

JOON FANG OF JAEAN – A RETROSPECTIVE

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Joon FANG, Emeritus Professor of Philosophy at Old Dominion University (Norfolk, Virginia) announced his retirement in late 1991 and has moved to “a tiny village” to escape the scholarly world. He had an acquaintance with many major logicians and mathematicians during his career and developed a negative perspective on logic and its relation to philosophy of mathematics.

Joon Fang (of Jaean) was born of royal Mongolian and Korean ancestry on 30 March 1923 in Piongyang [A: CV]\*, in what is now the capital of North Korea, but which was then the imperial capital of Korea. The Fang paternal ancestor arrived in Korea some 850 years ago with his cousin, a Mongol princess who became a queen of Korea. His mother's family's ancestry has a 2000-year old recorded Korean genealogy [A: 2.3.86]. He was a music-lover all his life, able at age four to annoy his sisters by loudly singing “*La donna é mobile*”, at age six to whistle most of *La Traviata*, and at nine to play the piano [A: 11.4.86].

The Fang family farm near Harbin in Manchuria became a haven for ‘White’ Russians after their defeat by the ‘Reds’ in the Russian Civil War [A: 4.2.86]. During a visit to Japan in 1987 for an “International Conference on the History and Pedagogy of Mathematics in Chinese Characters” (6-11 August 1987), he learned from Japanese-language history books that he lost most of his family and many of his early teachers after the communist takeover of North Korea [A: 14.10.87]. The treatment of his relatives was particularly severe because North Korean premier Kim Il Sung and his family had once been servants of the Fangs [A: 14.10.87]. (For more than 300 years, Kim's family served as caretakers of one of the two Fang family cemeteries; among the premier's first acts upon taking power was to declare that one of these cemeteries, the “Hill of Ten Thousand Scenes,” once in the suburbs of Piongyang, today within the city limits, should become a national park [A: 4.2.86]). Joon Fang has been a naturalized citizen of the United States since 1961 [A: CV].

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\*‘A’ designates archival materials, followed either by ‘CV’, indicating curriculum vitae, or by the date (day.month.year) of Fang's correspondence.

Fang was trained first in mathematics, especially in class field theory, and later in philosophy, receiving his undergraduate education at Chou University in Tokyo (1939-41) and the Technical Institute (1941-44) in Seoul, Korea [A: CV]. His most important mathematics teacher had been a student of Teiji Tagaki (Tagaki had studied with Hilbert and Emil Artin) and then of Tagaki's successor Shokichi Iyanaga. Fang received his graduate education at Yale University, where he studied with number theorist Oystein Ore [A: 26.2.86] and earned the M.A. degree in 1950, at Columbia University (1951-53), the University of Marburg (1954-56), and the University of Mainz (1957) [A: CV], writing his doctoral thesis in philosophy under the direction of Kant scholar Gottfried Martin (A: 14.4.87). He carried on his post-doctoral studies at the University of Münster (1959) and the University of Strasbourg (1961) [A: CV].

His teaching carried him around the world, and he has held posts at Pusan National University and Jinhae College (1945-48), where he taught "watered-down" courses based on van der Waerden's *Moderne Algebra*, at Defiance College (Defiance, Ohio; 1957-58), Valparaiso University (Valparaiso, Indiana; 1958-59), Saint John's University (Jamaica, New York; 1959-61), University of Alaska (1961-62), Northern Illinois University (1962-66), Memphis State University (Memphis, Tennessee; 1966-73), and the University of Münster (1971) before occupying his last post at Old Dominion (1974-91) [A: CV]. He taught logic classes, both as philosophy and mathematics courses, at introductory, intermediate, and advanced levels, from the outset of his teaching career (see [1979, 314]). In addition to teaching abstract algebra and logic, he taught mathematics courses from differential equations to Banach spaces, and philosophy courses in philosophy of mathematics and on Kant. He served as a reviewer for *Zentralblatt für Mathematik* from 1969 to 1983, and for *Mathematical Reviews* from 1971 to 1982 [A: CV]. In 1964, he founded the journal *Philosophia Mathematica* and served as its editor until his retirement. He has been listed in *American Men of Science* (to become *American Men and Women of Science*) since 1965, in *Who's Who in America* since 1971, and in *Who's Who in the World* since 1977 [A: CV].

Fang's interest in logic originated at the age of twenty. He wrote of that period of his life that his "world went round 2 volumes of Hilbert-Bernays: *Grundlagen der Math.*" [A: 25.7.85] as a student in Germany in the 1950's. Later, when teaching at Münster, he attended some of the seminars of the logicians H. Arnold Schmidt and Kurt Schütte [A: 25.7.85]. Both had been doctoral students of Hilbert. Schmidt's specialty was foundations of mathematics and many-sorted logic; Schütte's was proof theory. It was at this time that Fang also met Wilhelm Ackermann [A: 25.7.85]. His study of Hilbert-Bernays resumed at Yale under Frederic B. Fitch, but he began to feel what he described as a "discomfort" with the "vacuousness" of set theory and Cantor's transfiniteism (later expressed in *The Illusory Infinite – A Theology of Mathematics*), and showed a decided preference for Kronecker's constructive finitist position.

As a student in Japan, he had been taught from van der Waerden's *Moderne Algebra*. His discomfiture with logic and set theory led him to return to his study of algebra, and especially to the study of ring theory under the direction of Nathan Jacobson. This eventually led to publication for the Schaum's Outline Series of his *Abstract Algebra* [1963]. *Abstract Algebra* was heavily influenced by Garrett Birkhoff and Saunders Mac Lane's *A Survey of Modern Algebra*, which Fang discovered soon after his arrival in the United States in 1948 (see his [1979, 314]) and for which he had a special affection and enthusiasm. He recalled that people his age "grew up" with the *Survey* and that he enjoyed hearing about it from his mathematics tutor when he was seventeen and eighteen years old, especially after having found van der Waerden's book so difficult [A: 26.2.86]. Mac Lane became for him "almost a demigod" [A: 27.3.86].

In the first years of his studies in the United States, Fang met Alonzo Church at Princeton University and Ernest Nagel at Columbia University. His most vivid memory of Church dates from 1948: it is of observing Church licking stamps to prepare mailings of the *Journal of Symbolic Logic*, which was then already in its fifteenth year [A: 19.1.86]. For reasons connected with their views, Fang disliked both Nagel and Church, and came to dislike strongly his old friend Friedrich Kambartel, whom he had known when he [Fang] gave his first colloquium lecture at Münster in 1960 and Kambartel was a young student at Münster of Frege expert Friedrich Kaulbach and of Heinrich Behnke (the latter best known for his work on theory of functions of several complex variables) [A:11.4.86]. But he ended his friendship with Kambartel after – and because – Kambartel became a specialist on Frege when Kambartel and Kaulbach began what Fang calls the "Frege-Industry" [A: 11.4.86]. Fang's animus towards Frege and the "Frege Industry" stems from Frege as being the first to express the logicist program of reducing mathematics to logic and the first to attempt to carry out that program (see, e.g. [Fang 1970, 89, 93; 1976, 290]). Fang was militant in his views, frequently allowing his philosophical views to be carried to polemical extremes in his writings and personally in his relationships with colleagues. An exception was Alan Ross Anderson (1925-1973), best remembered for his work in non-classical logics, especially modal logics and relevance logic, who remained a valued friend and served on the editorial board of *Philosophia Mathematica* until his death [A: 12.8.85]. Fang met Anderson at Yale when he was a graduate student and Anderson was an undergraduate who received his B.A. the same year that Fang earned his M.A. What Fang [1975a] remembered about Anderson was his "personal warmth" and that "his devotion to logic and philosophy or to the human knowledge in general was extraordinary," exemplified in a willingness to argue in a friendly manner for hours at a time over Fang's attacks on Anderson's criticisms of Wittgenstein, both "happily oblivious" to what could otherwise have been uncomfortable, even embarrassing circumstances because they, unlike other participants at the formal reception during the International Congress of Philosophy in Vienna in 1969, were attired in summer suits rather than formal wear.

*Philosophia Mathematica* was founded to combat the kind of 'combination of "logic and mathematical education"' [A: 31.1.88] that typifies such foundational philosophies of mathematics as logicism and formalism. It takes aim as well at the pedagogical practice itself. "No amount of lessons or rather idle talks on the infinite and its paradoxes is to help any student in any way [to learn differential and integral calculus]. Neither are the first chapters – sometimes long enough to last one-third of the first semester – on Logic in the course on the Calculus," Fang wrote [1991, 207], adding that in fact, this practice borders on pedagogical crime. This view is an expression of his rejection of what he calls "*Logik über Alles*."

Fang's most original contributions were to philosophy of mathematics, where his efforts were directed towards combatting foundational philosophies of mathematics and "*Logik über Alles*." These efforts were carried out in such books as *Bourbaki* [1970] and *Hilbert* [1970a] as well as in the pages of *Philosophia Mathematica*.

Fang used his valedictory article "Idola fori et theatri" in *Philosophia Mathematica* [1991] to argue that the paradox of material implication should convince mathematicians that logic is not coextensive with the method of natural deduction as found in such textbooks as Copi's *Introduction to Logic* and *Symbolic Logic* and does not provide a legitimate model of mathematical reasoning as that is carried out by practicing mathematicians.\* Here he is reiterating a theme that can be found in greater detail in such papers as "The Most Unnatural 'Natural Deduction'" [1984] which were part of his public feud with Copi. It is worth examining the feud at greater length as an illustration of Fang's polemical style.

The feud with Copi goes back to December [1978] when Fang's paper the "Illogical in the Logical" first appeared in print. Copi's response, "Logic versus Illogic," appeared in print a year later [1979]. The "Illogical in the Logical" was written as early as 1966 but was rejected by several journals (see [Fang 1987, 78]). Fang might have published it in *Philosophia Mathematica*, but he preferred, he said [1987, 78] to be "comforted by the thought that someone other than [himself], someone far better known or a better qualified 'specialist in logic' would write about the matter sooner or later." When after a decade no one else had undertaken to express the same views, Fang submitted the paper to Franco Spisani's journal *International Logic Review*, even though Copi was listed on the journal's editorial board and the paper was an attack on the method of natural deduction in general and especially on Copi's *Symbolic Logic* and Copi's "followers." The paper was accepted, but that part of Fang's paper purporting to exemplify the "illogical aspect of basic 'Logic'" was deleted from the published version (see [Fang 1987, 79]).

The principal points of Fang's [1978] paper are that (1) material implication as defined by logic is counter-intuitive; (2) because the traditional truth-functional definition of mate-

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\*Fang borrows the title of his article from Francis Bacon's *Novum organum*, I, 41-44; "Idols of the Market-place" and "idols of the theater;" see [Fang 1979, 4, 16].

rial implication is 'illogical,' the use in proofs of *modus ponens*, and even more so the use of proof by contradiction cannot be regarded as legitimate; (3) textbooks define the *vel* as inclusive disjunction but do not make account of exclusive disjunction; and (4) textbooks attempt to reduce complicated philosophical arguments to symbolic propositions. Most of Fang's comments are directed against Copi because for Fang [1978, 114] he is the "norm."

Copi's reply to Fang's attacks dealt with the specific points which Fang raised. In "Logic versus Illogic," Copi [1979] reminded us that the truth-functional definition given in *Symbolic Logic* is one of several possible definitions, and that the definition chosen here for use is the conventional one. In particular, Copi noted that Fang's suggestion that Copi obfuscated the treatment of the paradoxes of implication is false, because in fact several definitions of implication are noted. The usual one is chosen, but only with the caution to the student that the truth-functional definition of the 'horseshoe' may indeed seem strange, but that it is a technical term and should not be confused with the word 'implies' as used in ordinary language. On this score, Fang's difficulty with the truth-functional definition of material implication appears to arise from Fang's failure to distinguish the various uses of *implies* in the vernacular and *material implication* as a truth-functional connective.

In "The Illogical in the Logical" [1978], Fang does not deal in detail or directly with his objections to proof by contradiction. This is taken up specifically in his [1984] paper "The Most Unnatural 'Natural Deduction'" and again in "The 'User-hostile' Logic: 'Logic versus Illogic'" [1987]. In [1978] it remains in the background, in the objections to the use of *modus ponens*, which in turn is viewed unfavorably because of Fang's rejection of material implication. Fang declared that *someone* – seeming to suggest that it was Copi – symbolized it as " $[(p \supset q) \cdot p] \supset q$ ." But as Copi [1979, 113] pointed out, this was simply *not* the symbolization he gave, either in his *Introduction to Logic* or his *Symbolic Logic*. Copi then added that, as a matter of fact, in *Symbolic Logic* he introduced "the notion of an 'associated conditional' and [said] (correctly) that any given truth functional argument has an associated conditional statement that is a tautology if and only if the given truth functional argument is valid," and he remarks that "this seems objectionable to Fang, but he has not explained why." In fact, Fang's left many objections or corrections unexplained or insufficiently elucidated or described. Moreover, Copi is correct in seeing that Fang would not be satisfied with any explanation or rebuttal on behalf of the inference rules of natural deduction. We shall see that the same criticisms of the definition of material implication and of *modus ponens* arise again in Fang's writings.

In response to Fang's complaints regarding disjunction, Copi [1979, 113] reminds us that in his *Introduction to Logic* he distinguished inclusive and exclusive disjunction and explained that which sense is intended in any instance of the use of the work 'or' must be determined by the context in which it occurs. He then added that it appeared to him that Fang was claiming, without arguing the case, that only the exclusive sense exists. Fang [1978, 119] criticized as "senseless" the tautology " $p \supset (p \vee q)$ ," which becomes the

"meta-theorem" or "Rule" that: "*p. Hence p and/or q.*" The "senselessness" of this tautology appears again when in "The Most Unnatural 'Natural Deduction'," Fang [1984, 14] took Gentzen's rules (3a) and (3b) as being wholly "unnatural." In [1978, 119], Fang was combining his attack on the unnaturalness of the rule with an attack on the use of inclusive disjunction. In the "The Most Unnatural 'Natural Deduction'," he separated these two issues, attacking inclusive disjunction in the context of his difficulties with the Law of Excluded Middle.

The question of translating complicated philosophical arguments into symbols is easily laid to rest. It can readily be settled on the side of Copi, who recommends that one has only to read his textbooks; as Copi [1979, 111] reminds us, one will search in vain for statements or arguments from philosophers, whether symbolized or not.

Copi's textbooks *Introduction to Logic* and *Symbolic Logic* have enjoyed great popularity, and Fang could not refrain from telling his reader how many copies of Copi had been sold. (In [Fang 1978, 112], Copi's *Introduction* is described as "the most [by far?] widely circulating textbook in English;" according to [Fang 1987, 78], it "may enter the Guinness Book of World Records by now. Over one-million copies sold...;" in [Fang 1979, 7], we are told that Copi's *Symbolic Logic* sold "some 750,000 copies by 1978....") If Fang has a quarrel with symbolic logic, then these statistics provide him with an excuse for picking Copi as his most convenient and visible whipping-boy. Fang's constant switches between Copi, Copi and his "followers" or "Professor Copi and a great multitude of his school or related schools" (see [Fang 1987, 78]), and "some textbook writers" as his target make it unclear when Fang is criticizing Copi or some unnamed author, but his choice of Copi as the representative author of the type of logic textbook which he dislikes gives the impression that all of his criticisms are being levelled specifically at Copi, making it easy for Copi to point out Fang's major errors, and in particular where and how Fang misread his *Introduction to Logic* or confused it with other, unnamed, introductory textbooks.

In "The Most Unnatural 'Natural Deduction'," Fang [1984] takes up the cudgels again. He argues against the backdrop of the history of logic that Gentzen-style natural deduction, such as that adapted by textbook writers such as Copi, is itself quite unnatural. He states (p. 13) that Kneale and Kneale's [1962, 539] assertion that Gentzen's presentation of logic is more natural than that of Frege, Whitehead and Russell, exhibits a "flagrant Fallacy in Equivocation," and cites (at p. 14) without evidence or reference the putative admission by Gentzen himself that some of his inference rules – in particular rules (3a) and (3b), the laws of addition  $P \rightarrow P \vee Q$ ,  $Q \rightarrow P \vee Q$  – were quite "unnatural." (In fact, Gentzen [1934, 189] does indicate that these are among a handful of rules in which the implication sign is not used in a contentual sense – "*inhaltlichen Sinn.*") Also problematic in Fang's view is the Law of Excluded Middle. Fang argues [1984, 15; see also 1991, 213] that logicians since Reichenbach have formulated the law as  $P \vee \sim P$  but translate it as "*P and/or  $\sim P$* "; or what is the same: '*P or  $\sim P$  or [that] both  $P$  and  $\sim P$* .' Here and elsewhere, Fang

argues that the truth-functional character of material implication which permits the principle that *ex falso quodlibet sequitur* is blatantly counter-intuitive and is never used by mathematicians. For Fang (e.g., [1991, 213]), it follows that the *reducto ad absurdum*, proof by contradiction, is suspect when indirect proofs are made the basic tactic in logic textbooks. No mathematicians, he added [1991, 213], ever were so “foolish enough or plain stupid” as to base a proof on the principle of *ex falso quodlibet sequitur*.

Fang also argued that the exercise of translating natural language into the formalism of mathematical logic is artificial at best [1984, 13], and he declared [1989, 238] that “logicians or some logically-minded philosophers, so proud of their knowledge that several hundred (!) formidable (!) pages of *Principia Mathematica* were needed for the ‘proof’ of ‘ $1+1=2$ ’ or any other equally inane sum, are often indifferent or even contemptuous of ‘calculation’ or computation.” This led him to remind his readers [1984, 14] that Tagaki had once said that “mathematical logic is only for a lazy-bones.” In a more moderate moment, he admitted that he was not so much “against” Russell, Frege, Wittgenstein and their ilk as he was “somewhat against their ‘*Epigonen*’ who are unapt to be able to say or write anything unless they wrote in in their *formidable* language” (sic), and he had little patience for those who try to write in formal language outside its “proper domain of mathematics” [A: 28.3.86]. In Fang’s view [1984, 13-14], Gödel’s incompleteness theorems firmly established what philosophers from Nicholas Cusanus and Kant had always known – that it is beyond human ability and the powers of logic to produce “an all-embracing proof of the completeness and consistency of mathematics,” and that Hilbert’s dream of finding such a proof was doomed. It was, according to Fang [1984, 14], Gentzen’s attempt to vindicate Hilbert against Gödel that led to the creation of Gentzen’s “most unnatural ‘natural deduction’.”

Where Fang sees Gödel’s incompleteness results as negative, as breaking down the Hilbert program, Saunders Mac Lane saw Gödel’s work as opening the way to an opportunity. According to Mac Lane [1986, 4], the foundational studies involved in Gödel’s result led to recursion theory as an “offshoot” that has become “a more and more elaborate display of techniques for solving particularly recondite problems.” Mac Lane gave the development of recursion theory out of foundational studies as one among many examples in support of his thesis that mathematical logic, once “strongly tied to problems about the philosophy of mathematics,” has grown over the years to loosen the “connections between logic and foundations...until they have practically disappeared” [1986, 3]. Fang agrees “100%” with Mac Lane’s thesis that mathematical logic is neither foundation nor philosophy of mathematics [A: 26.2.6], and has even expressed his willingness to take the article in which Mac Lane expressed this view as the manifesto of *Philosophia Mathematica* [A: 27.3.86]. Indeed, Fang’s enthusiasm for Birkhoff and Mac Lane’s *Survey* and his memory of youthful appreciation for their book prompted him to assert his willingness to have Mac Lane’s article stand alone, if need be, as an entire issue of *Philosophia Mathematica* [A: 26.2.86]. What distinguishes Fang from writers such as Mac Lane is

Fang's unrelenting combat against foundational philosophers of mathematics who pursue "*Logik über Alles*", especially Russell's logicism (see, e.g. [1979, 7]) while Mac Lane applauds the development of mathematical logic and assesses its development as a branch of mathematics that has matured technically and split into several specialties, each of which has contributed to mathematics and to understanding the interconnections and relationships among various different formalizations and different branches of mathematics.

Fang's textbook, *Logic Today – Basics and Beyond: An Informal Introduction* [1979], was meant as a corrective to the use of natural deduction in logic textbooks and in particular to attempt "to turn back...the immense tidal wave caused by [Copi's *Introduction to Logic* and *Symbolic Logic*]" in particular (see [1979, 6]). Fang's book uses truth tables to carry out proofs in propositional logic and considers the monadic predicate calculus strictly in syllogistic terms. Nevertheless, Fang argued ([1991, 213]; see also [1979, 124]) that a truth table is really "nothing but an absolutely arbitrary logical 'computation table'," which (in [1979, 124]) he likened to the multiplication table. Interspersed with the passages of *Logic Today* on these techniques are remarks expressing Fang's views on mathematical logic. The topics with which he deals in this book are typical of other introductory logic textbooks for philosophy undergraduates, although their presentation is atypical. *Logic Today* has had no audience other than Fang's own logic classes at Memphis State and Old Dominion, and has long been out of print.

Fang's [1987] article "The 'User-hostile' Logic: 'Logic versus Illogic'" is a combination of the previous articles "The Illogical in the Logical" and "The Most Unnatural 'Natural Deduction'" along with the parts of "The Illogical in the Logical" which did not appear in the published version, supplemented by his replies to Copi's [1979] criticisms. These "replies" amount to *ad hominem* attacks on Copi, who is, according to Fang [1987, 78] "in the business of writing basic textbooks, to suppress any effort to clarify and explicate such problems" and to unfounded and misleading assertions [Fang 1987, 85-86] that Copi's original [1979] responses to his criticisms in [Fang 1978] consist of fallacies (specifically those of *argumentum ad misericordiam* and *ad verecundiam*). Fang's overriding complaint [1987, 78] continues to be that "the 'symbolic logic' practiced and taught by Professor Copi and a great multitude of his school or related schools is either 'user-hostile' at best or plain illogical' at worst."

In tracing Fang's relationships with his colleagues, teachers, and friends, we observed that he permitted disagreements with their views to affect his attitude toward them, e.g. Nagel, Church, and Kambartel. Thus we should not be surprised that in [1987] and elsewhere, the attack on logic textbooks, especially those employing natural deduction, became a personal attack on Copi as the representative author of those textbooks. For example, after declaring that in fact "material implication can mean neither more nor less than 'not-P and/or Q,'" but not the conditional, Fang [1987, 82] adds that "the examples presented by Prof. C[opi]...cannot possibly be even 'partially' honest or sane."

If we set aside Fang's views on logic and on its relationship to philosophy of mathematics, we can identify aspects of Fang's work which contribute to mathematical scholarship in several ways. An invaluable resource for philosophers of mathematics is his compilation of "The Nature of Modern Mathematics, A Selective Bibliography: 1940-1970" [1971]. The rest of his efforts in philosophy centered on Kant's philosophy of mathematics in such works as his *Kant-Interpretationen* [1967] and "Kant as 'Mathematiker'." He also fought against the "New Math" movement of the 1960's in such works as *Numbers Racket* [1968]. His most far-reaching work was in the field of sociology of mathematics, which he pioneered; the beginnings of this field can be traced to his work *Sociology of Mathematics and Mathematicians* [1975], co-authored with K.P. Takayama and which Kitcher and Aspray [1988, 31] describe as a "survey of methods and theory in the social history of mathematics."

Fang's main contributions to the history of mathematics were his *Mathematicians from Antiquity to Today* [1972] and its companion, *A Guide to the Literature of Mathematics Today* [1972a]. The former gives brief sketches of the life and most notable mathematical contributions of each biographee. It is comparable in its intent to A.I. Borodin and A.S. Bugai's *Vydaiushchiesia matematiki: Biograficheskij slovar'-spravochnik*, and could well have become an important and valuable research tool had it been completed; but only volume 1, *Mathematicians from Antiquity to 1945 (A-D)* [1972] was actually written; later volumes remained unfinished for lack of funds and time [A: 4.2.86]. Fang described his *Mathematicians from Antiquity* as having been initially inspired by the contributions to mathematics of operator theorist Mark Aronovich Naimark (without however explaining in what that inspiration consisted). Even his *Hilbert* and *Bourbaki*, for all their polemics against the Hilbert program and its Bourbakist successor, were praised for their contributions to scholarship. Paul R. Halmos [1970] commented that "every quotation [in *Bourbaki*] is accompanied by a meticulous reference," and Morris Kline [1971] stated that "a valuable feature of [Hilbert] is the inclusion of the famous list of twenty-three problems....," noting that Fang "gives references to the progress made on these problems up to the present date," while adding that "another valuable feature is the ample number of references to papers and the biographical information in notes on men associated with Hilbert and his work." Fang, for his part, had little patience with their praise ([A: 12.12.88]; also [1991, 202]), although quotations from the reviews by Halmos and Kline were used in advertising Fang's books. Their view of the value of Fang's contribution to scholarship has been reaffirmed by such historians of mathematics as Lilliane Beaulieu [1987], a specialist on the work of Bourbaki who asserts that today Fang's *Bourbaki* still remains the best place to begin a search for secondary references on Bourbaki.

Fang's views on the distinction between logic and foundational philosophies of mathematics failed to exert influence because of the combativeness and rhetorical negativity with which he expressed his views. This served only to offend and alienate even those who, like Mac Lane, were sympathetic to the distinction between mathematical logic and foundations

or philosophy of mathematics which Fang drew. Fang's acerbic attacks were compounded by his deliberate alienation of those whose views were contrary to his own. Students of philosophy of mathematics will require patience in sifting through Fang's polemics in search of his distinctive views in a controversial area.

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