GENERAL

THE GÖDEL EDITORIAL PROJECT: A SYNOPSIS

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The final two volumes, numbers IV and V, of the Oxford University Press edition of the ***Collected Works of Kurt Gödel*** [3]–[7] appeared in 2003, thus completing a project that started over twenty years earlier. What I mainly want to do here is trace, from the vantage point of my personal involvement, the at some times halting and at other times intense development of the Gödel editorial project from the first initiatives following Gödel's death in 1978 to its completion last year. It may be useful to scholars mounting similar editorial projects for other significant figures in our field to learn how and why various decisions were made and how the work was carried out, though of course much is particular to who and what we were dealing with.

My hope here is also to give the reader who is not already familiar with the Gödel ***Works*** a sense of what has been gained in the process, and to encourage dipping in according to interest. Given the absolute importance of Gödel for mathematical logic, students should also be pointed to these important source materials to experience first hand the exercise of his genius and the varied ways of his thought and to see how scholarly and critical studies help to expand their significance.

Though indeed much has been gained in our work there is still much that can and should be done; besides some indications below, for that the reader is referred to [2].

§1. Early initiatives and serendipitous events. In the first years after Gödel died, there was considerable discussion in the Association for Symbolic Logic as to how best to pay tribute to the greatest logician of our time, and to do it in a way that would have scientific and historical value as well. In 1979, Hilary Putnam, then president of the Association, appointed a committee consisting of George Boolos (chair), Burton Dreben and Warren Goldfarb, whose aim was to produce an edition of Gödel's publications as well as to

Reprinted from ***The Bulletin of Symbolic Logic***, vol. 11, no. 2, 2005, pp. 132–149.

The material for this article was presented under the title, "Gödel on the installment plan" to a special session on Gödel and Mathematical Logic in the 20th Century at the annual meeting of the Association for Symbolic Logic held at Carnegie Mellon University, Pittsburgh, May 19–23, 2004.

Kurt Gödel: Essays for his Centennial
Edited by Solomon Feferman, Charles Parsons, and Stephen G. Simpson
Lecture Notes in Logic, 33

see if further publishable materials could be extracted from his *Nachlass* at the Institute for Advanced Study in Princeton. Unfortunately, the faculty member at the Institute who had been assigned the responsibility of dealing with the Gödel *Nachlass* failed to respond to all inquiries, so the committee was not able to make any progress on that front. Then when I became president of the Association in 1980, we received the disheartening news that a group in Vienna had initiated the production of two volumes, one in German which would include Gödel's doctoral dissertation together with considerable personal correspondence and memorabilia, and the second in English which would include his complete published works. Since the impression we were given was that they were well advanced in this venture, we decided it would be a mistake to pursue a competitive publication; so, rather unhappily—but with our offer to assist the Viennese in whatever way possible—we threw in the towel.

But then a sequence of serendipitous events occurred that succeeded in reviving our project. First of all, a (then young) set-theorist named John Dawson at Penn State in York had come across some minor publications of Gödel that had been overlooked in all the published bibliographies, and in researching the matter, he decided to prepare a complete annotated bibliography. In the process, this bold fellow conceived the idea of writing a biography of Gödel, and he made serious first steps in that direction, including making contact with appropriate parties in Vienna. Dawson's work came to my attention through an announcement in the ***Notices of the American Mathematical Society***, and we began a correspondence about his efforts. Much to my surprise, one response he received from the Austrian Academy of Sciences seemed to imply that not only was the Viennese initiative for a Gödel edition not far advanced, but also that the plans for it were much more restricted than we had initially been given to understand. As an aside—just to give you an idea how things can go in this business—Dawson's biography of Gödel [1] was not published until 1997 and the Viennese edition [9], [10] did not end up hitting the stands until 2002.

In the winter of 1982 when the possibility of renewing our own efforts thus opened up, it happened that Jean van Heijenoort ("Van") and Gregory Moore were both visiting Stanford, Van to escape the rigors of the Cambridge winter and Moore to continue his historical research on Cantor's continuum problem and the development of the method of forcing. As president of the Association, I consulted both of them about undertaking preparation of a comprehensive edition of Gödel's works under the aegis of the ASL and both urged me to pursue that. I then discussed this with colleagues elsewhere and received further strong encouragement to renew the project. Then the main question became, who should lead the effort? I had asked van Heijenoort if he

would take on that responsibility; Van, who had spent some ten years of his life working on the source book in mathematical logic, ***From Frege to Gödel*** [12] demurred, saying instead that I should do it. Everyone else I asked either said they were too busy or felt that they lacked the confidence for that kind of editorial, historical and scholarly work, or both. I *also* lacked the confidence that came with the extensive experience of the sort that van Heijenoort and Moore had, but both assured me they would give me full assistance if I were to accept the position of editor-in-chief. So I did. They further convinced me that, given the relatively small number of Gödel's publications and our full knowledge, finally, of the extent of this corpus, we could produce a volume of his published work in short order, say two years (!). In fact, that projected volume turned into two volumes that took eight years altogether to see into print.

Also in early 1982 there was a changing of the guard at the Institute in Princeton, and the new committee in charge of the Gödel *Nachlass*, headed by Armand Borel, proved to be much more responsive. In connection with his biographical work, John Dawson had applied for membership in the Institute for 1982–1983 in order to study the *Nachlass*, then stored in its basement. Not only was his application approved, he was also invited to catalogue the material, a task that he eagerly accepted. Little did he know what he was in for. His first inspection of what he would have to deal with was overwhelming, stored as it was in ten file cabinets and over fifty cartons, some of them fairly bursting at the seams. Not surprisingly, Dawson's one year there turned into two, but it was clear from the beginning that the outcome of his work there would dramatically widen the scope of what we could draw on for our edition. Once catalogued, the *Nachlass* proved to be a gold mine, containing among other things, unpublished manuscripts, lecture notes, notebooks, and, of course, extensive correspondence. Having made a start on the publications, our problem then was how and when to deal with all this additional material; as it turned out, much of this went on in overlapping ways, with sometimes one thing taking priority, sometimes another, sometimes too many things at once.

§**2. Dealing with the published work; some basic decisions.** The first editorial board of the Gödel ***Works*** consisted, besides myself, of John Dawson, Stephen Kleene, Gregory Moore, Robert Solovay and Jean van Heijenoort, with Moore as managing editor and copy-editor. Volume I appeared shortly before Van's tragic death in the spring of 1986. Volume II was in an advanced stage by that time, and Van had already begun turning his attention to Volume III. Then in 1994, the year before *that* volume came out, Kleene passed away.

The first order of business for the newly constituted board was to deal with the published material, and that led to some major decisions that had

a big effect on the rest of our project. The easiest thing to do for any edition of collected works is to assemble everything in print by the given author, in whatever language it appeared, and reproduce it photographically. We decided instead to print everything anew in a uniform format, and—since this was to be an English edition—to provide facing translations of everything not in English. We also decided that since this would require checking and rechecking the reprinted versions against the originals and vetting and correcting the translations, we should take control of the typesetting process. That appeared to be feasible by means of Donald Knuth's then relatively new computerized typesetting system TEX, and we found someone in the Stanford area, Yasuko Kitajima, who was both expert in the system and willing to do the work for us.[1] One thing we discovered to our surprise and dismay is that once proofread did not mean forever proofread: each iteration required proofreading *ab initio*, since there were computer devils that introduced random errors in previously checked parts. So, control over the typesetting had its disadvantages as well as advantages.

Another basic decision we made early on, in order to make the full body of Gödel's work and thought as accessible and useful to as wide an audience as possible without sacrificing historical and scientific accuracy, was that each article or closely related group of articles should be preceded by an introductory note elucidating it and placing it in historical context. This was modeled on the introductory notes in van Heijenoort's source book [12], but ours turned out to vary in length to a much greater extent, from a few lines to substantial essays, sometimes much longer than the item being introduced. Finally, all references in the original articles together with those in the introductory notes were to be unified.

§3. **Dealing with the published work.** Gödel's publications fall naturally into two parts, chronologically and substantively. The first part, which ended up comprising Vol. I [3], consists of works dating from 1929 through 1936, and proceeds from his dissertation—in which Gödel established the completeness theorem for first order logic—through the incompleteness theorems, to the short note on length of proofs. We decided to include the Vienna dissertation along with its 1930 published version because the former begins with a quite interesting discussion of the significance of the completeness theorem and the nature of its proof that was suppressed in the latter; among other things, one point in it prefigures the incompleteness theorems. The major publication in that volume is of course the 1931 article containing the incompleteness theorems. Along with that we have Gödel's 1934 lectures at the Institute for

[1] In later years, as the mainstream shifted to LATEX or AMS-TEX, we remained with TEX, and when Kitajima left to do other work, we had some difficulty finding someone versed in the original system to replace her.

Advanced Study in Princeton on that same subject, which contain some interesting variations of detail and comments. Also of marked interest in Vol. I are the articles on special cases of the decision problem and on intuitionistic logic and number theory. There too are the previously overlooked articles, including several on geometry, that had been unearthed by Dawson. Finally, all of Gödel's reviews, many of which contain interesting or pointed observations, date from this period.

The second part, comprising Vol. II [4], consists of works dated 1938–1974 (there being no publications in 1937). It begins with the first published outlines of the great proofs of the consistency of the axiom of choice and the continuum hypothesis with the axioms of set theory, followed by their exposition in the 1940 monograph (reproduced in full with corrections.) After that we move on to the 1944 article on Russell's mathematical logic—in which Gödel first advanced his Platonist philosophy of mathematics—and then to the 1946 Princeton bicentennial remarks on the notion of ordinal definability. That is followed by "What is Cantor's continuum problem?" in 1947, in which Gödel's set-theoretical Platonism is made more specific by its application to the major undecided set-theoretical problem. (Its republication in 1964—also included in Vol. II—contains interesting revisions, and remarks on the significance of Cohen's independence results found the year before.) The years 1949–1952 bring three articles on new solutions of Einstein's field equations for general relativity theory and the philosophical implications of the possibility of "time travel" into the past. After a break of six years without publications we come to Gödel's 1958 ***Dialectica*** article on an extension of finitism via a quantifier-free functional interpretation of Heyting Arithmetic, a piece dedicated to Paul Bernays on his 70th birthday. A translation and revision by Gödel of that article, initially slated to be published in ***Dialectica*** in 1968 for Bernays' 80th birthday, was found in marked-up proof sheets in Gödel's *Nachlass*; he was apparently dissatisfied with the philosophical aspects of the interpretation, and was reworking the discussion of those aspects up until 1972. This version, revised as far as it was taken by Gödel, only saw the light of day in Vol. II of our edition. In addition, we included three notes on the incompleteness theorems that were appended to the proof sheets of the revised ***Dialectica*** article. Vol. II concludes in 1974 with a remark by Gödel lauding non-standard analysis as "the analysis of the future."

§**4. Dealing with the unpublished work in Volume III.** Having reached this point, our next step was to deal with the unpublished articles and texts of lectures found in the *Nachlass*. As I said, van Heijenoort had already started on this when his life was taken in 1986. In the immediately following years, Kleene decided not to continue and Moore was drawn away by work on the gargantuan Bertrand Russell project at McMaster University, so a new editorial board had to be constituted for Vol. III [5]. This consisted of John

Dawson, Warren Goldfarb, Charles Parsons, Robert Solovay and myself. In addition, Cheryl Dawson took over from Moore the absolutely essential role of managing editor and copy editor. With the basic format set as in Vols. I and II, here our basic decision was what to select from the available material. We settled on the following criteria for inclusion:

(1) The manuscript had to be sufficiently coherent.
(2) The text was not to duplicate other works substantially in content and tone.
(3) The material had to possess intrinsic scientific interest.

We were also guided in part by two lists prepared by Gödel, entitled "Was ich publizieren könnte." In some cases it was quite clear what the items in those lists referred to, in other cases less so. But we did not feel bound to restrict ourselves to those items. One of the former items was the 1972 version of the ***Dialectica*** article already included in Vol. II; also listed were the three notes on incompleteness that had been appended to its proof sheets and that were included in Vol. II as well. Of course the question has to be asked what Gödel would *not* have wanted published. Indeed, one item, a supposed disproof of the continuum hypothesis. that he had submitted for publication in 1970 was withdrawn by Gödel when an error was found in a key argument. Nevertheless, we decided to include that because we felt there was still much to be learned from the approach taken therein.

Another concern was that Gödel would surely have wanted to make revisions in the items he thought worthy of publication, just as he had kept reworking the 1972 version of the ***Dialectica*** article. Here, as we shall see, our problem was compounded in certain cases by the existence of multiple drafts of the same article. A final problem was that some of the material had portions, sometimes substantial, written in the Gabelsberger shorthand system; how we dealt with that will be described below in connection with the transcription of Gödel's notebooks.

For readers familiar only with Gödel's main publications, here, with brief annotations, are some (but by no means all) of the interesting items that we included in the rich and varied Volume III of the ***Collected Works*** (cited with stars as they appear there).

- "The present situation in the foundation of mathematics." This was the text for a lecture that Gödel gave to a meeting of the Mathematical Association of America in 1933 during his first visit to the United States and the Institute for Advanced Study. After describing the problem of foundations to be that of "avoiding the paradoxes [while] retaining all of mathematics", he says that this has been solved in a completely satisfactory way by axiomatic set theory. But then he says, surprisingly, that the set-theoretical axioms "necessarily presuppose a kind of Platonism, which cannot satisfy any critical mind and which does not even produce

the conviction that they are consistent." The final part of the lecture is devoted to Hilbert's program and the possibilities of overcoming its limitations by intuitionistic foundations of mathematics. (**1933o*)

- A second, related, item was a lecture to Edgar Zilsel's seminar in Vienna (**1938a*).[2] This is notable for its pursuit of several possibilities for a revised Hilbert program part of which is a precursor of later work by Gödel and some of which anticipated work by others. In particular he sketches there a quite interesting reinterpretation of Gentzen's consistency proof for arithmetic in terms of what has since been called the no-counter-example interpretation as later developed by Kreisel in 1951; cf. William Tait's article [11] in this volume for an analysis.
- We included two interesting lectures on the consistency of AC and GCH, the first in Göttingen (**1939b*), and the second at Brown University (**1940a*) after Gödel had emigrated to the United States. The first is an exceptionally clear exposition behind the ideas of his relative consistency proof using constructible sets. The second gives an alternative approach which Gödel described as related to Hilbert's earlier failed attempt to prove CH, though Solovay, who wrote the introductory note, judged the connection to be tenuous.
- An item that we could not date but that was clearly considered for publication by Gödel was an untitled article, probably prepared for a lecture. Based on its contents, we called it "[[Undecidable diophantine propositions]]" and dated it **193?*. In this text Gödel proves that diophantine problems of the form $\forall \ldots \exists \ldots (p = 0)$ with p a diophantine polynomial are recursively undecidable. This work was unknown to those who later worked on undecidable $\exists \ldots (p = 0)$ diophantine problems.
- The Gibbs lecture (**1951*). Two philosophical consequences of the incompleteness theorems are drawn: First, either mind infinitely surpasses any finite machine or there are absolutely unsolvable problems, and, second, each of these disjuncts "are very decidedly opposed to materialistic philosophy." Arguments favoring the first disjunct are given.
- "Is mathematics syntax of language?" (two of six drafts, **1953/9*) offers direct and full criticisms of "linguistic" accounts of the foundations of mathematics as developed by the logical positivists. These drafts were prepared for Paul Schilpp's ***Library of Living Philosophers*** volume devoted to Rudolf Carnap but, in the end, Gödel made no contribution to it. He seems not to have been fully satisfied with any of the drafts, and he may also have held back from publication due to his concern with "widely held prejudices" of the time.
- "The modern development of the foundations of mathematics in the light of philosophy" (**1961/?*) deals with Left (skepticism, materialism,

[2]The notes for this lecture were entirely in Gabelsberger, transcribed by Cheryl Dawson.

positivism, empiricism, pessimism) vs. Right (spiritualism, idealism, theology, apriorism, optimism) in philosophy. Gödel inveighs against the leftist conception of mathematics and finishes with a Husserlian turn.[3]

- An ontological proof of the existence of God, told by Gödel to Dana Scott when he thought he was dying. Gödel later told Oskar Morgenstern that he hesitated to publish it, even though he was satisfied with the proof, because people might think he believed in God. (**1970*)
- Axioms for scales of functions and the proof that the cardinal of the continuum is $\aleph_2$, submitted to Tarski for publication in the ***Proceedings of the National Academy of Sciences*** (**1970a*). Martin and Solovay found a key error in the argument, after which Gödel withdrew it. The note **1970b* uses modified axioms to prove that the cardinal of the continuum is $\aleph_1$; this was never published or sent. Item **1970c* is a letter to Tarski apologizing for the submitted note. Gödel says he had been ill and was affected by drugs when working on it; the letter may never have been sent.

§5. **Dealing with the correspondence.** When Solovay decided to retire from the project following the completion of Vol. III, his place was taken by Wilfried Sieg for Volumes IV and V; also John Dawson joined me as co-editor-in-chief for these last two volumes, [6] and [7]. Besides the two of us, the new editorial board thus consisted of Warren Goldfarb, Charles Parsons and Wilfried Sieg; Cheryl Dawson agreed to continue in the increasingly demanding job as managing editor. The basic problem faced with those volumes was that of selecting from the overwhelming extent of Gödel's correspondence, consisting of approximately 3500 items in 219 folders. In order to make this manageable our basic decisions were to:

(1) Publish primarily the scientific correspondence.
(2) Include only items that possess intrinsic scientific, philosophical or historical interest, or illuminate Gödel's thoughts or his relations with others.[4]

These decisions allowed us to whittle down to fifty correspondents; even so, each of volumes IV and V, consisting of correspondence, facing translations where necessary, introductory notes and ancillary materials ran to over 660 pages.

Names of the twenty-one correspondents in Vol. IV go from A to G. But the exchange with Paul Bernays, ranging from 1930 to 1975, alone takes up almost half this volume (300 pages, including introductory note and facing translations). It covers a rich body of logical and philosophical material including

[3]Transcribed from the Gabelsberger by Cheryl Dawson.

[4]This is not at all to say that this is all that may be of interest in the correspondence; indeed, there may be much that we did not include that could reward further study on other grounds, both personal and historical.

the incompleteness results and Hilbert's program; the metamathematics of set theory; Gentzen and proof theory; the limits of finitism and Kreisel's work on that; type-free systems; foundations of category theory; philosophy of mathematics; Friesian and neo-Friesian (Nelson) schools of philosophy; the proposed translation/revision of Gödel's 1958 ***Dialectica*** article; Bernays' proof of transfinite induction up to ε_0; limits of finitism revisited; and Gentzen's "original" consistency proof. One of the gems is Gödel's put-down of Wittgenstein's book on the foundations of mathematics (30 October 1958): "I also read parts of it. It seemed to me at the time that the benefit created by it may be mainly that it shows the falsity of the assertions set forth in it." As a footnote he added: "and in the *Tractatus* (the book itself really contains very few assertions)."

Among other correspondents of interest in this volume are Heinrich Behmann, William Boone, Rudolf Carnap, Alonzo Church, Paul Cohen, Burton Dreben, Paul Finsler and Gödel's mother Marianne. To give a taste, here is a brief sampling from among these.

The first letter to Cohen found in Gödel's *Nachlass* is a handwritten, messy draft dated 5 June 1963. We do not know what was actually sent, but may assume it contained some version of the following laudatory passage:[5]

> Let me repeat that it is really a delight to read your proof of the ind[ependence] of the cont[inuum] hyp[othesis]. I think that in all essential respects you have given the best possible proof & this does not happen frequently. Reading your proof had a similarly pleasant effect on me as seeing a really good play.

But the follow-up correspondence was largely devoted to Gödel's suggested revisions of the announcement Cohen had submitted to the ***Proceedings of the National Academy of Sciences***; that dragged on, to Cohen's increasing discomfort.

In 1966, Church was to give a talk at the Moscow meeting of the ICM at which Cohen would receive the Fields Medal, and he asked Gödel whether there was anything that should be credited to him. In a response formulated for inclusion in Church's talk, Gödel wrote (29 September 1966) that

> he [Gödel] only had a proof of the independence of the axiom of constructibility in type theory, which, he believed, could be extended to an independence proof of the axiom of choice. But, due to a shifting of his interests toward philosophy, he soon afterwards ceased to work in this area, without having settled its main problems. The partial result mentioned was never worked out in full detail or put in form for publication.

About this unpublished work, more in the next section.

[5] Paul Cohen refused to let us use his part of the correspondence and did not share the letters from Gödel in his possession.