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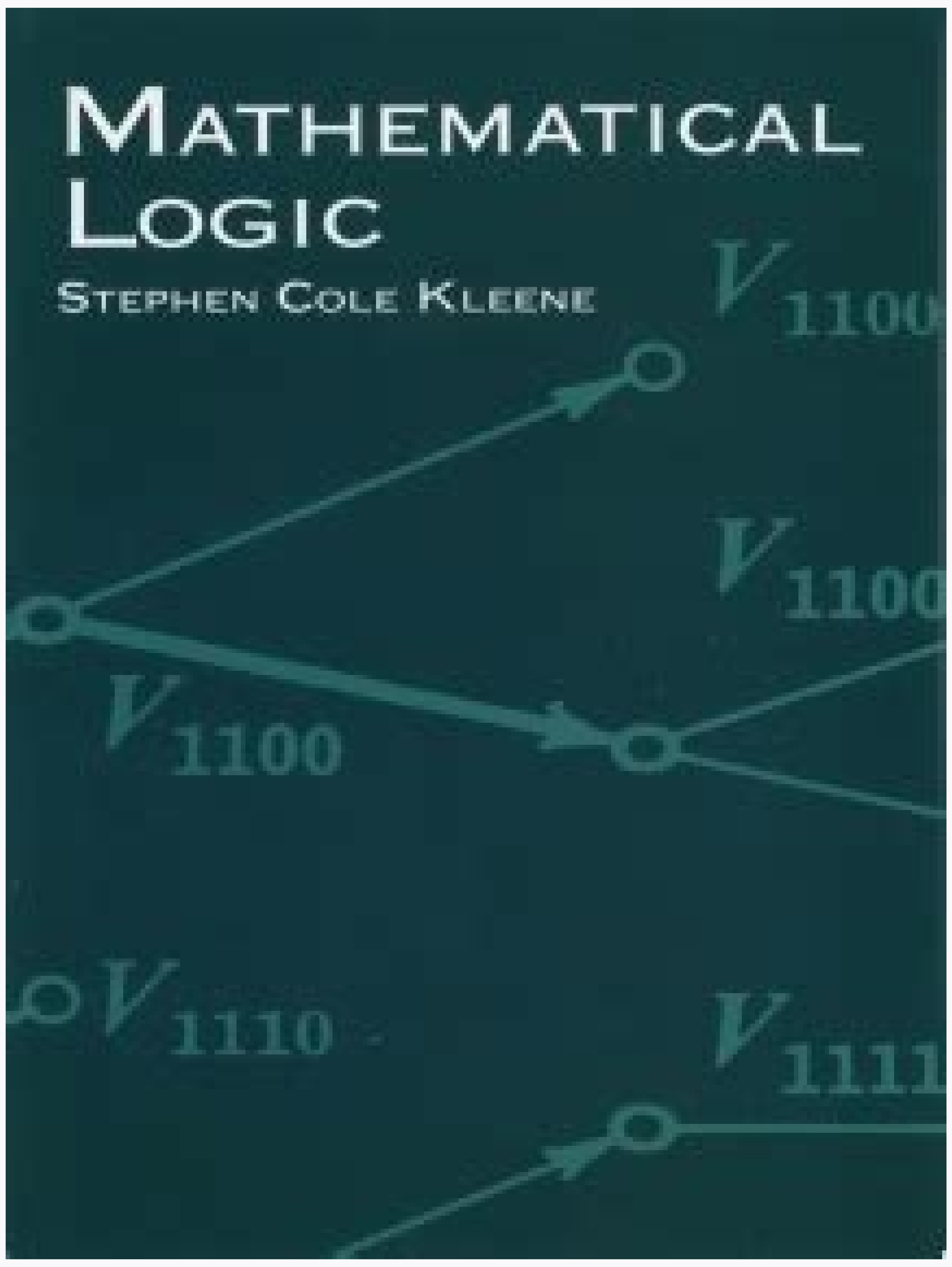

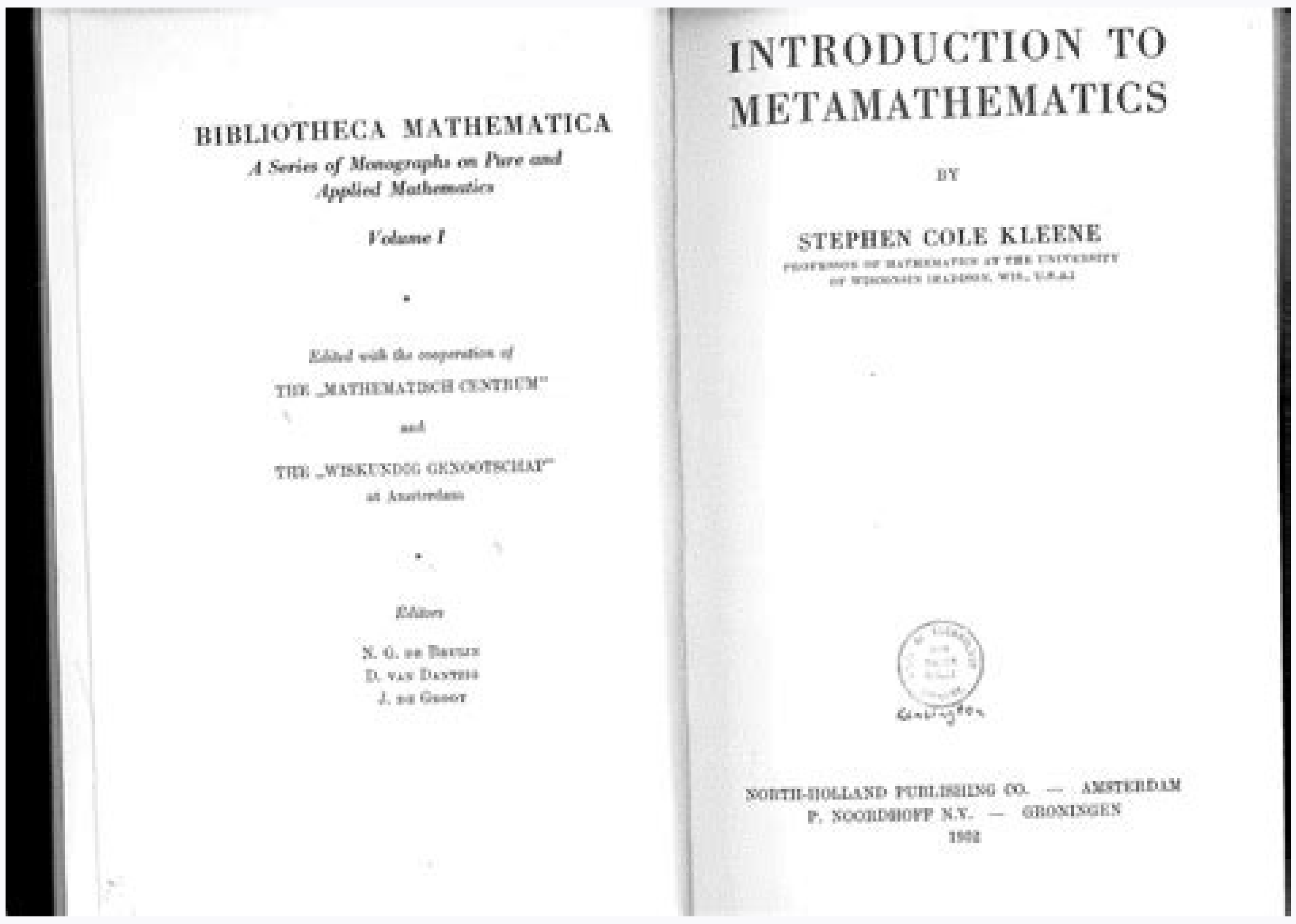

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INTRODUCTION TO METAMATHEMATICS

BY

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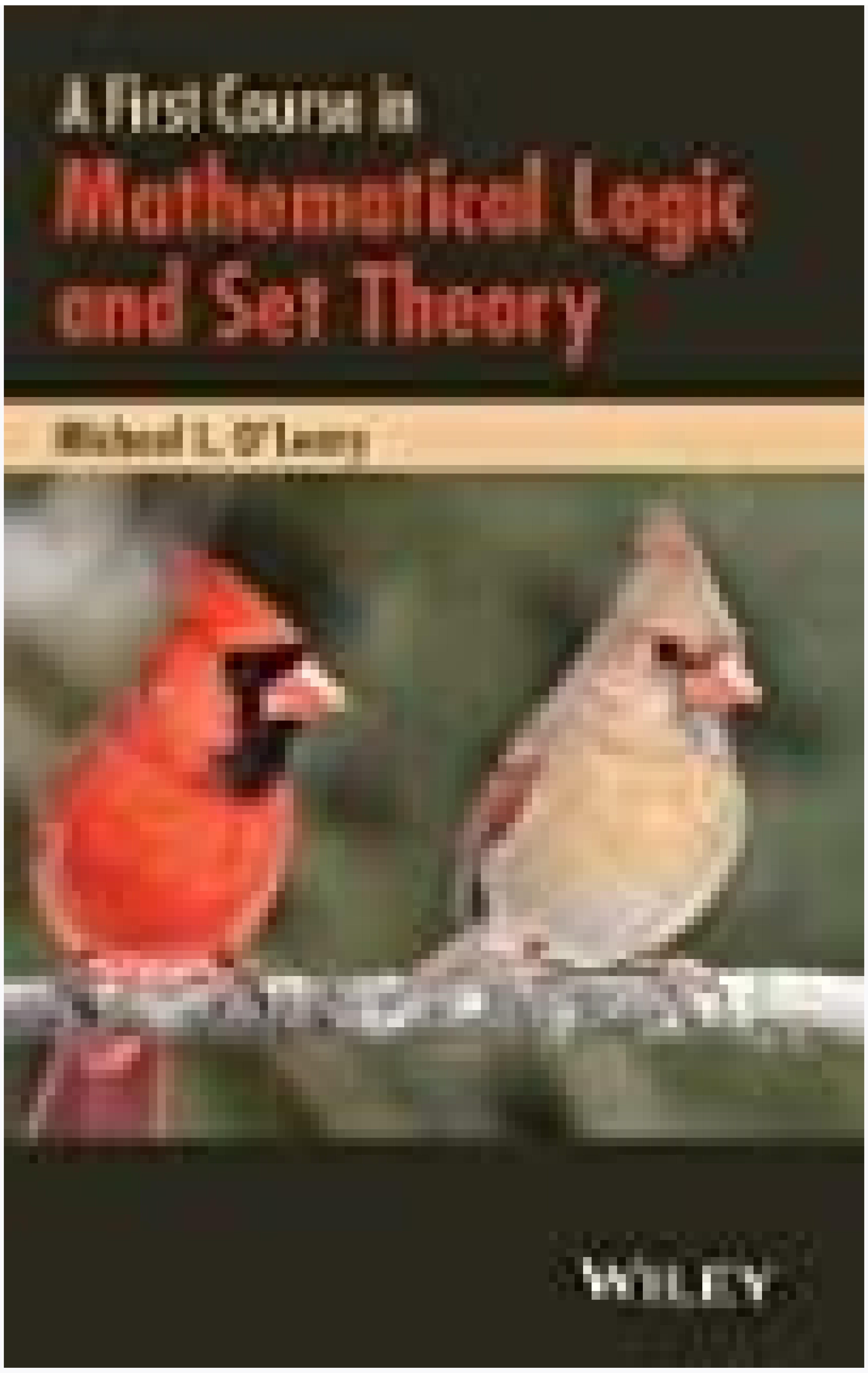
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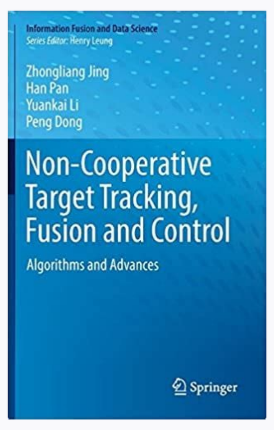
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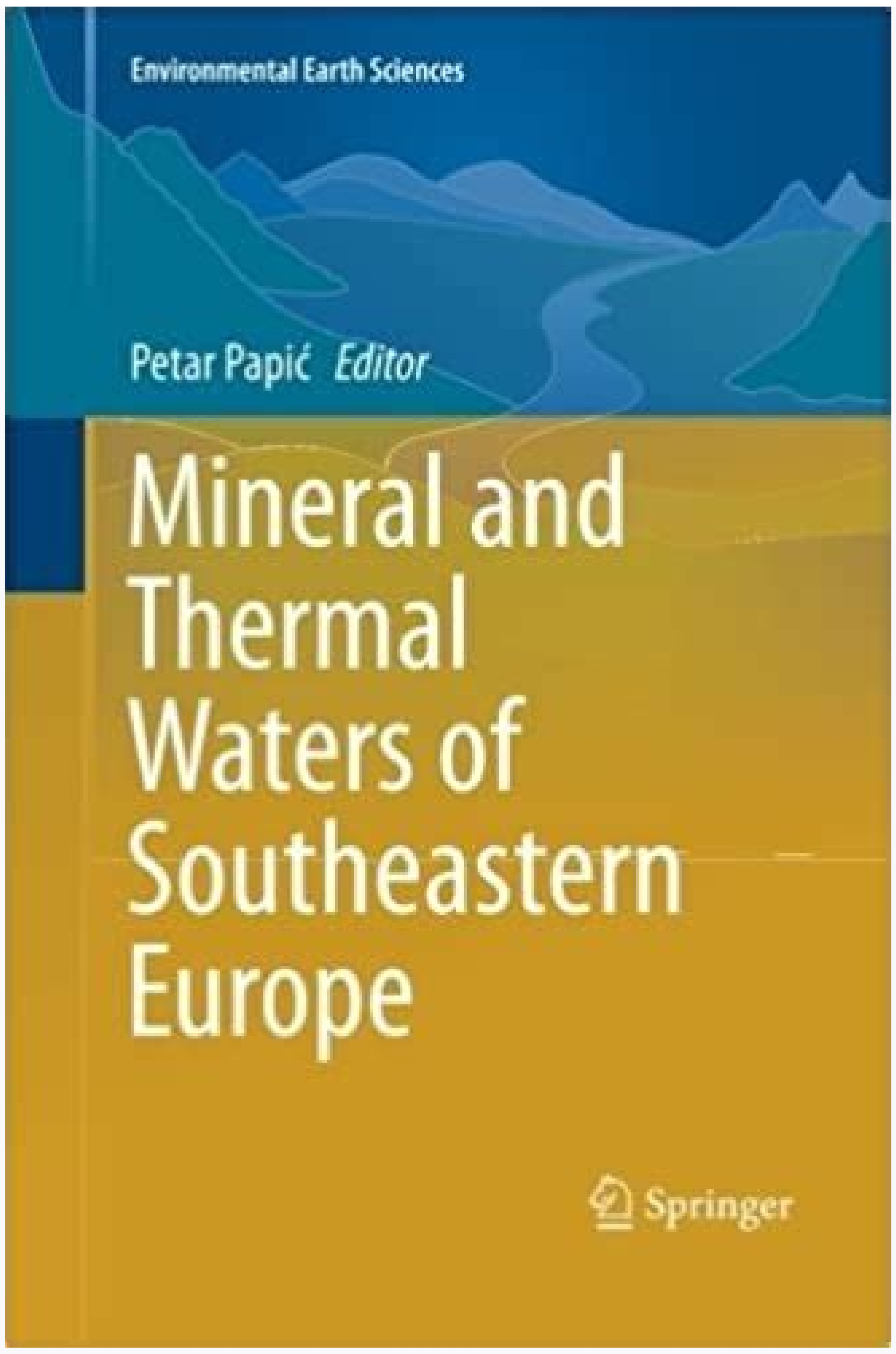

By saying this, I am claiming that, when you produce the paper showing the value of n, then I will be able to factor xn + yn for the n you produce if it turns out to be odd (and I am making no claim about the factorability of xn + yn in the contrary case). Are any of these formulas valid? By theorem 5 with *49: ,) (for n = 4),), we can put this proof in the following shorthand: Since in § 3 we could accept all the results of Theorem 2 as established by someone else's computation, the real point of these reproofs is to make it evident how, if we remember *49, and any two of *55a-*61 which together contain all three of the symbols ⊃, &, ∨, we can quickly derive the others. 330-320 B.C.), in which theorems are deduced by logic from axioms (or postulates). 3.2. Establish la, 4a, 6, 7, *50, *51 by the automatic method (indicated above), except using shortcuts when you can in the truth table computations. We say that B is a valid consequence , if, in truth tables for A and B entered from P1, . The computation of the corresponding value of A⊃B consists in first computing the values of A and B, and thence computing the value of A⊃B by the table for ⊃ (beginning of . Since this is the case for each assignment to P1, . 's to P1, . For example, before an election I might say [1] If our candidate for President carries the state by 500,000, then our man for the Senate will also win. Establish the following, using as far as possible recent results rather than new direct appeals to truth tables: * § 6. Namely, we then know that the truth values of P, Q, R must form one of the four assignments (Lines 1, 2, 5, 7) which give t to (P ⊃ Q) & (P ∨ R) in Table (h). My admitting that If I am going too fast, then I am going too fast can hardly give any of you much satisfaction. In B). (c) Prove Theorem 7a (d) . Model theory: duality.[21] THEOREM 7°. § 2. For, in Exercise 2.1 (c) we saw that Q ⊃ P ∨ Q is valid; and hence by Theorem 1 B ⊃ A ∨ B is valid. Different theories can be deduced from the same mathematical postulates, the differences depending on the system of logic used to make the deductions. EXAMPLE 2°. (a)For each assignment, is if and only if A and B have the same truth value. " holds as a material implication (. Theorem and Lemma Numbers: Pages. We postpone further discussion of the relation between our symbols and ordinary language to the end of the chapter. Please wait... Then the new table differs from the original table only in that the value column of the new table splits into 2m parts, corresponding to the 2m 's to the atoms Pn+1, . In Tables (). Thus, if you have bet that I am wrong, to settle the bet you produce the number n. (We shall say a little more about this in § 36.) Similarly, there are different systems of logic. A and B stand for here, *55a will hold when its A and B are the present B.) (Example 2), infer *10a from 5a. It comes to nearly the same thing to think of the object language as a suitably restricted and regulated part " can be thought of as names in the observer's language for the verbal expressions at the right in the table.[6] The names at the left in the table above apply to the propositional connectives or to the formulas constructed using them. If for example it is 3, I then show you the factorization $(x + y)(x^2 — xy + y^2)$, and you pay me. In the left-hand columns we list all the possible assignments to the immediate component(s). Now we make one further assumption about the atoms, which is characteristic of classical logic. 4.6. Give three proofs that: If A and , then B.(By theorem 4 (b); by corollary theorem 5; using 10a and theorem 3.) 4.7. Show by an example that corollary ". Similarly, logic is used in organizing scientific knowledge, and as a tool of reasoning and argumentation in daily life. That knowledge would require us to look into the constitution of the atoms, or to consider facts to which they allude under an agreed interpretation of the words or symbols, none of which is within our purview in the propositional calculus. Each formula E is equivalent to a formula) in which occurs only applied directly to atoms. in its first line. (This is illustrated by Table (E if and only if the table for E entered from any particular list P1, . Finally, within its scope, Example 1). Let E′, F′ come from E, F by interchanging & with ∨.[19] Then: . , Pn in 's, exactly if, for every assignment, A and B have the same value. 4.4°. Our definition is the only reasonable one with such a table.[12] A related question is why we should want to assert a material implication A⊃B, when if A is true we could more simply assert B (or if our hearers don't know that A is true, we could more informatively assert A & B), and if A is false we could more simply say nothing. Checking available domains. , Pn of the prime components of E. (Cf. the first remark following Theorem 1.) §4. I could truthfully say [2] "If n is odd, then xn + yn can be factored". This practice is familiar in algebra, where "a + bc² = d" means (a + (b(c²))) = d. All of logic, like all of physics or all of history, constitutes a very rich and varied discipline. This leads us to the following definition. Symbols and Notations. To make this easy, we shall enter each table from one list of atoms P1, . THEOREM 3. chain of (three) equivalences.). if and only if both A and B. From Example 2 by theorem 5, The part A of CA is underlined. Let E be any formula constructed from atoms P1, . (Why?) Such formulas are therefore always true, regardless of the truth or falsity of their prime components. Returning to the example preceding 's for every E" established, we can apply the theorem with any choice of A1, . , Pn of atoms as described. This is a very fortunate situation, and one should not hesitate to do this in any case of doubt. Since the discovery of non-Euclidean geometries by Lobatchevsky (1829) and Bolyai (1833), it has been clear that different systems of geometry are conceptually equally possible. By (b) of the theorem with the result of in each line. Let come from E by interchanging & with ⊃ and each unnegated atom with its negation (cf. This form of statement enables me to predict what will happen in one eventuality without attempting to say more. progressively to the right (inward) across all the &'s and ∨'s, which interchanges them. Distinct such letters shall represent distinct atoms, each of which is to retain its identity throughout any particular investigation in the propositional calculus. , to stand for any formulas, not necessarily prime. The chain method which we present next is useful in establishing such equivalences. Second, the language is to provide five particular constructions or operations for building new sentences from given sentences. This will be determined by repeated use of five definitions, given by the following tables. Yet thus far we have dealt only with tautologies, i.e. valid formulas, which logic asserts to hold without regard to any extra-logical assumptions whatsoever. 's to a list P1, . Index. Underline the common parts (as in Table (a), (b)). Then A⊃B is true under our table (because A is false), even though there is no connection of ideas between A and B. By theorem 5 with *55a (as in Exercise 4.4): . Model theory: valid consequence. , Pn+m not in E. The same proposition may be expressed by different (declarative) sentences. The portion of logic we study first deals with connections between propositions which depend only on how some propositions are constructed out of other propositions that are employed intact, as building blocks, in the construction. This implication, and the present equivalence, are called more specifically material implication and material equivalence.[11] It is, of course, possible to be interested in other senses of implication; but then one must have recourse to ways of defining it other than by a two-valued truth table. As we eliminate the ⊃, we supply a pair of parentheses, which before were superfluous since ⊃ outranks &. For example with n = 2 and m = 1, Tables (e), (f), (g) below have been constructed by entering from three atoms, although the formula at the head of each of those tables contains just two atoms. The table for A⊃B entered from A and B (E", does not hold. Distinct such letters A, B, C, . The classical logic, like the Euclidean geometry, is the simplest and the most commonly used in mathematics, science and daily life. , Am If A is a given formula, is a (composite) formula. We deal with propositions through declarative sentences which express them is some language (the object language); the propositions are the meanings of the sentences.[2] Declarative sentences express propositions (while interrogatory sentences ask questions and imperative sentences express commands). .) as the A and B, the resulting formula B ⊃ A ∨ B is valid. As 5b, we claim that, for each choice of formulas (built up from P, Q, R, . This should become clear from the following illustration. (Alternatively, (β) is *19; (γ) follows from *20 by Exercise 4.6; and (δ) from *21 using (α) and theorem 3.) for each of the 16 pairs of subscripts i, j (i, j = 0, 1, 2, 3); i.e. with (δ), and the result with (γ); etc. (Substitution for atoms.) Let E be a formula containing only the atoms P1, . Mathematical logic (also called symbolic logic) is logic treated by mathematical methods. Every development of mathematics makes use of logic. When we are studying logic, the logic we are studying will pertain to one language, which we call the object language, because this language (including its logic) is an object of our study. (In (1), we used the list P, Q, R; we could have used instead Q, P, R or Q, R, P, etc. Without knowing the truth values of the prime components, we can nevertheless say that the composite formula is true. (Replacement rule, or replacement property of equivalence.) If CA and , then CB . Table (a) is the same as Table (c) E as a short way of saying E is valid".[15] THEOREM 1. List of Postulates. Then by If we had established 4a, 4b, *31, *33, *35, *37, *39, *50 and duality (which is *51. THEOREM 5. These observations suggest new proofs of . Logic has the important function of saying what follows from what. This part of logic is called propositional logic or the propositional calculus. (Replacement theorem.) Let CA be a formula containing a formula A as a specified (consecutive) part, and let CB come from CA by replacing that part by a formula B. THEOREM 4. Part I offers an elementary but thorough overview of mathematical logic of first order. If when I speak, returns are in showing our candidate ahead by a safe 500,000, I would more likely say [la] Our man for the Senate will win or [lb] Since our candidate for President is carrying the state by 500,000, our man for the Senate will win. We assume that each atom (or the proposition it expresses) is either true or false but not both. Similarly establish that: 4.3. Illustrate the proof of . §3. In the fourth and final formulas, we omit a pair of parentheses (as mathematicians do in writing "a+b+c"), since by *31 and *32 it is immaterial for present purposes which way the triple conjunction and disjunction are associated.[20] EXERCISES. Suppose the truth table for a formula E is constructed as in § 2 by using exactly its prime components P1 ..., Pn, and suppose that a new table is constructed for E using additional atoms Pn+1, . The student may accordingly take the whole list on faith, as he does a table of square roots or trigonometric functions or integrals. Some controversy has arisen about the name implication, and the reading implies, for our ⊃. applied only to atoms: 5.3°. and ⊃ from E by *63a, and *58 or *59 (or possibly *55c, *60 or *61). 6.1. Prove Theorem 7 (d) . Nevertheless, if we are told that (P ⊃ Q) & (P ∨ R) is true, we have been told something. Anyone not familiar with simple examples of valid formulas and with methods for proceeding to others (whether or not he has officially studied logic) would properly be described as sluggish in his mental processes. Of the 45 results in Theorem 2, 26 are thus assertions of equivalences holding in the propositional calculus. (The prime formulas and the composite formulas together constitute the formulas.,)[3] If each of A and B is a given formula , A⊃B, A & B and A ∨ B are (composite) formulas. One simple principle is this. So we shall write (A⊃B) ⊃ C or A⊃(B ⊃ C) and not simply A⊃ B⊃ C. Now we use the chain method to get a new result. For, how can we treat logic mathematically (or in any systematic way) without using logic in the treatment? But it will appear as we proceed that the tautologies are important. Consider an example; say A is (P ⊃ Q) & (P ∨ R) (Table (h)). Instead of compartments, we can speak of languages. These tables relate the truth value of each molecule to the truth value(s) of its immediate component(s). and P ⊃ P, as the reader may verify (Exercise 2.2). While English is ambiguous, Latin is clear, using vel for the inclusive disjunction and aut for the exclusive disjunction. But our title has a double meaning, since we shall be studying the logic that is used in mathematics. , An simultaneously for P1 . So if A and B do not contain the same atoms, the table for A or for B is entered from more atoms than occur in it. It will be very important as we proceed to keep in mind this distinction between the logic we are studying (the object logic) and our use of logic in studying it (the observer's logic). If then . 4.2°. We simply put the logic that we are studying into one compartment, and the logic that we are using to study it in another. We are not assuming that we know of each atom whether it is true or false. (δ) If and , then . Thus John loves Jane and Jane is loved by John express the same proposition, but John loves Mary expresses a different proposition. Not only are we restricting ourselves in this chapter to the study of the logic of propositions. (Duality.) Let E and F be formulas of the type described in Theorem 6. (b) From the proof of Theorem 7a (a), infer (b). The following example illustrates this proof. How does this alter our position with regard to what formulas we can assert to be true by use otherwise of only the propositional calculus? , An. We use this principle to establish in the next theorem a collection of forms of valid formulas.[16] For example, as *1 we give the result just established. , An for any n ≥ 2 (and trivially even for n = 0, 1). Preface. Here we are confronted by a bit of a paradox. , Pn) is used in each part. , as the reader may verify. But [1] would not have become false, just partially redundant and thus unnatural for me to say (unless I haven't heard the latest election returns). To take an analogous mathematical example, suppose a positive integer n > 1 is written on a piece of paper in your pocket, and I do not know what the integer is. and P ⊃ P are valid. These examples should make it clear that material implication A⊃B (If A, then B) is a useful and natural form of expression.also in the first row. Subsequent chapters introduce the study of formal number theory, with surveys of the famous incompleteness and undecidability results of Godel, Church, Turing, and others. We call these sentences prime formulas or atoms; and we denote them by capital Roman letters from late in the alphabet, as P, Q, R, . B if and only if A and B have the same truth table. , Pn. . THEOREM 6°. Starting with the prime formulas or atoms, we can use these operations, over and over again, to build other sentences, called composite formulas or molecules, as follows. 3 — 2 = 1 and (481 — 581) + 101 = 1 express two different propositions (both true). , then . , PnB, as was to be shown. 3.1. Redo the illustration preceding as the A). Such formulas are said to be valid, or to be identically true, or (after Wittgenstein 1921) to be tautologies (in, or of, the propositional calculus). However, we do not ask him to learn the list outright now, but rather to use it for reference and in doing so to become familiar with the results most often used.[17] THEOREM 2. In the same way, every one of the results in Theorem 2 can be proved automatically, by first verifying the validity of the particular formula which has P, Q, R in place of A, B, C, and then using Theorem 1 (or equivalently, by constructing a truth table entered from A, B, C). Then we can use *49 to remove the resulting double negations, so that the atoms will be interchanged with their negations. Unabridged republication of the edition published by John Wiley & Sons, Inc. You can try to sign in using VPN or TOR browser Go to TOR browser Enable VPN Undergraduate students with no prior classroom instruction in mathematical logic will benefit from this evenhanded multipart text by one of the centuries greatest authorities on the subject. need not represent distinct formulas (in contrast to P, Q, R, P1, P2, P3, . (Examples will be given later.) Throughout this chapter, we shall simply assume that we are dealing with one or another object language in which there is a class of (declarative) sentences, consisting of certain sentences (the aforementioned building blocks) and all the further sentences that can be built from them by certain operations, as we describe next. [23] (c) [[8 in Theorem 2 with theorem 3]. We started this chapter by saying that logic has the important function of saying what follows from what, and thus of saying what propositions are theorems for given axioms. This is immediate from the truth table for & (or we can infer it by theorem 3 from 3, 4a and 4b in Theorem 2). From the table for ⊃, this can only be the case when Line 1 of that table applies, and in Line 1 of that table B is also t. 's, then the formula is not valid. But also in this and later chapters we shall concern ourselves primarily with a certain kind of logic, called classical logic. To give a verbal example, the proposition If I am going too fast, then I am going too fast is true on the basis of the propositional calculus; indeed, it has the form P ⊃ P. 's, then so does the table for E entered using given additional atoms; and conversely. Still keeping in mind that in the propositional calculus we do not look at the internal structure of the atoms (or will not know the propositions they express), let us suppose that we are given from outside the propositional calculus that a formula A is true by assumption or fact. Model theory: implication and equivalence. (The first four operations are binary operations, the last is unary.) " are called propositional connectives[4] They can be read by using the words shown at the right in the following table; but the symbols are easier to write and manipulate.[5] " which play roles described accurately below but suggested or approximately described by the words. Next, we can suppress any double negations by *49. , which represent distinct prime formulas). Bibliography. , Pn, and let E* come from E by substituting formulas A1, . If for example it is 4 (or 6), I win automatically. Completed truth table: Computation of the third line: The computation process illustrated just now constitutes a mechanical procedure by which we can compute the truth table for any formula E, or more specifically the truth table for E using (or entered from) a given list P1, . New York, 1967. , Pn, including all that occur in either of A and B. Composite formulas would sometimes be ambiguous as to the manner in which the symbols are to be associated if we did not introduce parentheses. Under the usual definition of > from 5 express the same proposition (which happens to be false), namely that increasing 5 by a suitable positive quantity will give 3; but $5^2 — 4^2 = 10$ expresses a different proposition (also false). Now suppose m formulas Al, . Linguistic considerations: formulas. Similarly, we find it convenient to use the name implication to designate the operation defined by the second truth table above; and then in our logical discussions we usually read A ⊃ B as A implies B, even though if A then B or A only if B probably renders the meaning better in everyday English. By , i.e. when the formula asserting the (material) equivalence of A and B is valid. 4.1. In the manner of Example 2, reprove *31, *34, *49, *55a, *55c of Theorem 2. These sentences we call formulas, in deference to the use of mathematical symbolism in them or at least in our names for them. The order of listing the prime components does not matter here. Consider two formulas A and B, and let P1, . But any orderly arrangement of the content of mathematics would exhibit logical connections. COROLLARY. , Pn 's. If it turns out that our candidate for President doesn't carry the state by 500,000, my prediction will not have been proved false. (a) ((P ⊃ Q) ⊃ P) ⊃ P. PART I ELEMENTARY MATHEMATICAL LOGIC CHAPTER I THE PROPOSITIONAL CALCULUS § 1. The hypothesis of) is equivalent to . The symbol ∨ comes from the first letter of vel. is true exactly when A is false. It has the properties that we can establish its validity by establishing the validity of the (three) links, and that once the chain is established as valid we can infer the equivalence of any pair of the formulas A0, A1, A2, A3 (joined by links) in the chain. , Pnis E′, as the following example illustrates. Each of 5 < 3, 3 > 5 and $5^2 - 4^2 = 10$ asserts something about the outcome of a mathematical process, which is the same process in the first two cases, but a different one in the third. To any student who is not ready to do so, we suggest that he close the book now, and pick some other subject instead, such as acrostics or beekeeping. Thus & is our symbol for conjunction; and A & B is a conjunction, namely the conjunction of A and B. However, computing truth tables of formulas at random would be a rather slow way of discovering valid formulas. the example in the proof).[19] Then . The solution of this paradox is simple, though it will take some time before we can appreciate fully how it works. , P1, P2, P3, . , Pn and their negations using only & and ∨. By simultaneously for the atoms P1, . In writing CB, a pair of parentheses is required which was unnecessary in CA. If E, then E*. It might seem that the valid formulas or tautologies are the least interesting, because from one point of view they give no information. Now we are proposing to study logic, and indeed by mathematical methods. This is considered paradoxical by some writers (Lewis 1912,1917, Lewis and Langford 1932).[10] In modern mathematics the name multiplication is often used for various mathematical operations that behave more or less analogously to the arithmetical one called multiplication. (b) (P ⊃ Q) ⊃ (Q ⊃ P).[14] . Also A ⊃ B is the implication by A of B; etc. 6.2. By applying § 7. Model theory: chains of equivalences. Pnto T, F at the end or at the beginning. Remember that what P, Q and R really are is top-secret information, and practitioners of the propositional calculus are not cleared for it. , An not necessarily prime, which must then retain their identity (be treated as prime) throughout the transformation. The treatment does not stop with a single method of formulating logic; students receive instruction in a variety of techniques, first learning model theory (truth tables), then Hilbert-type proof theory, and proof theory handled through derived rules. , Pn contains still more atoms. , and B is any formula. So by 's. We prove Theorem 7a° (= Theorem 7 similarly extended), thus. . In defining validity, we use a truth table entered from the prime components, so as to take into account all the structure of the formula available to the propositional calculus. Say A is the moon is made of green cheese and B is 2+2=5. We are using capital Roman letters from the beginning of the alphabet, as A, B, C, . A familiar example is the presentation of geometry in Euclid's Elements (c. However, to establish is of the form A ⊃ A; in computing Line 2 of Table (a). , Pn be the atoms occurring in A or in B. Or it may be a proposition which is true in physical fact or by intuitive mathematical reasoning. , Pn, respectively. , P1 P2, P3, . That is, we may be told that it is an axiom of some abstract theory (like geometry or group theory), so it is true by fiat for the purpose of that theory. which the molecules have.[7] For example, Socrates is a man, John loves Jane, John loves Mary, 5 < 3, 3 > 5, "a+b 3 > 5" would be molecules. It is often useful to know that two formulas A and B have the same truth table, or to transform a given formula A into a formula B of some specified sort which has the same table. The emphasis in the final chapter reverts to logic, with examinations of Godel's completeness theorem, Gentzen's theorem, Skolem's paradox and nonstandard models of arithmetic, and other theorems. Or ( ) can be recognized as true directly from theorem 4 (b); for, the three hypotheses of ( ) say that in the list A0, A1 A2, A3 each successive formula has the same table as the preceding, and the conclusion says that any pair of formulas in the list have the same table. Now we remark that, once *49, *55a and *55c in Theorem 2 are established (as proposed in § 3, or by Exercise 4.1), then all of *55b, *56-*61 follow by the chain method. For example: . For any choice of formulas A, B, C: (Introductions and eliminations of logical symbols.) (Principle of identity, chain inference, interchange of premises, importation and exportation.) (Denial of the antecedent, contraposition.) (Reflexive, symmetric and transitive properties of equivalence.) (Associative, commutative, distributive, idempotent and elimination laws.) (Law of double negation, denial of contradiction, law of the excluded middle.) (De Morgan's laws 1847,[18] negation of an implication.) (Expressions for some connectives in terms of others.) EXERCISES.) said using A0, A1, A2, A3 applies similarly to A0, . Part II supplements the material covered in Part I and introduces some of the newer ideas and the more profound results of logical research in the twentieth century. On the other hand, to show by truth tables that a formula is not is of the form A⊃B. The question now arises: How does the truth or falsity (truth value) of a composite formula or molecule depend upon the truth value(s) of its component prime formula(s) or atom(s)? " is a stronger statement than "; by this we mean that the first statement always implies the second, but the second may hold without the first holding. The result is shown first as ((which we use three times). We intend that the student should acquire the ability to use these results, and indeed should learn enough of them so that he can operate without Theorem 2 before him. The successive stages in this computation are shown in successive lines for clarity, and are then summarized in a single line. If A and A⊃B, then B. The effect of using Theorem 1 (substitution) with Theorem 7 is to allow the duality transformation to be applied to a resolution of E (or of E, F) into components A1, . We save time, and retain flexibility for the applications, by not now describing any particular object language. Here a second pair of parentheses has been inserted, but our ranking of the symbols makes parentheses around Q ∨ R superfluous. So now, in trying to decide what other formulas B are true on the basis of the propositional calculus plus in Line 2. to obtain different tabulations of the same collection of eight computation results.) In the trivial case that E is a prime formula P, the computation takes zero steps, and the value column is identical with the column of assignments to P. Model theory: the substitution rule, a collection of valid formulas. In this book we shall find the space for only brief indications of other kinds of logic.[9] Thus far we have assumed about each prime formula or atom only that it can be identified; i.e. that each time it occurs it can be recognized as the same, and as different from other atoms. To see this, let us view the tables in the square arrangement (available in the case of two components), in which properties of the tables are more easily visualized. These three statements are immediate from theorem 4 (b). Use .(Observe that, whatever formulas constructed from P, Q, R, . In this case, we may say that A and B are (logically) equivalent (in the propositional calculus). No available domains were found It seems the domains have been blocked by your Internet Provider. We now prove 's assigned to the atoms P1, . The parentheses enable us to see how the formula was constructed, starting from the atoms P, Q, R, and using five steps of composition to introduce the five numbered occurrences of propositional connectives, thus : In a manner obvious from the parentheses or the construction, each occurrence of a connective connects or applies to or operates on one or two parts of the formula, called the scope . We follow the usual strategy for approaching such disciplines, by picking a small and manageable portion to treat first, after which we can extend our treatment to include some more. EXERCISES. Our assumption is thus that, for each atom, there are exactly two possibilities: it may be true, it may be false. , A1, A2, A3, . (Peirce's law, 1885.) (b) 2.4. Show the following not valid by computing just one suitable line of the table: (a) P ∨ Q ⊃ P & Q. Model theory: truth tables, validity. (Similarly with Theorem 6 and corollary.) — . Then our table for & would for him read as our table of ∨ for us, and vice versa. Each of these 2m parts is a duplicate of the value column of the original table, since the same computation (based only on the assignments to P1, . By the preceding discussion, it will make no difference if the list Pl, . Then by *49 with colloary . First, in this language there are to be some unambiguously constituted sentences, whose internal structure we shall ignore (for our study of the propositional calculus) except for the purpose of identifying the sentences. in the last four lines of the above table without further ado. Then in the line (or row) for a given assignment, we show the resulting truth value of each molecule in the column headed by that molecule. COROLLARY°. .. Then by EXAMPLE 3°. However we can minimize the need for parentheses by assigning decreasing ranks to our propositional connectives, in the order listed:[8] . Our study of this language and its logic, including our use of logic in carrying out the study, we regard as taking place in another language, which we call the observer's language.[1] Or we may speak of the object logic and the observer's logic. 's. But the proposition I am going too fast, if true, is true on other grounds. (c) Q ⊃ P ∨ Q. Similarly, if B is 2+2=4, A⊃B is true (because B is true), quite apart from whether A bears any relationship to 2+2=4. §5. Since we are committed here to a two-valued logic, my statement should then be regarded as true, though perhaps uninteresting. , Pn+m which do not occur in E. 5.1. Use the chain method to derive *56, *58, *59, *61 (taking *49, *55a-*55c as already established). But we ordinarily assert sentences of the form If A, then B when we don't know whether A is true or not.

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