

## The Origin of the Group in Logic and the Methodology of Science

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# The Origin of the Group in Logic and the Methodology of Science

## **Cover Page Footnote**

This paper was written on the occasion of the conference celebrating 60 years of the Group in Logic and the Methodology of Science that took place at UC Berkeley on May 5-6, 2017. I am very grateful to Doug Blue, Nicholas Currie, and James Walsh for the help they provided in assisting me with the archival work.

# The Origin of The Group in Logic and the Methodology of Science<sup>1</sup>

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## Synopsis

The Group in Logic and the Methodology of Science at UC Berkeley was founded in 1957. It has been a key institutional element in carrying out Tarski's vision for making UC Berkeley one of the most important centers of logical research in the world. In this brief history, I look at the emergence of the Group in Logic with an eye towards understanding the circumstances that made it possible.

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## 1. Introduction

In a letter to Leon Henkin, sent from Mexico City on July 25, 1957, Alfred Tarski wrote:

I have received a letter from Dean Stewart informing me that our proposal for a Ph.D. examination in Logic and the Methodology of Sciences [sic] has been finally approved by the Graduate Council and that his office will extend all possible help to us in organizing the new field of studies. Of course, nothing can be done about it before September. Since this seems to be the first experiment of this kind in the world, it may be worthwhile

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<sup>1</sup> This paper was written on the occasion of the conference celebrating 60 years of the Group in Logic and the Methodology of Science that took place at UC Berkeley on May 5-6, 2017. I am very grateful to Doug Blue, Nicholas Currie, and James Walsh for the help they provided in assisting me with the archival research. I am also grateful to Prof. Dana Scott for informative conversations on the history of logic at UC Berkeley.

to inform publicly the members of the Summer Institute of our achievements and our plans. (Tarski Papers, Bancroft Library, Carton 12, folder 27)

The Summer Institute mentioned in the letter was the Cornell Summer Institute in Logic which ran for the full month of July 1957. It was a watershed in the history of logic and the list of participants reads like a who's who of prominent authorities and future stars in mathematical logic (see [7], [8, chapter 9]). The one-month long meeting at Cornell was winding up by the time Tarski wrote the letter quoted above. Tarski had been able to attend only the first three weeks on account of an invitation to lecture in Mexico City. The news of the approval of the Group in Logic and the Methodology of Science must have given Tarski and Henkin great satisfaction. It was one more success in the campaign for making UC Berkeley the most prominent center for the study of logic in the world. Hence the need to convey the important news to all the scholars who were attending the Cornell Summer Institute.

At the Cornell Summer Institute, Tarski had also approached Robert Vaught, one of his former Ph.D. students, for a possible position at UC Berkeley. In November 1957 that possibility became concrete and Tarski lost no time in using the existence of the Group in Logic as leverage in attracting Vaught, who became, after Henkin, the next key appointment in mathematical logic at UC Berkeley. In a letter dated November 2, 1957, Tarski wrote to Vaught saying that he was ready to recommend him for a new position in foundations that had opened up in the mathematics department. As a consummate salesman, Tarski went on to explain the attractions of UC Berkeley for someone working in foundations:

To sell my merchandize [sic], I want to tell you more about the present situation of our field of research in the Bay area. As you know, Berkeley is now the unique place in the world which offers a Ph.D. degree in logic and methodology; in a sense logicians and methodologists (Henkin, Mates, Myhill, I, and a few other people) constitute now a separate unit in the University (denoted as a "group", not as a department); however, we all remain in our original departments. I expect that the majority of students working with Henkin or me will still get their degrees as regular mathematicians specializing in foundations; at the same time the

way is open for those who wish to become full-blood [sic] logicians. We have this year several visiting people — Wanda Szmielew, Orey, Lightstone, Beth may come to the Philosophy Dp't for the spring term. (R. L. Vaught Papers, Bancroft Library, 1:32)

Tarski went on to explain that he was hoping to be appointed research professor in the Institute for Basic Research starting in February 1958, a two-year appointment which would have allowed him to also employ Vaught as research associate for the first year. This would free two salaries for further visiting positions:

If I get an appointment, my present salary will be available to the department and will be used to invite a “big shot” as a vis. professor; we are planning to invite Mostowski for 1958-59 or may be even for 3 terms, and van der Waerden will probably be here in the spring term. The same will apply to your salary if you accept my plan; we may then get Shepperdson [sic for Shepherdson] as replacement for you in 1958-59. It seems very likely that Dana Scott will be either here or at Stanford beginning next year. What a group! (R. L. Vaught Papers, Bancroft Library, 1:32)

What a group indeed! Tarski's plans worked out as anticipated. He was awarded the research professorship, Vaught was hired as assistant professor in mathematics (spending the first year as research associate at the Institute for Basic Research), and 1958-1959 was rich in visitors (but not unusually so given that the influx of visitors in logic at UC Berkeley remained very high in subsequent years).

In order to clarify how the creation of the Group in Logic and the Methodology of Science came about we need to take a step back to describe Tarski's campaign for logic at UC Berkeley in the period 1942-1956.

## 2. Tarski's campaign for logic at UC Berkeley

When Tarski joined UC Berkeley in 1942, as a lecturer with a one-year contract, there was not much strength in mathematical logic to speak of.<sup>2</sup>

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<sup>2</sup> For some parts of this section I am indebted to [8].

Indeed, Tarski did not seem too impressed by the overall level of research at UC Berkeley. He wrote to his friend J. Woodger on November 4, 1942:

Berkeley is a beautiful place — one of the most beautiful I saw in my life. It is so charming here that people don't seem to bother much about science. After all, life is so short, the weather so delightful (no summer, no winter), the ocean so immense, the hills so green, the eucalyptus trees so tall, — and mathematics is so hard a piece of work. Of course, there are exceptions. (Woodger Papers, Special Collections, UCL, London)

Tarski's letters between 1942 and 1945 bitterly complain about his isolation. In the first year he lectured to undergraduates but nothing related to foundations. In a letter to Kurt and Adele Gödel, written in December 1942, he mentioned that he was running a seminar in logic where the “participants are exclusively professors and instructors of philosophy and mathematics; but the level is almost the same as in my other [undergraduate] classes” (cited in [8, pages 151–152]). But already in his second year he was able to offer a seminar titled “Topics in Algebra and Metamathematics”. What else was available in logic at UC Berkeley when Tarski arrived?

In the mathematics department, Benjamin Bernstein did work in logic but his style of work, tied to the old postulationist school,<sup>3</sup> seemed to Tarski awfully outdated. Bernstein was also very close to the algebraist Alfred Foster with whom Tarski did not get along too well. Bernstein and Foster taught the only course that could by any measure count as close to logic, “Foundations of Mathematics” (Math 127A-127B). The description was “Mathematical development of logic, and the logic of algebra and geometry”. In the hands of Bernstein and Foster this included a development of the algebra of logic and systems of postulates for various mathematical theories. No set theory or advanced logic was covered in it. Faced with this situation, Tarski was soon campaigning for the introduction of an upper level course in mathematical logic to be offered in the mathematics department at UC Berkeley. Such an additional course, he claimed, would not be in conflict with the already existing “Foundations of Mathematics”. On the contrary, he added, the two courses would complement each other. The document Tarski wrote,<sup>4</sup>

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<sup>3</sup> On the postulationist school see [14].

<sup>4</sup> The document is not among those preserved in the Alfred Tarski Papers at the

probably not later than 1947, is remarkable. It shows how the empire in logic that Tarski soon built at UC Berkeley started with some fairly modest proposals. The title of the document was “Remarks concerning the study of mathematical logic in the department of mathematics.” Tarski wrote:

It is my strong belief that the fundamental ideas of modern logic and methodology of deductive thinking should be regarded as an essential element of higher learning and be made available to the widest possible circle of students; furthermore, that students majoring in mathematics should be encouraged to take systematic courses in mathematical logic and foundations of mathematics so that they can bring to clarity in their minds the fundamental ideas and methods of argument involved in the major subject of their study; and finally that students working for a higher degree in mathematics should be given the opportunity to acquaint themselves with the important achievements of contemporary metamathematics and possibly to prepare themselves for research work in this field in case they become interested in it.

Tarski did not want to raise the issue of lower level courses in logic, for philosophy had a staple course called Phil 12 (it still has the same name!).<sup>5</sup> However, he strongly advocated for the creation of at least a one-year upper division course and a one-year graduate course. Other ideas presented in the document clearly hinted at the possibility of joint seminars with philosophy. Given the importance of this document I reproduce it fully in Appendix A.

Let us take a closer look at the situation in logic at UC Berkeley when Tarski arrived there. We have already seen that a minimal amount of logic was offered by Bernstein<sup>6</sup> and Foster. A much more interesting colleague for Tarski was a versatile mathematician who had contributed to logic, Raphael Robinson (1911-1995).<sup>7</sup> Robinson had done his Ph. D. at UC Berkeley and

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Bancroft Library. I found a copy of it in a set of folders related to Paul Marhenke’s teaching stored in the so-called “cage”, a storage room in the Howison Library in the Philosophy Department at UC Berkeley.

<sup>5</sup> Philosophy 12 makes its appearance in the University Catalogue in 1927 with Paul Marhenke teaching it. For more information on Marhenke see Dennes, Lenzen, Mates 1957.

<sup>6</sup> The Benjamin Bernstein Papers are preserved at the Bancroft Library at UC Berkeley.

<sup>7</sup> On Robinson’s work in logic see [13] and [2].

after a two-year appointment at Brown he returned to Berkeley in 1937 where he worked until his retirement in 1972. Another important presence in logic was his wife, Julia Robinson (they married in 1941). Julia would go on to get her Ph.D. with Tarski in 1948 and to a distinguished career in mathematics. I will say more about Raphael Robinson's output in logic later, for he was one of the founding fathers of the Group in Logic and the Methodology of Science. It is fair to say that in the 1940s, logic was just beginning to take its first steps at UC Berkeley. The department of mathematics itself did not have the size or the reputation that it later acquired.<sup>8</sup>

Philosophy did not have much by way of logic, either, but perhaps a bit more than mathematics. In the 1940s, the major presences in this area were Paul Marhenke (1899-1952) and Benson Mates (1919-2009). Marhenke had obtained his bachelor, M.A., and Ph.D. at Berkeley. He began his career as Instructor of Philosophy in 1927 and rose through the ranks until he became Professor of Philosophy in 1947. He was responsible, until the late 1940s, for all the offerings in logic and philosophy of science. A perusal of some of his lecture notes preserved in the Howison library at UC Berkeley (see note 4) shows that he was quite knowledgeable in mathematical logic and philosophy of science.<sup>9</sup> His "In Memoriam" at UC Berkeley reads:

Professor Marhenke was among the first American scholars not only to recognize the importance for logic of Russell and Whitehead's *Principia Mathematica* (and some of its sources in the treatises of Frege and Peano), but also to study the method and structure of that work meticulously. He was able thus to give many generations of students a thorough introduction to recent logic, and to help them to appreciate the striking new developments made by logicians in recent years" [5].

However, his research output could not be characterized as having been informed by formal techniques and it was to be found mainly in the series "University of California Publications in Philosophy"<sup>10</sup> edited by other col-

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<sup>8</sup> For the history of the mathematics department at UC Berkeley see [17].

<sup>9</sup> Incidentally, Richard Montague and Dana Scott took courses with Marhenke.

<sup>10</sup> Another frequent contributor to this series was Victor Lenzen, a physicist at UC Berkeley quite close to the Unity of Science movement. This establishes his close relation to the Philosophy Department and not surprisingly he was to become one of the founders of the Group in Logic.



leagues in the Philosophy Department (including William Dennes,<sup>11</sup> Edward Strong, and Stephen Pepper).

Benson Mates began his doctoral studies at UC Berkeley in 1945 concentrating on Greek philosophy and mathematical logic. After finishing his Ph.D. in 1948, he began his career in the Philosophy Department where he taught a variety of courses, including logic, philosophy of language, and history of philosophy. Mates became an important supporter of Tarski's vision for logic at UC Berkeley and I will come back to him later because he was also one of the founders of the Group in Logic.

During the war years (1942-1945), things did not improve much by way of offerings in logic at Berkeley, but through his magnetic personality Tarski was beginning to attract outstanding students. One of the first undergraduates who got the logic bug was Bjarni Jónsson (1920-2016) who ended up writing a Ph.D. thesis under Tarski's supervision in 1946. Another important visitor during 1942-43 was J.C.C. McKinsey (1908-1953) with whom Tarski had already been acquainted during his stay in the East Coast between 1939 and 1942.

Tarski was promoted Associate Professor in 1943 and Full Professor in 1944, and with his more stable academic position, he could now start to replicate what he had experienced in the 1920s and 1930s at the University of Warsaw, namely an environment in which foundational studies, including connections to mathematics, philosophy, and other sciences, could thrive. In the immediate post-war years, more students began working with Tarski (in addition to Bjarni Jónsson, Louise Chin and Julia Robinson got a Ph.D. under Tarski in 1948).

Meanwhile, his vision for adding logic courses to the curriculum in mathematics began bearing fruit. A yearly upper level course in mathematical logic (109A-109B) was added to the offerings in 1948-49 and was taught by another natural ally of Tarski, the topologist John Kelley (Tarski was on sabbatical during that year). The first yearly graduate seminar in metamathematics (225A-B) was instituted the following year and was taught by Tarski,<sup>12</sup> while Wanda Szmielew, who was visiting Berkeley from Warsaw

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<sup>11</sup> Incidentally, Dennes was one of the speakers at the 1939 Harvard Congress on the Unity of Science (see [19, page 431]) and he might have gotten acquainted with Tarski on that occasion.

<sup>12</sup> The Robert Lawson Vaught Papers at the Bancroft Library contain Vaught's notes of

for one year, taught the 109 sequence. 225A-B is still the core seminar on foundations required of all the students in the Logic and the Methodology of Science program. New graduate seminars were now added year after year. In 1950-1951 we find 235A-B, Set Theory, taught by Tarski. With the retirement of Bernstein in 1951, Raphael Robinson took over the “foundations of mathematics” sequence (127A-B) and added an important set theory part to the course.

In the early 1950s, a number of prominent appointments in the areas of logic and foundations were made both in philosophy and in mathematics. The Polish mathematician and philosopher Jan Kalicki had visited UC Berkeley in 1951-52 where he taught in the mathematics department. (Dana Scott, then an undergraduate, took a course with Kalicki in 1951 and wrote with him some joint papers.<sup>13</sup>) After a year at UC Davis he was appointed in the Philosophy Department at UC Berkeley. Kalicki had replaced Paul Marhenke who had unexpectedly died in 1952 leaving the department with serious needs in the areas of logic and the philosophy of science. Kalicki would have obviously been ideal as a member of the yet unborn Group in Logic. He was an excellent logician and philosopher who had been educated in Warsaw, where Tarski himself, years before Kalicki, had benefited from the interaction between philosophers and mathematicians on foundational issues.<sup>14</sup> Alas, it was not to be. Kalicki died in an automobile accident in November 1953 just two months after he had begun teaching in the philosophy department.<sup>15</sup> The department then offered a position to John Myhill (1923-1987) who began teaching in Fall 1954 and was to become another founding member of the Group in Logic.<sup>16</sup>

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many graduate courses offered by Tarski between 1946 and 1953. They are an invaluable resource for the history of logic at UC Berkeley. One finds there, among others, Vaught’s notes for Tarski’s graduate courses in Metamathematics (1949), Set Theory (Math 235; 1950-1951), and Metamathematics and Algebra (1951). Vaught obtained his Ph.D. under Tarski’s supervision in 1953.

<sup>13</sup> Dana Scott was an undergraduate at UC Berkeley from 1950 to 1954 and then a graduate student in 1955 before he had a falling out with Tarski and went to Princeton to do his Ph.D. under Alonzo Church.

<sup>14</sup> For the Polish tradition in logic and foundations see [27] and [8].

<sup>15</sup> See “Jan Kalicki In Memoriam” [16]. In the car with Kalicki were Alfred Tarski, Maria Tarski, and C.C. Chang who were unharmed.

<sup>16</sup> On Myhill’s work in logic, see the obituary [6].

But the decisive hiring for the fortunes of logic at UC Berkeley was that of Leon Henkin in mathematics in 1953. Henkin, who had earned a Ph.D. in logic at Princeton under the supervision of Alonzo Church in 1947, was to become Tarski's right arm in his campaign for logic.

The late forties and fifties were also an extremely productive period for Tarski (see [8, Interlude IV]) who cemented his reputation as one of the most important logicians of the century. By 1957 the list of Ph.D. students of Tarski already included, among others, Chen-Chung Chang, Solomon Feferman, Richard Montague, and Robert Vaught.

Let us take a quick look at what was taught in logic at UC Berkeley in the period between 1950 and 1956, namely the year in which a proposal for the creation of the Group in Logic was submitted to the Graduate Division.

In Philosophy, offerings included lower level undergraduate courses in logic (12A-12B), a sequence in intermediate logic (113A-113B), and a seminar called "Seminar in Logic" (213A-213B). In Spring 1950 Mates taught 12B, Marhenke 113A and 213B. With the loss of Kalicki and the arrival of Myhill, the line-up in Fall 1954 saw Myhill teaching 12A, 113A-B, and 213A-B. A noticeable weakness after the death of Marhenke was the lack of any teaching in philosophy of science. This was addressed first with an invitation for one semester to Patrick Suppes (who was already teaching at Stanford) and then with the arrival of Ernest Adams (1926-2009) in 1956. In fall 1953, Kalicki was in charge of 141A (Survey of Modern Logic) and of the Seminar in Logic (213A) which was devoted to Philosophy of Mathematics. Both courses had to be cancelled on account of the untimely death of Kalicki. In the same semester, 12A was taught by Leon Henkin, who had just accepted a position in the mathematics department. It is noteworthy to point out that while Henkin was teaching in philosophy, Mates was lecturing in the mathematics department. This shows a level of interaction between the two departments that might have facilitated the creation of the Group in Logic. In a letter to Myhill, dated March 22, 1954, the Chair of the Philosophy department, Stephen Pepper wrote:

We have very pleasant relations with the mathematicians, particularly with Tarski and Henkin, and there has been some interchange of courses between Henkin and Mates. This year Henkin has been giving logic courses in this Department, and Mates has given courses in the Mathematics Department. The only require-

ment is that in the interchange equal time be distributed between the two Departments and, of course, departmental approval on both sides. (Myhill personnel file, Philosophy Department, UC Berkeley)

In contrast to philosophy, which was struggling to staff the areas of logic and philosophy of science, the mathematics department was experiencing a surge of offerings in the areas of logic and foundations (and in other areas as well). For instance, in 1953-54, we find as offerings in these areas: 225A (metamathematics) taught by Henkin; 290B (Foundations of abstract algebra) taught by Tarski; 109A (mathematical logic) taught by Anne Davis; 127B (foundations of mathematics) taught by Raphael Robinson; 225B (metamathematics) taught by Henkin; 245A (introduction to modern algebra) taught by Tarski; 290E (Foundations of modern algebra). In the following years the increase of the number of students in the area of foundations would bring about new hirings in logic, a constant stream of visitors in logic and foundations, and an explosion of course offerings in logic and the foundations of mathematics.

To conclude this section on course offerings let us look at the course offerings in 1956-1957, the year in which the administrative steps for the creation of the Group in Logic were completed. In mathematics: 125A and B (Mathematical Logic) taught by Henkin; 135A and B (Foundations of Mathematics) taught by Henkin; 235A and B (Foundations of Set Theory) taught by Kelley; 255A and B (Foundations of Geometry) taught by Tarski; and 290 seminars offered by Henkin on Metamathematics and by Tarski on Foundations of Mathematics and Abstract Algebra. The list in philosophy is less impressive with Myhill offering most of the teachings in logic (12A and B, 113A, and 213A and B). Noteworthy are new courses taught by Ernest Adams, who had just joined the department, in philosophy of science (124) and in semantics (218A).

One gets a good idea of the work done in logic at Berkeley during this period by perusing the multi-year reports that were completed for the NSF grants that Tarski received with almost unflinching regularity starting in 1952.<sup>17</sup>

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<sup>17</sup> See bibliography under Tarski *et al.* ([21]–[26]). Copies of these reports are found in the Logic Library at UC Berkeley.

The first such report, co-authored by Chen-Chung Chang, Anne Davis (later Morel), and Alfred Tarski, covers the period June 25, 1952–October 31, 1954. After an introduction, it details the five main areas of work which occupied Tarski and his team during the period: 1. The Decision Problem; 2. The Theory of Models; 3. Abstract Algebras; 4. Foundations of Set Theory–The Axiom of Choice; 5. The Theory of Relations.

The staff list gives us a vivid sense of how much things had changed since Tarski's arrival at Berkeley. The list includes: Anne C. Davis, Roland Fraïssé, Chen-Chung Chang, Richard Montague, Dana Scott, and Raphael Robinson. Among the collaborators who “were engaged in research closely integrated with that of the project staff” we find: William Hanf (UC Berkeley), Leon Henkin (UC Berkeley), Bjarni Jónsson (Brown University), Jan Kalicki (UC Berkeley), Herman Rubin (Stanford University), Andrzej Mostowski (University of Warsaw), Robert Vaught (University of Washington). This first report to the NSF already indicates some invariants in Tarski's approach to logic, namely the encompassing spectrum of areas of investigation and the broad international style of collaboration. All of this is confirmed in the second NSF grant covering the period January 15, 1955–January 15, 1957, the last relevant period before the creation of the Group in Logic. The staff was composed by Chen-Chung Chang, William Hanf, Leon Henkin, Roger Lyndon, Richard Porter, and Alfred Tarski. Lyndon, a professor at the University of Michigan, was a visiting professor at UC Berkeley in 1956–1957. Among the people who were engaged in scholarly research closely related to that of the project staff we find: Anne Davis (UC Davis), Solomon Feferman (Stanford University), Bjarni Jónsson (University of Minneapolis, visiting Associate Professor at UC Berkeley in 1955–56), Richard Montague (UCLA), Dana Scott (Princeton), Robert Vaught (University of Washington). The report states: “All these persons are present or former students of A. Tarski. In particular, Mr. Feferman and Mr. Montague have completed their doctoral dissertations and are to receive Ph.D. degrees in June, 1957.” The main topics of investigations were indicated as: 1. the general theory of models; 2. formalization and algebraization of logic; 3. foundations of set theory and models of set-theoretical axiom systems; 4. foundations of geometry; 5. study of fundamental mathematical notions (consistency, completeness, decidability, and axiomatizability), 6. general theory of algebraic systems and study of special classes of algebras (lattices, Boolean algebras, semi-groups, and groups); 7. Theory of relations.

The bibliography, representing the achievements for the period of 1955-1956, listed 32 items between articles and books and 39 abstracts.

Before we close this section, it might be worthwhile to point out that regular Stanford-Berkeley colloquia on “logic and the methodology of science” were taking place well before the Group was founded. Such colloquia would continue for several years. The regular Logic Colloquium associated with the Group in Logic seems to have been instituted at some point in the academic year 1961-1962 under the direction of Dana Scott who had come back to Berkeley as Assistant Professor in 1960.

By the mid-fifties, then, logic was already a thriving area at UC Berkeley. But this was only the beginning.

### **3. The foundation of the Group in Logic and the Methodology of Science**

The proposal for “offering the Ph.D. degree in a new field of study, to be entitled Logic and the Methodology of Science” was submitted to the Acting Dean of the Graduate Division, M. A. Stewart, on August 13, 1956.<sup>18</sup> The motivation for the new field of study was given as follows:

In recent years the University of California at Berkeley has become one of the most important centers of logical and methodological studies in the world. The prospect of doing advanced work in these fields under expert guidance has attracted students from all parts of the United States and even from Europe. If these students choose to work towards an advanced degree, however, they are forced to decide between two alternatives, neither of which is adequate for their purposes. (Group in Logic & Methodology of Science, Chair files)

The document went on to explain that the two alternatives were mathematics and philosophy. It then outlined what costs taking either one of these paths would have for the student interested in methodological studies.

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<sup>18</sup> The unusual “methodology of science” was vintage Polish. Polish scholars working in foundations often described their areas of work as methodology of (deductive) science; see for instance [4]. Attempts at changing the denomination of the Group throughout the years have never succeeded and for good reasons: it is a brand name.

Mathematics students would have to forego relevant subjects as “methodology of empirical science, semantics and the philosophy of language, many-valued, modal, and intuitionistic systems of logic, etc.” On the other hand, students of logic who pursued the philosophical degree would have to forego their mathematical training. The proposal anticipated that “students obtaining their degrees under this plan will be especially well-qualified to teach logic and related topics in both philosophy and mathematics departments, and that they will have been prepared, more adequately than has hitherto been the case at any university, to make original contributions to the advancement of the subject.” The document ends by pointing out that the program had been formally approved in separate meetings by the departments of philosophy and mathematics. (For the full document, see Appendix B.)

The co-signatories were: Ernest Adams (Philosophy), Yuen Ren Chao (Linguistics and East Asian Languages), Leon Henkin (Mathematics), Victor F. Lenzen (Physics), Benson Mates (Philosophy), John Myhill (Philosophy), Raphael M. Robinson (Mathematics), and Alfred Tarski (Mathematics).

### 3.1. *The Founding Fathers of the Group*

The eight co-signatories of the group proposal all had long, interesting, and influential careers, but I would like to sketch their background at the time they joined the proposal for the constitution of the new program of study.

Six of the founding fathers were present at the first major conference in logic organized at UC Berkeley, namely the international conference *The Axiomatic Method with Special Reference to Geometry and Physics* that took place at UC Berkeley from December 26, 1957, to January 4, 1958 (see [11] and Figure 1). Other major conferences on the Berkeley campus for the period we are covering were the conference on the theory of models in 1963 (June 25 to July 11; see [1]) and the Tarski conference in 1971 (see [12]).<sup>19</sup>

Let us now describe the careers of the founders of the Group up to the time they joined the Group in Logic in 1957.

Ernest Adams (1923-2009) was a recent acquisition in the philosophy department. After the death of Paul Marhenke in 1952, the Philosophy

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<sup>19</sup> Details about these conferences are given in [8] and many documents about them are found in the Alfred Tarski Papers at the Bancroft library.



Figure 1: Group picture of the participants at the conference on the axiomatic method held at UC Berkeley from December 26, 1957, to January 4, 1958. Courtesy of Dana Scott.

department had pressing needs in philosophy of science. Indeed, with the sudden death of Kalicki and with four full professors retiring in 1954 (in a department of nine people), a major crisis was looming. Both Adams and John Myhill were hired as part of the attempt to address the situation. Adams is now well-known for his work on conditionals, but that was far in the future when he got hired as visiting assistant professor at UC Berkeley in 1956 (and promoted to assistant professor in 1957). Adams had received his B.S. in electrical engineering at Stanford in 1949. Between 1951 and 1953, he had lectured in the philosophy department at Stanford, where in 1952-53 he was also fellow of the Office of Naval Research working on the axiomatic foundations of mechanics. He spent 1953-54 as Research Associate with the Behavioral Models project at Columbia University, where he carried out investigations on mathematical methods in the social sciences, especially economics and psychology. He then spent 1954-1956 as instructor



of mathematics at Wesleyan University and in 1956 he earned his Ph.D. in Philosophy with minor in Mathematics at Stanford. The dissertation was titled “The axiomatic foundation of rigid body mechanics”. In a letter to Benson Mates, dated April 23, 1956, he described his areas of concentration as “logic and the philosophy of science” and mentioned as strong secondary interests “epistemology and the theory of language”. Adams’ hiring was the first hiring in philosophy of science at UC Berkeley that was not limited to general philosophy of science (as Marhenke’s contribution had been).

Yuen Ren Chao (1892-1982) (see Figure 2) is a more surprising presence in the list of founders of the Group in Logic.<sup>20</sup> He was born in China but left at the age of eighteen to study physics and mathematics at Cornell.



Figure 2: Yen Ren Chao (1892-1982), one of the founders of the Group in Logic. Photo from the Guggenheim Foundation, <https://www.gf.org/fellows/all-fellows/yuen-ren-chao/>, last accessed on January 22, 2018.

He then got his Ph.D. in Philosophy at Harvard and began teaching mathematics at Cornell. In 1920, he returned to China to teach mathematics. In 1921 he met Bertrand Russell, who was visiting China, and served as Russell’s interpreter during his tour. It was this experience that kindled his interest in Chinese dialects and Chinese linguistics. In 1921, he left China again to study linguistics in Europe and the United States. After teaching appointments at, among other places, Yale, and Harvard, he joined the

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<sup>20</sup> For this section I found very useful Chao’s “In Memoriam” [18].

Berkeley faculty in 1947. In 1952, he became Agassiz Professor of Oriental Languages and Literature. He retired in 1961 but continued to be an active presence in the Group in Logic long after that. Chao is considered the scholar who gave modern foundations to the study of Chinese from the perspective of contemporary structural linguistics. He published in this area papers on theoretical phonology and a book titled *Language and Symbolic Systems* (1968). It is unclear how Tarski and Chao knew each other and whether the acquaintance might have antedated Tarski's arrival at Berkeley. But it is clear that from the very beginning, Tarski was hoping to have a strong representation in areas related to the study of language and linguistics. While this is still an area of great importance for the Group in Logic, that vision was implemented only to a limited extent for reasons that also have to do with the history of the linguistics department at UC Berkeley.

Leon Henkin (1921-2006) received an M.A. in mathematics and philosophy from Columbia College in 1941. He was a student of Ernest Nagel. In 1947 he received his Ph.D. in mathematics with a thesis supervised by Alonzo Church. After academic positions at Princeton and University of Southern California, he joined the Berkeley faculty in 1953 as Associate Professor of mathematics. His hiring was a key move in Tarski's vision for logic at UC Berkeley.<sup>21</sup> Given his background in mathematics and philosophy, Henkin was well respected in the Philosophy department where he sometimes taught elementary logic and, most importantly, where his opinion was highly valued when it came to hirings in the formal areas of philosophy. Correspondence between him and Myhill and letters of recommendation on behalf of Ernest Nagel (when the philosophy department tried to hire Nagel in the late 1950s) and other documents bear witness to his influence. Well-known for his new proof of the completeness theorem for first-order logic and the theory of types (1950), and for his work in algebraic logic, Henkin was a principal investigator in all the grants that he and Tarski regularly got from the NSF and that arguably made UC Berkeley the most important center for mathematical logic and foundations of mathematics in the world ever since. Henkin was a very active member of the Group until his last days.

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<sup>21</sup> The Leon Albert Henkin Papers are preserved at the Bancroft Library at UC Berkeley. For this section, see also Henkin's "In Memoriam" [3]. A recent volume celebrating Henkin's work is [15].

Victor Lenzen (1890-1975) was a Professor of Physics at UC Berkeley.<sup>22</sup> He took many physics courses as an undergraduate at UC Berkeley, although he graduated with a major in philosophy in 1913. He entered graduate school at Harvard in 1913 and earned his Ph.D. in Philosophy in 1916. During his studies he was deeply influenced by Bertrand Russell and Josiah Royce. After his Ph.D., he returned to physics and went to study physics at Cambridge with J.J. Thompson. At the same time, he pursued his methodological studies by attending the meetings of a small group that met in London with Bertrand Russell to discuss problems in mathematical logic. After one year at Harvard in the department of philosophy, he joined the faculty in the department of physics at UC Berkeley in 1921. He became full professor in 1939. Lenzen was quite close to the Unity of Science movement and had attended many meetings in Europe in the 1930s devoted to foundational issues in physics (see [19]). From the time of his return to UC Berkeley, in 1921, Lenzen had close ties to the philosophy department. Many of his articles at the time were published in the UC Berkeley Publications in Philosophy, a series edited by members in the philosophy department. While his output in physics was meager, he was a major contributor to philosophy of science with more than thirty papers in this area and two major books: *The Nature of Physical Theory* (1931) and *Causality in Natural Science* (1954). For the Encyclopedia of Unified Science Lenzen published the essay “Procedures of empirical science” (1938). Lenzen retired in 1958 and his active role in the Group in Logic was limited to his having been a co-signatory of the proposal for the new Ph.D. program.

Benson Mates (1919-2009) joined the Philosophy Department at UC Berkeley in 1948.<sup>23</sup> He had studied philosophy and mathematics at the University of Oregon receiving his B.A. in 1941. He started a Ph.D. in Philosophy at Cornell in 1941-42, but his studies were interrupted by the war. He resumed graduate studies at UC Berkeley in 1945, focusing primarily on the history of Greek philosophy and mathematical logic. His dissertation was on the logic of the old stoa and was published to wide acclaim in 1953 as *Stoic Logic*. Mates took his studies in logic very seriously, and in 1956-57 he went to

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<sup>22</sup> The Victor Lenzen Papers are preserved at the Bancroft Library at UC Berkeley. See the informative “In Memoriam” [10] and [9].

<sup>23</sup> On Benson Mates, see the “In Memoriam” [20].

Münster as Fulbright Research Scholar to work with Hans Hermes.<sup>24</sup> Mates was very close to Tarski and was a major force in the development of the Group in Logic. He was also behind the several appointments in logic and philosophy of science in the philosophy department at UC Berkeley. In addition, he taught in the areas of logic, history of logic, philosophy of language, and history of philosophy that were of central interest to the students in the Group.

John Myhill (1923-1987) (see Figure 3) received his B.A. in Moral Science at Cambridge in 1944 and then went to study at Harvard where he obtained his Ph.D. in Philosophy in 1949.<sup>25</sup> After temporary appointments at Vassar College (1948-1949) and Temple University (1949-1951), he served as assistant professor of Philosophy at Yale University from 1951 to 1953 and as visiting assistant professor at the University of Chicago in 1953-54. As a consequence of Kalicki's death, the Philosophy Department at UC Berkeley offered him a position and he joined in 1954. He became Associate Professor in 1956 and Professor of Philosophy in 1960, but despite his promotion he left UC Berkeley for Stanford in 1960.<sup>26</sup> He spent 1957-1959 at the Institute of Advanced Study at Princeton. At the time of his hiring at Berkeley in 1954 he had already published nineteen items (including reviews and abstracts). They concerned basic aspects of the problems of completeness, consistency, and decidability in logic and in formal theories of arithmetic. Immediately after his arrival at UC Berkeley, he contributed to recursion theory with his fundamental paper on "creative sets" (1955) and his work with Dekker on

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<sup>24</sup> In an amusing letter sent from Europe on November 20, 1956, to his colleague Stephen Pepper, who was chairing the department, Mates recounted having run by pure coincidence into a lady who turned out to be a Frau Frege ("her husband is a close relative of the famous Gottlob Frege") and even more remarkably to have been hosted by a German family by the name von Hegel who turned out to be the "Ururenkel of the Hegel and is one of the two descendants who still have the name". Mates added: "As you can well imagine I haven't yet confessed to him that the *Phenomenology of the Mind* is one of the books I can do without, but I did discover, with considerable relief, that he also has no idea of what his great-great grandfather was talking about" (Benson Mates, personnel file, Philosophy Department).

<sup>25</sup> See also [6].

<sup>26</sup> His departure was probably motivated by the fact that his request to be appointed 50% in mathematics and 50% in philosophy was rejected by mathematics. (See letter from Bernard Friedman, acting Chair of mathematics, to John Myhill, dated April 29, 1960; Myhill personnel file, Philosophy department).



Figure 3: John Myhill (1923-1987), one of the founders of the Group in Logic. Photo from the Guggenheim Foundation, <https://www.gf.org/fellows/all-fellows/john-myhill/>, last accessed on January 22, 2018.

recursive equivalence types. Myhill was in charge of most logic courses in logic in the Philosophy department. His contributions were both of philosophical and mathematical nature and this made him an ideal co-founder of the Group in Logic.

Raphael Robinson (1911-1995) did all his student career at UC Berkeley.<sup>27</sup> He got his BA in 1932, his MA in 1933, and his Ph.D. in 1935 with a thesis in complex analysis. After a two-year appointment at Brown University, Robinson joined the department of mathematics at UC Berkeley as assistant professor in 1937. He rose through the ranks to become a full professor of mathematics in 1949. Robinson retired in 1973. He contributed to several fields of mathematics, including number theory, complex analysis, geometry, logic, set theory, and combinatorics. Soon after Tarski's arrival at UC Berkeley in 1942, Robinson began contributing to issues of "essential undecidability", and his work led to several results that were incorporated in the classic book by Tarski, Mostowski, and Robinson titled *Undecidable Theories* (1953). His finitely axiomatizable theory Q for arithmetic is still important in many presentations of Gödel's first incompleteness theorem.

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<sup>27</sup> For further information on R. Robinson see [13] and [2].

His main results in logic were in the areas of recursive functions and r.e. sets, decision problems, and definability (see [13]).

Alfred Tarski (1901-1980) has already been discussed at length. He was born and grew up in Poland, where he earned his Ph.D. in mathematics at the University of Warsaw under the direction of Lesniewski. Between 1925 and 1939, he held at the same time positions as professor at the Zeromski high school in Warsaw and as Docent and Adjunct Professor at the University of Warsaw. In September 1939, while he was in Cambridge (Massachusetts, USA) for a conference on the Unity of Science, Poland was invaded and Tarski was forced to stay in the USA. After temporary appointments at Harvard University (1939-1940), the College of the City of New York (1940-1941), and a membership at The Institute for Advanced Study in Princeton (1941-1942), he was offered a lectureship at the University of California at Berkeley in 1942. He was promoted Associate Professor in 1943 and to Professor in 1944. For more details, see the biography [8].

#### 4. The Institutional History of the Logic Group during the first decade of its life (1958-1970)

Even restricting attention to the first decade of its activity, there are two possible ways to recount the history of the Group in Logic. One would be to focus on the research carried out by members and students of the Group and how it related to the wider history of logic at UC Berkeley (in mathematics, philosophy, computer science, etc.). The enormity of that task would be evident to anyone who perused Tarski's NSF grant proposals from the 1950s to the 1970s (see bibliography under Tarski *et al.* ([21]-[26])). I am happy to leave the task to someone who has an interest in writing a 500-page book. However, the reader can get a glimpse of the extent of those activities by looking at the titles of Ph.D. theses from the Group and the names of faculty who have been part of the Group since its inception in the web page for the Group in Logic.<sup>28</sup> In the following, and this is the second possible approach, I will limit myself to some details about the institutional history of the Group for the period 1958-1970.

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<sup>28</sup> <http://logic.berkeley.edu>, last accessed on January 21, 2018.

#### *4.1. Location*

The Group was originally located in Campbell Hall, together with the rest of the mathematics department, until the move to Evans Hall in 1970. In the late 1970s, the Chancellor and the Regents approved the assignment of 729 and 731 Evans Hall to the Group. In 1981, a ceremony was held in 729 Evans at which a plaque of Tarski was unveiled by the Chancellor and the room officially named The Tarski Room. Today this room houses the Group's library and is used regularly by students and faculty; it is also pressed into service for qualifying examinations, faculty meetings, and the tea that follows the logic colloquium held on alternate Friday afternoons. 731 Evans is used for Logic Group visitors, both temporary and "permanent". In the latter group belong, at the time of writing, Prof. Martin Davis and Prof. Dana Scott.

#### *4.2. Structure of the program*

The program was first advertised through posters and notices in specialized journals. A description of the program first appeared in the University Catalogue in 1967.

Admission to the Logic Group was from the start restricted to either mathematics or philosophy majors, or joint majors, who had at least completed a one-year undergraduate sequence in logic. In addition, the student had to have completed at least one upper level undergraduate course in some science and a one-year upper level undergraduate course in mathematics (other than logic), for philosophy majors, or in philosophy, for mathematics majors. The structure of the Ph.D. requirements was different than it is currently. The students had to show reading knowledge of two languages (chosen from French, German, and Russian) and knowledge of the grammar of a modern or ancient language. The qualifying examination consisted in three oral examinations on topics chosen from a set list of areas in mathematics and philosophy (see [Appendix B](#)). In addition, the student had to show capacity for independent work by taking one graduate seminar in mathematics and one graduate seminar in philosophy. Changes to the structure of the requirements were made at several stages.

Already in 1960, the qualifying examination was modified to require examinations in two topics from mathematical areas (one in the foundations of mathematics and the other one in algebra, in analysis, or in geometry) and

two topics from philosophical areas (to be chosen from theory of knowledge, philosophy of science, philosophy of language, and philosophy of mathematics, with at least one of the last two being included). Other changes were forced by the new qualifying examinations implemented in philosophy in 1965.

The language requirements were dropped in 1999 after a vote passed with a narrow margin. Some changes were forced by institutional constraints. In 2001, Graduate Division insisted that the structure for the qualifying examination was not in line with University requirements. This led to the current articulation of requirements, consisting of two prelims (one in foundations and one in philosophy) and the qualifying examination. Comparing the original requirements to those currently in place, the most remarkable differences are the lack of language requirements and the existence of two preliminary examinations with the qualifying exam focused on either philosophy, mathematics, or a special area (such as topics in computer science).

#### *4.3. Students*

The first student was admitted to the program in 1958. Four more students joined in 1959 and six in 1960. The first Ph.D. was awarded in 1964. A Student History Survey dated November 1966 shows that 44 students had been enrolled in the Group in Logic up to that point with 19 students currently enrolled. Four students had already received their Ph.D.'s, one was on leave, and one was admitted for course work only. Placement of students bode very well for the future. The four Ph.D.'s awarded up to 1966 got excellent academic jobs and the trend was to continue. Of the remaining nineteen students, one had failed the qualifying examination (the student who had entered in 1958), ten had transferred to different departments, four had transferred to other universities, one was deceased, and four left for an unknown future. The size of the graduate student body has steadily oscillated between 13 and 20 throughout the history of the Group. At the time of writing, 77 students have obtained a Ph.D. from the Group.

A major concern in the initial days of the Group was ensuring the quality of the students was of high caliber. In May 1966, a progress report stated: "The Group has continued to raise its admission standards and they are now such that only students of fellowship caliber have been admitted for the next quarter. The caliber of students now in the program appears to be well above the average of graduate students in the Departments of Mathematics



and Philosophy.” In a memo (dated August 5, 1968) to Dean Hammel, who was worried that the large number of students working in foundations (75 in the department of mathematics!) might indicate low standards of admission, Graduate Adviser John Addison explained that the Logic Group had very high standards of admission:

The Group in Logic and the Methodology of Science controls only admissions to the Group and has no control over students admitted to the Department of Mathematics or to the Department of Philosophy. If you will study the record of admissions decision by the Group I expect that you will find our standards among the very highest in the university. We first discourage weak students by a statement in our Announcement. Then of those who write enquiries we often write further discouraging words. Finally, of those who apply we admit what I would guess to be a lower percentage than is common in other departments. For example, we turned down a Woodrow Wilson Fellow last year because we felt he was not able enough. (Group in Logic & Methodology of Science, Chair files)

Nowadays we are less discouraging to prospective applicants but the standards of admission have remained very high indeed.

#### *4.4. Faculty*

The boom in faculty hiring of the 1960s<sup>29</sup> also reflected itself in the growing size of the faculty in the Group. In 1959 Lenzen was no longer in the roster, but Blackwell and Vaught were added. In September 1960 Myhill was gone, but Dana Scott entered the list. Craig joined in 1961, Addison in 1963, and Enderton and Harsanyi in 1965. In 1966 Chihara, Solovay, and Dubins were added. By 1967, the Group had 15 active faculty members. A total of 60 faculty members have been members of the Group since its inception (one member on two discontinuous periods).

Course offerings kept pace with the number of faculty and students. In 1965-66 there were eight graduate seminars (between philosophy and mathematics) offered in the fall and nine in the spring, all squarely within the areas

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<sup>29</sup> This trend is well described in [17].

of interest of students in logic and the foundations of mathematics. Here is the list for Fall 1965: Metamathematics (Vaught), Mathematical logic and computers (Rhodes), Set Theory (Tarski), Foundations of Geometry (Schwahauser), Transfinite constructions in recursive function theory (Enderton), On Cohen's method (Solovay), The vicious circle principle and the foundations of ramified type theory (Chihara), Theories and models (Maxwell), Many-sorted logic (Oberschelp).

Addition of new faculty members to the Group has always proceeded by internal nomination (at times with a preliminary invitation to give a talk in the Logic Colloquium). If there is enough enthusiasm for the nominee, an invitation to join the Group is extended after a vote. Most of the time nominations go through without much dissent. But disagreements have taken place from time to time. An amusing case is provided by the discussion on whether to extend to Paul Feyerabend, who had joined the Philosophy Department in 1961, an invitation to join the Group. The detailed informal minutes of a meeting which took place on February 3, 1965, are quite interesting in this connection. The original notes taken by the Group secretary read:

Feyerabend – Viennese. According to gossip from students his program is popular. A notorious eccentric, bachelor, ladies' man, quantum mechanics. Interested in everything under the sun. Reads everything in sight. Fond of advancing seemingly absurd position and then defending it. Nobody outside a psychologist knows the meaning of red. Physicists don't think too much of him. One says Feyerabend is fine and another says he is out of his head. Henkin makes the motion that we do not extend an invitation to him. Mates — suppose student would seek to axiomatize he would think. Having someone of his kind in the group will create difficulties. Having only those who concur is really inbreeding. Maybe ought to have him. Tarski worries if we had someone under his direction. Henkin — move his course to page 1. Let our students talk to him but not on our committee. Mates — doesn't wrangle on committees. Henkin — invite him to talk at our colloquium. Might very well turn it down. Would not be of any help to this group unless we are ready to broaden out. Mates — he knows everybody. Wide reputation in the field. (Group in Logic & Methodology of Science, Chair files)

The formal document summarizing the action of the Group reported:

Action on Feyerabend was deferred, but it was decided to invite him to speak at the Logic Colloquium and to list his course on Scientific Method on our Course and Seminar List as a course of “primary concern” to students in our program. (Group in Logic & Methodology of Science, Chair files)

Whether Feyerabend accepted the invitation to speak is not known to me but he never became a member of the Group. The kind of discussion I reported was of course unusual. The same documents report the unanimous decision to invite John Harsanyi from Business Administration. He accepted and was to become the only member of the Group to have been awarded the Nobel Prize (in 1994, co-recipient with John Nash and Reinhard Selten).

It is rarely the case that faculty members resign from the Group, but it has happened on a few occasions, the most notable cases being those of Robert Solovay and Robert Vaught. While Solovay claimed that responsibilities to the Group had been weighing heavily on him, Vaught’s resignation came as a consequence of political events related to the invitation to Yuri Ershov to speak at the Logic Colloquium in 1980 and of the protests that accompanied his presence on campus.<sup>30</sup>

#### *4.5. The Logic Colloquium and the Logic Library*

Two important aspects of the life of the Group are the Logic Colloquium and the Logic Library.

The **Logic Colloquium** started around 1961. On November 26, 1964, the Logic Colloquium organizer, Herbert Enderton, described it as follows: “This colloquium consists of reports on recent and current research by staff members (and occasional visitors). It is also attended by many of the graduate students working in the field of logic”. Talks were given in 3 LeConte Hall on alternate Fridays at 4:10, a time that has remained the same throughout the history of the Colloquium. With the years, the number of visitors went up, and now talks by the “staff” are limited to one or two a year. From 1993 to 2014 the Colloquium was run by John Addison, whose introductions of the speakers remain memorable.

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<sup>30</sup> The Ershov affair is recounted in [8, pages 363–365].

The **Logic Library** collects important materials in logic (off-prints, lecture notes, dissertations, etc.). The idea came straight from Warsaw where Tarski had witnessed the same effort in collecting recent articles and other materials of relevance to logic among his colleagues working in logic at the logic seminar in Warsaw. A memo from 1965 on the “Reprint Collection” describes it as follows:

The Group maintains an extensive collection of reprints, project reports, and some other not generally available materials in logic and the methodology of science. These items, now numbering about 4,000, are available in 257 Campbell Hall for use by regular and visiting faculty, visiting scholars, and interested students. (Group in Logic & Methodology of Science, Chair files)

By 1969, the number of items was estimated at more than 6,000. It is important to emphasize the essential contribution to research made possible by the collection. At a time when having the physical off-prints of articles was the only option, soliciting articles, say from logicians working in the USSR, was the only way to keep up with international developments.

By the early 2000s, the number of holdings in the Logic Library had become unmanageable, numbering more than 12,000 items. Since many of the items could be obtained through journals in the library or online, in 2005 it was decided to prune the Logic Library by preserving only items that could not be easily obtained by ordinary means. At the same time, a database of the library holdings was created. It can be consulted online at <http://logic-library.berkeley.edu/catalog>, last accessed on January 21, 2018.

The library now contains approximately 5,000 items. The Logic Library acquisitions benefited extensively from donations of articles and books by William Craig and later by a fund, the Craig’s Fund, set up by William Craig to finance acquisitions.

#### *4.6. Administrative Support*

Administrative support for the Group was given through secretaries working part time for Tarski and Henkin in mathematics and part time for the Group (Marion Harper, Eva Hayes, Alice Gowen, June Lewin, Valora Dawson, Dale Ogar, Nancy Buzzatto, etc.). Up to 2003, the Group had a dedicated 50% time staff member (the last one was Catalina Cordoba) paid by

the Mathematics Department, but after 2003, due to budget cuts, the Group was left without its own staff support (it does however receive some assistance from mathematics and philosophy staff).

#### *4.7. Financial Support*

The Budget for the Group was always an issue, but some support came from mathematics. As Chairman Vaught put it in a memo to Dean Elberg dated June 9, 1966:

Our Group has virtually no budget at all except for some informal arrangement with the Mathematics Department to cover secretarial supplies, etc. We want to request \$1000 annually to be used at the discretion of the Chairman. This money would be used, for example, to make small payments to out-of-town speakers at the Logic Colloquium, to allow us to photograph articles otherwise not available for the reprint collection etc. (Group in Logic & Methodology of Science, Chair files)

In fall 1966, Chair Adams estimated the annual budget for the Group at \$1677.81. He pointed out that for the previous four years, these expenses were covered by a NDEA Fellowship that was attached to one of the students. The problem of a budget for the Group in Logic haunted every Chair since the 1960s, and was not solved in a satisfactory manner until 2007, when a (historic) agreement, brokered by the Dean of Graduate Division, Andrew Szeri, was concluded between the Chair of the Group, the Chair of Mathematics, and the Chair of Philosophy to support the Group with the creation of a fund at the disposal of the Chair. The agreement is revisited every five years.

## **5. Conclusion**

In this brief sketch, I have outlined the origins of the Group in Logic and the Methodology of Science and its early activities during the first decade of its existence in the 1960s. The story was mostly limited to the institutional aspects of the history of the Group. A history of mathematical logic at UC Berkeley is a desideratum which will hopefully be fulfilled by a future historian. Whenever that will happen, the Group in Logic will be an important part of that story.

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**A. Tarski's "Remarks concerning the study of mathematical logic in the department of mathematics"**

[This document, found among a set of papers of Paul Marhenke, contains Tarski's proposal for instituting a one-year upper level undergraduate course and a one year graduate course in mathematical logic in the mathematics department at UC Berkeley. It can be approximately dated to 1947.]

The aim of the suggestion outlined below is to provide adequate conditions, in the University of California at Berkeley, for the study and development of the scientific field which comprehends mathematical logic, foundations of mathematics, and metamathematics. This field, which has been developing very intensely during the last century and whose role in modern science and influence in other scientific domains are ever increasing, constitutes essentially a part of mathematics in view of both the preparation required for successful work in this field and the methods applied in its development. Hence the department of mathematics is the natural place where the collaboration with other departments, especially the department of philosophy, seems very desirable. In these remarks I restrict myself to the problem of organizing the work in mathematical logic within the framework of the department of mathematics and to a large extent under the viewpoint of the needs of students in this department.

It is my strong belief that the fundamental ideas of modern logic and methodology of deductive thinking should be regarded as an essential element of higher learning and be made available to the widest possible circle of students; furthermore, that students majoring in mathematics should be encouraged to take systematic courses in mathematical logic and foundations of mathematics so that they can bring to clarity in their minds the fundamental ideas and methods of argument involved in the major subject of their study; and finally that students working for a higher degree in mathematics should be given the opportunity to acquaint themselves with the important achievements of contemporary metamathematics and possibly to prepare themselves for research work in this field in case they become interested in it. Consequently, courses in the field discussed should be given on all possible levels, i.e., lower division, upper division, and graduate courses. At this moment, however, I do not suggest an organization of any lower division course. The reason is that a lower division course in modern logic is now being given in the philosophy department (Philosophy 12) and it seems hopeful

that through a mutual understanding with that department the course can be extended so as to contain more material important for students studying mathematics and to give a more complete preparation for systematic courses in mathematical logic. On the other hand, an introduction of new courses on upper division and graduate levels seems imperative from the point of view of the goal outlined at the beginning of these remarks.

Specifically, I suggest the organization of a one-year upper division course in mathematical logic. The course should contain a systematic though rather elementary presentation of fundamental chapters of the so-called elementary logic: sentential calculus, the calculus of quantifiers, the theory of identity. Applications in other sciences, and especially in mathematics, should be emphasized. Some metalogical problems regarding the parts of logic listed (e.g., problems of consistency and completeness) may be briefly discussed. Furthermore, the course should deal with elements of what is sometimes called higher logic: or, in other words, it should give a modern treatment of fundamentals of set theory. Thus the following material may be included here: axiomatic foundations of set theory; elementary operations on sets; relations, functions, sequences; the equality of power and fundamentals of the arithmetic of cardinals; elements of the theory of well ordering. It goes without saying that the program of the course may have to be changed as a result of a few years' experience. While the course does not presuppose any special mathematical knowledge, it undoubtedly requires a certain training in deductive thinking. Hence it seems reasonable to list as prerequisites to this course at least Mathematics 3B and 8; one of these prerequisites could be replaced by the above-mentioned course Philosophy 12 if the latter is extended in a desirable way. The suggested course, as is seen from the description, does not interfere with the existing upper division course in foundations of mathematics (Mathematics 127); on the contrary, both courses will supplement each other in a natural way. Independent of its own merit, the new course may give students a desirable preparation for those graduate courses in which the instructors make an extensive use of set theory.

Furthermore, I suggest the organization of a one-year graduate course which may be called introduction to metamathematics. The program of this course does not have to be quite rigidly determined and may vary in details from one year to another. At any rate, it should contain a discussion of the following problems: fundamental components of all mathematical theories (propositions, axioms, theorems, proofs, definitions); models of de-

ductive theories, consistency and completeness; the notions underlying the decision problem, specifically that of general recursiveness; fundamental results regarding the non-existence of a general decision method in mathematics; examples of existing decision methods for special mathematical theories. Depending on the number of students interested in the subject, the course may be given every year or every second year.

It should be emphasized that the program suggested above has in a sense a minimal character. In suggesting an organization of new courses I have taken into account the present limited availability of members of the department who would be inclined to give them. For this reason, e.g., I am not suggesting a course which would be very important in regard to the general aim of these remarks; in fact, a graduate advanced course in mathematical logic. Such a course would contain material which would have less direct bearing on the work of mathematicians in general, but which would be of great interest for a student in mathematical logic and would have significance for those who are interested in applying logic to other domains of science. The course would contain, for instance, the following material: non-classical logical systems (many-valued logics, intuitionist logic of Brouwer, reform of logic in view of the requirements of quantum mechanics); foundations of deductive semantics; inductive logic and its relation to the theory of probability. Some material to be included in the course can now be discussed in seminar work, and it may be hoped that a systematic course of this kind will be organized in the future in cooperation with other departments.

Alfred Tarski

## B. Proposal for the founding of the Group in Logic and Methodology of Science

[The following set of documents, starting with the letter dated August 13, 1956, and ending with the minutes of the graduate council dated May 20, 1957, constitute the official documents that led to the the creation of a Ph.D. program in Logic and the Methodology of Science at UC Berkeley.]

BERKELEY: DEPARTMENT OF MATHEMATICS

August 13, 1956

Dean M.A. Stewart  
Acting Dean of the Graduate Division  
Administration Building

Dear Dean Stewart:

The undersigned hereby submit a proposal for offering the Ph.D. degree in the new field of study, to be entitled Logic and the Methodology of Science. We enclose a suggested list of requirements for this degree, and for purposes of comparison also the current lists of requirements for the Ph.D. in the Departments of Philosophy and Mathematics. Our motivation in making this proposal is as follows.

In recent years the University of California at Berkeley has become one of the most important centers of logical and methodological studies in the world. The prospect of doing advanced work in these fields under expert guidance has attracted students from all parts of the United States and even from Europe. If these students choose to work towards an advanced degree, however, they are forced to decide between two alternatives, neither of which is adequate for their purposes.

If they elect to obtain a degree in mathematics, on the one hand, they are in effect forced to forego training in such important and relevant subjects as Methodology of Empirical Science, Semantics and the Philosophy of Language, Many-valued, Modal, and Intuitionistic Systems of Logic, etc. The exceptionally heavy requirements for the mathematics doctorate simply do not leave them enough time for such studies, since they must spend much of their time familiarizing themselves with fields whose relevance to logic is slight.

On the other hand, those students of logic who elect to obtain their advanced degrees in the Department of Philosophy find that in addition to examinations relevant to their subject they must also pass a six-hour examination in History of Philosophy, plus three more three-hour examinations in such subjects as Ethics, Metaphysics, and one philosophical author – in addition to demonstrating a reading knowledge of philosophical French and German. It is impossible for them within a reasonable length of time to do all this work without slighting their necessary mathematical training.

Among the unfortunate results of the existing state of affairs are the following. (1) The time required to obtain the Ph.D. degree becomes unduly protracted for students of logic and methodology. (2) Students with special abilities in this area tend to become diverted by practical considerations into other fields in which the relevant subject-matter is not so evenly divided between the two departments. (3) Those who do persevere are of necessity often graduated with inadequate preparation for original work in this field.

In the opinion of the undersigned the program herein proposed is essentially the only way of taking care of this problem. This program is at least as broad in its scope as are the existing curricula leading to the doctorates in philosophy and mathematics. We anticipate that the students obtaining their degrees under this plan will be especially well-qualified to teach logic and related topics in both philosophy and mathematics departments, and that they will have been prepared, more adequately than has hitherto been the case at any university, to make original contributions to the advancement of the subject.

This program has been considered formally in separate meetings of the Departments of Mathematics and Philosophy. In both it was unanimously approved, with the proviso, in the case of the Department of Mathematics, that the list of subjects under group I be reviewed by a special committee of the department.

Sincerely yours,

Ernest Adams

Yuen Ren Chao

Leon Henkin

Victor F. Lenzen

Benson Mates

John Myhill

Raphael M. Robinson

Alfred Tarski

PROPOSED ADDITION OF LOGIC AND THE METHODOLOGY OF SCIENCE  
As a Field of Study for the Ph.D.

Faculty Group in Charge:

Ernest Adams, Ph.D., Assistant Professor of Philosophy

Yuen Ren Chao, Ph.D., Litt.D., Professor of Oriental Languages

Leon Henkin, Ph.D., Associate Professor of Mathematics

Victor F. Lenzen, Ph.D., Professor of Physics

Benson Mates, Ph.D., Associate Professor of Philosophy

John Myhill, Ph.D., Associate Professor of Philosophy

Raphael M. Robinson, Ph.D., Professor of Mathematics

Alfred Tarski, Ph.D., Professor of Mathematics

Preliminary requirements: For admission to the graduate program the student shall have completed an undergraduate major in philosophy or mathematics, or a joint major in both, including at least one full year upper division course in logic. In addition, he shall have completed (a) at least one upper division course in some science, and (b) at least one full year upper division course in mathematics (other than logic) if his undergraduate major was philosophy, or in philosophy (other than logic) if his undergraduate major was mathematics.

Qualifying examinations: Before formal advancement to candidacy the student shall demonstrate (a) a reading knowledge of two of the following languages: French, German, Russian; and (b) a detailed knowledge of the grammar of some language, ancient or modern. In addition, he shall pass three oral examinations from each of the following groups:

- I.    – Theory of Probability
- Algebra
- Mathematical Logic and Metamathematics



- Theory of Functions of a Real Variable
  - Set Theory and Point Set Topology
  - Mechanics
- II.
- Methodology of Empirical Science
  - Semantics and the Philosophy of Language
  - Theory of Knowledge
  - Many-valued, modal, and intuitionistic systems of Logic
  - Philosophy of Mathematics
  - History of Logic

Independent work: Before formal advancement to candidacy, the student must exhibit evidence of his capacity to work independently. This requirement may be met by successfully completing at least two half-year seminars, including one in mathematics and one in philosophy. Such seminars must call for the student's active participation, involving the oral exposition of assigned papers and topics.

Dissertation and Final Examination: The program will follow Plan A, as described in the Announcement of the Graduate Division, Northern Section.

REPORT OF THE SUB-COMMITTEE OF THE GRADUATE COUNCIL ON THE  
PROPOSAL FOR THE PH.D. IN LOGIC AND METHODOLOGY OF SCIENCE

In the fall of 1956 a proposal for the offering of a Ph.D. program in this field was discussed with the Council by Professor Tarski. The proposals are embodied in a letter (August 13, 1956) to Dean Stewart by Professor Tarski and others. A sub-committee was appointed to study the proposal, and reports to the Council recommending that this proposal be approved.

Professor Tarski and Professor Myhill kindly met with the sub-committee and answered many questions and explained the proposal in considerable detail.

We were concerned principally with the questions as to whether the proposal dealt with a definite field of broad interest as contrasted with the immediate investigative interests of a small, though distinguished, group of faculty members; whether there was need, in universities or industry, for the small number of students, perhaps two or three a year, who may be expected as at present to undertake the program; and whether the program of study and research as outlined in the proposal was in adequate detail to permit proper evaluation of its content and purpose. Our affirmative recommendation is based on favorable answers to these questions.

The proposed field of study comprises parts of the fields of mathematics, philosophy, science, and linguistics having to do with furthering our understanding of the nature and systematization of certain aspects of knowledge. This clearly cuts across recognized departmental lines and, if a program of this type is deemed desirable, it is unreasonable to expect the student to become expert in one departmental discipline and undertake the balance of necessary work in addition. We are convinced that this field in recent years has achieved substantial recognition, due, in considerable measure it must be noted, to Professor Tarski and his colleagues and students at Berkeley. Moreover, it lies at the base of information theory and will, we feel, undoubtedly grow in importance in other directions, such as the social and physical sciences. We thus feel that this field, while certainly involving only a small number of students, will continue to grow in importance and is worthy of encouragement in the University.

Regarding the demand of universities and industry for men so trained, we were assured that there is a definite (though, of course, limited) need for

such men in academic positions and in industry. It is felt that the proposed training, with the increasing interest in this field, would result in appointments in mathematics, philosophy, and economics in a number of universities. Moreover, there is a demand for people with such training in such industrial laboratories as Bell Telephone, IBM, etc. It may be noted in parentheses that the restricted IBM Graduate Fellowships are open to students in symbolic logic and information theory in addition to other fields.

Finally, we considered whether the proposed program of study was outlined in sufficient detail as to required graduate courses and seminars. In view of the flexibility of the program, permitting the student to select for the qualifying examination three broad topics from each of two groups in addition to language requirements, we agreed with the advocates of the program that this was impractical and must be left to the graduate adviser to decide in accordance with the student's needs and the general requirements of the Graduate Division. Such a procedure is presently in effect in mathematics and apparently works quite satisfactorily.

In view of the foregoing considerations, and others, we recommend to the Graduate Council that this proposal be approved.

G.A. Downs, Professor of Architecture

W. Galenson, Professor of Industrial Relations

I.C. Hungerland, Associate Professor of Speech

J. Yerushalmy, Professor of Biostatistics

R.L. Thornton, Professor of Physics, Chairman

May 8, 1957

MINUTES: GRADUATE COUNCIL: MAY 20, 1957

Meeting

The Graduate Council of the Northern Section of the Academic Senate met on Monday, May 20, 1957 at 3:10 p.m. in the Regents' Room, 221 Administration Building, pursuant to call. Present: Dean M.A. Stewart, Vice-Chairman, presiding; Professors B. Bresler, D.R. Carr, A.S. Crafts, G.A. Downs, W.J. Fischel, Y. Malkiel, J.J. Parsons, D.H. Russell, R.A. Stirton, R.L. Thornton and J. Yerushalmy; absent: T.L. Althausen, H.A. Bern, R.T. Clark, Jr., E.G. Linsley, W.O. Reinhardt, B.F. Ritchie, T.B. Steel, D.H. Templeton. Also in attendance: Associate Dean R.A. Cockrell.

Minutes

The minutes of the meeting of May 6, 1957 were approved as distributed.

Announcements by the Dean

Dean Stewart announced that there will be a special meeting of the Graduate Council on Monday, June 3, 1957.

Proposal for the Ph.D. Degree in Logic and the Methodology of Science

Professor Thornton presented the report of the subcommittee appointed to study this proposal. (This report is filed as Appendix A to the Secretary's minutes of this meeting.) In his presentation Professor Thornton pointed out that the subcommittee had directed its attention to three principal questions, namely, (1) whether or not Logic and the Methodology of Science constitutes a valid field of study, (2) whether or not there would be positions open to men trained in this field, and (3) whether or not the program as outlined is expressed in sufficient detail. Professor Thornton stated that the subcommittee had come to the conclusion that all three of these questions were satisfactorily answered

since this field is very much concerned with modern computing devices and is consequently a rapidly developing one in which trained men are increasingly needed. He further stated that since this is a broad field the required courses would necessarily vary considerably with each student's particular interest. Professor Thornton thereupon moved adoption of the report. This motion was seconded and carried out.

(I omit the rest of the document dealing with the proposal for the Ph.D. Degree in Comparative Literature.)