Bibliographical Remarks

The literature relevant to the topics treated in this book is vast and it would be an immense task to give a survey of it. Therefore here I only list sources that I used more extensively, the articles explicitly mentioned in the text and a few books that I either consider classical or find useful as further reading. In most cases I refer to the original publications, but the interested reader may find many old papers reprinted (and translated to English) in anthologies. The literature is commented in the main text and the notes after sections, so the purpose of the notes below is only to provide some additional information and suggest further reading.

Chapter 1

The approach to the foundations of mathematics based on mathematical structures is explained in the first volume of the Bourbaki series of monographs [32]. The standard reference for Ramsey theory is [107]. Cantor's most important paper about set theory is [36]. Paradoxes are treated at length in Fraenkel, Bar-Hillel and Levy [75], which is a classics in the literature about the foundations of set theory. Bertrand Russell wrote about the discovery of his paradox in [253]; Zermelo's discovery of this paradox is described in his biography written by Ebbinghaus [65].

To mention a few more classics in the foundations of mathematics, the two volumes of Hilbert and Bernays [128, 129] present Hilbert's proof-theoretical approach to the foundations, Beth [24] treats the foundations from a historical and philosophical standpoint, Kleene [154] focuses on computability and Feferman's book [72] is a more recent presentation of foundations from the position of a predicativist.

Chapter 2

There are many books devoted to formal language theory. The concept of a context-free grammar can be found in most textbooks about theoretical computer science.

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Essentially the same concerns other concepts treated in this chapter: proofs, models and computations. Thus I only mention a few that are among the most popular ones. Shoenfield [267] and Manin [190] are general introductions to logic and set theory. Grzegorczyk [110] is a readable introduction to logic. For further reading about proof theory, I recommend Takeuti [288], and the book by Troelstra and Schwichtenberg [291].

The history of first-order logic is treated in Moore's article [199]. The main part of Gödel's paper [96] is a proof of the First Incompleteness Theorem. The last section contains a sketch of a proof of the Second Incompleteness Theorem. Gödel intended to publish another paper on the subject with a detailed proof (with number II). That paper has not been written, probably because the sketch of the proof in the published paper turned out to be sufficiently clear. Three Brouwer's papers about intuitionism are reprinted in the anthology [118], which also contains other classical papers in the foundations of mathematics. The Church-Turing Thesis appeared for the fist time as *Thesis I.* in Kleene's book [154, page 300]. A classical monograph on the λ-calculus is Barendregt [13]. For a brief presentation of Churches type theory, see Andrews [4]. Many mathematicians discovered parts of the Curry-Howard Isomorphism and often these ideas were published much later (see the history of the λ-calculus, including the Curry-Howard Isomorphism, described in [130]). The key publications are Curry and Feys [55] and Howard [133].

Chapter 3

The standard reference for set theory is Jech [138]. Kanamori [148] is a survey of the history of set theory. Part II of Boolos's book [30] contains 13 essays about Frege's work and some proposals how to fix his system in order to be consistent. For a brief presentation of Type Theory, see Coquand [52]. I am grateful to Ilan Vardi for drawing my attention to his paper *Archimedes, The Sand Reckoner* [296]. The theory of large cardinals is treated in Kanamori [147]. For a survey on large cardinals and algebra, see Dehornoy [62].

Chapter 4

My presentation of the Galois theory is inspired by the readable introduction to this theory by Stewart [285]. The sketch of the unsolubility of a concrete quintic equation is based on Stewart's elementary approach. An excellent exposition of Matyasevich's Theorem and related results in logical investigations of arithmetic is Smoryński [276]. In Table 4.1 the number $3 \cdot 2^{402653211} - 2$ is from [152]; I have just computed the sequence a few steps back to obtain some more values. The collection of articles about the Collatz problem, edited by Lagarias [177], is a useful overview of this area. It contains an article by Collatz describing the history of the problem; Conway's article [47] is reprinted there too. Kunen [173] is an outstanding introduction to the independence proofs in set theory.

Chapter 5

Two monographs on computational complexity have appeared recently: Arora and Barak [8] and Goldreich [101]. There are a number of books that cover special topics in computational complexity such as circuit complexity, algebraic complexity, randomized computations and cryptography, but somebody with little background in complexity theory should rather start with general introductions such as the two above. Some of the standard reference monographs are Bürgisser, Clausen, and Shokrollahi [31] in algebraic complexity, Goldreich [102, 103] in cryptography, Nielsen and Chuang [205] in quantum computing, and Li and Vitanyi [185] in Kolmogorov complexity.

Chapter 6

I have already mentioned some books about proof theory in the notes for Chap. 2. The standard reference for ordinal analysis is Pohlers's monograph [219] and I also recommend a more readable survey of Rathjen [237]. The first book about Bounded Arithmetic was Buss [34]. Krajíček's monograph [161] covers all main subjects in proof complexity. A more recent monograph of Cook and Nguyen [50] focuses on theories associated with complexity classes.

Conjecture 2 of Sect. 6.3 first appeared in print in [223]; Conjectures 1 and 4 and Conjectures 3 and 5 appeared in [227] and [164] respectively.

Chapter 7

The 26 chapters of *The Oxford Handbook of Philosophy of Mathematics and Logic* [265], edited by Shapiro, cover all main positions in the philosophy of mathematics and several other topics. An on-line source that I find very useful is *The Stanford Encyclopedia of Philosophy* [316], which contains many articles about the philosophy of mathematics and history of logic. For a survey on reflection principles, see Smoryński [273]. Readable surveys about the axioms providing invariance with respect to forcing and other results on the Continuum Hypothesis are Woodin [310, 311] and Dehornoy [61].

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