About Truth and Possible Worlds: Pavel Tichý and His Logical and Philosophical Research*

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SYNOPSIS

This paper is devoted to the brilliant Czech logician and philosopher of language Pavel Tichý (1936–1994) who, after emigrating to New Zealand in 1970 and spending half his life there as a political refugee, committed suicide shortly before returning to his alma mater, Charles University in Prague, as Chair of the Department of Logic in the Faculty of Arts. After tracing a biographical profile of the Czech logician, the paper explains some of the central ideas of Tichý's highly original theory, called Transparent Intensional Logic, while locating it in the wider context of the analytic philosophy of language. The paper concludes by highlighting the role played by Tichý's intensional theory in advancing various disciplines, including artificial intelligence, with the aim of shedding light on the significant contributions of the Czech logician, who has yet to gain due recognition.

This paper aims to shed light on the personality and scientific work of Pavel Tichý, a gifted and original Czech logician and philosopher of language, who gained worldwide fame in the field of philosophical logic.

His personal and professional biography can be read as an example of the pressure and difficult conditions that intellectuals coming from Central and Eastern Europe were exposed to in the 20th century under the communist regime. After emigrating with his family from Czechoslovakia to Exeter, England in 1968, and to New Zealand in 1970, Pavel Tichý became Professor of Logic at the University of Otago in Dunedin,

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* Due to restrictions imposed to prevent the spread of the coronavirus, I could not travel to Otago, New Zealand, to conduct research in the University archive, nor meet with Pavel Tichý's wife, the writer Jindra Tichá. This paper is based on the available literature and a personal interview in Prague with Prof. Pavel Materna, Tichý's lifelong friend, colleague and passionate supporter, in December 2019.

where he spent roughly twenty-five years working in the field of intensional logic. At the end of the communist era, he was invited to return to his alma mater, Charles University in Prague, as Chair of the Department of Logic in the Faculty of Arts. He was considered in the selection process and ultimately offered the position, but before moving to Prague he commited suicide in Dunedin, on 26 October 1994.

The first aim of this paper is to trace a biographical profile of the Czech logician; the second is to explain some of the central ideas of Tichý's brainchild, a theory called Transparent Intensional Logic (often shortened to TIL), while locating it in the wider context of the analytic philosophy of language. It is organised in four parts: 1) a biographical profile of the Czech logician; 2) an anecdote from 1972 that helps to reconstruct the often noted polemical feature of Tichý's work; 3) an outline of Tichý's logical approach to meaning; 4) conclusions.

1. PAVEL TICHÝ'S BIBLIOGRAPHY

Pavel Tichý was born on 18 February 1936 in Brno.[1] He spent his early years in the Moravian cities of Zlín and Vsetín. After finishing secondary school in Vsetín in 1954, he began his studies at Charles University in Prague, where he studied philosophy and mathematics. During his studies, he became more and more interested in logic, a field which lacked a significant tradition in Czech academic circles.[2]

In 1961, after completing his compulsory military service, Tichý returned to the Charles University Faculty of Arts to work as a lecturer in the Department of Logic, where Professor Otakar Zich had formed a group of young logicians, including Karel Berka, Miroslav Jauris, Pavel Materna, Miroslav Mleziva, and Ota Weinberger. Although the philosophy scene of that period in Czechoslovakia was strictly dominated by Marxist ideology (whose principles Tichý, as a student and young scholar, accepted), the political atmosphere of the 1960s and liberalisation gave room for relatively free scientific work in the field of logic. Tichý graduated in 1959, with a master thesis written in German and devoted to the logician Kurt Gödel: *Eine Exposition des Gödelischen Unvollständigkeitsbeweises in der einfachen Typentheorie* ('An exposition of Gödel's incompleteness theorem in the simple theory of types'), published in *Acta Universitatis Carolinae, Philosophica et Historica* in 1962.

During 1961–1964, Tichý worked on his doctoral thesis *Vyčíslitelnost ve vztahu k teoriím* ('Computability and its relationship to theories'), which he successfully defended in 1964, and was awarded the title of CSc. (*candidatus scientiarum*, or 'candidate of sciences') the equivalent of a Ph.D. In the 1960s, he taught several courses on logic at

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1 As Cheyne — Jespersen — Svoboda (2004, p. 25) point out, the famous Austrian logician and mathematician Kurt Gödel was born in the town of Brno too. Unlike Gödel, who came from a German speaking community, Tichý's mother tongue was Czech, as was the cultural milieu where he spent the first half of his life.

2 The lack of a Czech tradition in the area of logic in the 1960s may seem surprising, given that the famous Bohemian logician, philosopher, mathematician, and theologian Bolzano spent his entire life in Prague. In fact Bolzano did not have any important followers among Czech scholars.

Charles University and wrote two textbooks: *Logika pro studující na pedagogických institutech* ('Logic for students in pedagogical institutes'), an elementary textbook, and *Logická stavba vědeckého jazyka* ('The logical structure of scientific language'), containing an original presentation of the syntax and semantics of the simple theory of types.

The freer political atmosphere of 'Prague Spring' in the early 1960s allowed Tichý to establish many contacts with Western colleagues. As a result, he was invited by Geoffrey Keene to the University of Exeter in England. A few weeks before his departure, in August 1968, Warsaw Pact forces invaded Czechoslovakia, ending Prague Spring and beginning the Soviet occupation. The Department of Philosophy at Charles University was closed. Tichý's reaction to this event was radical. He immediately left the Communist Party, which he had joined when he was eighteen, and became a committed anti-communist.

Nevertheless, he was allowed to leave for Exeter, and in 1969 he even received the title of assistant professor at Charles University, with the work *Intension in Terms of Turing Machines and On the Vicious Circle in Definitions: Two Studies in Logical Semantics*.

Once in Exeter, he realised it would be impossible for him to pursue an academic career in the 'normalised' Czechoslovakia, and he decided not to return. Fortunately, his wife Jindra and young son Petr were allowed to join him in Exeter.

In 1970 Tichý was offered a position as a senior lecturer at the University of Otago in Dunedin, New Zealand, by Prof. Alan Musgrave, who had just been appointed professor of philosophy at that university. Tichý accepted the invitation and emigrated with his family by ship to New Zealand, where he became Professor of Philosophy and Logic at the University of Otago in Dunedin in 1981.

Thus began the most fruitful period of his professional life. His papers on logic started to be published in leading journals on logic and logical philosophy.[3]

In 1974–1976, he worked out a system of atemporal intensional logic based on the simple theory of types. This book, entitled *Introduction to Intensional Logic*, remained unpublished.[4]

In 1976 and in 1984, he visited the University of Pittsburgh and University of Arizona in Tucson (United States), having been awarded two long term fellowships. During these visits, he had the opportunity to meet with leading philosophers and logicians, while presenting and defending his own work.

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3   His publications in this period include *What Do We Talk About?* (1975), *Verisimilitude Redefined* (1976), *A New Theory of Subjunctive Conditionals* (1978), *The Transiency of Truth* (1980), and *Constructions* (1986). As Jaroslav Peregrin points out (1996, p. 9), his success getting journals to publish his work was certainly made more difficult by the fact that he often engaged in sharp criticism of generally respected views in his articles.

4   One of the main reasons was that, while publishing the book in the late 1970s, Tichý came to the conclusion that a system of intensional logic cannot enable a satisfactory analysis of natural language if its apparatus is not adequately equipped to capture its temporal dimension. In the following years he developed a new version of his system — which I deal with later in this paper — in which variables for temporal moments (represented by real numbers) were introduced and in which possible world histories (instead of timeless possible worlds) play a crucial role in the semantic framework.

In the years that followed he published a series of important articles, culminating in his 1988 masterpiece *The Foundations of Frege's Logic*, in which he explains the principle of Transparent Intensional Logic, his most important and lasting contribution to philosophy.

Unfortunately, the book was not as well received as Tichý had hoped, and did not earn him the reputation he undoubtedly deserved.[5] Nevertheless, the Czech logician continued his work, continuing to develop his system, and in the 1990s he launched the project of a 'Meaning Driven Grammar' (MDG), whose goal was to provide a theoretical basis for computer-based machine translation of English sentences into a formal language, based on TIL principles.

After the fall of the communist regime in Czechoslovakia, Tichý was finally able to return to his homeland after more than twenty years, and reunite with his old friends and colleagues. In 1992 he spent six months in Czechoslovakia. He was happy to see that Transparent Intensional Logic was known and appreciated (especially thanks to his old friends and distant collaborators Pavel Cmorej and Pavel Materna), not only among young logicians but also formal linguists and computer scientists. His presence gave a new impetus to TIL studies. In early 1993 he was invited to apply for the Chair of the Department of Logic in the Faculty of Arts at Charles University. He hoped his close collaboration with his Czech and Slovak colleagues and his personal influence on Czech students would transform Prague into an internationally recognised center of logic, from which to disseminate the logical-philosophical ideas to which he had devoted his life worldwide. He was offered the position and began planning his move to Prague in early 1995. But there were several setbacks related to the move that deeply upset him, and an unfortunate coincidence of events led to his unexpected and tragic death in a bush reserve near his home in Dunedin, on 26 October 1994. The cause of death was drowning, but the medical examiner was unable to determine the precise circumstances.[6]

2. PAVEL TICHÝ: A FEROCIOUS DEBATER

As professor Pavel Materna recalls, Pavel Tichý impressed him from the very beginning, when he was still a young student of logic at Charles University in the 1960s. According to Materna, Tichý was extremely clever, accurate, and precise, and a perfectionist in everything he did, whether he was learning a foreign language or making a table, debating on a philosophical matter, or writing a paper on the logical structure of sentences.

His extraordinary sharpness as a critic of philosophy can be illustrated with an anecdote told on the webpage of the Department of Philosophy at Otago University:

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5 As Holster (2003) explains, the lack of appreciation and the weak critical reaction to his book can be explained by taking into account the unusual complexity of the formal apparatus he used and the fact that his ideas were too radical to be fully understood by mainstream logicians and philosophers.

6 The circumstances of Tichý's suicide, as well as many details of his life in New Zealand, are depicted by his wife Jindra Tichá in the novel *Death and Forgiveness* (2015).

He was a tough, even a ferocious, debater and since he was also supremely clever, it was very difficult to get him to back down about anything. But the slightest suggestion that some view of his might lend some support to paraconsistent logic would cause him to recoil like a vampire threatened with a crucifix. A high point of his career was in 1972 when Sir Karl Popper visited the Department as a William Evans Fellow. Popper had recently proposed a definition of closeness to truth, which was intended to explicate the intuitive idea that one false theory can be closer to the truth than another. Tichy demolished this definition with a proof that on Popper's account all false theories are equally far from the truth, finishing in a typically downright manner: 'I conclude that Popper's definition is worthless'. There was a pause as everyone awaited the response of the notoriously temperamental Popper. When it came it was remarkably gracious: 'I disagree with only one word of this paper' — its last word. 'No definition can be worthless, when it provokes such a devastating criticism. I hope that Dr Tichy will join me in this project, and produce a better definition than mine.'[7]

In this case Tichý, who was allegedly never satisfied with giving purely negative criticism, went on to develop a theory of 'verisimilitude' with his student and collaborator Graham Oddie. The theory, which aims at solving the problem of how the veracity of scientific theories can be judged, is presented by Oddie (1986) with clear and simple explanations of the concept of the 'logical space' employed by Tichý.

In the following section, I will outline the general logical approach with the aim of better understanding the extraordinary Czech logician.

3. THE FOUNDATION OF TICHÝ'S THEORY

Througout all his professional life, Tichý dealt constantly with two central topics: his theory of Transparent Intensional Logic and his conception of constructions. He developed the first of these topics as early as the 1970s; he began to deal with the second in the 1980s. Both constitute original contributions, and are considered ahead of their time.

Let us first take a brief look at the first of these, Transparent Intensional Logic, which is often shortened as TIL.

3.1. FREGE'S LEGACY

As Jespersen argues, the central question that TIL aims to answer can be characterised as follows: 'what it is that we know, learn, communicate, understand, and are otherwise intellectually related to when we know etc. a linguistic sense' (2004, p. 9).

From the point of view of the history of philosophy, TIL can be traced back to the tradition of 'objectual semantics', generally regarded as originating with Gottlob Frege, the German logician, mathematician and philosopher who played a crucial role in the emergence of modern logic and analytic philosophy. The idea of objectual se-

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7   https://www.otago.ac.nz/philosophy/dept/history.html.

mantics is to define what words mean, i.e. to specify the direct connections between the expressions and the things, or 'objects of reference', a term which is taken broadly to include 'abstract objects' such as concepts.[8]

While conventional accounts of meaning considered expressions to have just one feature (reference, i.e. extension), Frege introduced the view in his famous essay *Über Sinn und Bedeutung* ('On sense and reference'), published in 1982, that there are two levels of 'meaning': expressions in a language, which primarily denote what we might intuitively call 'concepts'; and specific actual things, or actual values (the reference), which these 'concepts' may or may not refer to. This intuition was of paramount importance for the philosophy of language and led ultimately to the development of intensional logics in the 20th century.[9]

Let's consider the following example, presented in Jaroslav Peregrin (1996, pp. 17–18). According to Frege, the expressions 'the first president of the Czech Republic' and 'the author of *The Garden Party*' have the same reference (or extension), i.e. Václav Havel, but differ in their sense (or intension), because the first expression presents Havel as the first president of the Czech Republic and the second as the author of the play *The Garden Party*.

According to Frege, as far as sentences are concerned, they refer to a truth value, i.e. their extension corresponds to a truth value, while their intension is a thought. If we take the sentence 'Václav Havel is the author of *The Garden Party*' and we analyse it with the help of Frege's predicate logic, we get the following analysis: the name 'Václav Havel' refers to an individual; the predicate 'is the author of *The Garden Party*' indicates a function that assigns to every individual who is the author of '*The Garden Party*' a TRUE truth value, and to every individual who is not the author of *The Garden Party* a FALSE truth value; the sentence 'Václav Havel is the author of *The Garden Party*' thus indicates the truth value that this function assigns to the individual named 'Václav Havel'.

While being fundamentally influenced by Frege, Tichý considered his two-level theory to be too simple to represent the mechanism of meaning creation in natural or artificial languages.

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8   This approach is to be contrasted with non-objectual theories of meaning, which typically appeal to the implicit causal processes underlying language use. As is well known, some philosophers interpret the meanings of expressions as mental states (for example Hume), or as behavioral systems of rules for the use of expressions (for example late Wittgenstein), even if the expressions do not explicitly refer to either such mental states or rules of linguistic behavior. On the contrary, objectual semantics focuses on the literal meaning of linguistic expressions; it is therefore a study of the logic of meaning, rather than an anthropological or psychological study. Questions of how we learn, use or perceive meanings are not within its scope.

9   As far as intensional logic (also called intensional semantics) is concerned, the first works were published in the first part of the 20th century by Russell, Church, Gödel, Carnap, Tarski; later, from 1950 to 1970, a growing body of researches in this field emerged. The second part of the 20th century is traditionally dominated by the work of Richard Montague, who published in 1970 the first formal systems of what is now called 'Montague's Grammar'.

In general terms, Tichý introduced a new level, which he called 'constructions', that aims at representing the meaning of complex expressions. According to Tichý, complex expressions (whether they are mathematical operations such as '1 + 3 = 4', or natural language expressions such as 'the red carpet') do not directly 'pick up' intentions, but represent ways of constructing or generating intensions from simpler constructions and intensions. Starting in the 1980s, Tichý started to focus on this constructive dimension of meaning, which was absent in Frege's logic and other intensional systems.

While Tichý's theory is thus an 'objectual' one, inserted into Frege's tradition, his definition and formalisiation of intensionality are deeply innovative.

Before we define 'constructions' (3.5.), the most relevant of Tichý's invention, we will outline the essential concepts of TIL, i.e. intensions and possible worlds (3.2.), Tichý's definition of logic (3.3.), and the sense of the term 'transparent' in TIL (3.4.).

3.2. INTENSIONS, TIME, AND POSSIBLE WORLDS

We have seen that, according to Frege, the meaning of a proposition is a truth value. In Tichý's formulation of intensional theory, unlike that of Frege, it is considered that the truth values of typical propositions can change over time, and are generally only contingent: in other words, they are only the values that propositions take at certain times, and in certain states of affairs. If the world were different, some propositions would have different values to those they actually have. Thus, Tichý's formalisation of the concept of intension is based on the idea of 'possible worlds', a concept which can be traced back to the German philosopher and mathematician Leibniz (1646–1717) and which was intensively debated in the 1960s, in the context of modern modal logic (Kripke 1963).[10] Worlds are conceived in his theory as maximal classes of facts, including all historical facts past, present, and future, about everything that ever happens.

Tichý's great merit has been to formalise the notion of intensionality, proposing a system with a small number of explicit categories (objects): possible worlds, times, individuals, and truth values, enriched with a 'lambda abstraction apparatus'.[11] Moreover, he introduced explicit quantification over worlds.

According to Tichý, to find the value of a proposition, we have to apply it first to a world, and then to a time in the world. For example, if we let P be a proposition, ω the class of possible worlds, τ the class of times, o the class of truth values —

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10   It is notable that Tichý discovered intensional logic independently of Montague, and published his first system (in English) almost simultaneously. Those who know Tichý's work often regard his system as more elegant, simple and transparent from a formal point of view than Montague's, although the essential idea is the same. But unfortunately for Tichý, his theory was first published in 1971, shortly after Montague's papers of 1970, and he has received little credit for his originality (cf. Peregrin 1996, p. 16).

11   Lambda calculus (also written as λ-calculus) is a formal system in mathematical logic for expressing computation based on function abstraction and application using variable binding and substitution. It is a universal model of computation, introduced by the mathematician Alonzo Church in the 1930s as part of his research into the foundations of mathematics.

i.e. {True, False} —, then we can identify the proposition as a specific mapping, from worlds and times to truth values. Tichý separated this mapping into two steps:

$$P: \omega \rightarrow (\tau \rightarrow o)$$

He stated that the actual truth-value of a proposition P at the present time is the extension of P, while P itself is its intension (i.e. the general mapping). So, the intension of a name is a function that assigns an object to each possible world.

In short, to construct intensions, Tichý introduces a precise ontology of intensional entities, which include possible worlds, times, individuals, and truth values, enriched with a lambda abstraction apparatus. As Jespersen (2004, p. 10) states: 'in Tichý's sense of intensionality, […] the logic in question comes with an ontology of intensional entities and the means to logically treat these entities'.

Having explained TIL's intensionality, we can proceed to outline Tichý's concept of logic.

3.3. ON TICHÝ'S 'LOGIC'

Based on Peregrin's explanation (1996, p. 17), there were two dominant conceptions of 'logic' during the period in which Tichý was working. The first took 'logic' to be a language whose expressions have a fix and stable meaning and can be used by the researcher as a framework to theoretisation. This is Frege's and Russell's conception of logic, to which Tichý adheres.

The second approach, which became very popular in the second half of the 20th century for the study of purely symbolic systems, or 'grammars', started from the mathematician Hilbert and took 'logic' to be a formal system which can be modified by the researcher, in order to represent information. This second interpretation remains common in many modern semantic theories.

Tichý was opposed to this second 'formalist' interpretion of logic.[12] While he introduced a number of formal systems to help perform logical analysis, he was not interested in the study of formalism for its own sake. Formal systems were only proposed to help with the analysis of meaning.[13]

TIL's 'logic' is thus a framework that allows the researcher to make an accurate analysis, to compute information, to capture the 'mechanics' of meaning.

In the next section, we will try to define the adjective 'transparent'.[14] In which sense is TIL transparent?

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12 He was especially opposed to a certain dominant line of development in mid-to-late 20th century logic and semantics, which he calls the 'linguistic' tradition, examplified by such 'authorities' as Quine, Montague, Kripke, Hintikka, Dummett, Kleene, Putnam, Dowty, Partee and many others.

13 It is sufficient to take into account the ambitious project he developed in the 90s, Meaning Driven Grammar, which was based on the hypothesis that form and meaning are inseparable and that an adequate grammar must generate not only well-formed sentences but also sentence-meaning pairs in which meanings are identified with logical constructions of TIL.

14 The name TIL is intended as an allusion to Richard Montague's 'intensional logic' (IL).

3.4. ON TIL'S TRANSPARENCY

The first interpretation of 'transparent' in TIL reflects the use of a symbolic system that shows explicitly the logical structure of linguistic expressions.[15]

Contrary to Richard Montague's semantics, Tichý seeks to explain the logical form of sentences with explicit reference to world-time dependencies, using abstractions on world-time indices.

A second, important definition of TIL's 'transparency' has to do with the role of context. Tichý argues that semantic properties are contextually invariant, deviating from Frege and today's formal semantics.[16] In this sense, TIL is transparent because it denies that context (pragmatic or logical) in which an expression occurs contributes to its semantic properties. 'Transparency' is thus contrasted with contextualism.

This leads us to another very important concept in Tichý's theory: the principle of compositionality, which states that: *The meaning of a complex expression is a function of the meanings of its parts, and the way they are combined.*[17]

Tichý draws attention to the fact that simple terms are combined with each other to form complex terms, like in the proposition 'the red carpet' or in the mathematical operation '1 + 2 = 3'. In an objectual theory, such as Tichý's, this means that objects that provide the meaning of simple terms can be combined with each other to generate other objects, which provide the meaning of a complex expression.

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15 In TIL's symbolic system there are two main features: a system of logical types and world-time indices (Tichý 1988, p. 202).

16 As Jespersen points out 'to a greater extent than does Montague's, Tichý's theory belongs to what David Kaplan once called the "Golden Age of Pure Semantics", characterised by such logicians and philosophers as Rudolf Carnap and Alonzo Church. Pragmatic and other contextual features of language are ignored. The focus is instead on all and only those a priori features of language that can be described in a purely logical manner. Issues like language acquisition, understanding, and communication form no part of the story' (Jespersen 2004, p. 9).

17 This principle, originally advanced by Frege, had proven inadequate for explaining the contexts in which natural language expressions are ambiguous, and subsequently abandoned by many philosophers of language (see Carnap 1957). According to Tichý, natural language ambiguities were not a reason to abandon the principle of compositionality: he stated that a piece of natural language has to be interpreted and disambiguated. TIL's idealised language serves this task precisely.
He discussed in particular two contexts of ambiguity: statements about propositional beliefs, and '*de dicto* and *de re* suppositions'. Let's briefly comment on the ambiguity showed by the following two sentences, each one containig a *de dicto* or *de re* supposition.
   A. 'John met a poet'.
   B. 'John is looking for a poet'.
In case A the expression 'a poet' is used with a *de re* supposition (it refers to an individual), while in B it is ambiguous whether it features a *de re* supposition (where 'a poet' refers to an individual), or a *de dicto* supposition (where it refers to a so called 'office'). This ambiguity seems to contradict the principle of compositionality, because the term 'poet' seems to take on an alternative type of meaning in each of these contexts. But, with the use of TIL's explicit symbolic system, Tichý is able to disambiguate this context and to maintain the principle of compositionality.

This leads him to create the concept of 'constructions', which he started developing in the 1980s and which plays a central role in his theory. In the following section we will try to explain what constructions are.

3.5. ON CONSTRUCTIONS

In the 1980's Tichý seemed to recognise serious limitations in the concept of intension. The problem is that intensions alone are not capable of fully representing propositional meaning, as seen through the logic of propositional beliefs. A simple argument shows this: the intensions of any two true mathematical theorems are the same because a true mathematical theorem is true in every possible world and for all occasions. Take for instance: 1 + 2 = 3, and: 16 × 16 = 256. These are both true in every world and for all occasions, and hence their intension is simply the mapping from every world and time to the value true. But many people believe that [1 + 2 = 3] is a true proposition without believing that [16 × 16 = 256] is true. Hence, the intensions cannot completely represent the full 'propositional meaning', in the intuitive sense of the term, of the statement that we 'believe one proposition but not the other'.

According to Tichý, to serve as objects of mathematical beliefs, we need a category of objects which falls between propositions (construed as intensions) and sentences: the category of constructions appeared to him an obvious candidate.

To explain why we need constructions (or 'higher order objects' as Tichý called them), we will quote an excerpt from Tichý's paper 'Constructions', where he explains the concept of construction by referring to a mathematical operation:

> The term '9 – 2' names the number seven. It does not name it, however, in the same way as does either '7' or '3 + 4'. It names it qua *what results when two is subtracted from nine. Thus, apart from naming seven, '9 – 2' also expresses a specific indirect way of arriving at seven; '3 + 4' expresses a completely different way of arriving at the same number. Also '7' can be regarded as presenting seven qua the result of a particular, albeit trivial, procedure: the procedure consisting in starting with seven and leaving it at that. I shall call such procedures constructions, borrowing the term from geometry* […] (Tichý 1986, p. 514).

In the same passage, Tichý draws a clear distinction between constructions and expressions[18]:

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18 Tichý extends the same reasoning to natural language expressions, stating: 'Failure to distinguish clearly between entities and different ways of constructing them is an inexhaustible source of philosophical confusion and doubletalk. The notion of proposition is a typical case in point. There is an almost universal tendency to impute the structure of propositional constructions to propositions themselves. Although few would maintain that the numbers nine and two and the subtraction function are ingredients of the number denoted by "9 — 2", few will hesitate to regard Tom, Sam, and the taller-than relation as ingredients of the proposition, or state of affairs, denoted by "Tom is taller than Sam". Yet the situation is completely parallel. The number seven does not contain the minus function because if it did, it would also have to contain the plus function, since sev-

The construction that consists in subtracting two from nine is clearly something completely different from the expression '9 — 2'. The expression contains occurrences of the symbols '9', '2', and '–', while the construction involves the entities denoted by these symbols, the numbers nine and two and the subtraction function, respectively. It is these numbers and the function themselves that are involved in the construction of, not their linguistic representations. The construction is also something completely different from the number seven that it constructs. There is clearly no sense in which the numbers nine and two or the minus function are parts, or constituents, of the number seven; but all three of them occur in the construction: they are the stepping-stones of which this particular path to the number seven is made up (ibid., p. 515).

A construction in Tichý's theory is thus an abstract (usually structured) theoretical procedure, consisting in one or more steps, for inputting and outputting objects. As such, it is a dimension of meaning that intensional logic alone does not describe and which represents the radical aspect of Tichý's invention. As Jespersen states:

Tichý often likens constructions to calculations. Just as an arithmetic calculation takes numbers, processes them and yields another number, construction are, semantically speaking, calculations whose results may be, for instance, truth-values, truth-conditions, individuals, sets, as well as other calculations. It is important not to confuse procedures (calculation) *with the agent-, world-, and time-bound processes of executing the procedures or with their product (results, output) or with the symbolic encoding of a computer programme in a programming language* (Jespersen 2004, p. 12).

Tichý's theory of constructions is thus an explicit theory of what is involved in the calculation of intensions. But how many different kinds of constructions are there? Can we define them all? Given that we seem to understand how to perform complex constructions by combining simpler constructions, Tichý proposes that constructions can be defined recursively, from a few simple or primitive types, which can be applied to each other to build more complex constructions.

Tichý's main theory of constructions proposes six types of primitive constructions:

(i) Variables: primitive constructions, denoted by terms like: 't', 'w', 'i', 'x', 'y', 'z', etc.
(ii) Trivialisation: the simplest construction, which takes an object, X, and generates the same object. This construction is written: '0X'.
(iii) Composition: it corresponds intuitively to functional application; if F is a function and x is an argument, we often write '[F x]' to indicate the application of F to x.

en is not only nine minus two but also three plus four. Likewise, the fact that Tom is taller than Sam does not contain the taller-than relation, for if it did, it would also have to contain the shorter-than relation, for Tom being taller than Sam and Sam being shorter than Tom are surely one and the same fact' (Tichý 1986, p. 515).

(iv) Closure: it corresponds intuitively to what we call functional abstraction; if 'Fx' expresses the application of F to x, then we can return to F itself by leaving a 'gap' for the argument x. This construction is written as '– x.Fx'.

(v) Execution: it corresponds to 'carrying out' or 'executing' a construction. The execution of X is written '₁X'.

(vi) Double Execution: it is used if X 'constructs a construction'; it corresponds to the execution of the latter. This is written: '₂X'.

This small set of constructions can be applied recursively to build complex constructions. Due to its infinite hierarchy of higher-order objects, Tichý's theory of constructions is quite complicated and comes at a high ontological price; on the other hand, it provides a framework to make accurate analysis of our judgments about logical inferences, semantic relationships, and computations of information.

In a wider context, Tichý's 'universe' can be seen as a reaction to the poor ontologies propagated by Quine and other nominalist philosophers, whose extensionalist conception of semantics, combined with pragmatics, states that only extensional entities can be denoted.

Tichý's conclusion, with his Platonic objectual theory of semantics, is opposite to Quine's, and his theory enables us to understand the real processing of information in language.

4. CONCLUSIONS

Since Tichý's tragic death, many steps have been taken by his colleagues and friends — expecially Pavel Materna, Marie Duží, Bjørn Jespersen, and many others — to spread, develop, and apply his theory to further topics, expecially computer linguistics. Thanks to their work, TIL has helped to develop a variety of different approaches, including programs in artificial intelligence, computational logic, philosophical logic, and new approaches to conceptual and linguistic analysis.

In a broader sense, however, Tichý's personality, as well as his theory, are still not widely known, not only to the vast public but also to specialists in the field of formal semantics.[19]

With this paper, I hope to help raise awarness on this extraordinary scholar, who, despite the difficulties he must have endured in writing and debating in a language that was not his mother tongue, succeeded in developing a theory that represents an advancement in the field of logical semantics, and whose advantages are yet to be recognised and applied.

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19 It is significant, in this respect, that the outstanding scholarly reference on modern logic and intensional semantics *Handbook of Logic and Language* (ed. van Benthem and ter Meulen, 1997) includes a long article on Montague Grammar written by Barbara Partee, which contains few acknowledgements of Tichý.

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