Seminar of I. Vekua Institute
of Applied Mathematics
REPORTS, Vol. 34, 2008

GEORGIAN LANGUAGE'S THESES [1]

Pkhakadze K.,* Maskharashvili A.,** Abzianidze L.**

*I.Vekua Institute of Applied Mathematics
**Iv. Javakhishvili Tbilisi State University

Abstract. The main topic of the paper is our lingual ideology according to which any Natural Language and Thinking is a result of natural extension of Primary Mathematical Theory. Here, the Primary Mathematical Theory is a formally extendable Euclid type axiomatic theory, whose language is called as Primary Mathematical Language and whose basic notions, axioms, general rules of inference, and general rules of extension are called as Primary Mathematical Concepts.

Keywords and phrases: The natural logic of the natural Georgian language, the mathematical foundation of the Georgian language and thinking.

AMS subject classification (2000): 03B65; 68T50; 91F20.

1. Introduction

In the paper we will discuss only generally, as we call them, Georgian Language's Theses (GL's_Theses) and those theoretical results and ideological views of our researches, which are direct bases of these theses.

Above-mentioned theoretical results and ideological views were obtained through researches, which were current in the confines of scientific aims of Tbilisi State University (TSU) State Priority Program (SPP) "Free and Complete Programming Inclusion of a Computer in the Georgian Natural Language System" in 2000-20008 years.

We call, in this paper, discussing theses as GL's_Theses, because of their main authors are not we, but the Georgian Language (GL) itself. - According to our views these theses are only verbal description of that natural reality, which exists in us by Georgian Language and Thinking (GL&T): **Our role in the formation of these theses is recovering of subconscious part of GL&T, which we call as Subconscious GL&T (SGL&T) and in understanding of GL&T, conscious part of which we call as Conscious GL&T (CGL&T), as a whole system constructed by interaction of SGL&T and CGL&T.**

The theoretical results and ideological views, on the bases of which is formed the GL's_Theses, at the same time, are main bases of one year subproject "Foundations of Logical Grammar of Georgian Language and its Methodological and Technological Application" of the TSU SPP.

The main purpose of this one year subproject is to rich to the complete foundation of Logical Grammar of Georgian Language (LGofGL) as the basis for creating complete Mathematical Theory of Georgian Language and Thinking (MTofGL&T).

[1]This work was carried out with the aims of the State Priority Program "Free and Complete Inclusion of a Computer in the Georgian Natural Language System" (2003).

Besides already mentioned in the paper we will discuss those deep natural specifics of GL&T, which play main role in the formation that of our lingual ideology, according to which **in any human by the help of his/her native language existing lingually given and logically developable conscious knowledge is based in he/she on subconscious level universally existing Primary Mathematical Theory (PMT), which, in turn, is a theory constructed on the bases of Primary Mathematical Language (PML) and Primary Mathematical Concepts (PMCs).**

The fact that till today there does not exist MTofGL&T, without working out of which it is impossible to construct basic Georgian Intellectual Computer System (ICS), makes evident as the very high scientific novelty of researches defined by the TSU SPP, as well as the very high actuality of mentioned researches.

More than fifty years open research process goes on in order to create ICS. The aim of these processes is to construct such computers with which the users in the case of any kind intellectual or imperative necessity will be able to make free and complete communication based only on their native language knowledge.

Today, it is quite clear that the future streaming of world-wide cultural processes can not be considered without active participation of such type intellectual computers.

This makes clear that in case of non-existence of such type Georgian ICS, in near future, Georgians will completely lose ability to take part in the world-wide cultural processes by means of Georgian Language (GL).

High estimation of the TSU SPP was caused by the above mentioned, and, also, this was caused by that circumstance that till nowadays, there are only very few number of Georgian specialists in contemporary mathematical linguistics.

The main cause that GL is not studied from the point of contemporary mathematical linguistics, is late formation of mathematical logic in Georgia. Because of these, Georgian logicians were not involved in the previous processes of Georgian Linguistics researches. - This makes clear why there does not exist MTofGL&T yet.

The local researches for creating MTofGL&T began only about 10 years ago, and from this point there are still very serious problems in Georgia.

Only abovementioned and nothing else explains the fact that in 2006 the University reform rejected the studying process in Logic of Natural Languages and Mathematical Linguistics, which were founded in 2004-2006 years at the University taking into account very high actuality of research aims of The TSU SPP.

Appellate process, which we started immediately, brought us to the result, which was announced on February 7, 2008, and according to which the high actuality of rejected studying process was confirmed one more time. - We hope that in near future once already founded studying process in Logic of Natural Languages and Mathematical Linguistics will return at the TSU.

It is obvious that in the case of non-existence of Georgian specialists in Logic of Natural Languages and Mathematical Linguistics it will be impossible to create MTofGL&T and, respectively, to construct basic Georgian

ICS.

2. About Our Lingual Ideology

From general points, LGofGL is a Montague's Grammar for GL&T and, also, from very general points, in our researches we use Chomsky's methods too. Nevertheless, our methods are basically different from Montague's and Chomsky's ones in their fundamental parts.

This fundamental difference is not result of our persistence or wish, but it is a result of natural specifics of GL&T, and it is clear that it was almost impossible to perform our researches without foreseeing these specifics.

General view on a language of Montague is based on Frege's Mathematical Language (Frege's_ML), which by him was understood as an artificial one. Chomsky was trying to study Natural Languages (NL) only in the confines of the NL. In other words, he was trying to study NLs without using artificial Mathematical Languages (ML).

According to our views, like Chomsky's one, it is almost unfair using elements which are out of that Natural Language and Thinking (NL&T), which we are studying[2]. In spite of this clear fact we do not exclude ML from the lingual researches. But, differently from Montague, we do not consider ML, which we are using, as artificial ML.

Moreover, according to us, any NL&T is founded on PMT, which, as it was mentioned, is constructed on the basis of the PMCs and PML. Sometimes, because of that PML and PMCs of PMT exist in all humans subconsciously, we call the PML as Primary Subconscious Natural Language (PSNL), PMCs as Primary Subconscious Natural Concepts (PSNC) and PMT as Primary Subconscious Natural Theory (PSNT). Because of PSNT (i.e. PMT) is standing at the grounding level of any NL&T (see figure 1), one of the basic aim of our researches is complete recovering of the PSNL (i.e. PML), PSNCs (i.e. PMCs) and by them constructed PSNT (i.e. PMT).

Generally, Prof. Sh. Pkhakadze's Notation Theory (Pkhakadze's_NT), which is a one of the main basis of our researches, is a system of formally extending formal rules of formal theories and languages. At the same time, we call a formal language (theory) without, respectively with, possibility to be formally extended, i.e. developed as formally non-developable, respectively formally developable, language (theory).

In Pkhakadze's_NT, which was formed on the basis of by him defined $\Im$ Sufficiently General Mathematical Language ($\Im_{SGML}$), there are described different type formal rules, which we call as Sh. Pkhakadze's Contracted Rules (Pkhakadze's_CR).

By the help Pkhakadze's_CR one can extend, i.e. develop any $\Im_{SGML}$ type ML in almost any case of developing needed. This means that, Sh. Pkhakadze's_NT gives us scientifically founded understanding of $\Im$ Formally Developable Mathematical Languages ($\Im_{FGML}$ s). At the same time, on the basis of $\Im_{SGML}$ is defined $\Im$ Sufficiently General Mathematical Theory ($\Im_{SGMT}$) and any $\Im_{SGMT}$ together with Pkhakadze's_CR gives us scientifically founded understanding of $\Im$ Formally Developable Mathematical Theories ($\Im_{FDMT}$ s).

In addition, it must be mentioned that if $\Im_{FDMT^e}$ is any extension of any se-

[2]This unfairness is as clear as clear is unfairness of researching one's physical world using elements, which are out of this physical world!

mantically completely solved $\Im_{FDMT}$ and if this extension was made by the help of Pkhakadze's_CR, then $\Im_{FDMT^e}$ is a semantically completely solved theory as well. - Here, non-formally and very shortly, is described Prof. Sh Pkhakadaze's General Semantic Program (Pkhakadeze's_GSP)[3], which is a main result of Prof. Sh. Pkhakadze's_NT.

As a conclusion: Because of any Frege's_ML is a $\Im_{SGML}$ type language and any Hilbert's Mathematical Theory (Hilbert's_MT) is a $\Im_{SGMT}$ type theory, we can conclude that Pkhakadze's_NT equips before existed formally non-developable Frge's_MLs and Hilbret's_MTs with formally developable abilities.

It is widely known, that $\Im_{FDML}$ and $\Im_{FDMT}$ give us very fruitful new possibilities to construct non-simple intelligence systems, but besides of mentioned $\Im_{FDML}$ and $\Im_{FDMT}$ give us scientifically founded new understanding of in humans existing lingual nature and lead us to state following important conclusion:

According to our lingual views any NL&T is a result of step by step extensions of PMT, which together with its constituents, i.e. together with PML and PMCs are in all humans genetically, i.e. universally existing ones and worked, i.e. intellectually act automatically, i.e. instinctually, because of which we say that humans intellectual abilities are much more instinctual, i.e. subconscious datum, then conscious one. - Here PMT is a $\Im_{FDMT}$ constructed on the bases of PMCs and PML, which, in turn, is a $\Im_{FDML}$. This means that according to our lingual ideology any NL (NL&T) is a result of that step by step extensions of PSNL (PSNT), where, in any step of mentioned extensions, the extensions are realized according to extension rules of this NL (NL&T), which rules are some type generalized form of Pkhakadze's_CR. - The truth of above stated general view for GL&T is already sufficiently proved by our researches, and this is a one of the main result of our researches.

Moreover, it is well known that Chomsky's scientific aim was not only mechanical foundation of natural languages, but he aimed to find universal genetic linguistic program too. Also, it is well known, that Montague's scientific aim was not only mathematical foundation of natural English language, but he was aimed to research a universal grammar too. In addition, also, it is well known about Wierzbicka's at-

[3]In more details about Pkhakadezes_GSP: Assume that, $\Im_{n+1}$ is any extension of $\Im_n$ theory with any new word or symbol, were the extension is made by Pkhakadezes_CR. Also, assume that $\Im_n$ is any n-times extension of $\Im_0$ theory, were all extensions are made by Pkhakadezes_CRs. Then, in spite of that $\Im_{n+1}$ theory is lingual richer than $\Im_n$ theory, $\Im_{n+1}$ theory is completely understood, i.e. is semantically completely solve if and only if $\Im_n$ theory is completely understood, i.e. is semantically completely solve as well. This means that $\Im_{n+1}$ theory is completely understood, i.e. is semantically completely solve if and only if $\Im_0$ theory is completely understood, i.e. is semantically completely solve too. This, in turn, means that complete lingual and logical, i.e. mathematical foundation of $\Im_0$ theory results automatically complete lingual and logical, i.e. mathematical foundation of this $\Im_{n+1}$ theory. In addition, one must take into account that from lingual points $\Im_{n+1}$ theory is much more richer than $\Im_0$ theory: It is very important, because of this high lingual wealth of $\Im_{n+1}$ theory gives us new possibilities of constructing new and much more simplified intellectual procedures in $\Im_{n+1}$ theory, than it is possible to make in $\Im_0$ theory.

tempts to find all those lingual concepts, which are sufficient for complete semantic understanding of NLs. On all here mentioned we think that (see figure 1):

As linguistic universals can be considered only constituents of PML and PMCs, bases of which are constructed PMT, which by its different extensions give us all different NL&T.

Above, non-formally and very shortly, is described main ideological basis of our semantic program, which we call as Natural Semantic Program (NSP), and which is elaborated on the bases of natural formal, logical, and semantic specifics of GL&T and Pkhakadeze's_GSP. In addition, it must be mentioned that the NSP and our lingual ideology, which we will summarize below, are completely new and differ with today existing ones: Firstly, we differently from Montague, do not consider ML as from the NLs separately standing artificial language. Moreover, we declare that any NL&T is a result of step by step formal extensions of PSNT (i.e. PMT), were extensions are made n the bases such type extension rules, any of which is a result of natural generalization of Pkhkadze's_CR; Secondly, differently from Chomsky, we declare that in our researches semantics play crucial role, but because of this our attempts to make complete mathematical and mechanical foundation of GL&T do not become unrealizable; Thirdly, the languages, which are understood as NLs, we have understood as Conscious NLs (CNLs) and as Subconscious NLs we have understood the languages, which are understood as artificial MLs; Fourth, we declare that PML, i.e. PSNL is the naturally, i.e. genetically existing universal mediator language[4] between all CNLs.

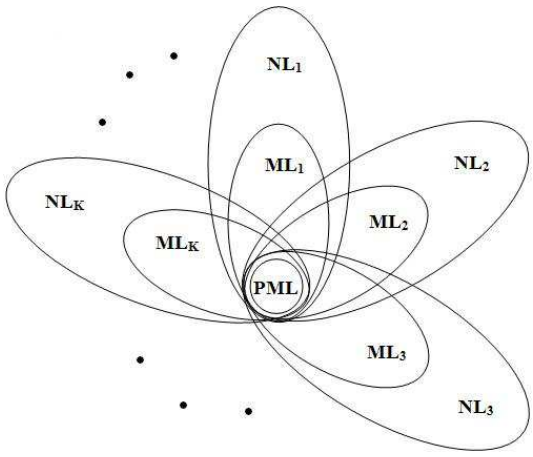

Fig.1.

Now, we are ready to state following important conclusions, which are in close relation to below formulated GL's theses:

1. As it is known, a problem of artificial intelligence and a problem of automatic translation are the most important ones from the cultural point of view. Also, it is known that active researches are performed to find mediator language between various different languages. In spite of this, even today, automatic translator systems are basically constructed for previously taken languages, and while constructing these systems

[4]In the case of non-existence of such PML children would not be able to study a foreign, i.e. non-native language.

they mostly use statistical methods of translation, than exact intellectual translations on the basis of the previews taken universally agreed mediator language.

We say, that the only way to solve completely the problem of automatic translation is to use the Universally Agreed ML (UAML) as a mediator language between the NLs (see figure 2).

In this case, two-way translation connection between two NLs will be available with the help of two-way translation connections between UAML and these certainly taken NLs.

Also, in this case, any NL society will be independently responsible to provide two-way translation connection of its native language with the UAML.

In additions, it must be underlined, that Because of universality of mentioned aims, it is clear, that any specifics of any NL must be in the UAML only in their universally, i.e. mathematically understandable form[5].

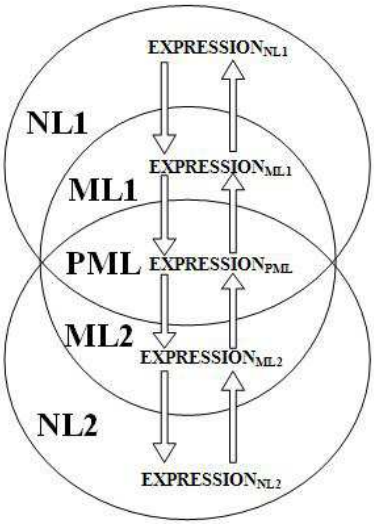

Fig.2.

2. As it is known till Nowadays a problem of semantics is one of the main problems from the pints of linguistics, mathematic and philosophy. Our semantic approaches, which are based above very shortly presented NSP, which, in turn, is elaborated on the basis of Pkhakadze's_GSP, differs from Montague's semantic approaches and bring us to new views on above underlined problem:

According to our views, any NL&T is a natural semantic system and any attempt to understand and represent it as non-semantic formal theory is the way without final result.

At the same time, according to our approaches semantic problem in any NL is reduced to problem of understanding, which, in turn, is reduced to ability to answer the question - what does it mean from lingual points?

[5]It is clear, that without abovementioned mediatory role of the PML, it would be impossible to make strict intellectual transfer, i.e. translation of contents from one language into another one.

If we can define any language expression of any language system on the bases of primary lingual expressions, then we say that the language system is fully understandable and, respectively, only in this case we can say that here is no semantic type problem from lingual points in such defined and organized language system.

In this way, in order to completly solve of the problem of semantic for any NL&T it is necessary to recover completely as in all humans naturally existing PSNT, formal extension of which is this NL&T, as well as to recover completely that naturally existing extension rules, by the help of which are obtained this NL&T.

We declare, that These naturally existing extensions rules are NL&T natural generalizations, i.e. NL&T specifications of Pkhakadze's_CR and they are naturally existing only in those human, which native language is this NL&T.

3. About Natural Specifics of GL and GL's Theses

Now, shortly on those natural specifics of GL&T, which have caused our above shortly described lingual views and ideology.

Firstly, why is not such necessary Church's λ-operator for mathematical description of Georgian words as it is for English words: The reason is that English language is much more non-morphologic language than Georgian language.

Bloomfield's principle of immediate constituents, which is conditioned by the non-morphologic nature of English language and, also, by the English CN type words, which have unfinished nature from the points of syntactic and semantic kind lingual relation, makes impossible to make direct mathematical, i.e. functor/argument, i.e. categorical description of English words without using sentences and different type phrases, only in where they take that syntactic and semantic type lingual specifics, which Georgian words have on the basis of their morphologically realized complete nature.

Because of mentioned, we think, the only way to make functor/argument description of English words is to make this through the λ-abstraction of well-formed expressions of English language.

Moreover, we think that English words, which take their lingual syntactic and semantic value according of their location in the well-formed expressions, have no any functor/argument nature on the non-syntactic, i.e. on the morphologic level! - But because of non-existence of English lingual intuition in us, we have no rights to be categorical in here mentioned. As it already was mentioned, GL is morphologically sufficiently rich and in Georgian there are no words like English words of type CN. This implies that Bloomfield's principle is not acceptable for Georgian and, at the same time, this implies existence of natural possibility to make direct mathematical, i.e. categorical i.e. functor/argument description of Georgian words without direct using Georgian well-formed expressions and λ-abstraction. - We have not only all rights, but also we are obliged to be categorical in here mentioned.

Above underlined very important difference between Georgian and English languages was confirmed at the first stage of our researches.

This leads us make very important insight about Frege's ML and GL: The Frege's ML and GL are languages of one and same general type. This insight was based on the fact of general sameness of Georgian words and Frege's mathematical symbols.

Further researches, which were based on Pkhakadze's NT and his $\Im_{SGML}$, made deeper our already existed views.

In the development of these views, the key role together with $\Im_{FDML}$ and $\Im_{SGML}$ has played, the understanding of Georgian noun phrases as a restricted mathematical variables and/or constants, this, as it seems, it is very specific feature of the GL&T.

On the base of these researches was sufficiently proved the possibility to understand GL's words, morphemes, punctuation marks and word spaces as symbols of $\Im_{FDML}$, i.e. as Frege-Pkhakadze's symbols. This lets us declare following statements as GL's Theses:

GL's First Thesis: Natural Georgian Language (NGL) (more strictly, Natural Conscious Georgian Language (NCGL) is a result of formally extension of PML. GL's Second Thesis: NGL (more strictly NCGL) is a $\Im_{SGML}$ (more generally, $\Im_{FDML}$) Language.

According to our lingual ideology, the natural laws of NGL are in Georgian Written Language (GWL) only partially, these laws are in Georgian Spoken Language (GSL) more completely, and these laws are only in Georgian Thinking Language (GTL)[6], i.e. in GL&T, which, as it was mentioned, consists of and CGL&T and SGL&T, completely and exhaustively. Because of this, in this paper we have understood NGL as GL&T, CNGL as CGL&T, and Subconscious NGL (UNGL) as SGL&T.

4. Brief Comparison of Frege's and Frege-Pkhakadze's MLs and Some Coments About Above Underlined Points

Symbol of Frege's ML (Frege's_MS) is characterized by its placeness, which is indicated by a natural number, but symbol of Frege-Pkhakadze's ML (Frege-Pkhakadze's_MS) is characterized by its weight, which is indicated by a pair of natural numbers.

The fact that σ is a n-place Frege's_MS is denoted by σ^n and it is called as n-place operator. The fact that σ is a Frege-Pkhakadze's_MS of (m, n) weight is denoted by

[6]According to our researches, GWL is completely embedded in GSL, but not vice versa. It was found out that during speaking a Georgian speaker, in order to avoid syntaxes and semantic ambiguity, uses spoken parentheses, and the location of this spoken parentheses is depended on what the speaker wants to say. But, these very important parentheses are not used in GWL. For example, in GWL **Georgian language and logic** is semantically ambiguous because there is no unique restoration of omitted parentheses. Namely, there is two ways to restore parentheses: **(Georgian ((language) and (logic)))** and **((Georgian (language)) and (logic))**. But in GSL a speaker manages to pronounce the same string using spoken parentheses and a listener guesses which version of the string was pronounced. Herewith, not all abilities of GSL are available in GWL. This means that GSL more perfectly represents GTL, than GWL does. Moreover, according to our lingual ideology GTL is ML, which consist of all PMC.

$\sigma^{(m,n)}$ and it is called as operator-sign[7] of (m,n) weight. Herewith:

1. If $m=0$ and $n=0$, then $\sigma^{(0,0)}$ is called 0-ary 0-place operator-sign.

Symbols of this type are as in Frege's, as well as in Frege-Pkhakadze's MLs. Sometimes, these symbols are called as non-operator symbols. Any non-operator symbol is an e type variable, or constant (i.e. objective variable or objective constant) or t type variable or constant (i.e. propositional variable or propositional constant)[8];

2. If $m=0$ and $n\neq 0$, then $\sigma^{(0,n)}$ is called as 0-ary n-place operator-sign.

Symbols of this type are as in Frege's, as well as in Frege-Pkhakadze's MLs. Sometimes, these symbols are called as (simple) n-place operators. Further, sometimes, we will use notation σ^n instead of $\sigma^{(0,n)}$.

Type indicator of σ^n operator is $((\alpha)_n, e)$, or $((\alpha)_n, t)$ ordered pair, where $(\alpha)_n = (\alpha^1, ..., \alpha^n)$ and for any $1 \leq k \leq n, \quad \alpha^k \in \{e, t\}$.

The first (second), element of the type indicator of σ^n operator is called as places type indicator (result type indicator), of the σ^n operator.

σ^n operator is called substantive (relative), if its result type indicator is $e(t)$.

k^{th} element of place type indicator of σ^n operator is called as k^{th} place type indicator of the σ^n operator.

σ^n operator is called as special (logical), if for any $1 \leq k \leq n$ its k^{th} place type indicator is $e(t)$. Frege's operator is a general name for special and logical operators.

σ^n operator is called as logical-special, if it is not a Frege's operator.

Sometimes, the places type indicator of σ^n operator is given by $e^{\{e\}}/t^{\{t\}}$ expression, were $\{e\} \cap \{t\} = \emptyset$ and $\{e\} \cup \{t\} = \{1, 2, .., n\}$. This assume that, if the k^{th} place type indicator of the σ^n operator is e, respectively t, than k belongs to the set $\{e\}$, respectively $\{t\}$.

Herewith, it is easy to understand that places type indicator of σ^n special (logical) operator is $e^{\{e\}}/t^{\emptyset}$ ($e^{\emptyset}/t^{\{t\}}$), where $\{e\} = \{t\} = \{1, 2, .., n\}$.

Let us make agreement of using e^n, respectively t^n, expression as short denotation of $e^{\{e\}}/t^{\emptyset}$, respectively $e^{\emptyset}/t^{\{t\}}$, expression.

Now we are ready to make general classification of simple operators of Frege-Pkhakadze's ML according to which there are next six different type operators (after this, underlined words are Georgian words written in English alphabet):

2.1. $e^n \to e$ type operator, i.e. n-place special substantive operator;
Exm.: (tsiteli(-)) = (red (-)), ((-)mimatebuli(-)) = ((-) plus (-));
2.2. $e^n \to t$ type operators, i.e. n-place special relative operators;
Exm.: [(-)tsitelia]=[(-) is red], [(-)tsers(-)]=[(-)is writing(-)];
2.3. $t^n \to t$ type operator, i.e. n-place logical relative operator;
Exm.: [[-] da [-]]=[[-] and [-]], [tu[-], mashin [-]] = [if[-], then [-]];
2.4. $t^n \to e$ type operator, i.e. n-place logical substantive operator;
Exm.: (vinc[-]) = (who[-]), (rac[-]) = (what [-]);
2.5. $e^{\{e\}}/t^{\{t\}} \to e$ type operator, i.e. logical-special substantive operator;

[7]One of the main differences between Frege's and Frege-Pkhakadze's languages is in that, that, generally, Frege's_MS is an operator, but Frege-Pkhakadze's_MS is an operator-sign. Below we will see that this is really very important difference.

[8]Here t and e are Montague's basic types.

Exm.: ((-)ukharodes[-]), ((-)fiqrobdes[-]) = direct translation is impossible;

2.6. $e^{\{e\}}/t^{\{t\}} \to t$ type operator, i.e. logical-special relative operator;

Exm.: [(-)ukharia[-]]=[(-)is happy about[-]],[(-)fiqrobs[-]]=[(-)thinks[-]];

From above classified operators only the first four occur in Frege's ML, but, as we have already seen, the complete mathematical analysis of GL&T essentially requires all above described ones. - This sufficient operational richness of Frege-Pkhakadze's ML, i.e. of $\Im_{SGML}$ is an important argument of above stated GL's theses.

3. If $m \neq 0$, then $n \neq 0$ and, in this case, a symbol $\sigma^{(m,n)}$ is called m-ary n-place operator-sign, shortly m-ary operator-sign.

If $\sigma^{(m,n)}$ is m-ary n-place operator-sign and $\nu_1, ..., \nu_n$ are so-called operator letters, then $\sigma^{(m,n)}\nu_1...\nu_n$ is called as compound, or complex n-place operator.

Binding indicator of $\sigma^{(m,n)}$ operator-sign is a non-empty subset $\{k_1, k_2, ..., k_j\}$ of the set $\{1, 2, ..., n\}$.

$\sigma^{(m,n)}$ is called as complete (partial) operator-sign, if $\{k_1, k_2, ..., k_j\} = \{1, 2, ..., n\}$ ($\{k_1, k_2, ..., k_j\} \subset \{1, 2, ..., n\}$).

If $\sigma^{(m,n)}$ is a complete operator-sign, then n-place compound $\sigma^{(m,n)}\nu_1...\nu_n$ operator bounds in all its operands all free occurrences of $\nu_1, ..., \nu_n$ operator letters and nothing more.

If $\sigma^{(m,n)}$ is a non-complete, i.e. partial operator-sign with binding indicator $\{k_1, k_2, ..., k_j\}$, then n-place compound $\sigma^{(m,n)}\nu_1...\nu_n$ operator bounds all and only free occurrences of $\nu_1, ..., \nu_n$ operator letters and bounds them only in those operands which are placed in $k_1^{th}, k_2^{th}, ..., k_j^{th}$ operator places.

We have already seen that when six type simple operators are in Frege-Pkhakadze's ML, from them only four are in Frege's ML.

Also, we already have seen, that Frege-Pkhakadze's language almost completely describes various operators existing in GL.

But, it is clear, that all six above described operators can be produced by categorical approaches, founded on basic e and t types.

That is why we do not consider variety of simple operators as main difference between Frege-Pkhakadze's and Frege's languages.

Besides this, as it was already mentioned, Frege's and Frege-Pkhakadze's MLs differ essentially from each other.

Namely, lingual symbol characterized with weight, i.e. operator-sign is that new lingual idea, based of which these two languages are classified as MLs of different types. - There is two way: or $\sigma^{(m,n)}$ m-ary n-place operator-sign is an unfair lingual idea (i.e. concept), or the conclusion made here must be taken into account.

From pure mathematical points of view the high validity of Prof. Sh. Pkhakadze's lingual approaches are confirmed fully. Below, as it was made above, we will concentrate on presentation and argumentation linguistics validity of Prof. Sh. Pkhakadze's approaches:

Our researches let us declare that in languages similar to GL, where non-quantified noun phrases are naturally understood as restriction variables

and/or constants, which area of definition is by them given sets, quantifier words, because of their lingual-logical nature, are understood as Frege-Pkhakadze's operator-signs. In other words, this means that the restricted free and bound constant and variables, which are presented in Georgian sentences by simple and complex noun phrases make unreasonable to analyze Georgian quantifiers using operator approaches that are developed in the confines of theory of Generalized Quantifiers. - At the same time, here is mentioned the especially important argument of above stated GL's theses.

In addition of mentioned, that we use Pkhakadze's operator-sign in mathematical processing of quantifiers of GL, is one of the basic differences between our researches and those ones, which are pursuing today.

It must be underlined that according to our already pursued researches it is proved that above mentioned understanding of Georgian quantifier completely coincides with the natural semantics of it. - This was the one of, but not only argument which made us to use Prof. Sh. Pkhakadze's approaches as main basis of our researches.

Another natural feature of GL&T, which made us to use $\Im_{FDML}$ as basic formal tool of our second stage researches, is the evident existence of Prof. Sh. Pkhakadze's contracted symbols (Pkhakadze's_CS) in the Georgian Language.

For example, in GL simple verbs are obviously distinguishable from verbs of integrated understanding, which are Pkhakadze's_CS, because they are formally defined by simple Georgian verbs according to the Pkhakadze's_CRs. - This is widely characterizing specific of GL.

Moreover, after understanding of GL&T as system obtain by interaction of SGL&T and CGL&T, there was sufficiently proved that almost any word of GL is a Pkhakadze's_CS.

All these reasons together make intuitively clear truth of above state GL's theses and make clear that $\Im_{FDML}$ allows us completely and naturally solve difficulties of semantic study of GL&T and these, in turn, are clear reasons that made us pursue our researches basing on Frge-Pkhakadze's formally developable MLs.

5. Some Examples to More Enlighten Above Mentioned Points

Below we will consider some examples to enlighten our theoretic approaches and the differences, which are between that ours and

classical one.

vashli aris tsiteli	(1)	**es aris vashli**	(2)	**es vashli tsitelia**	(3)
apple is red	(1)	**this is apple**	(2)	**the apple is red**	(3)

1. In GTL full stop of declarative sentences is a contracted, i.e. abbreviated symbol determined as **[S]**. $\_\_\_\_\_$**[S]**$=t$ (S is a sentential variable, t is truth value "true").

2. In GTL the word **vashli (apple)** has dual nature: In (1) the word **vashli (apple)** represents non-proper constant, which we denote as **(vashli)**^{c} **((apple)**^{c}**)**. In (2) the word **vashli (apple)** is a proper constant and it represents the set of all apple, which we denote as **{vashli} ({apple})**. To understand fully the word **vashli**

(apple), it must be mentioned that in (1) the area of definition of it is the set **{vashli} ({apple})**.

3. In CPofGLT the word **aris (is)** is a simple contracted, i.e. lingual expressing form of the well known left-and-right 1-place operator $[\_\__1 \in \_\__2]$.

4. In GTL Georgian word **tsiteli (red)** is understood as set of all red things, which we denote as **{tsiteli} ({red})**[9].

5. In GTL the word **es (this) (kvela (every))** is understood as operator-sign of weight (1,1). It operates on non-proper constant and transforms in proper constant (bound variable). Because of this, we call it as a transformer[10].

6. In GLT the word **tsitelia (is_red)** is a contracted word, which abbreviates lingual form **aris_tsiteli (is_red)**, which, in turn, abbreviates 1-place lingual-mathematical predicate $[(\_\_\mathbf{1}) \in \mathbf{\{tsiteli\}}] = t$ $([(\_\_\mathbf{1}) \in \mathbf{\{red\}}] = t)$.

Below, in the first column, there is given results of reduction of sentences (1), (2), (3) according to reduction methods elaborated on the bases of the new views and results obtained by direct formal-logical description of GL. In the second column, there is given deeper mathematical forms of the same sentences.

(1)	$[\mathbf{(vashli)}^c \in \mathbf{\{tsiteli\}}] = t$		$[a \in \mathbf{\{vashli\}};\ A = \mathbf{\{tsiteli\}}:\ a \in A] = t$
(1)	$[\mathbf{(apple)}^c \in \mathbf{\{red\}}] = t$		$[a \in \mathbf{\{apple\}};\ A = \mathbf{\{red\}}:\ a \in A] = t$
(2)	$[\mathbf{(es(?)}^c)^p \in \mathbf{\{vashli\}}] = t$		$[q \in \mathbf{\{?\}};\ A = \mathbf{\{vashli\}}:\ q \in A] = t$
(2)	$[\mathbf{(this(?)}^c)^p \in \mathbf{\{apple\}}] = t$		$[q \in \mathbf{\{?\}};\ A = \mathbf{\{apple\}}:\ q \in A] = t$
(3)	$[\mathbf{(vashli)}^c[\mathbf{tsitelia}]] = t$		$[a \in \mathbf{\{vashli\}}:\ \mathbf{tsitelia}(a)] = t$
(3)	$[\mathbf{(an\ apple)}^c[\mathbf{is\_red}]] = t$		$[a \in \mathbf{\{apple\}}:\ \mathbf{is\_red}(a)] = t$
(4)	**Every man walks**	(4.1)	$\forall x : (\mathbf{man}'(x) \Rightarrow \mathbf{walk}(x))$
(4.2)	$\forall \mathbf{x} \in \mathbf{\{man\}}:\mathbf{walk}(x)$	(4.3)	$x \in \mathbf{\{man\}}:[\mathbf{walk}(x) = t]$
(5)	**Some man walks**	(5.1)	$(\exists x)(\mathbf{man}'(x)\ \&\ \mathbf{walk}(x))$
(5.2)	$\forall x \in A\mathbf{:walk}(x)\ \&\ \forall x \in \mathbf{\{man\}} \backslash A : \neg\mathbf{walk}(x)\ \&\ A \subset \mathbf{\{man\}}\ \&A \neq \emptyset$		
(5.3)	$x \in A : [\mathbf{walk}(x) = t] \& x \in \mathbf{\{man\}} \backslash A : [\mathbf{walk}(x) = f] \& A \subset \mathbf{\{man\}} \& A \neq \emptyset$		
(6)	**Every student is reading a book**		
(6.1)	$(\forall y)[\mathbf{student}(y) \Rightarrow (\exists x)(\mathbf{book}(x) \& \mathbf{read}(y, x)]$		
(6.2)	$\forall x \in \{\mathbf{student}\}\ \exists y \in \{\mathbf{book}\}\mathbf{:}\ \mathbf{read}(x, y)$		
(6.3)	$x \in \{\mathbf{student}\}\ a(x) \in \{\mathbf{book}\}\mathbf{:}\ \mathbf{read}(x, a(x))$		
(6.4)	$\forall x \in \{\mathbf{student}\}\ \exists y \in \{\mathbf{book}\} : x \in \{\mathbf{reading}(y)\}$		
(6.5)	$x \in \{\mathbf{student}\}\ a(x) \in \{\mathbf{book}\} : x \in \{\mathbf{reading}(a(x)\}$		

Above (4.1), (5.1),(6.1) are classical translations of (4),(5),(6) sentences. (4.1), (5.1), (6.1) are reduction forms of (4), (5), (6) sentences according to our approach based on

[9]The set **{tsiteli}**, differently from the set **{vashli}**, is linearly ordered by redness quality. Also, word **tsiteli (red)** in noun phrase **tsiteli vashli (a red apple)** differs from the same word in the sentence (1): In the noun phrase **red** is contracted, i.e. abbreviated form of $\mathbf{\{tsiteli\}} \cap \_\__1$ $(\mathbf{red}\_\__1$ —— $\mathbf{\{red\}} \cap \_\__1)$, which is left 1-place lingual-mathematical operator. This shows that by word space in the **tsiteli vashli (a red apple)** is assumed well known operator of intersection, when by word space **aris tsiteli (is red)** in the sentence (1) is assumed formal operator of placing by activity of which **tsiteli (red)** is placed in right place of **aris (is)**.

[10]by word space in **vashli aris (apple is)** and **es aris (this is)** are assumed formal operator of placing, by activity of which **vashli (apple)** and **es (this)** are placed in right place of **aris (is)**. Also, in spite that in sentence (2) the word **es (this)** is without its argument in GTL, it is understood together with its assumed argument.

restricted quantifiers. (4.2), (5.2), (6.2) are reduction forms of (4), (5), (6) sentences according to our approach based on restricted existential and universal constants (variables).

R E F E R E N C E S

1. Pkhakadze K. (with co-author), To Direct Formal-Logical Description of Georgian Language based on the Language as a Natural System, IV TIS on LLC, 2001.

2. Pkhakadze K. (with co-author), Towards the Strong Formal-Logical Understanding of the Word Based on the Natural Georgian Language System, Annals of the Kurt-Gödel-Society, Vienna, 2002.

3. Pkhakadze K., About Syntactic Relation Between Words, GEU, Journal "Iveria", Paris, **VII-VIII** (2002 2003), 117-126 (in Georgian).

4. Pkhakadze K. (with co-author), About the Main Ideas of the Direct Formal-Logical Description of the Georgian Natural Language System through One Example, RS I.Vekua IAM, **29** (2003), 11-14.

5. Pkhakadze K. (with co-authors), About the Main Ideas of the Direct Formal-Logical Description of the Georgian Natural Language System Through the Examples, Proceedings of the V Tbilisi Symposium on Language, Logic and Computation, University. of Amsterdam, 2003, 129-137.

6. Pkhakadze K, A fragment of the Georgian Natural Language System as a Set-Theoretic System, GEU, Journal "Iveria", Paris, **X-XI** (2003-2004), 104-116 (in Georgian).

7. Pkhakadze K. (with co-authors), Logical, Programming and Natural Languages - Do They Represent Three Different Types of The Semantic System? - or About linguistic Sing and our Lingual -Logical Points of Views, GEU, Journal "Iveria", Paris, **X-XI** (2003-2004), 220-248 (in Georgian).

8. Pkhakadze K. (with Co-Author), About Main Ideas of Direct Formal-Logical Description of the Georgian Language, Proceedings of I. Vekua IAM, Tbilisi, **53** (2004), 33-40.

9. Pkhakadze K. Pre-verbal Semantic Unit, Problem of Personal Signs, Integral and Non-Integral Verbal Semantics and Incomplete or First Semantic Classification of Georgian Verbs, Additional Course in Modern Mathematical Linguistics, Tbilisi, 2004 (2006), 72-152 (in Georgian).

10. Pkakadze K. (with co-authors), The Logical-linguistics Analysis of the Georgian Lingvo-logical System on the Base of the ϑ Notation Theory, The IV Congress of The Georgian Mathematics, 2005.

11. Pkhakadze K. (with Co-Author), On the Linguistic Relations and Logical Declension in Georgian, S-E Journal "Georgian Language and Logic", **1** (2005), 19-77 (in Georgia).

12. Pkhakadze K. (with co-author), General Quantifier-Predicative Analysis of the Georgian Language and First Experimental Version of the Logical Reasoner for Georgian, S-E Journal "Georgian Language and Logic", **2** (2005), 82-87 (in Georgian).

13. Pkhakadze K. (with co-author), Georgian-German Translator and Syntaxes Type Synthesizer and Analyzer for Georgian, S-E Journal "Georgian Language and Logic", **2** (2005), 88-91 (in Georgian).

14. Pkhakadze K., Abzianidze L., Maskharashvili A. (with co-authors), Fundamental Questions of the mathematical theory of the natural logic of the Georgian natural language system, V RC on NLP of Arn. Chiqobava Institute of Linguistics, Tbilisi, 2007, 42-44.

15. Maskharashvili A., Mathematical Analysis of Some Complex Sentences, TSU Bachelor Thesis, research supervisor Dr. K. Pkhakadze, 2008 (in Georgian: www.gllc.ge).

16. Abzianidze L., Simple Sentence Syntactic Spellchecker Constructed by Mathematical Methods for Georgian Langiage, TSU Bachelor Thesis, research supervisor Dr. K. Pkhakadze, 2008 (in Georgian: www.gllc.ge).

17. Pkhakadze K., Contacted Symbols in Georgian Language, TSU Bachelor Thesis, research supervisor Dr. K. Pkhakadze, 2008 (in Georgian: www.gllc.ge).

18. Pkhakadze K., Maskharashvili A., Abzianidze L., (with co-authors), Some Aspects of the Mathematical Theory of the Georgian Language and Thinking, VI Conference of Arn. Chiqobava IL on NLP, Tbilisi, 2008, 22-24.

19. Pkhakadze Sh., Some Problems of Notation Theory, TSU, 1977 (in Russian).

20. Pkhakadze Sh., A.N. Bourbaki Type General Theory and the Properties of Contracting Symbols and Corresponding Contracted Forms, GMG, Kluwer Academic/Plenum Publisher, **6**, 2 (1999).

21. Jurafsky D., Martin J. Speech and Language Processing, Prentice-Hall, 2000.

22. Hausser R. Foundations of Computational Linguistics, Springer, 1999.

23. Partee B., Meulen A., Wall R. Mathematical Methods in Linguistics, Kluwer Academic Publishers, 1990.

24. Benthem J. Essays in Logical Semantics, D. Reidel Publishing Company, 1986.

Received: 14.06.2008; revised: 29.10.2008; accepted: 26.11.2008.