded the initiative for yet another school. Even so, the initiative stayed in the shadows for a very long time, and in that way grew up out of a genuine need."

"Excellent!" said Jan, "so people had clearly not yet lost their feeling and sympathy for the world."

"Did this have any consequences for the rest of education?" asked Sonia.

"The real breakthrough only came when a few people began to understand that an even more far-reaching synthesis was needed," answered the teacher. "There was another remarkable consequence of the observational paradigm in the traditional education of the time. The teachers in the primary schools, for children up to 12, had studied to be 'schoolmaster' or 'schoolmistress'. The teachers in the secondary schools, for children up to 18 years, had bachelor degrees from the universities. In the universities the teachers were professors who had to have a doctorate and had therefore also carried out specific research. This situation was very strange when we think about it now. Let's just consider another area of human action, medicine. Regardless of the speciality they were to practise later, all doctors had completed a university course. It would have been very strange, even in the twentieth century, if one were to propose that doctors specialising in paediatrics needed a less intense training because they 'only' occupied themselves

with children. But no, on the contrary, paediatricians first had to become doctors and then, rightly, specialise in paediatrics. It was already clear at that time that paediatrics was no less complex than adult medicine. In education, apparently, this was not how they thought. The highest training was required for those who had to pass on the most difficult subject matter within the observational ritual, and that was at university."

"Yes, I see what you mean," said Sonia. "Since the observational content of the material that had to be taught to children was classified as being simpler, because they assumed it consisted simply of packages of knowledge that had to be passed on from one mind to another, they thought it demanded less intense training. That was not the case for doctors, because their relationship with a patient was at that time already fundamentally participatory."

"Yes, that's it," replied the teacher. "Doctors had a clearly participatory role with regard to the patient. However, the participatory contribution of the patients themselves, within the patient-doctor interaction, was fundamentally affected by the observational paradigm, but that is another story. I only wanted to use the example of the doctor to demonstrate that in that case a participatory structure was acknowledged, at least on one side."

"So one should be able to say that the supervision of children's important experiences of the world is by no means simpler than the supervision of university students," said Jonito.

"Absolutely," agreed the teacher, "the projects that took place with the children in the social-group schools required a much greater expertise in experience and knowledge than projects done with adults. It all seems so clear now, and in our present system no difference is made anymore. We all know that our teachers at every level remain fundamentally involved in research. And in fact that insight, and the evolution that led to teachers always being given the same training and always remaining fundamentally committed to research, wherever they are teaching, also made a great contribution to the solution of the problem of unemployment and the eradication of the scarcity that had formerly prevailed in research."

"I see," said Ernest, "The fact that every school was linked to research released a great many potential researchers."

"And in that way the researcher was also finally liberated from his ivory tower," said Sonia, "and with both his feet on the ground, in every area of society, he was able to buoy up his research much more by means of the genuine problems of that society."

"That was one of the consequences," replies the teacher, "while on the other hand, in that way the children came into contact with the peripheral

areas of reality, where many researchers work, at a very early age. Here were the mysteries of the world, the unmarked area of the garden of Academe, which as feeling children they were able to 'participate in'."

The sun had now set and the cool of the evening was gradually making the grass damp. The conversation rippled on through the silence of the garden of Academe and turned down one of the many paths. In the background one could hear the hum of voices outside the Culture Café. The squirrel ran up to the crown of the great plane tree with its morsel of bread.

References

[1] Ovide Decroly (1871 - 1932), was one of the most important innovators in Belgium. We refer to [2, 3, 4] for an explanation of his ideas.

[2] **Decroly, O.**, *L'initiation de l'activité intellectuelle et motrice par les jeux éducatifs*, Delachaux et Niestle, Neufchatel, 1914.

[3] **Decroly, O. and Frickx J.**, *Documents pédotechniques*, Lamertin, Brussels, 1926.

[4] **Segers, J.E.**, *La psychologie de l'enfant normal et anormal d'apres le Dr. O. Decroly*, Stoops, Brussels, 1948.

[5] John Dewey (1859-1917) was one of the innovators in the United States. We refer to [6, 7, 8] for an explanation of his ideas.

[6] **Dewey J.**, *Schools of Tomorrow*, Dutton, New York, 1915.

[7] **Dewey J.**, *The Child and the Curriculum and The School and Society*, University of Chicago Press, Chicago, 1956.

[8] **Dewey, J.**, *Experience and Education*, Collier Macmillan, London, 1967.

[9] Maria Montessori (1870-1952) was an important innovator in Italy and the Netherlands. See [10, 11] for an explanation of her ideas and work.

[10] **Montessori, M.**, *Education for a New World*, Clio, Oxford, 1989.

[11] **Montessori, M.**, *To Educate the Human Potential*, Clio, Oxford, 1989.

[12] Celestin Freinet (1896-1966) was one of the innovators in France. We refer to [13, 14] for an explanation of his ideas.

[13] **Freinet, C.**, *Oeuvres pédagogiques*, Seuil, Paris, 1994.

[14] **Freinet, C.**, *Pour l'école du peuple: guide pratique pour l'organisation materielle, technique et pédagogique*, Maspero, Paris, 1974.

[15] **Guisen, A.**, *Le plan de Dalton pour l'individualization de l'enseignement*, Office de publicité, Brussels, 1930.

[16] **Ahlers, J., Buurslink. R. and Dallinga, J.**, *Wat is dat voor een school?*, Van Loghum Slaterus, Deventer, 1982.

[17] **Aerts, D.**, "Construction of reality and its influence on the understanding of quantum structures", *International Journal of Theoretical Physics*, vol. 31, No 10, 1992, 1815-1837.

[18] **Toulmin, S.**, *Cosmopolis; the hidden agenda of modernity*, The Free Press, New York, 1990.

[19] **Descartes, R.**, *Discours de la méthode*, Garnier-Flammarion, Paris, 1966.

[20] **Descartes, R.**, *Principes*, Vrin, Paris, 1964.

[21] **Descartes, R.**, *Oeuvres, (1618-1637), (1638-1642)*, Garnier, Paris, 1967.

[22] *Le doute méthodique*

[23] **Newton, I.**, *Principia, vol.I: the motion of bodies, vol II: the system of the world*, University of California Press, Berkeley, Los Angeles, London, 1934.

[24] *The 'Sensorium Commune'*

[25] **Brunner, H.**, *Altagyptische Erziehung*, Harrassowitz, Wiesbaden, 1991.

[26] *Artes liberales*

[27] **Brubacher, J.S.**, *A history of the problems of education*, McGraw-Hill, London, 1969.

[28] **Brubacher, J.S.**, *On the philosophy of higher education*, Jossey-Bass, San Francisco, 1982.

[29] Here are a few references in which this aspect of quantum mechanics is explained [31, 32, 33, 34, 35, 36, 37].

[30] **Heisenberg, W.**, "Uber den anschaulichen Inhalt der quantentheoretischen Kinematik und Mechanik", *Zeitschrift für Physik*, 43, 1927, 172.

[31] **Bohr, N.**, "The quantum postulate and the recent development of atomic theory", *Nature*, 121, 1928, 580.

[32] **Schrödinger, E.**, "Die gegenwertige Situation in der Quantenmechanik", *Naturwissenschaften*, 23, 1935, 807; 823; 844.

[33] **d'Espagnat, B.**, *A la recherche du reel: Le regard d'un physicien*, Gauthier-Villars, Paris, 1979.

[34] **Bohm, D.**, *Unfolding meaning: a weekend of dialogue wih David Bohm*, Mickleton, Foundation House, 1985.

[35] **Aerts, D.**, *De muze van het leven: Quantummechanica en de aard van de werkelijkheid*, Pelckmans-AgoraKok, 1993.

[36] This conflict is often linked to the renowned decades-long debate between Albert Einstein, who wished to exhaust all the possibilities of an observational interpretation of quantum mechanics, and Niels Bohr, who was from the start a supporter of a participatory interpretation [37, 38, 39, 40].

[37] **Einstein, Podolsky and Rosen**, "Can quantum-mechanical description of physical reality be considered complete?", *Physical Review*, 47, 1935, 777.

[38] **Bohr, N.**, "Can quantum-mechanical description of physical reality be considered complete?", *Physical review*, 48, 1935, 696.

[39] **Bohr, N.**, "Discussion with Einstein on epistemological problems in atomic physics", in: **Schilpp, P.A.** (ed.), *Albert Einstein: Philosopher-Scientist*, The Library of Living Philosophers, Evanston, 1949.

[40] **Aerts, D.**, "The construction of reality and its influence on the understanding of quantum structures", *Int. J. Theor. Phys.*, 31, 1992, 1915.

[41] Here are a few references in connection with the issue of the Bell Inequality [42, 43, 44, 45].

[42] **Bell, J.S.**, *Physics*, 1, 1965, 195; *Epistemological Letters*, 7, 1975, 14.1; *Epistemological Letters*, 9, 1976, 17.0.

[43] **Lahti, P., and Mittelstaedt, P.** (eds.), *Symposium on the Foundations of Modern Physics: 50 years of the Einstein-Podolsky-Rosen Gedanken-experiment*, World Scientific, Singapore, 1985.

[44] **Aerts, D.**, "The physical origin of the Einstein Podolsky Rosen paradox", in: **Tarozzi, G. and van der Merwe, A.** (eds.), *Open Questions in Quantum Physics*, D. Reidel Publishing Company, 33, 1985.

[45] **Aerts, D.**, "The physical origin of the EPR paradox and how to violate Bell inequalities by macroscopical systems", in: **Lathi, P. and Mittelstaedt, p.** (eds.), *On the Foundations of modern Physics*, World Scientific, Singapore, 305, 1985.

[46] **Aspect, A. et al.**, *Physical Review Letters*, 47, 1981, 460; *Physical Review Letters*, 49, 1982, 91; *Physical Review Letters*, 49, 1982, 180.

[47] Niels Bohr tried to apply the idea of 'complementarity', which even in quantum mechanics assumed a rather vague and ill-defined position, to other areas of reality (see, for example, **Bohr, N.**, *Nature*, 131, 1932, 421, 457; *Erkenntniss*, 6, 1937, 293; *Dialectica*, 2, 1948.). After the sixties there

arose all manner of attempts to connect quantum mechanics to anything and everything, from eastern religion (**Capra, F.**, *The Tao of Physics*, Shambala, Berkeley, 1975) to playing golf (**Enhager, K.**, *Quantum golf: the path to golf mastery*, Warner Books, New York, 1991).

[48] A good example of this is the statement made by Stephen Hawking, a notorious opponent of the participatory lessons of quantum mechanics, "When I hear one of my colleagues use the word 'measurement', I draw my revolver and shoot." In this way Hawking expresses the feeling of a number of physicists who were thoroughly fed up with always having to take account of the effect of the observer in practising their profession.

[49] **Von Foerster, H.** (ed.), *Principles of self-organization, transactions of the University of Illinois, Symposium on SelfOrganization*, Pergamon Press, London, 1962.

[50] **Von Foerster, H.** (ed.), *Purposive systems, proceedings of the First Annual Symposium of the American Society for Cybernetics*, Spartan, New York, 1968.

[51] **Von Foerster, H.**, *Observing systems, Intersystems Publications*, Seaside, California, 1984.

[52] **Von Glasersfeld, E.**, "An Introduction to Radical Constructivism", in: **Watzlawick, P.** (ed.), *The Invented Reality*, Norton, New York, 1984.

[53] **Von Glasersfeld, E.**, "An Introduction to Radical Constructivism", in: **Watzlawick, P.** (ed.), *The Invented Reality*, Norton, New York, 1984.

[54] **Heylighen F., Rosseel, E. and Demeyere, F.** (eds.), *Self-Steering and Cognition in Complex Systems: Toward a New Cybernetics*, Gordon and Breach Science Publishers, New York, 1990.

[55] **Heylighen F.**, "Selection Criteria for the Evolution of Knowledge", in: *Proceedings of the 13th International Congress on Cybernetics* (Association Internationale de Cybernétique), Namur, 1993.

[56] **Varela, F.J. and Maturana H.R.**, *Autopoiesis and cognition: the realization of the living*, Reidel, Dordrecht, 1980.

[57] **Varela, F.J.**, *Principles of biological autonomy*, North Holland, New York, 1979.

[58] **Bateson, G.**, *Mind and Nature: a necessary unity*, Wildwood House, London, 1979.

[59] **Bateson, G.**, *Steps to an ecology of mind: collected essays in anthropology, psychiatry, evolution, and epistemology*, Aronson, Northvale, New Jersey, 1987.

[60] **Luhmann, N.**, *Politische Planung*, Westdeutcher Verlag, GmbH, Opladen, 1971.

[61] **Habermas, J.**, *Communication and evolution of society*, Beacon, Boston, 1979.

[62] **Habermas, J. and Luhmann, N.**, *Theorie der Gesellschaft oder Sozialtechnologie*, Suhrkamp Verlag, Frankfurt am Main, 1971.

[63] **Giddens, A.**, *The constitution of society*, Policy Press, Cambridge, 1984.

[64] **Achterhuis, H.**, *Het rijk van de schaarste: van Thomas Hobbes tot Michel Foucault*, Ambo, Baarn, 1988.

[65] **Von Cranach, M. and Harré, R.**, *The analysis of action: recent theoretical and empirical advances*, Cambridge University Press, Cambridge, 1982.

[66] **Van Langenhove, L.**, "The theoretical foundations of experimental psychology and its alternatives", in: **Smith, J., Harré, G. and Van Langenhove, L.** (eds.), *Rethinking Psychology*, London, Sage, 1995.

[67] In: *The Emperor's New Mind*, Oxford University Press, 1989, Roger Penrose argues in favour of this hypothesis, and Freeman Dyson in *Een schitterend ongeluk*, Contact, Amsterdam, 1993, expresses his belief in the presence of such effects. William Calvin in *The Cerebral Symphony. Seashore Reflections on the Structure of Consciousness*, New York, Bantam, 1989 and Daniel Denett in *Consciousness Explained*, Little, Brown, Boston, 1991, claim that quantum mechanics has absolutely nothing to do with the brain's processes.

[68] **Aerts, D. and Aerts, S.**, "Applications of quantum statistics in psychological studies of decision processes", *Foundations of Science*, 1, 1994, 65, and in

[69] The struggle between the two paradigms can be clearly identified in the attempt to provide an overview of the new physics, with quantum mechanics alongside the new science of chaos and complexity, with an admitted weakness for unification (see [70, 71, 72]). It must be remarked that many of the participants in the movement surrounding the sciences of chaos and complexity were completely convinced of the fundamental participatory nature of reality, and even explicitly promoted this in the models they designed: Stuart Kauffman in *The Origins of Order: self-organization and selection in evolution*, Oxford University Press, Oxford, 1993, and John Holland in "Echoing Emergence: objectives, rough definitions and speculations

for Echo-class models", in: **Cowan, G., Pines, D. and Melzner, D.** (eds.), *Integrative Themes*, Addison-Wesley, Reading, MA, 1994).

[70] **Davies, P.** (ed.), *The New Physics*, Cambridge University Press, 1992.

[71] **Hao Bai-Lin** (ed.), *Chaos*, World Scientific, Singapore, 1984.

[72] **Cvitanovic, P.**, (ed.), *Universality in Chaos*, Adam Hilger, Bristol, 1984.

[73] One finds a very general start to the new quantum formalism in [74], and a more physical formulation of it in [75, 76, 77].

[74] **Randall, C.H. and Foulis, D.G.**, "The operational approach to quantum mechanics", in: **Hooker, C.A.** (ed.), *Physical theories as logico-operational structures*, Reidel, 1979.

[75] **Piron, C.**, *Foundations of Quantum Physics*, W.A. Benjamin Inc., London, Amsterdam, 1976.

[76] **Aerts, D.**, *Foundations of Physics*, 12, 1982, 1131; *Foundations of Physics*, 24, 1992, 1227.

[77] **Aerts, D.**, *De muze van het leven: quantummechanica en de aard van de werkelijkheid*, Pelckmans, Agora-Kok, 1992.

[78] **Latour, B.**, *Wetenschap in actie*, Bert Bakker, Amsterdam, 1988 (original title: Science in Action).

[79] Academie der Wissenschaften zu Berlin; Forschungsbericht 3, Einheit, Interdisciplinariteit, Complementariteit, 1991, Forschungbericht 4, Einheit der Wisseschaften, 1991.

[80] **Aerts, D., Apostel, L., De Moor, B., Hellemans, S., Maex, E., Van Belle, H., Van der Veken, J.**, *Worldviews: from fragmentation to integration*, VUBPress, Brussels, 1993.

[81] **Aerts, D., Apostel, L., De Moor, B., Hellemans, S., Maex, E., Van Belle, H., Van der Veken, J.**, *Perspectives on the World*, VUBPress, Brussels, 1995.

[82] *Medar, C.*, *Een school om te leven, een leefschool*, die Keure, Brugge, 1990.

[83] **Mutsaert, C.**, *De Jena-planschool van Peter Petersen*, Bijlefeld, Utrecht, 1972.

[84] **Rogers, C.**, *Client als middelpunt*, Lemniscaat, Rotterdam, 1975.

[85] **Maslow, A.H.**, *Ontplooing, menselijke mogelijkheden*, Lemniscaat, Rotterdam, 1971.

[86] **Vossen, A.J.M.**, *Zichzelf worden in menselijke relaties*, De Toorts, Haarlem, 1970.