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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

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[1]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.

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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.[2] 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 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

[2] 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.

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*).[3] 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 journal 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, positivism, empiricism, pessimism) vs. Right (spiritualism, idealism, theology, apriorism, optimism) in philosophy. Gödel inveighs

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

against the leftist conception of mathematics and finishes with a Husserlian turn.[4]

- 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.[5]

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

[4]Transcribed from the Gabelsberger by Cheryl Dawson.

[5]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.

including 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:[6]

> 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.

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

The correspondence with Dreben between 1963 and 1970 first concerned a crucial error in the proof of the fundamental theorem in Herbrand's thesis that had been discovered through work with Peter Andrews and Stål Aanderaa, and corrected a few years later by Dreben with John Denton.[7] It turned out that Gödel had anticipated this in his unpublished notes from the early 1940s, as was established by our project years later (see the next section). Another part of the correspondence had to do with Gödel's claim from the 1930s to have established decidability of the $\forall\forall\exists$ class with equality. As later shown by Goldfarb, this proved to be wrong.

Gödel's letters to his mother are of a very special quality. In the ones chosen for our volume he patiently, lucidly and poetically explains his personal ideas about some philosophical and spiritual matters.[8] To quote from one (27 February 1950):

> You are right about sadness: If there were a completely hopeless sadness, there would no more be anything beautiful in it. But I think that from a rational point of view there cannot be any such thing at all. For we understand neither why this world exists, nor why it is constituted just as it is, nor why we are in it, nor why we were born in just these and no other external circumstances. Why then should we fancy that we know precisely the one thing for sure, that there is no other world and that we never were nor ever will be in another?

And in answer to his mother's question whether they would see each other in a hereafter, he wrote (23 July 1961):

> About that I can only say the following: If the world is rationally organized and has a sense, then that must be so. For what sense would it make to bring forth a being (man) who has such a wide range of possibilities of individual development and of relations to others and then allow him to achieve not one in a thousand of those? ... But do we have reason to assume that the world is rationally organized? I think so. For the world is not at all chaotic and capricious, but rather, as science shows, the greatest regularity and order prevails in all things; [and] order is but a form of rationality.

Also in this volume is the little gold mine familiar to Gödel scholars and known as the "Grandjean questionnaire". In 1974, Burke D. Grandjean, then a doctoral student in sociology, sent Gödel a sheet of questions about his early life and influences. At some point, Gödel dutifully filled it out, but he never returned it. Among the responses is one that has been difficult

[7] It was Peter Andrews, while still a graduate student working with Alonzo Church, who first convinced Dreben that there was a problem with Herbrand's proof. See his *Herbrand Acceptance Speech*, ***Journal of Automated Reasoning***, vol. 31 (2003), pp. 169–187.

[8] Further excerpts from others of Gödel's letters to his mother are to be found in [10].

to square with other evidence, namely his assertion that he had held the philosophical view of mathematical realism since 1925. And as to religion, he said that his view was "theistic not pantheistic (following Leibniz rather than Spinoza)."

Among the exchanges of interest in Vol. V (Correspondence H–Z), are those with Jacques Herbrand, Arend Heyting, Karl Menger, Ernest Nagel, Emil Post, Wolfgang Rautenberg, Abraham Robinson, Bertrand Russell, Paul Schilpp, Thoralf Skolem, Alfred Tarski[9], Stanislaw Ulam, Jean van Heijenoort, John von Neumann, Hao Wang, and Ernst Zermelo. To whet the appetite, here are just a few piquant, more personal, excerpts.

Gödel and Heyting had a lengthy exchange during the period 1931–1933 concerning a proposed collaboration on a book surveying (then) recent developments in the foundations of mathematics, but that came to nothing. The correspondence lapsed until January, 1969 when the following came from Heyting:

> I am writing in the name of the editorial committee of the series "Studies in Logic". We were told that you consider the publication of your collected works. We are convinced such a publication will be very useful and we shall be happy to publish the book in our series. ... I take this opportunity to send you my best wishes for 1969.

Gödel's response came a couple of months later:

> Thank you very much for your letter and New Years' Wishes. I have so far never been considering an edition of my collected works. In fact, I am very doubtful about the usefulness of such a project, since practically all my papers (and, at any rate, all of my important papers) are readily available ... There are only a few notes in the "Ergebnisse eines mathematischen Kolloquiums", edited by K. Menger, which, perhaps are hard to get. But I think they are, at present, more of a historical and biographical, than of a logical interest.

(So much for all *our* work.)

Ernest Nagel's 1957 correspondence with Gödel concerned his prospective publication with James R. Newman of ***Gödel's Proof***. Nagel and Newman wanted to include as appendices to their exposition an English translation of Gödel's 1931 incompleteness paper together with his 1934 IAS lectures on that subject. In the course of trying to arrange this and in collateral correspondence with Allan Angoff at NYU Press, Gödel imposed both financial and editorial conditions. In Nagel's final letter on the matter to Gödel before abandoning the proposal, he wrote:

[9]Incidentally, Tarski was the only one of Gödel's correspondents in these volumes, other than his mother, that he addressed with the personal "Du" when writing in German.

> According to the information Mr. Angoff sent me ... you stated two conditions for giving your consent to reprinting your papers in our book: the first related to financial matters; the second required that the *manuscript* of our expository essay be submitted to you *for your approval*. Now, as far as I know, your financial conditions never constituted serious obstacles .... The real hitch arose over your second condition. I must say, quite frankly, that your second stipulation was a shocking surprise to me, since you were ostensibly asking for the *right to censor* anything of which you disapproved in our essay. Neither Mr. Newman nor I felt we could concur in such a demand with⟨out⟩ a complete loss of self-respect.[10]

That ended *that* matter.

Emil Post made Gödel's personal acquaintance at a meeting of the AMS in New York in October 1938. Soon after he wrote Gödel, apropos his own anticipations of the incompleteness theorem,

> I am afraid that I took advantage of you on this, I hope but our first meeting. But for fifteen years I had carried around the thought of astounding the mathematical world with my unorthodox ideas, and meeting the man chiefly responsible for the vanishing of that dream rather carried me away. ... As for any claims I might make perhaps the best I can say is that I would have *proved* Gödel's Theorem in 1921—had I been Gödel.

In a follow-up letter, Post enlarged on his ideas, and concluded by apologizing for his "egotistical outbursts". Gödel responded graciously.

Gödel first met Abraham Robinson during the latter's visit to Princeton University in 1960, the same year that Robinson realized his method to create non-standard analysis. Much of their correspondence between 1971 and 1974 concerned that subject, for which Gödel had very high hopes. In his remarks included in Robinson's book, as noted above, he lauded it with the expectation that it would be "the analysis of the future" (cf. [4] p. 311). But in his correspondence with Robinson, Gödel thought more specifically that it would form a necessary part of his program to find new axioms to settle number-theoretic problems; Robinson, however, sought to dissuade him of that idea by pointing out conservation results for non-standard over standard results. In the latter part of their correspondence there are several references to Gödel's hopes of bringing Robinson to the IAS as his successor, but they were put in question when it was learned that Robinson had been diagnosed with pancreatic cancer. Gödel wrote him as follows in March, 1974.

[10] Ironically, the book contained several now-well-known errors (both in the Gödel coding and Rosser's strengthening of the first incompleteness theorem) that Gödel might have caught had he been given the opportunity to vet the manuscript.

> In view of what I said in our discussions last year you can imagine how very sorry I am about your illness, not only from a personal point of view, but also as far as logic and the Institute for Advanced Study are concerned.
>
> As you know I have unorthodox views about many things. Two of them would apply here: 1. I don't believe that any medical prognosis is 100% certain, 2. The assertion that our ego consists of protein molecules seems to me one of the most ridiculous ever made. I hope you are sharing at least the second opinion with me.

Robinson died a few days after this letter was written.[11] Gödel followed with two letters of condolence, one to Dan Mostow, then chair of Mathematics at Yale, and the other, in quite heartfelt tones, to Mrs. Robinson.

The correspondence between Gödel and John von Neumann, which extends with some lengthy gaps from 1930 to 1956 (the year of von Neumann's death) begins and ends with some remarkable technical discussions. Once von Neumann learned of Gödel's first incompleteness theorem, he was drawn to conclude the second theorem, on the unprovability of consistency. But Gödel had already sent in an abstract, announcing that theorem as well, so von Neumann wrote that "[a]s you have established [the theorem] as a natural continuation and deepening of your earlier results, I clearly won't publish on this subject." Following that, they had an exchange in which they differed on the significance for Hilbert's program of the second incompleteness theorem, with von Neumann arguing strongly that the program was essentially doomed as originally conceived while Gödel thought it was possible that there are finitary proofs that cannot be formalised in the systems considered. But by 1933, Gödel came to the same conclusion as von Neumann.

Gödel's final letter to "Lieber Herr v. Neumann" (20 March 1956) was written to him at Walter Reed Hospital where von Neumann was being treated for bone cancer. In it, after expressing his deep concern and wishes for the improvement of his condition, Gödel raised a problem concerning feasibility of computations which he thought "would have consequences of the greatest significance. Namely, that the thinking of a mathematician in the case of yes-and-no questions could be completely replaced by machines, in spite of the unsolvability of the Entscheidungsproblem." His question was recognized many years later to be a precursor of the currently open $P = NP$ problem. There is no extant response from von Neumann. He died in the hospital the following year, in August, 1957.

Other than a few letters written on Gödel's behalf, Ernst Zermelo is Gödel's final correspondent represented in Vol. V of the ***Collected Works***. Zermelo thought he had found a gap in Gödel's proof of the incompleteness theorem, but it was due to a confusion on his part between truth and proof. Gödel

[11] And four years before Gödel's own death in early 1978.

tried, respectfully and patiently, to straighten him out, but without success. Their correspondence broke off with that.

One thing that Gödel scholars will find particularly valuable in Vol. V comes toward the end: it is the finding aid for the Kurt Gödel Papers in the Manuscripts Division of the Department of Rare Books and Special Collections of the Princeton University Library. Running to almost one hundred pages, it was prepared by John Dawson on the basis of his 1984 catalogue of Gödel's *Nachlass*, with some revisions in the late 1990s by Rebecca Schoff and Barbara Volz; further revisions in the finding aid as it appears in Vol. V are by Cheryl Dawson, incorporating references to the microfilm edition of Gödel's *Nachlass*.

§**6. Dealing with the notebooks.** The material that attracted perhaps the most interest at the beginning of our project were Gödel's notebooks, of which there are over one hundred altogether. Those of *prima facie* scientific or philosophical interest were classified by him in subseries, labelled as follows:

— "*Arbeitshefte*" (mathematical workbooks, sixteen in number)
— "Logic and foundations" and "Results on foundations" (reports of results by others, six of the first and four of the second)
— "Max" and "Phil" (philosophical notebooks, fifteen in number, with another one missing).

In addition there were three theological notebooks, one of which was missing. The notebooks of greatest potential interest to us were the *Arbeitshefte* and the philosophical notebooks. These are almost entirely in Gabelsberger, one of two competing German shorthand systems in widespread use during the early part of this century. Among those who used this script regularly in addition to Gödel were Heidegger, Husserl, Schrödinger and Zermelo. However, the Gabelsberger system was officially superseded by a unified script in 1926 and thus by 1982 there were very few people left who knew it. We were eager to decipher those notebooks, because their contents could be gleaned from an index with 55 headings, that Gödel had prepared in longhand for his *Arbeitshefte*, among whose tantalizing entries are the following:[12]

1a. Corrections to Herbrand.
3. Attempt [to prove] the consistency of analysis.
4. Ordinals in analysis.
4′. First ordinal number not constructible in an[alysis].
5. Consistency [of] Quine ['s system].
11. Consistency of analysis.

[12] A shorter, simplified list in a different order was given in Vol. I, p. 28. The listing here follows Gödel in his partial index of the *Arbeitshefte*. An English translation of the complete list of 55 items is to be found in Appendix A of Dawson and Dawson [2].

15. Consistency of $\neg(p)(p \vee \neg p)$.
20. Computable functions of finite type.
21. Souslin's problem.
22. Independence of the continuum hypothesis according to Brouwer's method.
27. Analytically measurable functions, with an application to the proof program for the independence of the continuum hypothesis.
31. Existence of undecidable arithmetic propositions for the system of all ordinal logics (for ordinal numbers of the second class that are constructible (in the strict sense)).
32. Independence of the axiom of choice; For Zermelo set theory; Systems of representation; Consistency of the existence of lawless sets.
35. Attempt to resolve the antinomies by means of a notion of freedom from circularity.
50. Absolute definability.
51. Principle for constructing axioms of infinity (Mahlo).

The contents of some of these, e.g., numbers 20 and 50 could be guessed at from published work of Gödel, but we were eager to decode the other items, especially numbers 22, 27 and 32. Of course, in view of Paul Cohen's independence results, we expected them to be of primarily historical interest. Moreover (as noted above in his correspondence with Church), Gödel had never claimed to have obtained the independence of the continuum hypothesis, and only the independence of the axiom of choice from type theory (or Zermelo set theory). The problem was to find someone within convenient working distance who could help transcribe the shorthand. With good fortune, in the very first year of our project we were led to Hermann Landshoff, a retired photographer living in New York City who had learned Gabelsberger as a student in Germany and was very willing to help. He knew no mathematics but was able to train Cheryl Dawson in the script; Cheryl had a background in both mathematics and German that allowed her to transcribe the contents of the notebooks in a form that could then be digested by experts. It also helped that a Gabelsberger textbook was found in Gödel's *Nachlass*; it contained some special signs that he had designed for his own use.

Then, out of the blue, a couple of years after Landshoff and Cheryl Dawson had immersed themselves in the notebooks, I received an inquiry from a student named Tadashi Nagayama in Tokyo, who was a student of a student of Gaisi Takeuti. Nagayama's teacher had been given copies of extracts from Gödel's notebooks by Takeuti, in the hope that someone could be found to transcribe them. These were passed on to Nagayama, whom Takeuti also supplied with a copy of the same Gabelsberger textbook used by Gödel. Nagayama diligently set to work mastering the system, after which he wrote me asking whether he could assist on the project. The whole thing was a bit hard to believe, but after testing him with some passages that had already been worked out by Hermann Landshoff and Cheryl Dawson, we recognized that he could indeed be a help. Nagayama came to Stanford in 1985 under support from our grants, and worked full time for about six years, both in collaboration with Cheryl on the Gabelsberger part of the project and in many other ways. During this period, his wife Misao Nagayama joined him and entered graduate study in mathematics at Stanford, finishing with a Ph.D. thesis on Boolean algebras with Philip Scowcroft. Afterward, she returned to a position in Tokyo and Tadashi moved on to do free-lance technical translation—surely first-rate if our experience is any guide.

In this way, substantial portions of the notebooks were transcribed into German, from which they were translated into English. That's the *good news* of the story. The *bad news* is that what we have as a result is not at all suitable for publication in its present form; after extensive discussion the editors judged it would take a considerable further investment in time, energy and funding to make that material widely available—time, energy and funding that we could no longer draw on either individually or as a group. That is one promise we have thus, regrettably, had to break. For that reason we decided in 1995 to bring our project to a conclusion with the final two volumes of the Gödel ***Works*** as described above.

To wrap up, I know many of you will want to know what, in particular, was gleaned from the notes on the independence of the Axiom of Choice. Well, those extracts were put in the hands of Robert Solovay and Donald A. (Tony) Martin, and they tried very hard to connect the dots of what formally looked like a topological model for the negation of the Axiom of Choice. The best that they could come up with was that it looks like a form of forcing, but they were unable to extract a coherent proof of its independence from Gödel's working notes. Only item 1a, "Corrections to Herbrand", received as much attention, in that case from Jean van Heijenoort and Warren Goldfarb. (Cf. Goldfarb's article [8].) They were excited to see that, unbeknownst to Dreben and his co-workers years later, Gödel had recognized the problems with Herbrand's proof of his "théoreme fondamentale", and had worked out a fix. No doubt there are many more gems to be unearthed, but we'll have to bequeath them to those with the capacity and inspiration to carry on this work. The challenges of dealing with all the left-over material (including but by no means restricted to the notebooks) is well described by John and Cheryl Dawson in their article "Future tasks for Gödel scholars" [2], to be found in this journal.

§7. "Without which . . . and without whom . . . we could not have . . . ". In the preface to each volume of the Gödel ***Collected Works*** we have expressed our extensive indebtedness to the institutions and individuals whose contributions in one way or another were indispensable to the success of our project. As prefaces tend not to be read, I want at least to single out a few of the most important of these, to repeat here our gratitude:

- The ASL for sponsoring our project throughout and for initial and final financial support[13]
- The Sloan Foundation and the National Science Foundation for grants to support the work on Volumes I–III
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Finally, I wish to express my personal gratitude to all my co-editors over the years—John Dawson from the beginning to the end, and, as detailed in secs. 3–5, Warren Goldfarb, Stephen Kleene, Gregory Moore, Charles Parsons, Wilfried Sieg, Robert Solovay, and Jean van Heijenoort for their editorial work on various of the volumes. My special thanks go to Cheryl Dawson for her work on both the Gabelsberger part of the project and for taking over as managing editor from Gregory Moore following completion of Vol. II. Last but not least, Stefan Bauer-Mengelberg gave us extensive help with the translations from the German in Vols. I–III and with the heavy proofreading; sadly, he passed away in 1996.

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[2] John W. Dawson, Jr. and Cheryl Dawson, *Future tasks for Gödel scholars*, this Bulletin, vol. 11 (2005), no. 2, pp. 150–171, this issue.

[13] As explained in the Preface to Vol. I, seed money to get us off the ground during a difficult early period was provided through the ASL by two donors who wished to remain anonymous; one of them was later revealed to be Julia Robinson, following her death in 1985 (cf. Vol. I, p. xii).

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[9] Eckehart Köhler et al.(editors), ***Kurt Gödel, Wahrheit und Beweisbarkeit. Bd. I. Dokumente und historische Analysen***, Öbv & Hpt, Vienna, 2002.

[10] Eckehart Köhler et al.(editors), ***Kurt Gödel, Wahrheit und Beweisbarkeit. Bd. 2. Kompendium zum Werk***, Öbv & Hpt, Vienna, 2002.

[11] William W. Tait, *Gödel's reformulation of Gentzen's consistency proof for arithmetic: The no-counterexample interpretation*, this Bulletin, vol. 11 (2005), no. 2, pp. 225–238, this issue.

[12] Jean van Heijenoort, ***From Frege to Gödel. A source book in mathematical logic, 1879–1931***, Harvard University Press, Cambridge, 1967. (Third printing, with corrections, 1976.)

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