

Summary

The book *Transparent Intensional Logic as Characteristica Universalis and Calculus Ratiocinator* provides the foundations of Transparent Intensional Logic (TIL) which was developed by the Czech logician and philosopher Pavel Tichý (*1936 Brno, †1994 Dunedin) in his New Zealand exile. The book focuses on TIL as a logic *sui generis*. This leads to the expansion of its former boundaries and many new findings are presented. The main aim of the book is to show that TIL is not only a powerful *characteristica universalis*, but also a noteworthy *calculus ratiocinator*.

The book has three main parts. The part *I. Tichý's Logic* focuses on Tichý's two key contributions: his concept of construction and his type theory. The part *II. Characteristica Universalis* utilizes Tichý's convenient instance of his type theory, viz. TIL, for the explication of many concepts of our conceptual scheme (by explication of the meaning of a certain expression we mean explication of the corresponding concept). The third part, *III. Calculus Ratiocinator*, introduces Tichý's system of deduction from the contemporary perspective and provides certain modifications of its kernel part, which are needed for their use within Tichý's late version of his type theory.

The chapter *I.1 The Concept of Construction* introduces the concept of construction of an object which is quite atemporal and independent of one's thinking. Constructions are abstract, structured algorithmic computations. We can liken them to geometrical tasks such as constructing an intersection of two medians of a triangle. Constructions have parts organized in a complex way. As such, they are convenient for explication of meanings of expressions in hyperintensional way. The resulting semantical theory is thus neofregean (or neochurchian): an expression means a construction which constructs the denotation of the expression. For example, „2+3“ means a structured procedure (a construction) consisting in applying + to 2 and 3; the construction yields the number 5, which is denoted by the expression.

In *I.2 Kinds of Constructions*, we provide a systematic exposition of six kinds of constructions. Although constructions can be written by certain λ -terms, they are not identical with them; note also that we have six kinds of constructions while there are only four kinds of common λ -terms. We explain that, in a very important sense, constructions differ from λ -terms: they are not amenable to interpretation because they stick to set-theoretic entities they construct.

The chapter *I.3 Tichý's Type Theory* exposes Tichý's type theory. In early 1970s, Tichý expanded Church's simple theory of types by adding (multiargument) partial functions. In 1988, he published a (simply) ramified version of his early type theory. Tichý's type theory is thus a unique combination of two approaches. We added a number of investigations extending the system in such a way that analysis of its metalanguage is possible, e.g. type ascriptions are explicitly treated in the system (we argue that familiar objections to ramified type theories are inapplicable to this type theory).

The content of *II.1 Foundation of Semantic Doctrine of TIL* is also apparent from its title. Construction is the meaning of a given expression while an extension or a possible world intension constructed by the construction is its denotation. TIL offers a comfortable framework for analysis of natural language expressions, it thus rivals the familiar system by Montague. In *II.2 Semantic Analyses of Basic Kinds of Expressions*, we show analyses of typical names, predicates, sentences and descriptive phrases.

In *II.3 Modality*, we focus on words related to modality, including words such as necessarily, subjunctive conditionals, existence statements and deontic modalities (the analysis using TIL is quite novel). The content of the chapter *II.4 Temporality* is adapted from Tichý's papers on tenses, temporal adverbs, episodic verbs and verb aspects.

The chapter *II.5 Attitudes* provides a synoptic overview of TIL-based analyses of sentences reporting attitudes; these include intensional transitives, sentences about wishing and belief sentences. We recognize attitudes to intensions and non-intensions. Belief attitudes relate agents to constructions of possible world propositions; this hyperintensional way of modelling explicit belief is then discussed with help of derivation rules (and systems) accessible to an agent. In *II.6 Questions, Answers and Imperatives*, we extend Tichý's erstwhile contribution to the topic and show how to make derivations with questions and answers.

In the last two chapters of the part II., *II.7 Truth and Related Semantic Concepts* and *II.8 Entailment and Related Concepts*, we investigate two important logical concepts, namely truth and entailment, from the viewpoint of TIL. Both concepts have type versions: truth (or entailment) applicable to propositions, truth (or entailment) applicable to propositional constructions, truth (or entailment) applicable to expressions (of a given language). Because our logic deals with partial functions, we have strong and weak versions of each concept. We have found that entailment (as well as truth) of constructions of truth-values is more primitive concept than the concept of entailment (and truth) applicable to propositional constructions. It would be wrong to conclude, however, that TIL-based approach to entailment is (only) model-theoretic because entailment is best expressed in terms of sequents of Tichý's deduction system.

The investigation of Tichý's deduction system is exclusively carried out by the present writers in recent times. In the chapter *III.1 Deduction in TIL*, we compare Tichý's approach with more familiar approaches, natural deduction and sequent calculus (Tichý combined them into a unique whole) and show useful reformulation of its presentation of proofs. The chapter *III.2 Substitution and Conversions* provides a modification of Tichý's early concepts of substitution and conversions to their versions usable in the framework of his ramified type theory. The proof of β -conversion-by-value from β -conversion-by-name and the proof of η -conversion from β -conversion-by-name seem to be novel in the framework of partial type theory. In *III.3 Derivation Systems*, we expose a concept useful for investigations of our conceptual scheme that is independent of some assumptions related to the familiar concept of (formal) theory.