John-Tagore Tevet

The story of S.E.R.R.

S.E.R.R. is the abridgement of an Estonian research group (Struktuurisemiootika Edendamise ja Rakenduse Rühm) of structure's semiotics that deal with semiotic modelling of the graphs. Here provides an overview about the antecedent activities, instituting and activities of SERR from 1999 to 2012.

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Preface

The roots of activities of research group SERR to comes to in the eighties of the last century, when were actual the problems of *systemic approach* and in this area was published a lot of explicit writings. At the time, was interested in the cognitive aspect of systemic approach, where it was argued that the qualitative specificity of a system is reflected by its *structure*, which is presented in the form of a *graph.* As well the system, structure and graph consist of elements and their relationships. Traditionally, the structure is defined as "an *organizing form* of the system's elements, revealed as the relationships between elements". From system theorist comes also the assertion, that *structure is an abstraction of the system*, its "skeleton", where its elements and relationships are lose their empirical properties but retain their qualitative distinctness in the form of different *positions* in the structure.

These findings prompt to study the newly published monograph of graph theorist Frank Harary, where for me a special interest had the diagrams of graphs with six vertices. Stood out they insufficiently systematized presentation. With help of some valence-vectors succeed to arrange these in somewhat. Had to begin to look for the *specific attributes* of the structure, and on they basis the possibilities for *description* of the structure. This led to the idea of using elements of *semiotics*.

In the course of time become evident that: a) *Isomorphic graphs*, and only they, *have the same structure.* b) From system theorists asserted *position* correspond to concept of *orbit* knowing in graph theory. c) The position or orbit constitute an *equivalence class* of nodes or/and node pairs (i. e. edges and "non-edges"). d) The structure of the graph can be *ascertained by deep identification* of node pairs and represented in the form of a *model.*

For ascertaining the structure were used some *invariant attributes* or *signs.* Sign system and its control is semiotics. Manipulation with structural signs was named *structure semiotics.* It is, of course, a synthesized expression. Here we must say that by some of the authoritative reference books is semiotics a *medical* term, by others a term of *computer science*, and by thirds a *privacy phenomenon*.

Ascertaining of the graph structure includes ascertaining of the *positions (orbits)* and other structural features. It began to emerge the problems of interrelations between structural features, of structural changes and of graph systems.

Since this was an unusual approach graphs had in years 1973 to 1990 to participate in various conferences and workshops. It was possible to listen to others and to submit their ideas. It turned out that for many professionals was strange use of the elements of semiotics in graph theory, and it remained unclear to them. And also be able to contact with known theorists and continue contacts with the Kiev Institute of Cybernetics, Belarusian University and others. But contact with the semioticians almost did not happen, they do not feel the slightest interest in graphs. However, this does not prevent me from moving on, and the first version of this subject was written in 1990. Something of this topic could be used, due to the specifics of my then place of work, in environmental research.

Since this was an unusual approach graphs, I had to in the years 1973 to 1990 to participate in various conferences and workshops (workshops). It was possible to listen to others and to submit **of one's own** ideas. It turned out that for many professionals was strange use of the elements of semiotics in graph theory, and it remained unclear to them. And also be able to contact with known theorists and continue contacts with the Kiev Institute of Cybernetics, Belarusian University and others. But contact with the semioticians almost did not happen, they do not feel the slightest interest in graphs. However, this does not prevent me from moving on, and the first version of this subject was written in 1990. Something of this topic could be used, due to the specifics of my then place of work, in environmental research.

Excitements arises with the visit of *grand old man, distinguished professor* Frank Harary, who had invites to Estonia by undertaking of that time Botanical Garden of Estonian Science Academy in year 1989. His first lecture takes place in Botanical Garden for representative of schools from Odessa/Kishinew, Minsk, Kaunas, Riga and Tartu.

Essential was The First Estonian Conference on Graphs and Applications, dedicated to 70th birthday of Frank Harary, were organized by Tartu University in 1991. The participants were from many countries. Had been published a collection of theses. The third and last lecture tour of F. Harary takes place still by undertaking of Botanical Garden in year 1993.

Since 1993, as a self-styled freelance structure semiotician I was able to commit to more to this topic. At the time, the nearest cooperation partner was PhD student at TUT Praust Valdo, who first realized a computer algorithm for structure recognition, which is used even today.

Since the owning a structure (i. e., presentable in the form of a graph) are all the *association's types objects,* then is structure an *interdisciplinary* subject. Structural analysis was carried out to investigate biological, ecological, as well as artwork objects. By the spring of in the 1999th was such a "structurological" material accumulated enough, but there was only one to publish a small book and several articles. Arose (there) the need to discuss problems of the structure as an interdisciplinary subject in a broader range of workshops

Of these workshops aimed to organize, describe (formulate), to formalize and to solve problems related to structural balance. Interdisciplinarity of structural problems are also characterized by initiative group of workshops composed of *informatician* Leo Võhandu, *ecologist* Jüri Martin, a *mathematician* Ants Tauts, a *self-proclaimed structure semiotician* Johntagore Tevet and *textile artist* Helen Kauksi. The first, a comprehensive workshop takes place in the auditorium of Eurouniversity in April on the 1999th. Some of the first workshops were dedicated to the *artwork analysis*, as composed association Also the first publication contains upon the initial principles the working hypotheses and examples of structural analyses of artworks. Its own understanding in this matter have presented by art professionals Tõnis Vint and others. Well it was changing the with *interstandings principle* of Leo Võhandu.

In spring of 1999th arise the idea officially to establish our structure-studying activity. Became draw up the Statue of SERR, and the protocol was signed. SERR was entered in the register in August 1999. Were also strived for SERR funding of projects, but it was not successful.

In August of 2000th, initiated from Leo Võhandu, was the topic of artwork analysis presented to workshop of creative media in the Swedish Royal Institute of Technology. Since the "perception" of structure is a very important problem, we had to organize a corresponding workshop. From the report of Talis Bachmann was hatched out that between sight sense and structurality is not something in common – all comes down to *evergreen isomorphism problem.* The same structure can have a different shape. It turned out that the isomorphism's perception on the view-point of sign's sense is not at all investigated. It is obvious that the artwork is perceived on the ground of shapes localization, not the structure.

An interesting event can be regards a workshop where Ants Tauts found one of mismatch in edge variant of Ulam Conjecture. Lots of excitement was raised in a workshop on the concept of structure. It turned out that the present day do not agreed in the commonly acceptable definition of the structure. In the years 2001 and 2002, by initiative of researchers Einar Aavik et al the (University of Helsinki) take place a few workshops on topics of *analysis of biological objects.*

The main attention of the workshops was focused after all to the *structurality of the graphs.* Were realized the workshops and published the corresponding problems, in which also dealt with the issues of structure, symmetry, heuristics and semiotics. SERR was invited to the 2003rd in Sao Paulo, and Odessa to graph theoretical conferences (to the first do not arrived). The last workshops of these years

were dedicated to the *heuristic algorithms of structural processing* of the graphs. In parallel takes place the publications of these materials.

In September of 2006 takes place on the base of Eurouniversity (Tallinn) The Second Estonian Conference on Graphs and Applications. This was dedicated to the 270th anniversary of discovery the graphs by Leonhard Euler, to 85th anniversary of the birth Frank Harary and to the 70th anniversary of publication the first monograph on graph theory by Denes König. These conference materials were published in a special edition of the journal *Baltic Horizons No. 8 (107).*

That same year, began cooperation with the Indian Mathematical Ashay Dharwadker, which bring to creation of an original and well-designed polynomial algorithm isomorphism of isomorphism ascertaining. This has published as the SERR edition and as the edition of *Amazon Books.* A Dharwadker is also author of a voluminous monograph on *graph theory.* On the initiative of Dharwadker was established in 2009th with SERR the *Institute of Mathematics* (in Gurgaon), where in its concerted charter is emphasized the need to explore a fundamental problem and to attempt to implement them. The Institute is also engaged in the training of informatics specialists..

In collaboration between SERR and the Institute of Mathematics appeared in the 2010th on the basis of EuroAcademy a special edition, *Baltic Horizons No. 14 (111).*

During these years, is the promotion of structure semiotics is reach to the level of *semiotic modeling*, where showing that:

- The structure of a graph is ascertainable with exactness up to positions (orbits) and isomorphism in the form of the semiotic model that is obtained by *deep-identification of node pairs.*
- Semiotic model of the graph *contain all the needed data about the graph* and opens it „hidden sides".
- Knowing the positions (orbits) of the graphs and morphisms between the structures, open the way for *formation and research of graph systems.*

The roles in all these have the former discussions with Frank Harary, Regina Tyshkevich and Ants Tauts.

I express my great thanks to the Rector of EuroAcademy Jüri Martin for creating an orderly basis for SERR's activity and to professor emeritus Leo Võhandu for effectively aiding and abetting. I thank my former cooperation partner Valdo Prausti present colleague Ashay Dharwadker for their contributions to this course. Sincere thanks to Ilya Sundelevich and Erki Tevet for supporting.

List of workshops

1. Structurality, its meaning and applicativity. *Speaker: J.-T. Tevet*, *19. April 1999.*
2. Mathematical problems of structurality. *Speakers: L. Võhandu, J.-T. Tevet*, *17. May 1999.*
3. On the structural analysis of artwork. *Speakers: A. Kristenson, J.-T. Tevet*, *31. May 1999*.
4. On the problems of structural analysis. *Speakers: L. Võhandu, J.-T. Tevet*, *27. September 1999.*
5. How to make a mutually understandable different ways of thinking – Interstanding. *Speaker: L. Võhandu*, *15. November 1999.*
6. Graph reconstruction problem on the structure semiotic viewpoint. *Speakers: J.-T. Tevet*, *A. Tauts, 24. April 2000*.
7. Structurality on the viewpoint of sight's sense. *Speaker: T. Bachmann*, *15. May 2000*.
8. Artwork and its structural analysis – a conflict of different thinking, reciprocal attempt to understanding or disinterest. *Speakers: J.-T. Tevet, L. Võhandu*, *M. Antson, 23. October 2000*.
9. Visions on semiotics. *Speakers: J.-T. Tevet, L. Võhandu, 27. November 2000.*
10. Graphs and semiotics. *Speaker: J.-T. Tevet, 19. February 2001.*
11. What mean the word "structure". *Speaker: J.-T. Tevet, 19. March 2001.*
12. How to structuralize a real object. *Speakers: J.-T. Tevet, T. Vint 16. April 2001.*
13. Are the problems isomorphism and reconstructivity the taboo topics? *Speakers: J.-T. Tevet, L. Võhandu, 11. June 2001.*
14. On the structural analysis of biological object I. *Speakers: J. Martin, J.-T. Tevet, 24. August 2001.*
15. On the structural analysis of biological object II. *Speakers: E. Aavik, J.-T. Tevet , J. Martin. 17. September 2001.*
16. On the structural analysis of biological object III. *Speakers: J.Martin, L.Võhandu, E.Aavik. 17. December 2001.*
17. On the structural analysis of biological object IV. *Speakers: L. Võhandu, E. Aavik, J.-T. Tevet. 10. June 2002.*
18. On the structural analysis of biological object V. *Speakers: J. Martin, E. Aavik, J.-T. Tevet. 30. September 2002.*
19. Presentation of the "Chronicle". *Speaker: J.-T. Tevet. 4. February 2003.*
20. On the recognition of graph's structure. *Speaker: J.-T. Tevet. 10. March 2003.*
21. Elementary changes of graph's structure. *Speaker: J.-T. Tevet. 28. April 2003.*
22. On the structural characteristics of a graph. *Speaker: J.-T. Tevet. 26. May 2003.*
23. Algorithms of structural processing of the graphs I. *Speaker: J.-T. Tevet. 17. November 2003.*
24. Algorithms of structural processing of the graphs II. *Speaker: J.-T. Tevet. 12. January 2004.*
25. Five years of the SERR's seminars – on their sense and nonsense. *Speaker: J.-T. Tevet. 19. April 2004.*
26. On the heuristics. *Speakers: L. Võhandu, J.-T. Tevet. 13. September 2004.*
27. Symmetry in the graphs. *Speaker: J.-T. Tevet. 15. November 2004.*
28. The sign matrix. *Speaker: J.-T. Tevet. 7. February 2005.*
29. On the problems of structure semiotics. *Speaker: J.-T. Tevet. 30. September 2005.*
30. The Second Conference on Graphs and Applications. *23. September 2006*.
31. Presentation the publications of the graph's conference. *7. May 2008.*

32. Evergreen isomorphism-problem. *Speakers: L. Võhandu, J.-T. Tevet, M. Tombak. 11. January 2009.*
33. The clique-regularity. *Speaker: J.-T. Tevet. 22. April 2009.*
34. What to do with Ulam's Conjecture. *Speaker: J.-T. Tevet. 27. May 2009.*
35. A seminar, dedicated to 10^{th} anniversary of SERR. *16. September 2009.*
36. Imagination of the creation processes in art and sciences (Dedicated to 60^{th} anniversary of Helen Kauksi). *Speaker: J.-T. Tevet. 28. April 2010.*
37. The system, structure and graph. *Speaker: J.-T. Tevet. 9. February 2011.*
38. The graph isomorphism disease in 21^{th} century. *Speaker: I. Panomarenko. 23. May 2011.*
39. On the semiotic modeling of the graphs. *Speaker: J.-T. Tevet. 21. September 2011.*
40. Semiotic model and experiences of 1- and 2-isomorphism. *Speaker: J.-T. Tevet. 14. February 2012.*

Participates from Euroacademy (Tallinn), University of Helsinki, Yväskylä University, Steklov's Institute of Mathematics, Dharwadker's Institute of Mathematics, Tallinn Technology University, Tallinn University, Tartu University, Estonian Academy of Arts, Estonian Society of Artists, Estonian Centre of Informatics et al.

Fragments of recollecting

These fragments present the SERR's story as it is memorable. Part of the fragments to present the events authentically, so as was written at that time. The lasts characterize the everyday life and condition so as it was.

Before the instituting

The preliminary conceptions about the structural treatment of graphs arise already in the 80th years previous century. Unfortunately, there was no opportunity to begin immediately intensive working in the structure of graphs. I was working at that time in various designing and research agencies where they had to deal with so-called the practical problems. I worked out a robust method of data processing (isoquanta analysis), which became successfully applied to technological, ecological, biological and medical research.

At the same time, I managed to continue to participate in the conferences organized by the Institute of Control Sciences, Kiev Institute of Cybernetics, and others, and to present their views. According to the profile of the work, I took an active part in the Spring School on Theoretical Biology.

The relationships with Kiev's Institute, where managed a couple of presentations on „graph systems" to make, also caused fact the visits.

Monday, 11 April 1988. Guests from Kiev Institute of Cybernetics of biocybernetics sector, Yuri Antomonov and his lady have again arrived in Tallinn. They are into the hotel Palace in a great hall well established oneself. The comment to Jüri Martin's dissertation was very pathetic. On the ground of initial data of JM they had by differential equations computed the growth of biomass of epigenic epilithic lichens synusiae. They regard my theme to very interesting and want the graphics of my structural complexity to work out. In their opinion from this to gets an interesting article. They walked out with the idea to set up a cooperative institute for consultations on biocybernetics. An "western" concept of this project was already ready. The point is worth considering. Antomonov has activity is plentiful.
They were both interested in our efforts to re-independence. Accompanying him, the lady was very anti-Gorbachev. This was primarily about cutting of wine-grape vineyards and off sugar sales only by cheques.

I was quite carried away. I sent in one of his articles in the so-called prestigious journals, which in some ways it caused any confusion. But with the editor in chief, however, we diverged especially friendly and we exchanged the calendars and New Year's greetings a couple of years.

Working relationships were also with the algebraists of Tartu University and graph theorists of Belarussian University.

Thursday, 1 December 1988. I am back from Minsk. Time went rapidly. In Minsk airport took me to the same young man who approached me in Nizhni-Novgorod, with a large poster with "Встречаю John Tevet".
My presentation of graphs was based on the canonical presentation of the isomorphism and reconstructions and was held at the Faculty of Mechanics and Mathematics of Belarus University. Be present about 15 listeners, led by Prof. Regina Iosifovna Tyshkevich. I presented my material in English on slides, where I gave explanations in Russian. Based on the Nizhny Novgorod's experience I had with a small slide projector. The presentation lasted over an hour. After the break, advance a number of quite detailed questions whose discussion lasted an hour as well. Most questions on reconstruist V. Tyurin. Obviously, our contacts, R. Tyshkevich and his group of people yet continue.

But that was not all. They would that I also speak on "Situation in Estonia". I talked on our movements and about the truth of the decisions of the Supreme Council. To heard with an attention. Mrs. Regina at first seemed to be a bit reserved, this is not surprising, but later took to hear. Others did not dare to openly ask for anything.
With reservation in the hotel was a mess and I got in the ladies room. Day return flight was stormy. I thought that now I have to wait a few days at the airport. Tallinn's was the only plane that landed safely in Minsk.

Regina Tyshkevich (born 1929) is (emeritus) Professor of Belarusian State University, expert of graph theory and co-author of the monograph. She is a direct descendant of the noble family Tyszkiewicz, known contemporary Poland. She got the moniker "графина Регина – graph countess Regina". His understandings about the orbits of the graph are coordinated with structural concept of "position".

Contacts with Belarusian University, especially R. Tyshkevich were more then most constructive. The meaningful exchanges of views, was also with automatics professor H. Sillamaa from Tallinn Technology University, who had a special interest for graphs.

Russian translation of Frank Harary's graph monograph (1973) was the sole available at the time of the publication in this field. I started to investigate and to compare it with my specific understandings. I sent some questions to Harary about the problems that I was interested, and he responded.

My work in the ecology sector of Botanical Garden consisted mainly in statistical analysis of observational data, but we were interested also in the use of graphs. Thanks to the effective management of Jüri Martin in what was then the soviet bureaucracy was succeeded to invite Harary to Estonia.

To his reception and workshop we sent invitations to graph-theorists of universities of Tartu, Latvia, Lithuania, Belarus and Ukraine. At the time, from USA was allowed to enter Estonia only through Moscow. In 18th May Frank Harary arrived to Moscow, where his receiver Piret bears a great effort with placement our guest to hotel.

Monday, 22 May 1989. In morning of 20th May at the train station I have already personally met the Grand Old Man, Distinguished Professor Harary. He is a shorter, probably Middle Eastern origin. I spoke to him in German. We received in hotel Olympia a good room 22nd floor with overlooking to the old town. I organized a private meeting to Võhandu.
This morning at 10.15 am, was the official reception of Frank Harary and an opening lecture in the Botanical Garden. Members were "Russian Harary" Alexander Zykov with wife, "Minsk school" with Regina Tyshkevich and his four disciples, and the participators from others universities. Jüri Martin said the opening remarks in English, but Frank Harary in Estonian. Frank Harary knew exactly, that he was in Estonia, not in the Soviet land. About the political situation, he was already in the U.S., with his Latvian counterpart informed in detail.
After the lecture and discussion, we went with Harary, Martin and Piret hotel Viru 22 floors for lunch. Since this day was my birthday, I invited them to her, where Frank greeted me with the birthday's song, and gave me his theory of graphs, with dedication. I also tried to talk about my work, but it does still not suit him. We agreed with him that I send him my treatise upon linguistic and terminological adjustments (other claims he was not), that he was in a "general order" promised to reconsider. I gave him the album about the known Estonian artist Viiralt that his was pleased. Time passed quickly, and the guests went late.

This was followed the lectures Harary in Tallinn University of Technology, Institute of Cybernetics and Tartu University. He had a habit of being late, or even as a joke somewhere to disappear. However, we have always found it. Our cultural program was sufficient, even Marriage of Figaro was heard. In initiative of Lithuanians Harary was by the so-called illegal form a few days in Lithuania, but most of all he enjoyed an audience at the University of Tartu.

Frank Harary, Jüri Martin and John Tevet in Tallinn Botanical Garden, May 1989.

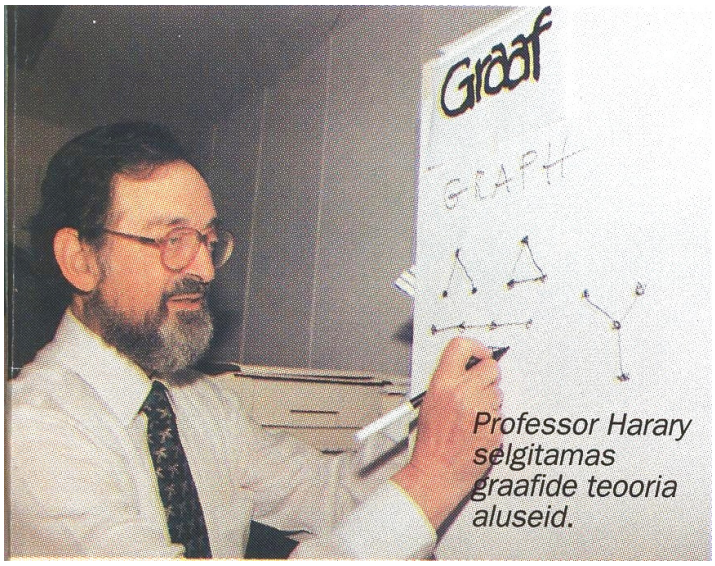
3rd June, I sent it along with Piret to Moscow flight departing at 7.50. Moscow, he applied his fees for the issue of his monograph in Russian, which, however, was not successful. There he was visited by Russian shops and bought hats and ties (he was a collector of these things). To Estonia intends to come back after two years.

I was published some papers about structural approach to the graphs. The year 1990 was completely dedicated to writing and publishing a little monograph *Interpretation on some Graph Theoretical Problems.*

In 1991th was planned a graph-theoretical conference, dedicated to 70th birthday of Frank Harary. In the meantime we had significant changes and we cannot it to organize. Really, Botanical Garden's not the right place for such undertaking. We gave all the management to Tartu University. It was take place in South Estonia.

Tuesday, 18 June 1991. To Frank Harary's 70th birthday dedicated "The First Estonian Conference on Graphs and Applications" was held in Kääriku 12th-19th May. Participants were from the U.S., Austria, Finland, Latvia, Lithuania, Belarus, Ukraine and Russia. It so happened that I could not go there. Piret has distributed my theses and my friend Serge Lavrenchenko had read the text. Frank himself saw to it that my theses to publish. The members obtain also copies of my monograph about graph interpretations and Harary takes one copy for S. Hedetniemi. According to participants, the conference was well organized

In 22nd June 1993, Frank Harary arrive his third visit to Estonia. To begin with we made him a proposal with Piret and his *Imp* (Piret's folk ensemble) evening to go to St. John's fest, which he gladly agreed. 25th June had a lecture at TUT. Planned was also Harary's lecture in Tartu University. He did not want to go there by bus. My son Erki agreed to bring Harary to the Tartu, but wanted to make up for the cost of petrol. How to make money? There was an idea to find a sponsor. We found that there is a design firm Graph – the name fits! We were contacted and agreed to come to the talks. We were friendly received and Harary did there a popular overview on graph theory. There was also attended the editor and photographer of magazine Life's Picture. Later was published a nice article about how advertising to the graphs and to the firm. But we got the support for Harary's driving to Tartu.



Frank Harary in the design firm GRAAF, June 1993.

It was his last visit to Estonia. Until his death in 4th January 2005 he was in contact with the University of Jyväskylä in Finland. Frank Harary was the founder of the modern graph theory and its monograph has been widely adopted (used) work in this area.

In the period 1987 to 1990, I visited the summer schools on the graphs in Odessa, organized by Alexander Zykov. They were very popular and had a large attendance. So as in Minsk, also in Odessa required us (me, a Latvian and a Lithuanian), at the end of the workshop, for a large audience to explain the political situation in the Baltic countries. Zykov was the first author of in Russian published books on graph theory. Therefore, his nickname is "Russian Harary". Zykov's opinion on structure is similar to our opinion. He was published works about algebra and philosophy of mathematics.

From 1994 to 1996, had SERR a predecessor – HERR – Heuristics research group. There were also some workshops, but mainly on a very practical purpose, the real estate market analysis and forecast by using an isoquanta method.

Contacts on the level of exchanging articles took place with Gottlieb Tinhofer of Munich Technical University and with others. Tinhofer sent me a tempting invitation to the *Graph Theoretical Conceptions Conference in Computer Science*, that had held in the summer of 1994 in a beautiful castle in Bayern. I arrived in Munich, but for technical reasons to not have time. But a trip to Munich, I would not regret. By this time was the first algorithm for structural processing of the graphs already compiled.

The mixed beginning

Before organizing the workshops arises an idea – to structuralize and analyze the artworks (experiences about biological and ecological objects we had). Under observation were the structuralizing and analysis of composition as a classical attribute of the artworks. We start from textile artworks, as an association of various shapes, colors, textures and formations, where to the relationships between them are the neighborhoods. We started, of course, from Helen Kauksi's tapestries *Contrasts*, structure of which appeared to be somewhat similar to the structure of natural community. We structuralize also some artworks of others textile artists. Finally I dared to take the works of the classics, such as Rembrandt's *Sacrifice of the Mana,* Roerich's *A Heavenly struggle* and others, that these to graphs to structuralize.

We began to realize the idea of the workshop. First of all must put in order the theoretical material and to make excerpt for the report of workshop. Graphic material was presented to the slides and draw up a scenario of workshop. With Jüri Martin, we agreed on the use of the assembly hall of the EuroUniversity. Finally, the theme of workshop – *Structurality, its meaning and applicability* – was been announced and the invitations to sent. As the theme of workshop was also related with the analysis of artworks, we decorated the Hall with gobelins Helen. For she, this has turned out as a small solo exhibition at the University.

The first workshop was held in Monday 19th April 1999. Place was won by a mixed party – mathematicians, ecologists, and artists – a dozen or so people. Jüri Martin leads in the workshop. I had in front a great heap of the papers and slides and started to calmly explaining the theme. Will soon it seemed that for a large part of the audience is the subject matter too broad. Some had no difficulties and some accepted this that considered it necessary to. However, there were also detailed issues. For such audience, must be this material to distributed for ten workshops, but I rattle off it with 2x1.5 hours. At least it was started with the workshops and I learned all about the fact that more or lesser to the audience suit. After this workshop was rooted the term *structure semiotics*.

In the second workshop, *on the mathematical problems of structurality* (May 17th) I tried to explain for mathematicians why and how can be by a sign matrix to ascertain the graph's structure (pro: graph isomorphism) and to interpret the reconstructivity. The last problem was not accepted. In the third workshop (May 31th) I tried to explain for artists my understandings *on structural analysis of artworks*. Discussion on this topic was alive.

It came time to recording our activities. In 15th July we signed with ecologist Jüri Martin, informatician Valdo Praust and artist Helen Kauksi the Statute of SERR and in 23th August 1999, it was entered in the register.

In the fourth workshop (27th September) we, with mathematicians and artists had discussed *on the problems of the structural analysis.* The artists had claimed that the ornaments are so complex and specific phenomenon that using structural and mathematical methods does not make sense. Mathematicians challenged it, claiming the opposite. They both had, from own viewpoint right. In fifth Workshop (15th November) presented mathematician Leo Võhandu his concept on *interstanding* – an effort to mutual understanding between the persons of different areas of activity and interest. This was an appropriate theme in the circumstances.

In statue of SERR is also a regulation on publishing of our materials. On the grounds of materials, that were corrected by experiences of workshops were published two opus. In the first, *Structure semiotics: representation the structurality on the graphs* (in Estonian) was a summary of this research and its applications, including the analysis of the artworks. In this epigram, among others, were noted: *Structural problems have always been topical. Semiotics of the structure set up the task to organize, formulate, formalize and solve problems related with structurality. Semiotics has the role of explication the structurality on the graphs. ... .* In the second, *Appendix to Structure Semiotics: A System of Graphs, their Characteristics and Changes* (in English) were presented detailed data of the system of graphs with six nodes (156 graph-structures and 1044 elementary structural changes), such as sign matrices, characteristics, adjacent structures, their probabilities etc.

There was a need to finance our activities. We intend to present in conjunction with the Institute of Informatics TUT application for Estonian Innovation Fund. According to the instructions, we were thoroughly the text of the petition, put innovative examples, etc. Unfortunately, we were not satisfied.

The sixth workshop was held in 24th April 2000 on theme *Graph reconstruction problem on the structure semiotic viewpoint.* Colleague Ants Tauts has accepted this approach and even shows that an edge variant of Ulam's Conjecture does not valid in case where there are two. Indeed, I am such situation for myself already to schematize – it is indeed the case. Prof. Võhandu arrived later and

announces that he has a good book, in which is the text of the methodology of how to determine whether the writer is a “freak” or not. Despite of such report we let know, that we just now have refuted the edge variant of Ulam’s Conjecture.

As for the structural analysis of the artworks, then a long have recommends me to meet with the artist Tõnis Vint. I sent him a brief overview of the concept, and we agreed to meet. We both spoke of a "structure." He's very an interesting about the structure of the "Livonia patterns", but I'm about the structures on graphs. He hopes that mathematicians will be interested about the regularities of the patterns. He is sure that they're there exists, he also had tries represent they, but so unique that they have remained for outsiders to the obscure. For my part, I tried to imagine some Tõnis Vint objects on the graphs, unfortunately could not handle it. Vint participated in several of our workshops, where he listened to our concept, and introduced their own. In a workshop he contacted also with Võhandu whom he presented a series of his paintings and materials. With all of this and had stopped. I also went to a large presentation of Vint, but it did not help me. If I was not occupied with their own theoretical problems, then can be was able catch something out of his materials. In any case, I appreciate his theoretical strivings.

As part of the structural analysis took place at that time a sensible discussion with the artist Kadi Pajupuu of the textile department of Estonian Academy of Arts. At first, it seemed that no problems, but then arises a difference in understanding the concept of the structure – the artist thinks only visually.

This, that structure and the sense of sight is not inter-related was also confirmed by Talis Bachmann in the corresponding workshop (15th May 2000). It remain unclear, with what kind of sense the students must to solve the tasks in graph textbook, where needs to be founds among the graphs the isomorphic. Interesting, is not the perception of isomorphism with sight’s sense ever investigated? It is obvious that the artwork is perceived as placing its shapes, not the structure. It is important to take into account if to deals with the structural analysis of artworks.

Võhandu reported that in August in Stockholm, Royal Institute of Technology will host a workshop on area of Creative Media, in where he is an organizer. He wanted to include in this a report on the structural analysis of the artworks.

I had to begin to prepare, to find suitable examples and a co-author from the artists. With the finding of a co-author were some difficulties. Finally, an art's student Mae Lambing was agreed join in and we had drafted a scenario. For the cover design for a planned issue were wished a photo of analysed artwork.

Our report *Visions about the skeletons of artworks* was held in the second day. All went according to script – Mae wore the text, I showed the slides. Immediately after our report had commented it by Võhandu. The lead manager asks some questions, and made thing was fine. The publication *FRONTIERS OF INTERSTANDING* – workshop from the Royal Institute of Technology (KTH) was beautiful, especially the *cover picture,* the gobelin *Aphelion* from artist Heli Kelt.

We were satisfied with the free trip to Stockholm. When we returned, I wrote an article about *measuring the Estonian textile art in Stockholm,* which contained and amusing lines:

Mae: *Are the measures of artworks in your opinion the price, size and weight?*
John: *Yes, of course, but I think an artwork is characterized also by some internal characteristics, such as, for example, the characteristics of its structure.*
Mae: *What is structure?*
John: *Structure is the skeleton or framework of the object that consists of its components relationships between them.*
Mae: *What is the structure of an artwork in your opinion?*

John: *Composition is the classical attribute of an artwork. Composition is a certain association, which can be decomposed, after which the relationships between components, is established and the structure exposed.*

Mae: *What are, in your opinion, the components of an artwork and relationships between them?*

John: *An artwork may be decomposed from the viewpoint of different shapes, patterns, colours or textures and the relationships between them could be neighbour relations.*

Mae: *But what is the meaning of all that?*

John: *Now we can present the composition of the artwork as a graph of the structure.*

Mae: *What is graph?*

John: *Graph is a graphical presentation of components and their relationships.*

Mae: *But, what about the characteristics of the structure?*

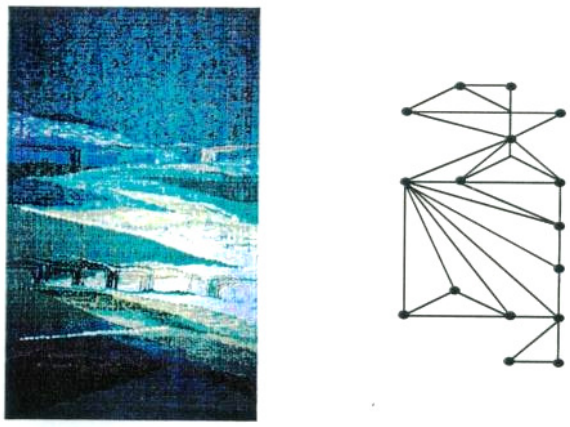
John: *Structure is a text that can be read and explained on the basis of the graph depicting it. This text includes the structural characteristics.*

Mae: *I create my artworks with intrinsic necessity and emotions but you try to disgrace them with your skeletons!*

John: *It is not exactly like that. I also have a taste, for example I like naivists. But if artworks have structure then it is worth to investigate it, even more because the structure of an object is regarded to be the carrier of its qualitative specificity.*

Mae: *I do not believe very much in all that but I will take to risk to go along with you.*

John: *Great!*



Helen Kauksi's tapestry *Contrasts* and their graph.

In 23rd October 2000 we organized the eighth workshop on the complicated theme *Artwork and its structural analysis – a conflict, an endeavour to mutual understanding or different ways of thinking.* The team was mixed – were presented artists, informaticians and mathematicians. I presented my vision and concerns on this issue. Of particular interest to me was the reaction of artist Kadi Pajupuu, who did it self-confident. Later, we met him again a few times, where we discussed in detail about the meaning of structural analysis of artworks. She agreed to collaborate in this field. After this, we submitted a corresponding application for the Estonian Cultural Endowment (*On the meaning of structural analysis of artworks*).

And then come the Finns, the working at the University of Helsinki, biochemist E.A. and medic M.P. The father of MP, who I helped in processing his observation data by my isoquanta method. Our collaboration was effective at the time, now he is dead. His son had to seek me up. Their international research group deals with costly animal studies (baboons in South Africa) to investigate vascular disorders and is stuck with some experimental data processing. They use some high-level computer programs, and contend that the results to be too formal. They suggested a co-operation.

Basically, here I could attach my method isoquanta analysis, but unfortunately, these programs are not left to me. Therefore I led them in contact with Võhandu, Martin and others. With they taken place a

series of workshops on the theme: *the structural analysis of biological objects.* I must honestly admit that isoquanta method and its application no longer interested me.

On the selected direction

The thoughts proceeded by own trail climbs, and I found that must to write and publish a *Primer of structure semiotics* (in Estonian), where all the things (problems) with the simple examples illustrated and explained with the simple terms. This epigram formulated as follows: *The structural treatment of graphs differs from the traditional – combinatorial and algebraic – treatment. So far, the graph theorists no have a special interest to graph's structure and its attributes (characteristics). Already in 1976, the analyst Jean Mayer noted in his article that the graph theory is in an isolated condition, that hinder (prevents) its development. The Primer trying to pokes a little the stagnant graph theory.*

I had think that the, content of with a cock labelled Primer must be for every literate human (people) be understood. The main examples were limited to eleven graphs with four nodes, for better understanding of the text was formulated nearly 70 actual exercises and so on. I submitted a corresponding application to Estonian Science Foundation.

The theme of ninth workshop (27th November 2000) was purely theoretical – *The visions on the semiotics* – where we listed the variety of semiotics (sign systems). Must come to the place also Mikhail Lotman, who had agreed to this, but he had to fly to Italy. In his place had the words Võhandu.

In year 2001 started to write a treatise *Graphs and semiotics: Foundations of the language of structural treatment of graphs* (in Estonian), which contain also exercises. In its epigram remarked: *A graph is an abstract formation of the elements and connections of element pairs. Semiotics treats the sign systems. The sign is an object that presents, represents, marks or replace any of its differ object. Connectivity of an element's pair is characterized by a partial graph that is presented by the corresponding sign. The structure of graph is presentable in the form of a text with such signs, that we to structure semiotics (semiotic model) to called. The models give new information about the graphs.* This work was preceded a looking of the most important monographs and they reviewing in the chapter *Graphs in various sign systems*. I considered it necessary to begin the introduction so: *This is a somewhat delicate theme, where graphs are considered to belong to the domain of mathematicians, treated from viewpoint of semiotics. On the other hand, this should not be something to be condemnable. It is necessary for raising the conceptual and qualitative aspects of the graphs. It should be noted that the graphs does not pure-mathematical objects ...* . On the end of introduction be noted, *... This of course does not mean that such an approach should be pleased to all. Experience has shown that to mathematicians seems the semiotic modeling too exotic, an unsuitable phenomenon to him. Reactions to this are often superficial and draw back to `a la "believe" or "no believe". The intellect-technician interested in algorithms and ecologist their finds this to be a suitable method for structuring the ecological communities. A right semiotician no trying to criticize something and philosopher not yet taken a position. An artist is interested that just as his works of art are analyzed, and the bureaucrat tends to look for this non-compliance with the "euro-standards". Searches for new ways of view to graphs should be necessary, because the traditional graph theory still seems to be hobble of Hamiltonian circuits and electrical networks. Lately, even the problems of the orbits and isomorphism are disregarded, for example in "Modern Graph Theory" (Bollobas 1998). .... Graphs and semiotics* was also the theme of the tenth workshop.

After this arises need to write and publish the theme *Semiotic testing of the graphs: Principles, Using and Dewelopments*, that begin with examples about structural formulas of chemical matters, ended with the system of graphs, contain many exercises and they solvings. This was a main issue on the semiotic approach to the graphs: *A side view on graph theory that allows us to see a structural essence of the graphs.*.

With regard to the preparation of the workshop on the concept of structure I took contact with a former physicist, philosopher and specialist of the structure L.V. There were a few polite phone calls. I sent her my understandings of the structure and asked her to participate in our eleventh workshop (19th March 2001). To the workshop he did not come and my views do not commented. Once again, I had to admit that today do not seek for yesterday's date. L.V. deals now with more practical philosophies. The workshop itself was quite speech-satiates, if by the 13 participants might say. There participates also a terms expert from Estonian Language Institute. Think I managed to explain the meaning of this word. For many of they may be came it to understanding

What is the structure? – I've explained this many times, would not want more. Unfortunately is the word "structure" devalued to an undetermined concept, which is used quite arbitrarily. By the *concise definition*, is structure a *stable association of elements and their relationships* where their empirical properties and spatial arrangement are not essential. Be argued that the structure *is presentable* in the form of a *graph*, but *not recognizable*. The assertion, that the *isomorphic graphs have the same structure*, is true and accurate. Thus, for the structure recognition is necessary and sufficient the *using the invariant attributes of isomorphic graph*.

The structure is *presentable* and *recognizable* in the form of an ordered complex of invariant attributes, in this case, in the form of the *sign matrix (semiotic model)* ***SM*** as the "text" of structure. Semiotic model represent the structure with exactness up to isomorphism, on this are readable all the structural properties, such as orbits, adjacent structures, paths, girths, cliques and others. On the basis of semiotic models can be distinguished a structure (i. e., a class of isomorphic graphs) on the other. The structure is an *abstraction of the system*, because in the latter are very important the empirical properties of elements and their relations. On the basis of semiotic models we can build also *the systems of structures*.

Structure is treatable as a "precision formation" of elements. Unfortunately, is this so precise, that in practice or in the nature have failed to find an application – even non in the case of structural formulas of chemical. Although the majority of the structural formulas of various chemical compounds differ, A. Zykov has found a variety of compounds that have the same structure (consisting of various elements though). I'm not familiar with the field of genetics, but I tend to think that also there with such precision structure and their attributes nothing to do. I would not mind if I here make a mistake. Therefore, *the structure is actually presenting (actually existing), interesting (at least to me) and beautiful (it is a question of taste)* thing, with which after studying and research has nothing to do with it. Maybe?. The regularities that need to study are in this area enough already. There exists obstacle to the realization of algorithms for the computer.

I found an article by Alexander Dultchenko (Tartu University) about Jakob Linzbach, whom he considers one of the founders of semiotics. I was previously been interested about her. He finished his time Tallinn Railway School, which at that time had a pretty good educational institution. In 1920th years he travelled to Paris, where he works with a variety of problems – the creation of an artificial language, cosmology, geometry and more. Dultchenko argues in his article that J Linzbach was at the time in many ways ahead, for that reason her concepts stay misunderstanding. Some of his beliefs about the semiotics maintains interest even today. I wanted to organize a workshop on Linzbach. I invited Alexander Dultchenko to speaker at this workshop. He agreed, if the costs travel and report were compensated. Unfortunately I'm out of my "scholarship" (i. e. pensions) could not do it. On other paths was about Linzbach interested Võhandu and who organized an article about his in the journal *Academy.*

To many of you seem the use of *semiotics* for studying of a mathematical object is a dubious undertaking. From this a lack interest to the structure, as such. Recognition of the structure to identified with the recognition of the isomorphism, which is only a part of the structure's recognition. *Recognition of the structure* must be considered alongside with *the recognition of equivalence of structures.*

As the key topics of structure-semiotic approach to the graphs are isomorphism and reconstructivity, was suitable to hold a workshop on the theme *Are the problems isomorphism and reconstructivity taboo topics?* (11th June 2001). It turned out that there is a kind of taboo indeed. Do not have time to start talking about this, when Võhandu on a completely different subject was performing. Since we were only three of us, then everyone was singing his aria and was staying to his position.

After this I write and publish a special issue, with examples and exercises on the theme *Isomorphism and Reconstructions of the Graphs: A Constructive approach and Development.*

Võhandu, who my binary signs to results of "look from an upper" called, tried by the multiplying of some vectors by a "much more simple way" the node orbits to obtain. He had on the base of j-languages made a program for multiplication the adjacency matrices $E \times E = E^2$, which was tested by some of my graphs. He was quite optimistic and showed me his results. Indeed, the node orbits of parts of the graphs can be recognized in this way. Later I understood that this method must be further developed to obtaining more definitive results.

Some "serrmans": in the firs plane J. Tevet, I. Sundelevich, L. Võhandu and Rector J. Martin, in 2003.

Multiplication of the adjacency matrices with itself (involution) was supplemented so that, must be multiplied to a degree $\boldsymbol{n}$, where the number of different values is maximum and further multiplication no enlarge this number. In this form, it is a good tool for the specifying the structural pair signs. We call it to *involuting method.* The "multiplicative pair signs" itself no contain structural information. Be argued, that elements of adjacency matrix of $\boldsymbol{n}$ degree, express the longest path between the node's pairs. On the structural aspect arise there some questions. What presents the values in the main diagonal of obtained adjacency matrix $\boldsymbol{E^n}$? Why increases the number of different values of the products, in the case of repeated multiplication? Why it no works in case of strongly regular and some other graphs? Why changed a part of products, in case of certain degree $\boldsymbol{n}$ to the zeros? This "mystery" of course, does not detract from the feasibility of the practical use of such method.

<u>Tuesday, March 11, 2003rd.</u> Yesterday was the 20th workshop, so-called latest about the explaining of structure's ascertainment. Võhandu took at the beginning a "threatening-stance". I had a decent presentation material available both onscreen and in the printed materials for the listeners. Feeling a dramatic situation remains also Jüri Martin to listen. The concrete material about the comparison of structural and involuting method made Võhandu seriously to listen. At first, I presented examples where the involuting method more or less perfectly worked, but at the end the examples on the graphs

of Weisfeiler, Mathon and Nechepurenko, where works only the structural method. Then began Võhandu protest and leads the talk to other theme.

In the beginning years, there were cases where the first-order binary signs in the some cases can not recognize the structure and structural equivalence. From Janos Csirik and Valdo Praust designed relevant contra-examples helped to develop the needed binary signs. It is now developed to some high-degrees binary signs. Theoretical basis of the structural approach: – one-to-one correspondence between an *automorphism* and *isomorphism* of corresponding binary graphs (*local isomorphism*) – is entirely correct. The involuting method is here in some cases a good tool. Information on the node pair will still give a first-order binary signs.

If we treat the structure, can be treats also its changes. The elementary changes of structure be presented: a) in the form of an *adjacent sub-structure,* obtained by removing of an edge from a binary orbit; b) in the form of an *adjacent super-structure,* obtained by adding an edge to a binary orbit. This is directly related to the problem of *reconstruction the graphs.* On the structural aspect it is simple: each adjacent structure has an "opposite orbit", where using opposite operation reconstruct the initial structure. The structure can be reconstructed by its adjacent sub-structures and by its adjacent super-structures. The wording of *Ulam Conjecture*, as isomorphism of all the pairs of sub-graphs, is elegant, but makes the problem too complicated. The reconstruction problem is related with the *systems of graphs.* An elementary change in this system is called *morphism.* The systems of graphs consist of structures and morphisms between them. For example, the system of structures with six elements consists of 156 structures, which have together 1144 orbits, and 572 morphisms between them. On this topic was held the 21th workshop. For some remains this theme too "mystical".

The homepage of SERR was establisher in June 2000th. It was titled: *Welcome to our express page! A constructive approach to the graph theory. The semiotic testing of the graphs opens their structural side and constitutes a rational way to the treatment of some essential graph theoretical problems.* One day, I discovered that the web site was refereed in BIGOWEB. Someone sent me an e-mail Mr. Ashay Dharwadker: *Your exellent site was suggested to me by editor. If you know of any other graph theory sites that are not in our list, to let us know.* After that, we were good acquaintances, but later we worked with.

I'm changed the website (http://www.graphs.ee) and had complemented it up to the present. The same is true with the publications. Each new edition is either a complementing or a new aspect to the previously treated topics. Thus, in year 2003th published issue *Graphs of the Structure and Structure of the Graphs* constitute a complementing and a new view-point for the two previous.

In summertime takes place also other activities. With Helen we roamed along the sea's coast, and had painted. Rather, she had painted but I wore she easel and other stuff. At that time, I write my "memoirs" *Chronicle of one's aspirations and exertion*, where included also the labour's experiences. This chronicle was presented in a workshop.

In the 22rd workshop we were discussed about the structural properties. Here have quite a high interest to the solitary, separated structural properties, including the identification of a *clique*. In this area has developed practical algorithms by Ashay Dharwadker and Denis Kumlander. Commonly, be interested only to finding a greatest clique. Why? For example, all the transitive (node symmetric) graphs have any greatest cliques. There exists *clique regularity*.

With regularities is the story such: *Regularity* of a graph is a property of nodes and/or edges being on some respect similar.

- A graph where the degrees *d* of all the nodes are equal is *regular graph.* We call it *d-degree-regular.*
- A degree regular graph where the distance ***d*** between all the adjacent nodes is equal is *d-distance-regular.*

- A degree regular graph where all the nodes belong to the girth with perimeter $\boldsymbol{d}$ is *d-girth-regular.*
- A degree regular graph where all the nodes belong to the clique with power $\boldsymbol{n}$ is *n-clique-regular*. Partial cliques of a clique regular graph can be *disconnected partial, mutually connected or intersected.*
- A degree regular graph where all the adjacent pairs have $\boldsymbol{a}\geq 0$ common neighboring nodes, and all the non-adjacent pairs have $\boldsymbol{b}\geq 1$ common neighboring nodes is *strongly regular.*

I remember also the workshops about *heuristic algorithms for structural processing of the graphs,* which took place on 17 November 2003 and 12 January 2004. Later, I understand that explaining several different algorithms in one workshop is risky. Were published also the corresponding materials.

To the present is the main algorithm, structure ascertaining, was realized two times. The first variant had realized by Valdo Praust. This was presented to him with a short laconic description. The idea of this algorithm consists in following:

- To operand is the list of adjacent nodes L.
- For each pair of nodes, $\boldsymbol{i,j}\in[1, |V|]$, to find its intersection neighborhoods $\boldsymbol{N_i}\cap\boldsymbol{N_j}$, as a *pair graph* $\boldsymbol{g_{ij}}$, fix its invariants and to order these. To the invariants are the *pair signs* as a quadruplet $\pm\boldsymbol{d.n.m._{ij}}$, where $\boldsymbol{+d}$ show collateral- and $\boldsymbol{-d}$ ordinary distance between vertices $\boldsymbol{v_i}$ and $\boldsymbol{v_j}$, $\boldsymbol{n}$ – number of vertices and $\boldsymbol{m}$ – number of edges, in this pair graph $\boldsymbol{g_{ij}}$.
- To result obtained the ordered and decomposed sign matrix $\boldsymbol{S}$ with exactness up to *orbits of node's pairs* $\boldsymbol{\Omega R_n}$ (binary orbits) and *node's orbits* $\boldsymbol{\Omega V_k}$.
- The orbits are *equivalency classes* that characterize their *positions in the structure.*

The orbits cab ascertain also by some other modes of *deep identification of node's pairs.*

That was at that time to enough for the realization of a respectable algorithm. In the second case demanded of more detailed, a step-by-step description, in which was a lot of effort on details. The simple fact, that the intersection of neighborhoods is limited with the distance between the node pair, remained unheeded. Another algorithm, the involuting method was realized by A.K.

The orbits (positions) of nodes and node pairs are related with *automorphisms*. Authomorphism is interpreted as a *local isomorphism (isomorphism with itself).* The automorphisms form an *authomorphism group AutG.* With a way of permutation technique, fixed in this group the *transitivity domains of authomorphisms (the orbits* $\boldsymbol{\Omega}$ *)*, elements of which take for equal. In case of *AutG* be interested mainly on node orbits. Because orbit is related with the local isomorphisms, then the isomorphism class of binary graphs is connected with binary orbits. Therefore, isomorphism of binary graphs corresponds to an authomorphism, but an isomorphism class to the binary orbit. Actually, the orbit constitutes an equivalency class or position of elements in a graph.

Comparing the recognition of orbits (positions) by group theoretic and structural modes.

- The orbits, recognized by group theoretic orbits, and positions, recognized by structural modelling, *coincide!*
- Graphs with different structures can be have one and same group *AutG*, but have different sign matrices $\boldsymbol{S}$.
- In case group theoretic treatment the number of permutations of completely symmetric graphs can be increase up to factorial. In case sign matrices of this does not happen.
- In case group theoretic treatment the recognitions of nodes and edge orbits takes place separately and the "non-edge orbits" does not exist. In case sign matrices the recognitions of node-, binary(+)- and binary(-)orbits take place completely, where semiotic model $\boldsymbol{S}$ express these in a complex.
- Up to present considered, that orbit recognition belongs to periphery of graph theory. On the structural aspect it is a central problem.

In 19th April 2004th has been five years since the beginning of workshops. We had to take stock and to mark it with a properly trained workshop. Were published something. In this summer has been concern with the exhibitions tapestries of Helen. For her it was a good year. In September, we held a workshop on heuristics.

In November I get from Võhandu a sad message that our Ants Tauts is dead and buried. Tauts was one of the few mathematicians in Estonia who had expressed an interest in intuitionistic logic. In Tartu University he was one of the algebraist Jaak Hion's students. He later worked in TU as a lecturer. He had also worked in the Institute of Physics, the Institute of Cybernetics and Institute of Energy. Tauts was Board member of the Estonian Mathematical Society, foundation member of the Swiss Cultural Society and the one of the member of the Board of SERR. Tauts had discovered of a defect in the edge version of Ulam Conjecture.

In November 2004, was a workshop on the *symmetry of the graphs.* There arises dispute with Võhandu about transitivity, but it seems that this was settled. Transitivity has in graph theory two completely different meanings: a) related with the transitivity domains of automorphisms; b) related with the some types of directed graphs.

The *symmetry kinds* of the graphs:

- Graph with only *one* vertex position (orbit) ΩV_k we call *vertex symmetric graph* that also *transitive* called.

For transitive or vertex symmetric graphs:

- Transitive graph with only *one* pair position (orbit) ΩR^+_n is *completely symmetric* or *complete graph. Empty graph* with only one "non-edge" or pair position (orbit) is also *completely symmetric*.
- Transitive graph with only one edge position (i.e. binary(+)orbit) ΩR_n^+ and only one "non-edge" position (i.e. binary(–)orbit) ΩR_n^- we call *bisymmetric graph.*
- Transitive graph with one edge position (binary(+)orbit) ΩR_n^+ and some "non-edge" positions (binary(–)orbits) ΩR_n^- we call *edge symmetric* or (+)*symmetric graph*. Complement of an *edge symmetric* graph is a *"non-edge"-* or (–)*symmetric graph*.
- Transitive graph with some edge positions (binary(+)orbits) ΩR_n^+ and some "non-edge" positions (binary(–)orbits) ΩR_n^- we call *poly-symmetric graph.*

For non-transitive graphs:

- Graph with more than one vertex position ΩV_k, whereby at least to one ΩV_k belong at least two elements we call *partially symmetric graph*.
- Graph where the number of vertices $|V|$ and vertex positions ΩV_k K is equal is a *0-symmetric* or *(completely) asymmetric graph.*

In the case of symmetric graphs have an essential meaning the *position graphs (orbit graphs).*

In year 2005 have enacted the workshops on the theme *How to read the sign matrix.* How to be finds in the sign matrix the cliques, girths, orbits, orbit-graphs and adjacent-graphs etc. Was also published corresponding matters.

To each *binary orbit* ΩR_n to correspond an *adjacent structure* GS_n^{adj}. The relation between initial structure GS and GS_n^{adj}, F_n: $GS \rightarrow GS_n^{adj}$ called *morphism*. To the adjacent structures are:

- *Largest subgraphs* $G \backslash e$, obtained by removing an edge from binary(+)orbit ΩR_n^+ .
- *Smallest supergraps* $G \cup e$, obtained by adding an edge to (binary(–)orbits) ΩR_n^- .

Expansion of cooperation

Interest for structuring of the artworks had not gone yet. Our Ilja S. considered it necessary to hold a meeting with the famous cultivator of *concrete poetry*, artist with engineering education Raul M. He

had prepared a large number of their artworks of concrete poetry. Behind the coffee table we started to work on it. Raul M explained his concepts, which were understandable, but his artworks remain to me incomprehensible. I was able to construct only a “concrete poetical graph”, which seemed to interest him. Our discussion was interesting, but we did not get beyond.

Cooperation began to develop with the Indian Mathematician Ashay Dharwadker, whose research focussed on fundamental research and application in the algebra topology, graph theory, computer science and physics. His significant contributions include *a new proof of four-color problem*, is based on algebraic and topological methods.

In 2005 was published some works about structure semiotic approach to graphs and graph systems.

We had a custom in every 30th September to hold *the day of graphs*. Graphs were discovered in 1736, when Leonhard Euler published his results of solving a logistic problem of Königsberg bridges. 200 years later has Denes König write the first monograph about graph theory. In 2006th was correspondingly the 270th and 70th years ago. In With Jüri Martin we decided, that it should be noted with a conference. All the more that 15 years had passed since the first Estonian conference on graphs and applications, where initiators we were. We began to make preparations for the conference.

The highlight of the year 2006th was *The Second Estonian Conference on Graphs and Applications,* dedicated to 270 years of graphs and 70 years of graph theory. It took place in 23th September in Eurouniversity (Tallinn).

The *introductory speech* had from Jüri Martin, John Tevet had made a *historical overview on graph theory*. Had been planned still:

- *Creating Graph Models in Universal Chess.* – by Jorma Kyppö, Jyväskyla University;
- *Current Data Mining Challenges Describes as Graphs.* – by Innar Liiv, TTU;
- *Graphs, Ordinations and Cliques*. – by Leo Võhandu, TTU;
- *The Clique Algorithm*. – by Ashay Dharwadker, Hariyana, Gurgaon;
- *The Foundations of Structure Semiotic Approach to the Graphs*. – by John-Tagore Tevet, SERR.
- *The Role of Graph Theory in the System Researching of Energetic.* – by Lembit Krumm, TTÜ

Between ourselves we called this conference to a *chamber-conference*. It can be considered to a success because everything was well organized and will be published also the conference proceedings. For the edition of the proceedings had needed time and presentation of these takes place later in a special workshop.

In 2007th was published the matter on *Symmetry of the Bisymmetric Graphs* (in Estonian). There was essential the circumstance that all the bisymmetric graphs (having two binary orbits) are also strongly regular. Was discovered many new strongly regular graphs. For example, between graphs with 4 to 20 nodes discovered six new strongly regular graphs.

I find in library a book *An Atlas of Graphs* (by Ronald R. Read and Robin L. Wilson). It contains pictures of over 10000 graphs, tables giving the number of graphs with given properties and tables with some parameters associated with many of the pictured graphs. This gives me a new idea.

In the same year was published also *A Selection of the Graph Structures* (in Estonian, later in English: *Constructive Presentation of the Graphs:* a selection of examples). This contains 55 selected examples about the graphs with various structural and symmetry properties. All the graphs are presented with their sign matrix (semiotic models) that open the structure with exactness up to orbits, isomorphism and other structural and symmetry characteristics. The aim of this issue was to explaining the meaning of graph structure and sign matrix.

So as in the *Graph Atlas* can be seen, up to present not have known how to systematize the graphs with *n* nodes, how to form the graph systems. And I publish a network issue about *Systematic analysis of the graphs,* which contain all the 156 structures with six nodes and 572 relations between these.

The concept of structure call forth still the confusions, for that reason I had to publish a little matter on the theme *What is structure* (in Estonian, 2008).

2008th in May struck us a second heavy deprivation, it refers mainly to me – one of the founding member of SERR, managing director, textile artist Helen Kauksi died. She studied at the Tartu Art School and Estonian Academy of Arts, she taught painting at the Estonian Academy of Arts, and later freelancing. Students remember him as a strong and powerful teacher: the culture of designing of the works, subtle highlighting grasps – precise orchestrations. About intensive creative work speaks she personal exhibitions. Its carpets were in Germany, Finland, Sweden, Denmark, Hungary, Latvia, Lithuania, Ukraine and so on. She's artworks can to find in Estonian National Museum, Design Museum and Tallinn City Museum, in private collections around the world. It is also remarkable activity as a painter. The original aspirations were expressed in the tapestries which dedicated to the events and persons, so as *Story* (to the 650th anniversary of the Town Hall), *Touch* (to the 85th anniversary of the Estonian Ballet), *Hymn* (dedicated to President Lennart Meri), and others.

In the same year began an intensive collaboration with Indian mathematician Ashay Dharwadker in the form of polynomial *The Graph Isomorphism Program.* The doings, co-ordinations and clarifications we had of the many. This program was completed in early 2009.

And so, the Dharvadker-Tevet polynomial algorithm of based on formation of incomplete sign matrices, as canonical representations $\boldsymbol{S_A}$ and $\boldsymbol{S_B}$, where the node classes $\boldsymbol{V_{Ak}}$ and $\boldsymbol{V_{Bk}}$ given on the level only of frequency vectors. Notable here are the following moments:

- To the input of algorithm are adjacency matrices.
- Transposition the rows $\boldsymbol{i}$ and columns $\boldsymbol{j}$ take place within node classes of corresponding partial matrices $\boldsymbol{S_{Ak}}$ and $\boldsymbol{S_{Bk}}$ and leaded to isomorphism recognition with exactness up to substitutions of nodes.
- Isomorphism recognition and its time complexity are proved in detail.
- Algorithm handling and presentation of results is an exemplary design.

Our article about the program was firstly published in Ashay's home page as a SERR publication. Later, I understand that our article with Ashay must be complemented with a brief review about the "evergreening" of this problem. A special workshop for presentation the program called *The evergreen isomorphism problem*, was successfully be carried out in February 2009. To end of workshop makes Võhandu a summary on the theme of "Tevet's measure". We took Ashay Dharwadker to member of

SERR: To Ashay I sent photos and a brief description about the last events, to which he very politely responded. It's okay, I was his to advertise.

In the isomorphism workshop: students, J. Tevet, M. Tombak, L. Võhandu and A. Raja.

Our isomorphism program finds various attentions. Some want to show his isomorphism program. The isomorphism algorithm of Blazej Podsiadlo was polynomial. To canonical output of a graph is its *biggest value* that not contains data about the graph, but enable to differentiate these, better as for example 3-cube-codes. It do no realized up to substitutions of nodes. To the canonical output belong after the biggest values also the number of paths, the number of automorphisms and the real time. As the "length" of value depends on the vertex number and coincidence on relation the "lengths" of intersections and full value, then can in principle to measure the similarity of graphs. In original program comparison the sums do not exist. As I have experience with these graphs, the results seem logical and acceptable. Naturally, their essence needed to research.

Yet the problems were continued. The essence of the *clique regularity* needs the complementary explaining. In the corresponding workshop turn out that this theme seems for clique fans very mystical.

What to do with Ulam's Conjecture? Such was the title of a workshop. Own viewpoints were received also from Ashay and Blazej Podsiadlo. Diapason of the standpoints was broad. The correctness and conservatism of Ashay, a bold initiative of Blazej and my systemic approach. Unfortunately was the issue for listener too capacious.

Since I am, along side of the interest to the graphs, arise the idea was to write a commemorative book on our partner Helen Kauksi. All of these deals of the structural analysis of the work of art had improvised from she. We met with her shortly before the establishing of the SERR. For compiling a commemorative book need to gather more information about Helen. Begin searching for the data. I gathered all the materials from the media about her and Helen creations, by asking questions to her colleagues and friends and collected photographs about her and her work. We agreed with one former colleague of Helen on the design of the book and on support application (grant) from the Estonian Culture Capital. All this takes time and a lot of travels. I called this activity to the *Helen's project.*

The main work himself goes in two directions. Firstly, I am to searching the counter-examples for my own beliefs. To this I've rooted out all the examples of the "Graph Atlas" and made contact with some people who are constructed hardly recognizable graph structures (for example, with Mikhail Klin et al.). Unfortunately (or perhaps fortunately?) failed to find any graph in which the structure and its orbits with my semiotic model, I could not identify. The second direction was the formulation of

concepts and publishing the SERR editions. In this time, I write on the theme about the *A 'mystery' of the semiotic invariants of graphs.*

Friday, September 18, 2009. The last days have passed to preparation of the topic "What is a graph," for decade jubilee workshop SERR. The views were presented from Mikhail Klin and Innar Liiv. Ashay remains faithful to the classical definitions. I reported to they about the experimental measurement of the "similarity" of graphs on the basis of the "largest sums" by Blazej. The workshop itself was nice, there were questions and discussion. After Võhandu remembered me, as if I promised to put the celebration of whiskey on the table. I beat equipped with a "Scottich Leader", soda water, just in case a box of chocolates and cardboard glasses. All this was to appropriate.
Today I sent a "report" about workshop to Ashay. .. Meanwhile, I obtain some materials for Helen's Project and can with it intensively deal.

Wednesday, September 30, 2009. Today is the 273rd anniversary of the graphs. Doings started with Helen's project and finish with the problems of Ashay's project "how to construct a self-complemented graph". On algorithms of additional invariants it does not seem to be fascinated. To Ashay liked the Praust's graphs and a link of Helen's artworks on the musical background work. I stabbed Mikhail Klin with the problem of "isomorphism measurement".
On the today's walk, I felt that I am with sitting behind a computer and a horizontal writing and become thick and wheezily, pants, etc. squeezed. Creepy! Nordic walking, or should any other action is required.

Tuesday, October 13, 2009. Ashay newly founded Institute of Mathematics, Gurgaon. Essentially, it is a Dharwadker's Institute of Mathematics which corresponds to the "Dharwadker's Profile". All the members of this worked with him. Have a question about co-operation form between SERR and Institute. I made a proposal to make SERR a Branch of the Institute of Mathematics. He was very willing and I'm happy with it. Here, I'll go here with my structure semiotic to soil, but in India on the surface it could blossom. The founding members of the Institute are Ashay, John, Jüri Martin, Vladimr Khachaturyan, Ashay's brother Vinay and S. Pirzada. The trends of the Institute of Mathematics are mathematical culture, basic research and applications.

We signed following charter:

CHARTER
24th October 2009

- The Institute of Mathematics has been created in collaboration with the Structure Semiotics Research Group S.E.R.R. Eurouniversity, Tallinn, to support the advancement of mathematical knowledge and its applications and to promote and enhance mathematical culture in India and around the world.
- The goals of the Institute of Mathematics are to expand the frontiers of mathematical knowledge through focused research projects and to act as custodians of the copyrights and patents, where applicable, for the research accomplishments of its members.
- The members of the Institute of Mathematics have come together through shared research interests and they aim to continue the dissemination of mathematical knowledge by publishing papers and books, organizing workshops and providing online lectures for the public benefit.

The home page of Institute http://www.dharwadker.org/iom is accurate. Ashay announced gladly that our opus have in Brazil officially comes under scrutiny as the study material and can maybe also have anew printed. Good for you, the Brazilians!

In the night to New Year's was accomplished my old idea to print a treatise on *Creativity in Art and Science* at the Computer. It was written by the so-called with one breath. Later, I illustrated this, and then translated into English. Now treatise added to SERR homepage.

Our EuroUniversity is now to *EuroAcademy* named. We discussed with Jüri Martin about publishing an article collection in co-operation with the Institute of Mathematics.

With *Helen's project* was making a lot. Most of the material I collected on basis of so-called archive data together and got the valuable keepsake fragments from shed former colleagues. This has demands a lot roam around, all it lasted almost the entire 2010th year. It must be published as a correct book, completely illustrated with reproductions. As with all projects of SERR, so also this project no obtained the support of the Estonian Culture Capital. Unfortunately it must issue in the form of an ordinary SERR forms. I must to designs it for own feet. The book contained a number of colorful artwork and arise the financial difficulties. The thing was settled on the basis of the Saaremaa Art studio where was sold one of the larger carpet Helen's and its former colleagues organized the sum to SERR account. In addition to this amount obtained also a support from the parish of Noarootsi (Helen's birthplace). So was the Helen's book published in the 50 copies and for all the necessary institutions and persons distribute. Not only copy remained, wishing to have had more.

The exhibition in the Short Foot's Gallery (18th April 2010), dedicated to 60th birth anniversary of Helen was well organized. It was also in newspaper announced. My contribution was only a large pretzel and a battery of white and red semi-sweeten wine. Besides the traditional textile artists comes also some the other people. As a follow-up event was held, was in 28 April a workshop on the theme on *Creativity in Art and Science*, with the participation of some textile artists. It proceeded normally, although for not all had such a familiar problem.

Helen Kauksi's gobelin *Touch* (2005, 190x190 cm)

<u>Thursday, 30th September 2010.</u> Today is the "graph's day". Yesterday was the 70th birthday of Jüri Martin. Takes place a festive meeting Takes place a festive meeting, where were presented his last monograph. I had presents him a reproduction of Helen's gobelin "Story".
Along of the work I try also clean up the room and found interesting material in the bottom layer of culture, such as in the 1996th a. written by "A sight to the heuristics". I looked it over, I'm satisfied and I think that is embedded in the next SERR's publication "Hidden sides of the graphs". Some days after, I discovered for itself the Rubik's Cube, but not for playing. In it can be very well be explained

the essence of the system, structure and orbit (position), and the relationships between them. To this needs only to compile the "Rubik's graph" and to form it semiotic model.

In the ending of this year begin ta private project *Aussieround* of serrman Erki Tevet. This tour has been described and illustrated with photographs in the site http://aussieround.com where Erki write: *Our trip lasted 82 days. We drove 18800 kilometers. We went though every state in Australia (sorry, without Tasmania). Despite making a long journey, we only saw small part of Australia. This country is very different from Europe and you could experience surprises in every step. Nature's pranks are everyday event here. While being in Australia there were over flood in Queensland and fire in Victoria. I managed luckily to make this trip without any force majeure or nature's interference.* Erki has restored a Volkswagen splitbus (from 1963rd year), with which he tours along the corresponding gatherings. Tour-mans are we both, Erki along the countries, I along the graphs.

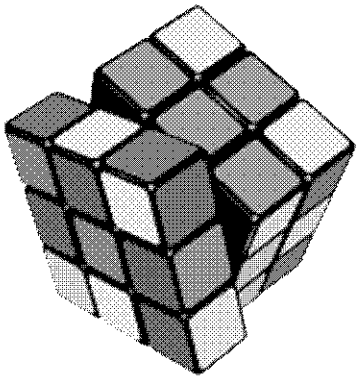
In end of January 2011 had the joint collection of articles of SERR and Institute of Mathematics between the covers of the *Baltic Horizons No. 14 (111) December 2010,* published. It is a nice issue, but with small forming errors.

In the workshop in February on theme *The System, Structure and Graph* I represented this on the basis of Rubik's Cube. I think that this topic is very appropriate to clarify just on the basis of this cubic. After this we had presented our new publications *Baltic Horizons*, Jüri's monograph on *Lichenometry* and my *Hidden Sides of the Graphs.*

What's the difference between such associations or connected sets as a *system, structure,* as well a *graph*. All three consists of *elements* and their *relationships.* The system has *many aspects* where therein have an important role their *empirical properties* of elements and relationships. In case of the system be interested on their *function* and *structure*.

The concept of structure is devalued to a fuzzy adjective of each object. On the other hand, it is sure characteristic of the associations. Structure constitute *an abstraction of the system*, its "skeleton", where its elements and relationships are lose at empirical properties but retain their qualitative distinctness in the form of different *positions* in the structure. Structure (Latin word *structura (inner)building*) is defined as a *connection, permanent relationship* or *organization manner* of system's elements. It is argued that to a *model* (interpreter, explicate) of the structure is a *graph.* All the structural properties are explained by a *graph,* including the *positions*.

Concepts of *system, structure, position and graph* are easily and pictorially explainable on the Rubik's Cube. To this end, let's look at a Rubik's Cube and answer to two questions: 1) Which positions have the elements of the cube? 2) With layers turning changed its structure or system?



- In Rubik's cube has each facet 9 elements, so on all the facets are 6x9 = 54 elements. Each facet has one element in the *middle*, four elements in the *edges* and four elements in the

angles. Thus, the 6 elements of the cube represent a "middle position", 24 elements an "edge position" and 24 elements an "angle position".
- With turning the layers of the cube is *changed the system*, because the relationships between its empirical properties of the elements (i.e. colors) are changed. However, the *structure does not change,* because the *positions are remain*.

Rubik's cube as a system has also the many aspects. If we had adopted to its elements the faces, we would produce a 6-cell system, in case of angles we can obtain a 8-elements and by edges a 12-elements system. The *function* of Rubik's system is derangement and reconstructing of colored facets. The *structure* of Rubik's cube can depict in the form of a *graph*. For example, each element of this cube has four neighbors: "upper", "lower", "right", "left" and can be presented as a graph, where its 54 vertices divide to *the three positions*. As a rule every structure can be presented in the form of a graph and it is intimately related with *invariance* and *isomorphism.*

The thoughts were sent again to the relationship between the *evergreen problem of isomorphism* and *structural equivalence.* I was looking for a specialist for opening this issue. I was recommended to turn to Ilya P. of the St. Petersburg Branch of the Steklov's Institute of Mathematics. I took contact with Ilya P., he was agreed, if all the expenses his and his lady's travel will be paid. Jüri Martin was to agree with this. The workshop's Day in 23rd May was also agreed. I began send to Ilya P. the overviews about the needed materials. I obtain also some sensible questions, to which I had to respond. Then were began small misunderstandings. I not obtained any more questions. In 21th May they arrived to Tallinn. The next day we meet with Ilya P. for agreement what he speaks in the workshop. I began, of course, with the question from what he has understood about my materials. I understood, he has no understanding on this. However, he only silently remarked, that the formulating an opinion is a very time-consuming and costly exercise.

The workshop was held on 23 May in the large auditorium. Jüri Martin tried to fill it also with students. This has predictably named *Evergreen isomorphism problem* was from Ilya P. crossed out and was replaced with the name of *Isomorphism disease in XXI Century*. His presentation was a usual treatment on this theme. Luckily Võhandu and Liiv had able present him some questions. The farewell with our high guests was in Rector Martin's office where the money was given to them. With this was our experiment realized.

It seemed that the workshops in this form have now been exhausted. I was again dived to the environment of *Wikipedia.* To Estonian Wikipedia I had introduced the first article about graphs a few years ago. It was the *Graph Theory* itself. To this was suitable a report in the chamber-conference, for which was preceded a looking through of the corresponding material. It exists there to today, almost the same. Wiki articles have not the author, are the "users", who be allowed to adjust and supplement the articles of other "users" and open new ones. I acted there by user name *Канеюку*. I had started and completed dozens of them. Aside of graph's articles I've presented there also my good acquaintances Ashay Dharwadker, Helen Kauksi, Frank Harary, Regina Tyshkevich, Ants Tauts and favorites Julius Petersen et al. In the memory is the story with Königsberg's bridge problem. When I tried to do it, then clicking on the Königsberg was showed Kaliningrad with Moscow Prospect and others such. I was surprised, because in Wikipedia of German, English and Russian such stupidity does not occur. Decided to write an article about the Königsberg (Prussia) which remained in place to today. The writing of Article itself, of course, was a big job. I had to use Knaurs Lexikon, materials of Wikipedia in German and Russian etc. It also demanded correction of some of the other articles, such as L. Euler is not engaged in the logistic problems of Kaliningrad, K. E. von Baer did not work in the meantime not to Kaliningrad university etc. About the contacts with Wikipedia could write a whole story. Wikipedia itself is of course praiseworthy endeavor.

<u>Wednesday, 21th September 2011.</u> Today was the penultimate, 39th workshop. I started with presentation of the books, in particular, of course, Ashay's opuses Graph Theory, The Four Colour Theorem and The Grand Unification, and next to them my Helen's book. The last book and also the

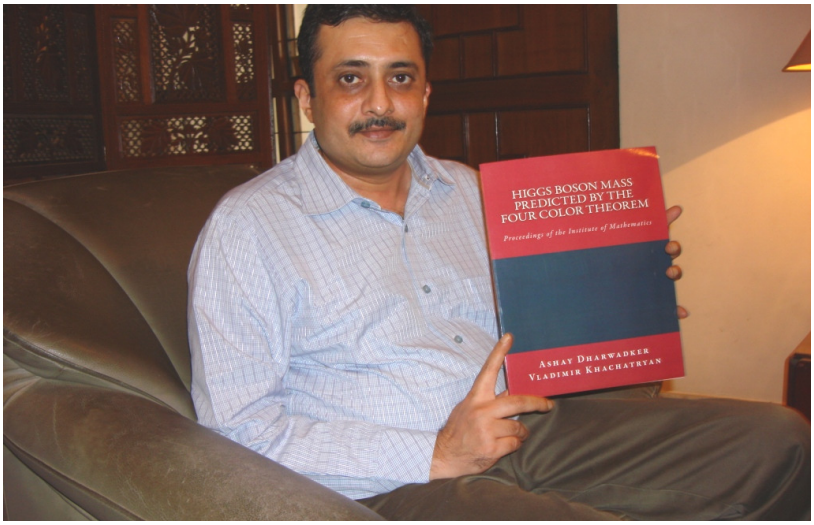
Graph Theory had of a great interest. The main theme of the workshop was the Semiotic Modeling of the Graphs. I hope that for this group of people was something clarified.

Semiotic Modelling of the Graphs constitute an expanded treatment and *application of sign matrices*:

- Ascertainment the graph's structure (semiotic model) of graphs with exactness up to orbits and isomorphism. Studying the properties of regularities, symmetry, orbit structures, structural equivalence (isomorphism) and other "hidden sides" of the graphs. Structure ***S*** is a function of the graph ***G***
- Ascertainment the graph's systems. The system of graphs is a set of graphs with ***n*** nodes, where are fixed the morphisms ***F*** between the elements, i. e. graphs. Studying the structural and probability properties of these systems. Graph's system is a function of the structures ***S***

For example, starting from a complete graph (or empty graph) is generated by corresponding algorithm all the 572 morphisms (and their probabilities) between 1144 binary orbits of 156 graphs (structures) with 6-vertice

The idea of Ashay Dharwadker's new, elegant proof of the four color theorem was at the beginning not a well to understanding, but just in it base managed to express one physics problem.



A. Dharwadker shows his, with V. Khachatryan published book *Higgs Boson Mass predicted by the Four Color Theorem.*

Mathematics Institute has issued twelve prints. We do have common understandings and "products" (publishing) with Ashay, but on some issues we are still different views. Perhaps, will be succeeded his better in the boat of semiotic modeling to pull.

But then had emerged the "Spanish graphs". Orthodox señor José Luis L. P. had found available on the Internet our Graph Isomorphism Algorithm, which was impudently called to polynomial. Worse still, they did not detect isomorphism. He sent a contra-example of two 44-nodes of a graph where really most of the so-called consumer programs ascertained the isomorphism. But our program and semiotic models have ascertained the structural difference. Thorough examination of these graphs explained that these are indeed isomorphic. In some time, I thought it was a mistake of our program. All signs, however, showed another. I started to explore the historical paper about the *1- and 2-isomorphisms*, i. e., the "weak" and "veritable" isomorphism", written by Hassler Whitney in 1932. The current impression is that the isomorphism is weaker than equivalence structures, because the first no ascertain differences between the orbits. But, the structure *S* is the *result of deep-measurement of the graph G*:

Signor P. argues that these graphs G_A and G_B to have one and the same group *AutG* that has 8 orbits and graph G_B obtained by a simple re-numbering of the graph G_A. This cannot be true! There have also been made yet another gimmick, because the structures are different (which they, of course, were disputed). If the graph G_A is indeed has 8 orbits and the graph G_B has 17, then there nothing catastrophic, because complementary orbits contains in the initial orbits. It had controlled in several ways:

- If $\boldsymbol{a, b \subset \Omega}$ and $\boldsymbol{\Omega \subset G_B}$, then $\boldsymbol{G_B \backslash a \cong G_B \backslash b}$. But in case of G_B they are non-isomorphic.
- Isomorphism tested also in foolproof factorial method, but that did not the substitutions.
- It should also be tested in a further the isomorphism by multiplicative, $\boldsymbol{E \otimes E}$ method.

Thus, the graphs G_A and G_B can be takes as *1-isomorphic* but they lacking the structural equivalence as a lacing of 2-isomorphism.

And so we had explain, that with the concept of isomorphism has happened is the same as with the concept of the structure – both are changed. Isomorphism is classically defined as a *bijection that preserves the neighborhood.* Whitney states: *bijection that preserves the neighborhood of + something else.* Ulo Kaasik defines: *bijection that preserves the structure,* which is completely understandable, although it does not define the structure. The structure is related with the *orbits.*

Such was the theme of the latest, 40th workshop in 14th March 2012.

The last events

Tuesday, 15 March 2012. Today I came to understand that the concepts of "structure semiotics" or "semiotic modeling of the graphs" are put in place. This does not mean that the work is completed, there is still a lot of trimmings. Some cooperation would also be welcome. But the reading of the postulates no longer makes sense. Let each shoemaker remain to his trim.

Friday, April 13, I was doing the so-called latest visit to Võhandu. Sharing information was comfortable by the traditional Irish coffee. He talked about the problem of organizing his vocabulary. We also falls to our traditional controversial topic – transitivity – as a property of a digraph and how the property of symmetry. I gave him his last book on the semiotic modeling with dedication. For a moment I had the idea for the project "back to nature", in which will investigated the material of Jüri Martin in a new light. Then I realized that these things for me more not interesting, I must remain by my selected topics.

I went over to a new operating mode: put in order the needed things. I started with the files and come to SERR's website updating.

Then I made an experiment and sent to a few dozen more or less familiar to people the follow message:

Dear colleagues, a remark,

The graphs are many-sided formations, they have a lot of "hidden sides", for researching (ascertaining) of which new methods and algorithms are needed.

Graphs were discovered, and these have been repeatedly rediscovered in the course of solving problems with paths and cycles. This has left a strong mark to graph theory and, in many cases, it limits its development. To hidden remains also the problems of graph's structure. The graph structure is a complete invariant of graph, i. e. such a graph representation attribute, which stay permanent for a class of isomorphic graphs, and only for them.

One of the important attributes of the graph structure are its orbits, i. e. equivalence classes of vertices and pairs of vertices. Orbits and the graph structure as a whole is useful to ascertain in the form of a model, what obtained in the way of deep-measuring and decomposition of the graph (where the obtained orbits coincide with the orbits of AutG). This finding to cause confusion, but is not able to find counterexamples.

Graphs with the equivalent models are isomorphic. The structural equivalence of two graphs is one-to-one correspondence between their orbits of vertices and vertex-pairs. The isomorphism is such one-to-one correspondence between corresponding vertices, which does not recognize the orbits. The model of graph's structure is a complete invariant of the graph (counterexamples cannot to find).

Ascertaining the orbits of the pairs of vertices (binary orbits) in the graph's model makes possible to form the systems of graphs. The system of graphs is a set of graphs with n vertices, where are fixed the relationships between the elements, i. e. graphs. To these relationships are the relations (called morphisms) between a graph G and its largest subgraphs (G\e), and its smallest supergraph (G∪e). To each binary orbit corresponds one morphism (counterexamples cannot to find). For example, starting from a complete graph (or empty graph) is generated by corresponding algorithm all the 572 morphisms (and their probabilities) between 1144 binary orbits of 156 graphs (structures) with 6-vertices.

Thus, here exist three conjectures:

1. *The graph orbits are ascertainable on the basis of deep-identification of vertex pairs.*
2. *The structural model of a graph is its complete invariant.*
3. *The graph systems can be ascertainable by generating the structural models of the graphs.*

For interested party is the base material available http://www.graphs.ee (see version June, 18, 2012). If you wish, you can prove or disprove these theoretical opinions! The first is simpler.

The graphs are a fundamental phenomenon, which does not fit into the existing attributes of discrete mathematics.

Sincerely,
John T. Tevet

I received only one response to this letter where is mentioned that could not understand anything. From this can be draw different conclusions, but I feel that I have to continue.

Discussion

The following improvised discussion is based upon real-life and authentic events. There are two imaginary personalities, a Professor Vertex and a Mr. Edge, added into scenario where take active part in the discussion. There are expressing the views of the local people of the times.

Mr. Edge: *John, I have been following your preoccupations with the graphs for a considerable time period now but I still fail to understand what is it that you are aiming at?*

F. H: *Dear John, and I miss completely the whole idea of yours.*

John T.: *Dear Frank, to some extent that is caused by my poor command of English especially when compared with that of yours. The bulk of your remarks and comments concern the linguistic side of my presentation. For clarification – I have interest to isomorphism problem.*

Prof. Vertex: *I get cautious when I meet graph isomorphism statements. Here we have a yet not solved problem of discrete mathematics that has kept busy mathematicians´ minds for decades though in recent times we can observe a decline in the research due to the lack of innovative fresh ideas. R.Read, D.Corneil and F.Gati have undertaken an analysis of a number of publications on the subject and have come to the conclusion that what is taking place can be called an* ***isomorphism disease.*** *Following this statement many well-known authorities in the graph theory such as N.Christofiedes, K.Thulasiramani, M.Swami, B.Bollobas and many more have dropped the problematic research area.*

O. B: *At our graph theory research centre we have closed the isomorphism-related research out of principle. All the amateurs who were associated with the isomorphic research activities have been fired from the ranks.*

Mr. Edge: *Tevet has engaged himself into activity that was declared a forbidden one already in 1982.*

John T.: *What an interesting attitude! I can't understand how such mind-set has developed amongst so many. Read, Corneil and Gati – despite that what they say in public about the research efforts of those engaged in the isomorphism studies, calling it an illness - do take pains in the analysis of their works. It's clear that there is no consensus about that how to treat the isomorphism problem in graph theory.*

F. H: *A complete set of invariants determines a graph up to isomorphism. No decent complete set of invariants for a graph is known.*

A. Z: *I think that the isomorphism problem can be solved by identifying graph´s ´thickness' density, valences´ cycles and cliques taken as whole in complex.*

John T.: *Isomorphism means also the equivalence of structures.*

Mr. Edge: *What is structure?*

John T.: *Actually, structure is an abstraction of a system (or an object) what constitutes a certain connectivity- or organizing mode of its elements. It does not depend upon the empirical properties and spatial arrangement of elements. The qualitative differences between elements are expressed by the differences in their structural positioning – in their positions in the structure.*

Mr. Edge: *"Structural positions of elements", which bullshit is this!?*

John. T.: *Excuse my, of course I have to explain this. The position constitutes an equivalence class, which coincides with the known concept of the orbit in graph theory. Different are here only ways of detecting them.*

Prof. Vertex: *But what nexus have structure with graph isomorphism?*

John T.: *Structure can be represented by a graph because graph, too, has elements, named vertices, and pair-wise connections, named edges. Structure in its own order generalizes or abstraction of the graph. All isomorphic graphs are structurally equivalent and thus* ***the structure is a complete invariant of the isomorphic graphs.***

Mr. Edge: *How do you visualise to yourself this all-embracing complete invariant of graphs or structure?*

John T.: *Structure is presentable in the form of the positions or orbits of its elements (vertices) and element pairs. A system of invariants of element pairs is ordered to a so called sign matrix S. The matrix formation is the main problem of structure identification and its representation. At this point I must say that structure reveals something of a qualitative and meaning-carrying nature that cannot be disclosed through mathematical apparatus only. That is why I am using here the concepts of sign and sign systems, which I define as* ***structure semiotics.***

Prof. Vertex: *Now, stop a while! People who have encountered graphs before know them as being mathematical objects and they are dealt with, for instance, by combinatorial methods.*

John T.: *Combinatorial methods provide us with quantitative solutions only. For instance, knowing the vertices and the edges that belong to a graph we are able to count the n u m b e r of non-isomorphic graphs or structures.*

C. H: *You'll be getting nothing without applying group theory hereabouts.*

John T.: *I have heard that said before. I have used automorphism groups too. It appears that different structures or non-isomorphic graphs can have one and the same group* ***Aut G.*** *Thus, automorphism group does not represent a complete invariant and I do no find for it any use.*

C. H: *Hmm!*

Prof. Vertex: *You with your structure semiotics will be get stuck to bog. Sure!.*

John T.: *Existence the bogs, is very beneficial to stay balanced. Graph theory needs them!*

Mr. Edge: *You are going too far with this bog's metaphor!*

John T.: *Right you are but it was you who have come out with the suggestive phrasing. What I actually mean is that traditional (customary) graph theory as a non-contradictive formal system is incomplete (non-conclusive), as my experience has proved. As Kurt Gödel already in 1931 – had the occasion to state the solution space must to be sought beyond system's boundaries. Being them even the "bogs".*

Prof. Vertex: *Gödel's theorem is formulated for arithmetic.*

John T.: *That's so, but I find it to be much more universal.*

Krishnamurti: *If you have decoded your problem, follow the solution from this itself, because the problem and its solution not isolated.*

Mr. Edge: *In that case, is your structure semiotics a "rescuing bog"? Can't we live without it?*

John T.: *We can and we cannot. We can in the sense that there is no need to treat my 'local invariants' corteges or codes as signs and thus apply the name 'semiotics' to the whole system. We cannot in the sense that, as experience proves the case to be when a mathematician sees a code he is apt to apply the notion 'vector' to it and is disposed to do multiplying and summing over it, not taking into account the informational or the meaning-carrying function of the latter.*

Prof. Vertex: *Very strange sounding indeed! Do you really want to say that you use a sign system to research graphs? Graph theory it is not that in this case.*

A financier: *Tevet lacks a clear and mathematically sound research concept. We cannot provide a grant for such a project.*

Mr. Edge: *The order is the order!*

John T.: *Gentlemen! Despite the established order, the structure semiotic approach provides new and complementary data about the graphs. I hereby dare to say that enables to treat the graphs from another viewpoint.*

Mr. Edge: *Your 'another vision' of graphs is just that what constitutes your main fault. It would have been better for you to view things as other regular people do, and do not deal with any paragraphs.*

B. B: *Graphs are the objects where the whole productive theory consists in combinatorial treatment of Hamiltonian cycles, networks, random graphs and other such things.*

R. G. B. and T. L. S.: *We believe that fruitfully is the studying of graphs in the aspect of topology.*

O. A.: *Graphs are most appropriate to research in a constructive way.*

A. Z.: *However, the graphs can be considered on the basis of its internal logic and development, in the aspects of combinatorial, algebraic, mathematical logic, linguistics, and systems theory.*

J. G. and J. Y.: *Gentlemen, you have outdated perceptions, graph theory is a branch of computer science.*

L. E.: *About which the "graphs" are you talking about here at all. If I the walking by the Königsberg's bridges had explored, I knew for sure that it is the task of the geometry. Also, your contemporary V. Alekseev thinks likewise so. And why are you now the Königsberg to Kaliningrad called?*

John T.: *You see, every graph theorists has his understanding! Paragraphs, dear Mr Edge no one has yet invented*

C. T: *In general, I would say that any new results about graphs could be regarded as graph theory as long as they shed new light on graphs. The substance is the most important. If you make generalisations just for the sake of generalisations, then most people might not find it too interesting. I wish you good luck with your project.*

R. T.: *Investigation of the graphs on the level of orbits is understandable and sensible. But how Tevet the automorphism groups here passes, is not habitual to me.*

Prof. Vertex: *Will you explain to us why it is necessary to take into consideration 'the meaning' of characteristics in graph theory?*

John T.: *It's the information that characterized the elements of structure, such as their belonging to paths and girths etc. There exist also such characteristics that not have a 'meaning'. For instance, there have been attempts to identify the structure of a graph by multiplying its adjacent matrices repeatedly to a certain degree. The products in this case are said to express the longest distances between vertex pairs.*

Mr. Edge: *Do you want to say that the multiplicative approach is on the wrong track?*

John T.: *The track is right but the way is wrong, because in the case of strongly regular an others types of graphs it is not sufficient to compute such distances only.*

Mr. Edge: *But still why was it so that some people could not understand your viewpoint? There are many who do not want read your publications. What are you pressing at?*

John T.: *Generally speaking, concepts (viewpoints) differ according to that to which caste or clique or party or reference group or school or confession one belongs. Hence, misunderstandings and misreading will never end.*

J. W. G: *We hear only what we comprehend.*

John T.: *As you understand, is here deal with the semiotic modelling of the graphs, what at the usual approach to graphs can present some difficulties. So, to achieve the aim, I use an algorithm which determines the characteristic invariants (signs) for every vertex pair that are further on re-arranged (re-ordered). So obtained a sign matrix or* ***semiotic model SM*** *where the structure is explicitly represented.*

S. L: *The most correct way to ascertain graph isomorphism is by 3-cube codes. If 3-cube codes* $\boldsymbol{C_A}$ *and* $\boldsymbol{C_B}$ *of the graphs* $\boldsymbol{G_A}$ *and* $\boldsymbol{G_B}$ *are the same (they coincide) then the graphs are isomorphic* $\boldsymbol{G_A \cong G_B}$*. Q.E.D.!*

John T.: *It's nice. But the 3-cube codes are so lengthy to use and they do not provide the information about the structure of the graph and its orbits. They do not suit me. The semiotic model presents the structure of the graph with exactness up to orbits and is its complete invariant. The use of them to ascertain isomorphism is not much more complicated than direct use of code's comparison.*

Prof. Vertex: *How can we be certain that the semiotic model is really a complete invariant?*

John T.: *The formation of the semiotic model (or the complete -invariant) is a convergent multi-step process, where at every step there takes place the perfection of the local signs, that is, invariants, up to the moment where new, additional class differentials are not created.*

J. L. L. P.: *I do not believe in anything, and it already because Dharwadker and Tevet praised your isomorphism program to polynomial, which is contrary to current scientific tenets.*

I. P.: *Here is deed with a continuation of the disease isomorphism in 21st century. Nothing else.*

Mr. Edge: *But seem John, how can believe to you! It is Impossible.*

John T.: *Gentlemen, the doubts can be come always, if you seriously observe the dogmatic or prejudiced positions, and no deigns go deep into essence of the thing.*

Mr. Edge: *Think what you wish, but your ambitions are too large – the isomorphism, the orbits, structural equivalence, clique-regularity and more – and all of it at one stroke! Besides you with your structure semiotics have put yourself in self-isolation from the regular research community.*

John T.: *As you have witnessed we are dealing here with the interrelated problems. Why should I split it? As I have already told you beforehand it was the structure identification problem itself that lead me that way. Be attentive, keep your mind open and you'll be getting the ideas of your own for you have not been bound by the paradigms of the graph theory. Apply your own brains!*

Prof. Vertex: *Are you not too optimistic in your belief that the so-called 'small' problems are in your capacity to be solved?*

John T.: *Well. I have progressed in the direction in certain ways. There are things that have become quite clear to me. I doubt not about the correctness of applying the structural approach which has lead me to the formation of sign matrices. Also I think it is all right to use the concepts of orbits and, as well the need to finally establish the identification methods for intersected cliques. I agree that the systems of adjacent structures will bring closer to the solution of the ill-famed reconstruction problem.*

Prof. Vertex: *The **graph reconstruction problem** is the one of the most important and yet unsolved problems in discrete mathematics and graph theory. The problem is known as **Ulam Conjecture**. It is considered to be a very hard problem to solve and it has resisted the solution efforts for more than 50 years.*

F. H: *I expanded the problem to graph edges, as well. The researcher is urged not to try to settle this conjecture since it appears to be rather difficult. Dear John-Tagore, do stop your attempts of yours and listen to my advice – take up the applied side of the graph science, the potential fields of application being biology and ecology.*

V. T: *It is true that up to now there does not exist a general solution of the problem. If we were able to reduce the problem to a conceivable number of finitely identified graph types then we could have applied – by analogy with the ill-fated 4-colour problem solution by K.Appel and W.Haken in 1976 – computational methods. Nowadays efforts are underway in that direction upon various graph types, such as, trees, regular graphs, non-connected graphs, Euler-graphs, cyclic graphs, branched graphs, not-branched graphs etc.*

John T.: *One can never be sure that 'the conceivable number of types' is complete taken from the point of view of reconstruction. As I have pointed out before the Gödel theorem in such a case suggests to looks for solution outside the boundaries of the system. In our case that would have been outside such a 'complete' partitioning.*

Mr. Edge: *Tevet is looking out to get famous by solving the Ulam Conjecture itself!*

John T.: *I have never set it my task to solve the Ulam Conjecture. All of it started when I - while exploring the graph diagrams published by Harary – noticed lack of systemized presentation about them. An interest arouses there above to do some research of my own upon the system of inter-relations between graphs. Structurally taken the graph reconstruction to the initial state is the one of the reversion of the structural elementary changes and their system.*

C. N.-W: *Pooh! All the attempts to prove or refute the Conjecture are speculative! Despite this, the problem still seems far from solution, and a proof or disproof of Reconstruction Conjecture would certainly be hailed as a spectacular achievement.*

Mr. Edge: *Yes, Tevet would have been better off if he'd engaged into the application of graphs in biology.*

John T.: *Will you allow me to proceed? Thank you very much. In meanwhile, for earthing the emotions talking about the **graph's systems**, which represents a set of the graphs*

where between the elements are the relationships be fixed. Each graph G has its largest subgraphs G^{sub} obtained by removing the edge and its smallest supergraphs G^{sup} obtained by adding an edge. Such graphs are together called to adjacent graphs G^{adj}. As already stated, the set of vertices in a graph is decomposed into vertex orbits ΩV *(ie, a type of equivalence classes), where the vertex pairs form one's own orbits* ΩR_n*. The adjacent graphs, obtained by a pair orbit are isomorphic and to form an* ***isomorphism class****. Thus, to each pair orbit correspondences an adjacent structure* $GS^{adj}{}_n$*. These correspondences constitute relations or* ***morphisms*** $F_n: GS \rightarrow GS^{adj}{}_n$ *between the structures. Fixation of the relationships (morphisms)* F *between the structures makes the set of graphs with n-nodes to a system of graphs which is directly related with the reconstruction problem*

W. T. T: *I have taken pains in labouring at the problem of the reconstruction. The idea of isomorphism classes suits me but otherwise I'd prefer to use polynomials.*

John T.: *On the base of the graph's system I want to state is that if a structure* GS *is* ***decomposable*** *into its adjacent structures* $GS^{adj}{}_n$, $F_n: GS \rightarrow GS^{agj}{}_n$, *via its orbits* ΩR, *then there it can be found in every adjacent structure* $GS^{adj}{}_n$ *a so-called opposite (reverse) orbit* $\Omega R'$*. The application of the opposite morphism* $F'_n: GS^{adj}{}_n \rightarrow GS$*, upon it effectively* ***reconstruct (restores)*** *the initial structure* GS*.*

Prof. Vertex: *It is a far cry from the Ulam Conjecture demand!*

John T.: *I clarify: it not coincides with the wording of Ulam Conjecture, but with reconstructions surely. Such is the* ***legitimacy*** *of graph's systems – non-decomposable and non-reproducible structures can not be. The difference is that we are here talking about the isomorphism classes (ie, structures) within which isomorphism detection is pointless.*

V. N: *The graph reconstruction problem has been my concern for a long time. The approach of Tevet has been seen by me as a very uncommon one. Still his original concept is worth of being taken into account.*

John T: *Of course, different structures can have the same adjacent structures. It is sensible here proving the assertion that in case of two different (no-equivalent) structures, each has at least one different adjacent structure. We can accept the viewpoint of Ulam about the reconstruction as a complex of all adjacent graph pair-wise isomorphisms, but from the structural changes system viewpoint there is no point in it. Actually it's misleading and mudding things up. It's clear that it is caused by the habitual vocabulary of mathematics. Gentlemen, do you accept the idea of viewing the reconstruction problem in the view-point of system of structures?*

Silence prevails.

S. H: *May I suggest that here we are having a real case of the significance of a potential discovery?*

Mr. Edge: *You are dealing with very specific problems. What could it be as the most essential research effort result of yours?*

John T.: *It is difficult to measure. When I was hired to work was, I had to do mainly with applications and rummaging with the literature in this area. As a freelance and retired, I have the freedom to do what interests me. It seems that now, simply dealing with a "new discovery" of graphs, and all the story.*

J. M. *As I already in 1973 showed, is graph theory, despite to the progress, in a kind of behind closed state, which has hampered its development. Graph theory research could indeed be more open.*

K. T. and M.N.S. S: *We agree in principle that there exist more than one graph theories and they may differ considerably.*

John T.: *I thank you very much indeed. I presume we have made the initial step forward towards mutual understanding of the problem. As experience shows, are the ones who are not attached to any "only true concepts" to do understand the idea of the structural approach. But I do not expect that someone will "change its faiths." I certainly no change my faiths. Thank you for your attention and meeting dear gentlemen!*

I. S. *Tevet appears to me as a thinker, well, kind of a Hindi style! That might be caused through the influence of his first name! His approach in his field of science – that is actually a little droplet in the vast ocean of mathematical knowledge – resembles the one followed by the Yoga adepts in their treatment of the fundamentals of world perception philosophy. The concentration of mind upon an entity is paramount. This is the essence of transcendence. The more one gets into entity's insides in his meditation the more treasurable is the achievement of finding the Unity with Wholeness, the God. TT is following his course of pursuit of knowledge in the like manner and finds this way his personal wholeness and God-identity. It's his sole and the only way of existentional personality delivery of his personality to the world.*

Prof. Vertex: *It seems that Tevet appears to be a very dedicated and purposeful researcher. Let the God bless many to follow him!*

H. J. *JT is a selfish and egoistic person with his social values turned completely upside down.*

After that was Mt. Edge still some questions to John T

Mr. Edge: *You as a cat who walks on one's own. I had also teases you with an enough degree?*

John T.: *You done rightly, otherwise the silence would be left the nod. Because the isomorphism ascertainers no interested in structural equivalence, the clique-fans no interested in clique regularity, the orbit's investigators in deep identification, the reconstructists no interested in graph systems, the researchers of strong regularity no interested in obtaining these on the level of binary signs, semioticans no interested in structure semiotics, and so on.*

Mr. Edge: *Obviously, you do not like the fact that others are not particularly interested about your ventures*

John T.: *Things are just balanced. Let each shoemaker remain to by its lasts (boot-trees). I do not interested isomorphism recognition only, finding a largest clique only, group theoretic orbit recognition, the wording of Ulam Conjecture etc. The only difference is that I have some understanding about these things.*

Mr. Edge: *So, now on it would be the right moment out to visit a pub.*

John T.: *We invite Prof. Tipp with us, then the kit is together.*

A review of semiotic modelling of the graphs

The ***semiotic modelling of the graphs***. It is a way (manner, technics) for *graph representation* (canonization) with exactness up to *structure* and its properties.

As a rule, graphs are canonized on the basis of polynomials, spectra, 3-cubecodes, and other *global invariants*. Unfortunately such canonization does not contain any necessary information about the structure of a graph, this is not modelling. It is argued that it is possible on the basis density, paths cycles and other *local invariants.* Representation of the graphs by their *automorphism groups* is very fine, but in the case of complicated structures, it is questionable.

Initial principles

Under the ***structure*** be understand the general as well as its cognitive (epistemological) meaning of a structure as a relationship or organizational form of its elements. Unfortunately is the concept of structure is devalued to a fuzzy adjective of each object. On the other hand, it is strict characteristic of the associations.

In each ***system*** have an important role their *empirical properties* of elements and relationships. Each system has its *function* and *structure*. Structure constitutes an *abstraction of the system*, its "skeleton", where its elements and relationships are loose empirical meanings and their diversity is expressed in the form of different ***positions*** in the structure. Structure is presentable in the form of a ***graph*** and is intimately related with ***invariance*** and ***isomorphism***. The structure of a graph is a *complete invariant of isomorphic graphs.* The concepts of the system, structure, invariant and position are easily and pictorially explainable on the Rubik's cube (see page 25).

It will start with a hypothetical, but efficient principle that the graph structure ***GS*** is an *identifiable (measurable)* attribute of a graph ***G***,

$$\boldsymbol{GS} = \varphi\,(\boldsymbol{G}).$$

To identifiers (measures) are the ***invariants*** of specific ***pair graphs*** $\boldsymbol{g_{ij}}$ which characterize the vertex pairs ***ij***.

Isomorphic graphs have one and the same structure. Ascertainment of isomorphism does not mean the recognition of structure, it means only a determination of the *identity* of structures. *Recognition* of the structure involves its *description* with structural signs in the form of a ***model***. Such models contain all the necessary data of structures.

On the base of such models can formed the *systems of structures* $\mathfrak{G}$, it is a function of structures ***GS***,

$$\mathfrak{G} = \Phi(\boldsymbol{GS}).$$

In the system $\mathfrak{G}$ expressed the relationships and lawfulness between the structures. It is directly connected with the problem of ***reconstruction*** of structures.

ψ

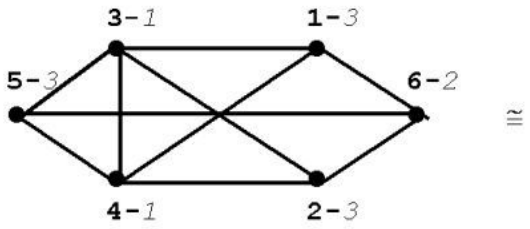
Realization

Corresponding heuristic algorithm **φ** be identify for each pair graph their invariants: the distance ***–d'*** or collateral distance ***+ d***, the number of vertices ***n*** and edges ***m*** in this *pair graph* $\boldsymbol{g_{ij}}$. Acquired quadruplets $\pm\, \boldsymbol{d.n.m._{ij}}$ called ***pair signs***.

The ordered (decomposed) matrix of binary signs is a ***semiotic model*** **SM** that *describes* the structure of the graph.

Ascertainment of the equivalence of structures constitutes a simple method of ascertaining the equivalence of their respective semiotic models.

Example 1. Results of the algorithm **φ**: semiotic models **SM** of two graphs.



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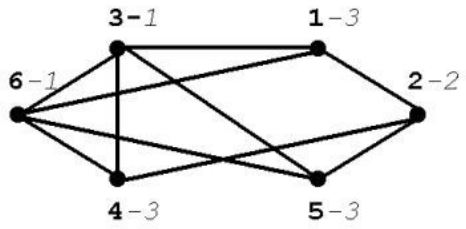


A:-2.5.7; B:-2.5.6;
C:+2.3.3; D:+2.5.7; E:+3.6.10.

1	1	2	3	3	3		u_i	k	s_i
3	4	6	1	2	5	i	ABCDE		123
0	D	-B	C	C	C	3	01310	1	103
	0	-B	C	C	C	4	01310	1	103
		0	E	E	E	6	02003	2	003
			0	-A	-A	1	20201	3	210
				0	-A	2	20201	3	210
					0	5	20201	3	210

A:-2.5.7; B:-2.5.6;
C:+2.3.3; D:+2.5.7; E:+3.6.10.

1	1	2	3	3	3		u_i	k	s_i
3	6	2	1	4	5	i	ABCDE		123
0	D	-B	C	C	C	3	01310	1	103
	0	-B	C	C	C	6	01310	1	103
		0	E	E	E	2	02003	2	003
			0	-A	-A	1	20201	3	210
				0	-A	4	20201	3	210
					0	5	20201	3	210

Explanation for the example 2:

- **a)** Different graphs have here *equivalent semiotic models*, this mean that the *structures are equivalent* and corresponding *graphs are isomorphic*.
- **b)** Graph model be recognize *three vertex orbits* and *five orbits of vertex pairs*, including two "*non-edge"* orbits.
- **c)** The one-to one correspondence between structures is expressed on the level of orbits of the vertex pairs.
- **d)** The pair signs ascertain for each vertex pair its connectivity mode, its belonging to a path, girth or clique with fixed size and so on. For example, ***E: +3.6.10*** means: *the vertex pair belongs to more than one girth with length* ***d*** *= 4.*
- **e)** In common case is the structure recognizable on the level of *initial pair signs*, but in case of some symmetric graphs is necessary to use the *adjusted pair signs*.

Study of the structure is equivalent to a study of its semiotic model **SM**.

Structural equivalence is isomorphism on the aspect of node- and node pair orbits. The number of different structures (i.e. different isomorphism classes) is equal to the number of non-isomorphic graphs. A semiotic model **SM** represents the common structure of isomorphic graphs, i. e. the ***isomorphism class*** of graphs.

The semiotic model constitutes a ***text of structure***, what make possible to explore the ***regularities***, such as *distance-, girth-, clique- and strong regularity.* A most important characteristic of structure is the ***symmetry***. Symmetry is a property of nodes and node pairs *to distribute into equivalence classes (positions, orbits)*. Symmetry properties, i. e. the orbits are recognizable in graph model as the *equivalence classes of pair signs*. These have an essential role in research of the graph structures. It can be argued, that each sign class coincide with a *transitivity class (orbit)* of node pairs. Thus, a simple method replaces the conventional method of studying the full *graph automorphism* ***AutG.***

The *node orbits* as well as the *vertex-pair orbits* are easily recognizable, including the last of the *edge-* and *non-edge orbits*. A *classification of symmetry properties* has been developed on the grounds of

some characteristics (the number of orbits and their power). This provides a way to *measure* the symmetry and also the asymmetry of the structure.

To each orbit of vertex pairs corresponds a ***sign structure***. It is formed on the basis of the vertex pairs of its orbit, and is a mean for studying the "hidden" properties of structure. For example, one of sign structures of Folkman graph is Petersen graph, etc.

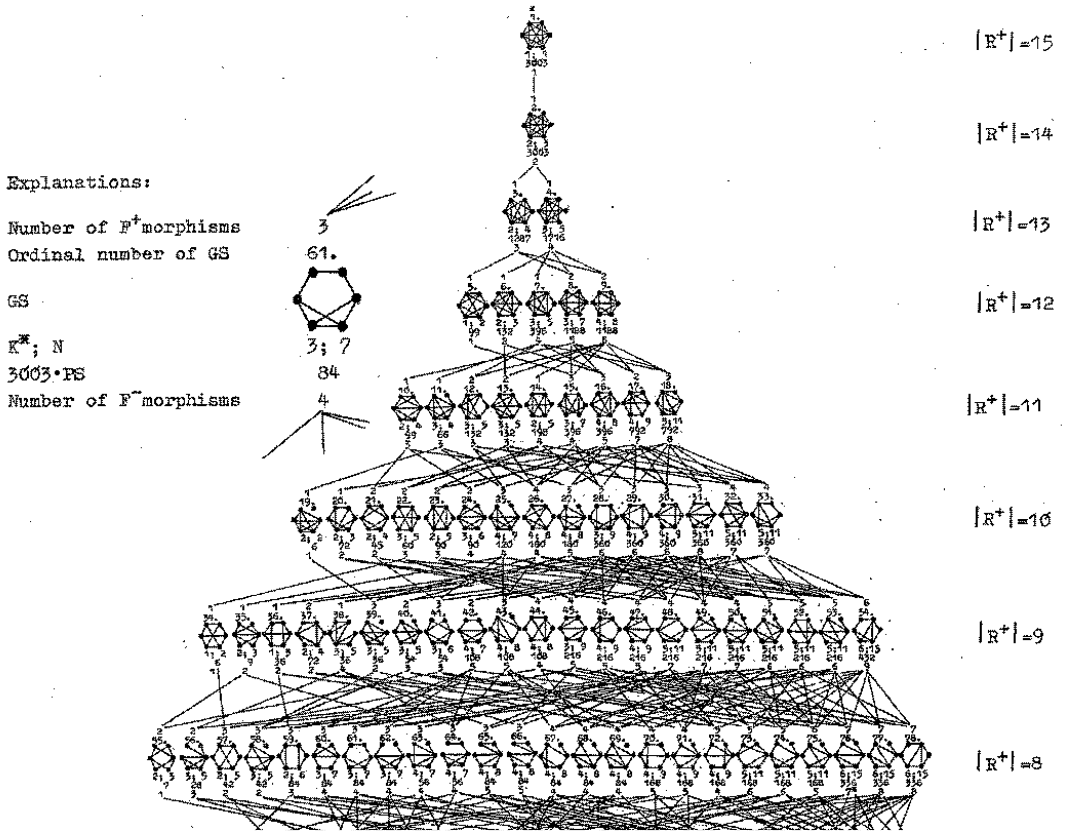
Development: the graph systems

Graph system $\mathfrak{G}$ is a set of graphs, where the relationships between the elements are fixed. Much work has been done in the field of graph enumeration according to the number of vertices and edges. Nevertheless, these cases do not constitute a system, because there is not a fixed relationship between the elements (i. e, between the graphs). These relationships were found in subsequent studies.

The algorithm **Φ** found the relationships, i.e. *adjacency relations* between structures. To each pair orbit in **SM** correspondence an ***adjacent structure*** GS^{adj} that obtainable by removal or adding an edge of a pair orbit. And so each structure (graph) has its own adjacent structures (-graphs). i. e. the largest substructures (-graphs) and smallest superstructures (-graphs). The number of *adjacent structures* GS^{adj} is equal to the number of the pair orbits, the number of *adjacent graphs* is equal to the number of vertex pairs. Thus, to each vertex pair orbit n correspondence an adjacent structure $GS^{adj}{}_n$. An adjacency relation that transforms structure GS to its adjacent structure $GS^{adj}{}_n$ is called ***morphism*** F_n, where $F_n: GS \rightarrow GS^{adj}{}_n$. Ascertaining the morphisms F between the structures (graphs) transforms a set of graphs to a system of graphs $\mathfrak{G}^{|V|}$ with $|V|$ vertices.

A graph system $\mathfrak{G}$ can be represented in the form of a graph (more precisely – of a lattice).

Example 2. A result of the algorithm **Φ:** the first half of lattice of the graph system $\mathfrak{G}^{|V=6|}$ with six 6 elements.:



Explanation for the example 3:

a) The system $\mathfrak{G}$ has m subsystems by the number of edges.
b) Each graph in this lattice represents their isomorphism class or structure GS.
c) In the example 2 presented equivalent structures are here showed under the number 22.
d) Each structure in the lattice is a largest substructure or smallest superstructure (i. e. *adjacent structure* GS^{adj}) of another structure(s).
e) Each structure can be ***decomoposed*** to its largest sub-structures or ***composed*** to its smallest superstructures.
f) The morphism F is reversible, each adjacent structure GS^{adj} of the graph has a "reverse orbit", where used "reverse morphism" F^{rev} reconstruct the initial structure, $F^{rev}{}_n: GS^{adj}{}_n \rightarrow GS$. The system $\mathfrak{G}$ is directly related with the problem of reconstructions.
g) Each structure is can be ***reconstructed*** by its largest sub-structures or smallest super structures.
h) The *complements* of proposed structures are located symmetrically in the second half of the lattice.
i) The number of structures with six elements is 156, the number of morphisms is 572 and the number of pair orbits is 1144.

Already by W. T. Tutte the *Reconstruction Conjecture* can be considered on the basis of *isomorphism classes of graphs*. It creates a whole new insight to the problem The Reconstruction Conjecture consists here in the question: Can be different structures own the same largest substructures and smallest superstructures, i. e. exactly the same adjacent structures? Think about it!

On the another properties of graph systems

- The ***randomness*** in the system $\mathfrak{G}^{|V|}$ is expressed as a selection of adjacent structures. The ***probabilities*** associated with the *internal diversity of structure*, i. e., with *orbits*.
- Be determined some concrete probabilities, such as: a) ***morphism probability*** PF_n from initial structure GS to the adjacent structure GS^{adj}; b) ***transition probability*** P_{ij} from an initial structure GS_i to a non-adjacent structure GS_j; c) the ***existence probability*** PS of the structure, which characterizes its presence among the other structures of the subsystem.
- Transition probabilities P_{ij} in the system form a ***stationary Markov chain***.
- The sum of the existence probabilities of the structures in a subsystem is equal to one, $\sum PS_m=1$.
- The existence probabilities of the structure and its complement are equal, $PS(G) = PS(\overline{G})$.
- If the structures of system $\mathfrak{G}^{|V|}$ treated as the *states* S_t of a real system in time moments t, then a sequence of morphisms $F_1\&F_2\&\ldots\&F_t$ applied to structures GS,

$$^{F1:}GS_0 \rightarrow {}^{F2:}GS_1 \rightarrow {}^{F3:}GS_2 \rightarrow \ldots {}^{Ft:}GS_{t-1} \rightarrow GS_t,$$

  is a ***succession of structures,*** denoted by SF. Such succession SF constitutes a *dynamic or evolutional phenomenon*, generated by the morphisms F, as the results of internal influences.
- The successions are traceable by the *changes of the output values*, i. e. of the values of structural characteristics.
- The lattice of a system $\mathfrak{G}^{|V|}$ is presentable in the form of semiotic model **SM.**

Summary

It was shown that:

- The structure of a graph is ascertainable with exactness up to isomorphism and orbits ΩV_k, ΩR_n on the basis of (deep)identification of vertex pairs.
- The semiotic model **SM** of a graph contains the necessary information on the structure and will also open the "hidden sides".
- Knowing the pair orbits ΩR_n of graphs and morphisms $F_n: GS \rightarrow GS^{adj}{}_n$ open the way for the formation and investigation the graph systems $\mathfrak{G}^{|V|}$.

Officially known are only the sets of graphs with $|V|$ vertices, but not the systems. Such a system of graphs can be created only by algorithmic, rather, by the semiotic modelling. It is unlikely that someone was trying to get the job done on the basis of combinatorics or algebra, as it lacks the attributes of the establishment of morphisms $\boldsymbol{F}$.

Here can be deal with a rather delicate topic. Firstly, nowadays no exist a satisfactory definition of the structure. Secondly, some mathematicians do not accept the using of “unknown semiotic attributes”. And thirdly, the semiotician no haves interests to the graphs.

A bystander's view: about the creative activity

To end, should remember the thoughts about the imagination of creation activity in art and science. This issue was to germ in the course of ten-year discussions with Helen, until after his death, in one of the New Year night, was typed into the computer. It was a long story, but here made a shorter summary of this.

Creations exist also in outside the art and science. A creation and recreation take place in the nature continuously. To creators are there various cosmic, atmospheric and earthly processes. Are these processes random?

Definitions

Creation as a human activity is a *purposeful undertaking* for accomplishment the new spiritual and material values. Both *art* and *science* is a specific form of human consciousness and -activity for *reflection of the reality.* How the accomplishment of new spiritual and material values coincides with the reflection of reality?

Arguably, the world is reflected in brain in the principle of a *model*. There is no doubt that both artwork and scientific presentation has a characteristic of the model. It must be borne in mind that the model is a product of both a cognitive and creative activities of a human. *To model*, i.e. to create a new reality that is similar to the "primary" reality. Modeling in general, including in art represents the human cognitive and creative (creative) of actions. Tartu-Moscow school of culture semiotics treats arts as a *secondary modeling system*, which uses the means of a primary modeling system (language, speech, image, etc.) in a specific and meaningful way. In science is important the adequacy and precision of model. It should also be borne in mind that the model is the human cognitive activity as well as the creative product. Furthermore, the model includes the concept still substantiality, human-created material texture, without which there can be no art at all.

On the other hand, both art and science are a special *sign system*, which mediates the artistic and/or scientific information to others. To this needs the maker certain *skills*. In scientific sign system is also a secondary modeling system and model, which is densely related with the cognitive approach and a philosophical outlook on life. Its aim is to obtain new knowledge and their presentation (fundamental sciences) and of course their using (applied sciences). Also be distinguished the exact sciences, natural sciences, humanities, frontier sciences and schools of thought.

Art reflects reality subjectively, in connection with human attitude to this, a reality together with value judgments. It is imposed from creation methods, talent, weltanschauung (world view), emotions and aesthetic ideals of the artist. An essential ensign of art is its *interactivity*. Art does not explain anything but it may raise problems. Art is one of the most important ways of *perceiving* the world. *Science should reflect an objective reality* in a rational manner, generalized and systematically, i.e. in the form of a *knowledge system* whereof authenticity to verify and in the practice permanently specify and supplemented. In science is central the transition from discovery the essential relations of relatively simple cause and consequences to formulation the fundamental laws of *being and thinking.*

This could refer to the Latin word ***ars***, which means the *skills*, as well as *art* and *science.*

Human activity of any description, including the creation is induced by its *senses.* To sense organs are only the eye, ear and nose, but to the senses are now listed seven: visual sense, aural sense, sense of smell, sense of taste, tactile sense, sense of balance and temperature sense. *Sensation* is a direct result of the environment's effects. The cognition process begins with sensations that are perceived beforehand, where the individual properties of objects and phenomena (signs!) are directly reflected in

consciousness. Sensation is the only channel through which a person is directly related to the environment. *Perception* is a model, based on the sensation of an object or phenomenon that also depends on the preceding experiences, emotions and thinking. *Consciousness* is the highest form of reflection of reality, it takes for attribute of “highly organized matter”, to reflection of the (objective) world. *Unconscious* constitutes an assemblage of psychic phenomena that stay on threshold of consciousness, but affecting the individual's activities. This has become known through the teachings of Freud. *Attention* to filter out all the information coming through the senses and concentrate to an object of consciousness. *Thinking* is a process of mutual influence between the sentient subject and the cognizable object, in practice, a primary form of the subject's orienteering in reality. Human thinking is related with *language*.

Creativity is expressed first of all in *creative thinking*, it means in the ability to solving the problems, create a new, both on the ideas level and the material world. In most cases this is linked to the ability to find unconventional, original relations also between things and noticed problems where others see only habitude. The borders of creative thinking extend from figural (visual) thinking to the abstract (mental) way of thinking. It is argued that creativity has a necessary *conditions*: a) atmosphere conducive to creativity, in which a person perceives a certain tension, feels that more can not be ignored, b) the creative person must be familiar with this area, but can not get used to the old solutions, c) are usually creative a good friend who supports and criticizes him.; d) criticism and advice to help ideas before release to the public, to the extent necessary to justify e) creative persons surrender at many live-weal and committed to work.

Platon treat creation as a “divine repute”, Schelling and E. Hartmann as “unconscious life-giving breath”, Bergson as a “mystical intuition”, Freud, of course, as an "instinct’s manifestation". In creative process take part all human intellectual power, especially *imagination*, there exist also the elements of *study* and *play.* Creative concentrating is expressed in the tension of willpower and an unique emotional condition (state). Often requires a creative moment so far unknown properties of things and phenomena and the relationship between behavior that reflects a new, capture or detection method. The creative processes are subjectively described in more, also by Henri Poincare. Unfortunately they have not been systematized and compared with each other.

Creativity is enkindled by *inspiration,* as a concentration of all the mental energy, to creation object. This is also supported by *intuition*, as a direct, adversative to logical discussion side and *association*, as an individual's life occurred during the mental link between actions and or conditions, which be expressed by call forth ones by the others.

Broadly speaking, it is divided into visual, auditory, sensory and mental creation. To visual creation are the visual arts as painting, graphic arts, sculpture and architecture, but it also includes the fiber- (fibre-), leather-, glass- and other to "consumer arts" titled branches. Auditory creation is, of course music. Almost in all the arts exists *sensuality*. *Mentality* (*thoughness*) or spirituality must be exists both in visual- and audio arts as well as in literature and science. Unfortunately, this is not always the case.

To create something, it must beforehand *be imagined* or *envisioned.*

The *imagination* is a sensual shape of a object (previously perceived object or phenomenon), the direct influence of the sense organs. According to Pushkin's is the vision or imagination necessary for both the geometry as well as poetry. In the *cognition process* is the imagination anything betwixt between sensuous perception and abstract thinking. The image is an essential element of *consciousness*, because he always associates the concepts of meaning and the spirit of things at the same time, shapes, and gives the opportunity to freely operate the conscious mind of images of objects. The imagination is an ability to create on the ground of impressions the human consciousness the new reprocessing or imaginary depictions of sensuality, which is not present us with the reality. *Fantasy* is an imagination, for which is a characteristic the special power, brightness and eccentricity of the created shapes.

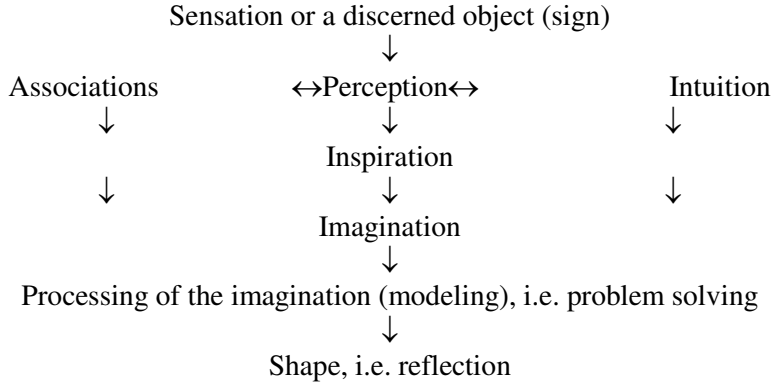
Thus, the *imagination* is a "semi-finished product" of creation on the ground which anything attempt to *imagine*. To imagine can be a picture, a sound, a subject, conception as well as a mathematical expression, algorithm and a proof until they are settled or realized or to *shapes (images) form*. Thus, the creative process begins with arise an imagination and ends with realization or shaping or consummation.

Shape (image) is ambiguous, we are interested in general cognitive meaning of the shape (i.e., in meaning of ~ *image, Gestalt*) as an essential attribute of *creativity*. Delete the following shapes:

- *Visual or "artistic" shape (image)* is a specific to artwork (artistic creation) form and mode of cognition and adjudge for representation of reality. It is a common general category of all fields of arts. Fine art reflects the cognizable and artist's experiences by visual sense perceived visual shapes.
- *Auditory or music shape (image)* represents something with aural sense perceptible. Music is art of intonated idea (thought).
- *Literary shape (image)* is a mode of the art of words, which seeks by word using, word format, conceptual coherence of a particular word, sentencement, a ratio of sounds the expressiveness of language, trope, figurativeness and influentiality. Literary shape is first of all sensuous, especially in poetry. Whit which sense is perceived literary shape? Acceptance of this by visual- and aural sense is not enough.
- *Scientific shape (image)* is first of all *mental* and *abstract* (considered, deep-laid, forethoughtful) and expressed by specific conceptual coherence of words and/or signs. To scientific shapes are concept, hypothesis, proposition, theorem, equation, formula etc.

Mentality (thinking, to render meaning) must be exists in each area of creation. Artistic and scientific shape can be perceived, but not to accept, its idea can be stay incomprehensible. So, as artists, as well as scientist *sense, perceive, think, represent, solves problems and produce.* Unfortunately take for creative persona only *artists, composers, writers* but not scientists. Why? Indeed, not all scientists are creative. But also among the artists, composers and writers can be found those who rather *reproduce*, than *producing,* say, not create.

To key words of creative processes are *a sensation, sense, an association, intuition, perception, inspiration, thinking, imagination, model, heuristics (problem solving) and the shape is perhaps a reflection.*



Both artistic and scientific creative process is *heuristic.* This "algorithm" implies more than the creative attributes also the individual qualities and "taste" of the creator (maker) and various adopted rules and beliefs. Its implementation is limited with the ability of creator.

Finding a solution may seem unawares *(Eureka!)*, although this is actually the fruit of intensive and long-term operation. Good, if creative person in his area also *gifted (talented)* is. Ideally, it is congenital, it has also been achieved through *commitment to professional,* but it can sometimes also *in the training.*

But who is this *genius*? Genius is a creative person who will effectively and a lot of work. An important factor can be heredity. For example, on Bach's house are 16 composers Bach, and the families of Strauss are full of talent. Some are "God created" geniuses. Childhood manifest talents poets, composers (Mozart), mathematicians (N. Abel). Others geniuses are with been slower progress. In childhood were even talentless. Newton had difficulties in school. In case of genius forming plays a role its environment. Creativity predisposed by openness of society, tolerance, diversity of influences, cooperation the creative personalities and so on. Creative individuals must also meet the knowledge, intellectual ability, certain personality and motivation. It was found that creative people take up such subjects, such what others to ignore. They develop it into a meaningful and important.

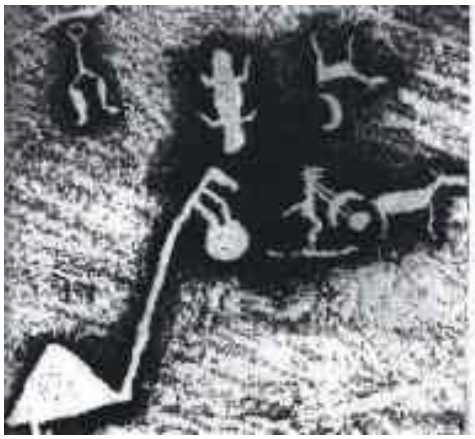
In principle the artistic and scientific creations are indistinguishable. On expression modes is the art very broad – from fine art to poetry, composing and black arts. The field of sciences is also spacious – from exact sciences to the Humanities. It is not excluded the direct contact domains of art and science. At the same time can be in the art and science to find anything such where the creative side disputable is.

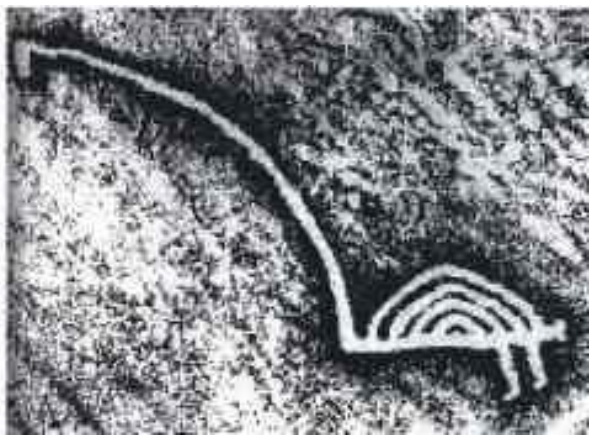
Discussion

As we have seen, the creation is a *deed (act)*, but such that bears "a qualitatively new material or spiritual values". It is difficult to measure, it appraising is inevitably subjective.

Which has arise earlier, art or science? Do cavern-frescos an art or a science? It is after all among the geometric shapes and other unexplained found. Creating something new seems primarily pertain to the field of science. When a human "under the tree had to be", then he think up the tools you need: spear, ax, bow and lever. The invention of the wheel was much later and it was already a great achievement. But it was not still science – it was just the ability to think.

It is alleged that the creations are accomplished on the religious inducements. In the painting caves can be find also the flutes of elephant bone. So, it was not so bleak of that time – had meditated, painted and make music.





Some of the petrographs in Äänisjärve (Karelia). It is asked, are these representations of cosmic objects? Many of the drawings have been noted for their compliance with the constellations. Man has already investigates the world and meditate.

Man reunited with long-term reflection of the world. This prompted him to create a variety of facilities that were supposed to help him to sense it. *Stonehenge* is as works of art and science phenomenon, because it was allegedly linked to the movement of celestial bodies examined. It is also referred to as "calendar computer".

Using the tools was artisanship (craftsmanship, handwork). Artisans (craftsmens) were the smiths: blacksmith, potter, mason, carpenter, and others. Handwork making – *skills* – takes for art. In addition to smiths were to *artists* later also writers, actors, painters, reckoners, musicians and so on.

The boundaries between art and science are in rather vague and variable. For example, the motto of Swedish Royal Institute of Technology (KTH) is "Science and the Arts", which no means that the art's cultivation in Technology Institute a very important role has. It is a medieval motto when only *medicine* and *astrology* take for science, whereby *mathematics, psychology, physics, alchemy (chemistry), stonecutting, painting and poetry* peaceably shack up to the arts sphere belonged. Why? Quite well known at the time was only the human body and firmament. The skills of mathematics, psychology, physics and other areas were rather inexplicable and no-systemized and each maker does without guidance.

In the initial years of computing skills were very popular writings à la "Art of programming" – and for the same reason, it was a set of inexplicable and no-systemized skills. Even now, it seems that IT is in one side in the science, the other side in the "art" on the meaning of their emerging skills. If various researchers have interpreted one and the same phenomena differently, the where is there attributed to science objective truthful, not to mention trying to systemization.

The creation both in art and science is the *sensuous activity.* Thus, both artistic and scientific creation is a directed, conscious and mindful (meaningful) activities, be aimed to shaping (imagine) an object. Both the scientist as artist touched in its creation with *analysis, abstraction, and synthesis.* But amongst artists and scientists are also found also those who reproduce, rather than create. Both art and science is fragmented, there is a whole range evens of niche-typical.

The main difference is considered that the artistic creation can to set up the problems but scientific creation strives to explain them.

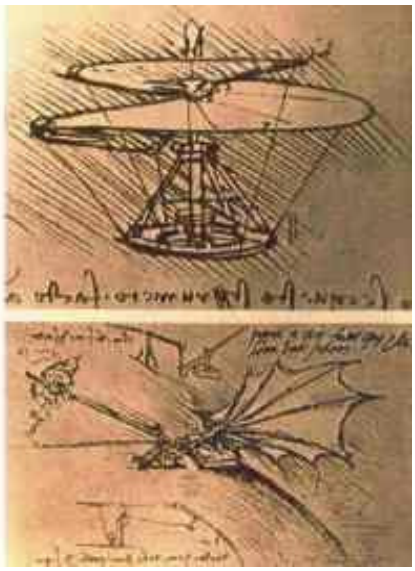
Artistic and scientific creation is divided first of all into *different imaging modality or shaping (images)* of the objects. Visual-, aural- (audio), literary- and scientific shapes (images) are quite different phenomena. If the first works only on the sight sense, then the aural is a shape of the intoning of an idea. Both the literary and scientific shapes (image) use the sight and/or aural sense. Of course, these shapes (images) may be a lot more to unravel. The most important difference exists between the visual and scientific shapes (images), for example, the visualists does not recognize the isomorphism problem, etc.

After the collapse of the Roman Empire dominated in Middle Ages, the architecture as Romanesque and Gothic styles emerging in height with the correlation of copper glazing. In mental life and science was dominated mysticism. Antic sciences were systematized to "seven free Arts" such as grammar, geometry, astronomy, music, metaphysics, etc. Sought links between religion and science, do well Alchemy and other mystic arts. Opened the universities of Bologna (1119), Oxford (1167), Cambridge (1209). Europe also amount to typography (Gutenberg, 1440). At the end of the Middle Ages was the Central and Western Europe an intellectual and cultural upheaval – *the Renaissance* – a striving for humanitarian and material values.

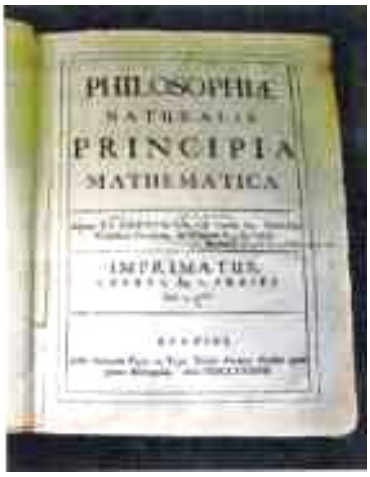
Arts and scientific creation differ from the approach modus, *aspect* and *imagining (shaping) modus* of results. Each object (phenomenon, system) is many-aspect. Each aspect is expressed by its *sign system* (*modeling system*). Artists and scientists trained to cognize very different sign systems. Yet "worse", various artists can be seen in the same object different sign systems, ie to approach on different aspects. So is it also in science. To imagine (to shape) can be only this, what is *perceived* (*observed, recognized*). This that the artist sees something generalized and research sees only "cause and effect" is untenable. Has a musical composition an initial object?

Leonardo de Vinci (1457-1519) has a wide-ranging sight- or sign system – he was a painter, sculptor, architect, engineer, art theorist and nature explorer. He followed the principle of Divine Proportion on

their artworks and makes the calculations for its inventions. In case of its flying machine he unfortunately mistake, they could start to fly until four centuries later. He is particularly valued as Grand Master of High Romans.



In Renaissance era was all seated – the art and science were segregated. Netherlands modern top-painter and graphics Rembrandt (1606-1669) haw a picturesque manner, free paintbrush using and warm palette. His paintings express also research topics, for example *"Dr. Tulp's Anatomy talks"* (1632). At the same age works *sir* Isaac Newton (1643-1727) with an Euclidean pertinacity put in place the principles of mathematics and mechanics (1687), which in school mathematics are hold good, so as Euclidean principles.



The artist sets to work an emerged imagination that it *to imagine* wish, but the scientist its imagination that it *to concretize* wish. A scientist is more *inquisitive.*

Speaking here about *perceiving (sighting)* and *sign systems* means that it is deal with ***semiotics***. The semiotics exist many, both in science and art. Semiotics characterized pluralism. By W. Nöth a *semiosphere* forms by cultural semiotics (Umiker-Sebeok 1977), multimedia semiotics (Hess-Lüttich, 1982), anthropology semiotics (Singer, 1984), philosophy and logic of the relationship semiotics (Klaus, 1963), psycho-semiotics (Ullmann , 1975), medical semiotics, socio-semiotics (Koch, 1971), economic semiotics, folklore semiotics (Bogatyrev, 1937), opera and ballet semiotics, law semiotics, history semiotics, and others. Most of semiotics can be considered as the *text semiotics*. For example, for the signs of medical semiotics are symptoms, by using the diagnosis will be applied. Exist also

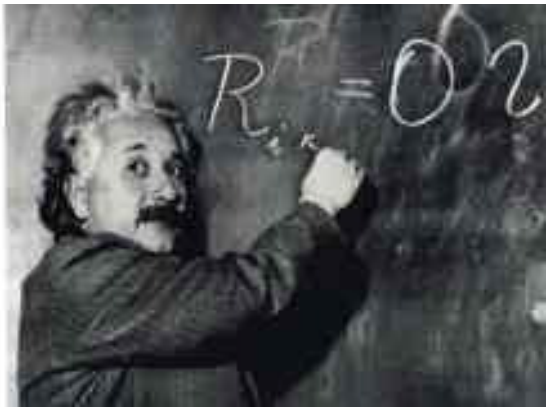
very specific, such as zoo-semiotics (Sebeok, 1963), in which the signs are secretions and smells. Therefore, semiotics is not in any way as only a humanitarian discipline. In W. Nöth's list figure also semiotics of mathematics (Hermes, 1938), one of the previous semiotics at all! The significance of mathematics be expressed in codes and in theirs be contained information.

It can be argued that each independently thinking creative person has its own perceiving- or sign system.

It is alleged that the artistic creation is a subjective imagination of the artist but scientific creation is an objective reflection of the reality. However, so drastic this difference is not. The artist can exhibit in his creation also rationality and objectivity, but scientific creation can not be fully emotion-free and without events of subjectivity.

Some of the *humanities*, such as philosophy, social sciences and history bear the signs of artistic creation, *world-views* and *subjectivity*. Well-known are slogans on the topics "forgers of history" or "rewriting the history". Can be the humans able to by the "historical truth", or should agree to do so but extraterrestrials? Currently it is limited only to the truth of epochs and dateless, but not on the level of their interpretation. *Is the history a science or an art of manipulation?* Such examples can lead others in the humanities field.

To the end of the 19th century are the arts and sciences as well as "crooked". In France had developed various flows of arts, such as impressionism, expressionism, cubism, futurism, and others. For example, fovist Henri Matisse (1869-1908) paintings represented something other than classical. To this time had N. Ivanovich Lobachevsky (1792-1856) the geometry to the negative and G. R. B. Riemann (1826-1866) to the positive side crooked. Albert Einstein (1879-1955) is over when the other remained than by his general theory of relativity (1916) all the space-time to crook.



If the artist sees his objects *externally, as a whole, in general*, it is somewhat *generalist*. By observation of anything natural association (community) can it bewitch its colors and harmony. A researcher can be interested there quite on the inner processes of the same association and its colors and harmony can be stay unnoticed. The researcher's approach to the object may be *narrower, deeper,* this is a *professional* approach. On the other hand, the artist may also be interested in a little detail in this association, if an eco-semiotic(an) there the *general principles* perceive.

As mentioned, in the times of arising the hardware was the information technology only an Art. Attributed to Arts *subjectivity*, and *manipulation with skills* also appears in sciences. For example, the geometries are at least three, and graph theories many. In graph theory cannot go over nor around on the creation of heuristic methods that need various *skills.* On this basis, we argue that there are, for example: "Art of the clique recognition", "Art of isomorphism identification" and so on. After all, there no exists the *objective truth* that is inherent for strict science. In creation a heuristic method must be *thinks and solve a problem*, so as in the case of poetry and literature.

If a scientist of a concrete discipline has attracted on any phenomenon, idea or method that no belong to this discipline, but he find a way for it using – then is touch with a creative *art-phenomenon*, where its inculcating can be *to conduce (promote)* this discipline. Science has grown out of the art and *science evolves by artistic expressions* higher as the art self.

Some researchers can be keen an art creation, and it even efficiently. Amongst the writers and artists are many that be trained to engineers and others. For a fine artist, who has interested in quantum mechanics to hear naught. Is noticeable the music loving of some exact scientists. Between music and science at all, it seems some mutual proximity. Is also know the by Ferenc Liszt write “mathematical notebooks”.

We are takes for the science all that exist between astronomy, mathematics, social sciences and the humanities. However, under Arts we think all the between fine art, poetry and black art.

The end of the last millennium is again tangled relationship of art and science gone. If the concrete poetry cultivating well-known fine artist Raul Meel offers merely *salt*, then the same well-known scientist of parallel programming Clay Breshears offers *arts*. And nor is his one and only. Various *arts* in information technology field to find more than salt package of Raul Meel.

The connection between art and science of art itself is due to the stem. As science is the arts also a reflection of reality, and possesses disposition function. The reflective nature of Art is evident in these fields of arts, in which the artwork is formed on the basis of the reality of the phenomena (visual arts, drama, theater, cinemas). But even in those fields of arts, where the figure is not based on imaging (such as music, architecture, design, choreography) is the world reflected not only subjectively but also objectively.

Over time the artistic creation is done through re-evaluations. If to 20 century was dominated there the aesthetic values, so called “lovely arts” then later is more interested in “social values” and others. For example, the “socialist realism” which is currently simulated in the Jehovah's Witnesses publications. In visual arts were the aesthetic values been replaced with various new “tricks”. These values are still remained in tapestry-, glass and some other fields of “applied arts”.

Scientific creation has always been encouraged by the two opposing sides – the practical needs and the desire of understanding (knowledge, inquisitiveness). If the first be interested everybody then the second only a few.

Conclusions

The activity of artistic and scientific creation is *similar*. Any creation as a sensuous cognition, begin from the *sensations* what with help the *associations* and *intuition* to *perceived can* and by obtaining the inspiration an *imagination* arise.

To imagine can be a *picture, image, a sound, topics, conception* as well as a *mathematical expression, algorithm and a proof* until they are settled or realized or *to shape (image) form*.

Both artistic and scientific creative process is *heuristic*. This "algorithm" implies after the creative attributes also the individual qualities of the maker (creator) and various accredited rules and beliefs. Its implementation has been limited with the ability of the maker.

A verbal heuristic algorithm of creative process could be, for example a derivation and extension of the Feynman Problem Solving Algorithm – for all the makers to know seem condition:

1) Hold your eyes open and senses uplifted, but no happen too straggle. To minimize your appliance loads.
2) If an idea has arisen that to an imagination be ripen, then sketch it (make a rough draft).
3) Make sketches eagerly. Think carefully adjusted, and struggled with his sketches (drafts)
4) If you are pleased with the effort (outcome), then to shape it.

Heuristic-based computer programs have tried to make "the machine creations", such as "Machine Music" and "Machine Tapestries" and other form. However, they were only contributing towards creativity. The former is now used by many contemporary composers, also the "Machine Tapestries" to exist. There are computer programs for the art of building. Flourish is lost "computer graphics", not to mention the variety research software. The attempts for "machine proofs" of the theorems are unsuccessful.

Artistic creation was takes for an immediate emotional and subjective shaping, but scientific creation for rational and objective shaping of reality. Such limit cases naturally exists, but objectivity and rationality can be found also in artistic creation and subjectivity and emotionality be found in scientific creation. The artistic and scientific creations are closely related to each other.

Artistic and scientific creation *differ from its phenomena* to different ways of depiction their objects to *shapes (realizations)*. It can be say that for each sense correspond an art class: to sense of sight visual art, to aural sense sound art (music), to sense of taste cooking art, to sense of smell odor art etc. To the "information carriers" of creation results can be papers, files, film, canvas, threads, musical instruments, languages, stage, props, people, equipment, food, taste and chemical agents, etc.

As we have seen, is science grew out from the arts, its roots are in the arts. There should be something terrible, when we scientific creation to a specific art phenomenon entitle. Scientific creation is an ***object-oriented art of deep-thinking.*** Artistic creation itself is an ***assemblage of shaping-modes of objects.***

Ars (Latin: *art, science, skills*) ***longa*** (*timeless*)***!*** We can here to add: ***Ars mutor*** (*changing*)***!***

In mathematics be found pure creations of a few, all comes down to knowledge and utilization of skills. Creative are the initiations and approaches of Newton, Gauss, Lobachevsky, Riemann, Abel, Hermes, Eilenberg, Collatz&Sinagowitz and many others. Is art necessarily creative? On which side is an artist more creative than an engineer? Some people who have a degree in engineering are well-known artists, some artists are quite successful in other areas, or remain unnoticeable anyway. Fantasy is a creative but do not necessarily provides new real values

List of publications

1. *J.-T. Tevet* Interpretations on some Graph Theoretical Problems. *Estonian Academy of Sciences, 1990, pp 92.*

By SERR published works

2. *J.-T. Tevet* Struktuurisemiootika: struktuursuse kujutamine graafidel. *SERR, Tallinn, 1999, 127 lk.*
3. *J.-T. Teve.* Appendix to Structure Semiotics: A System of Graphs, their Characteristics and Changes. *SERR, Tallinn, 1999, pp 95.*
4. *J.-T. Tevet* Aabits graafide struktuurist, süsteemsusest ja märgilisusest. *SERR, Tallinn, 2000, 92 lk.S*
5. *J.-T. Tevet, M. Lambing.* Visions about skeletions of artworks. – *Frontiers of Interstanding, Stickholm, 2000, 69-73.*
6. *J.-T. Tevet, M. Lambing.* Stockholmis eesti tekstiilikunsti mõõtmas. *"Koiliblikas", 2000, 17.*
7. *J.-T. Tevet.* Graafid ja semiootika. Graafide struktuurikäsitluse keele alused. *SERR, Tallinn, 2001, 97 lk.*
8. *Дж.-Т. Тевет* Графы структуры и структура графов. *SERR, Tallinn, 2001, 17 lk.*
9. *J.-T. Tevet.* Semiotic Testing of the Graphs. Principles, Using, Developments. *SERR, Tallinn, 2001, pp .76.*
10. *J.-T. Tevet.* Isomorphism and Reconstructions of the graphs. A Constructive Approach and Development. *SERR, Tallinn, 2002, pp. 78.*
11. *J.-T. Tevet* Ühe pürgimise ja ponnistuste kroonika. *SERR, Tallinn, 2003, 117 lk., online: http://tallinn.ester.ee/record=b2324713~S1*est*
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13. *J.-T. Tevet* Graafide struktuuritöötluse heuristilised algoritmid. *SERR, Tallinn, 2004, 18 lk*
14. *J.-T. Tevet* Heuristic Algorithms for Structure Processing of the Graphs. *SERR, Tallinn, 2004, pp. 18.*
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16. *J.-T. Tevet* Struktuurisemiootika '04: Aksioomist Otsustuseni. *SERR, Tallinn, 2004, 40 lk.*
17. *J.-T. Tevet* Sümmeetria graafides. *SERR, Tallinn, 2004, 20 lk., online*: *http://tallinn.ester.ee/record=b1985873~S1*est*
18. *J.-T. Tevet* Klikid. kaas- ja naabergraafid: Tunnusmaatriksit lugedes. *SERR, Tallinn, 2005, 26 lk., online: http://tallinn.ester.ee/record=b2009953~S1*est*
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