History of Programming Languages–II

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EDITORS' INTRODUCTION

In 1978, the ACM Special Interest Group on Programming Languages (SIGPLAN) sponsored a Conference on the History of Programming Languages (HOPL). Papers were prepared and presentations made at a Conference in Los Angeles, California. The Program Committee selected thirteen languages that met the criteria of having been in use for at least 10 years, had significant influence, and were still in use. The languages were: ALGOL, APL, APT, BASIC, COBOL, FORTRAN,GPSS, JOSS, JOVIAL, LISP, PL/I,SIMULA, and SNOBOL. The results of that conference were recorded in *History of Programming Languages*, edited by Richard L. Wexelblat [New York: Academic Press, 1981].

The Second ACM SIGPLAN History of Programming Languages Conference (HOPL-II) took place on April 20-23, 1993 in Cambridge, Massachusetts. The papers prepared for that conference form the basis of this present volume, along with the transcripts of the presentations, a keynote address "Language Design as Design" by Fred Brooks, a discussion of the period between HOPL and HOPL-II by Jean Sammet, and a talk on "What Makes History" by Mike Mahoney (the conference historian). There was also a banquet, hosted by Bernie Galler, and a closing panel of six language developers, chaired by Mike Mahoney. Unfortunately due to page limitations, the transcripts of the banquet, Forum, and the closing panel are not included in this volume. It is our hope that they can be published elsewhere. The Conference was preceeded by a Forum on the History of Computing, chaired by Bob Rosin, and the papers presented at the Forum complete this volume.

The Program Committee for HOPL-II decided to have both invited and submitted papers, and we believe that the range of languages and the quality of presentation will make this volume a classic in the history of programming literature. The languages at HOPL-II were: **Ada, ALGOL 68, C, C++, CLU, Discrete Simulation Languages, FORMAC, Forth, Icon, Lisp, Monitors and Concurrent Pascal, Pascal, Prolog, and Smalltalk.**

The majority of this volume is the material on the individual languages, with a chapter devoted to each language, as follows:

- a paper by each author;
- a transcript of the author's presentation;
- a transcript of a discussant's remarks (not all languages);
- a transcript of the question and answer session;
- biographies of the authors.

It should be noted that some authors' presentations closely followed their papers, and since the book is oversized, the transcripts of these presentations were omitted, with the kind permission of the authors.

All papers were published as preprints in *ACM SIGPLAN Notices*, Vol. 28, No. 3 (March 1993). The papers are reprinted here with the permission of ACM and of the authors. In some cases changes have been made by the authors to correct typographical or factual errors. In some cases additional material has been added, with an appropriate notation by an author or editor.

Jan Lee, Jean Sammet, and Bob Rosin, in their various capacities, have identified the numerous people who worked so long and hard on the Conference; however, we would like to identify the people who assisted us in the production of this volume:

Betty Henderson patiently transcribed 24 hours of difficult computer jargon, and put it on diskettes so Rick and I could begin editing;

We are especially grateful for the support of the National Science Foundation for providing partial funding for the conference and for the preparation of this book, under grant CCR -9208568 and to Nora Cortes-Comerer of ACM Press who secured the additional funding necessary for the completion of the project. In addition to sponsoring the conference, SIGPLAN and its current Chair, Barbara Ryder, provided additional funding for the preparation of photographs for this volume;

Alan Rose of Multiscience Press, Inc. (New York, NY) served as our producer, and Lauralee B. Reinke of Context Publishing Services (Sausalito, CA) formatted all of the material; without their expertise, the technical details of preparing a book of this size would have overwhelmed us;

Special thanks go to Anita LaSalle, Chair of the Computer Science and Information Systems Department at The American University for casettes, diskettes, thousands of pages of photocopies, and FedEx charges to send materials around the globe; and to Sandy Linden, Mark Davidson, and Maureen O'Connell who provided us with administrative support;

And last, but not least, a special thanks to Dick Wexelblat who started this book project; he was always there to share his experience and to give advice when asked.

We are especially indebted to those individuals whose presentations were deleted from this volume due to page limitations, colleagues who gave of their time and talent without the reward of seeing their efforts in print.

Our families deserve our sincere appreciation, since efforts of this magnitude naturally intrude on family life:

Diane, John and Jeannine, Michael and Kathleen Bergin, and a special thanks to Karen and *baby* Gibson.

Finally, we would be remiss if we did not thank Jean Sammet, who has spent much of her professional life preserving the history of programming languages. There is no way to thank her adequately for inspiring the conference or for almost two years of campus visits, telephone conversations, telephone reminders, e-mail messages, and other support that she willingly gave us during the preparation of this book. Without her single-minded devotion to her profession, our discipline would be missing the incredibly rich history captured in this volume.

Tim Bergin
Rick Gibson

GENERAL INTRODUCTION

We are indeed pleased to provide this introductory material for this book. The book is the culmination of work on a 1993 conference (HOPL-II) whose development started in 1990; HOPL-II in turn was a follow-on to the first HOPL, held 15 years earlier (1978).

First HOPL Conference

In order to put this conference in perspective, it is useful to provide some information about the first conference of this type that was held. In 1978 ACM SIGPLAN sponsored a History of Programming Languages Conference (HOPL) with Jean E. Sammet as General Chair and Program Chair, and John A. N. Lee as the Administrative Chair. That conference was composed of invited papers for the 13 languages that met the following criteria:

> "(1) were created and in use by 1967;
>
> (2) remain in use in 1977; and
>
> (3) have had considerable influence on the field of computing."
>
> [*History of Programming Languages*, Richard L. Wexelblat, ed., Academic Press, ACM Monograph Series, 1981), page xviii.]

(The cutoff date of 1967 was chosen to provide perspective from a distance of at least ten years.)

The languages chosen by the Program Committee as meeting those criteria were: ALGOL, APL, APT, BASIC, COBOL, FORTRAN, GPSS, JOSS, JOVIAL, LISP, PL/I, SIMULA, and SNOBOL. A key person involved in the early development of each of those languages was invited to write a paper according to very strict guidelines and with numerous rewrites expected. That conference was deemed a great success by its attendees. The final proceedings, edited by R. L. Wexelblat, is now the definitive work on the early history of those particular languages.

Several people asked at that time why a conference was held rather than simply having people prepare the papers and publish them in a book. We felt initially—and this was confirmed by the actual occurrence—that the audience discussion after each presentation would provide greater insight into the history of the events and decisions that led to the definition of the languages in their early forms. Some of the "cross talk" publicly and privately among the attendees—many of whom participated in the creation of several languages—provided significant insights into the early developments.

Second HOPL Conference

The first HOPL conference was intended to be only the beginning, and not the end of any consideration of programming language history. As a result, not long after the end of that conference, we began thinking about a second HOPL Conference, with the intent of building on what we learned from the first conference, and expanding its scope and coverage. Due to the pressure of other activities, it took many years before we were able to focus on a second conference. During that time period, a cadre of our colleagues was developed that also strongly promulgated the need to study the history of

computing. In fact, the establishment of the journal *Annals of the History of Computing*, to be published by AFIPS, was announced at the end of the first HOPL Conference with Bernard A. Galler as Editor-in-Chief. Since 1987, John A. N. Lee has been the Editor-in-Chief, and in 1992 the IEEE Computer Society became the publisher. In January 1996, Michael R. Williams took over as the third *Annals* Editor-in-Chief. ACM has also sponsored several other history conferences, covering the fields of scientific computing, medical informatics, and personal workstations.

Finally, we developed a proposal in 1990, and the ACM SIGPLAN Executive Committee authorized us to proceed with this Second History of Programming Languages Conference (HOPL-II). We then called back to voluntary duty several members of the original conference-organizing committees and many of them were happy to join us in this new endeavor. In addition, we made a conscious effort to bring in newer/younger people who also have an interest in examining the past. But organizing a history conference is by no means as simple as organizing a technical conference dealing with current or recent research in which all the papers are to be contributed and for which there is tremendous competition to participate. This is primarily because most professionals in the computer field prefer to concentrate on current and future work rather than looking backward to what they have accomplished. A detailed description of how the final program was created is given in the next section of this introduction.

The study of various aspects of computing history is not merely an intellectual exercise; it shows us how we reached our current condition, indicates effective approaches as well as past errors, and provides perspective and insight for the future, and a surer sense of how to get there.

The conference itself was held April 20 to 23, 1993, in Cambridge, Massachusetts with preprints issued as the March 1993 issue of *ACM SIGPLAN Notices* (Volume 28, Number 3). This book contains an enormous amount of material not included in the preprints, including some revised papers as well as transcripts of the talks, the Forum papers, the keynote address, and other material that provide a record of what occurred during the conference. We regret that space limitations prevented the inclusion of the transcripts of the banquet, the closing panel and the Forum. We hope that they can be published elsewhere.

We appreciate the hard work done by all the people who helped organize and run the conference. We are particularly grateful to Tim Bergin and Rick Gibson who unexpectedly took on the enormous task of preparing this book for publication.

John A. N. Lee (Conference Chair)
Virginia Polytechnic Institute and State University

Jean E. Sammet (Program Chair)
Programming Language Consultant
(IBM, Retired)

DEVELOPMENT OF THE HOPL-II PROGRAM

The success we tried to achieve in this conference is due to an extremely hard-working and dedicated Program Committee and equally hard-working authors and numerous other volunteers. This section explains how—and to some extent why—the program was developed.

MEMBERS OF PROGRAM COMMITTEE

The Program Committee consisted of the following people, and almost all of them carried out a major task in addition to his/her standard role on a program committee. The affiliations shown are those at the time the conference was held.

Chair:	Jean E. Sammet	(Programming Language Consultant)
Secretary:	Thomas J. Bergin	(American University)
Conference Historian:	Michael S. Mahoney*	(Princeton University)
Forum Chair:	Robert F. Rosin	(Enhanced Service Providers, Inc.)
Other members:	Jacques Cohen	(Brandeis University)
	Michael Feldman	(The George Washington University)
	Bernard A. Galler*	(University of Michigan)
	Helen M. Gigley	(Naval Research Laboratory)
	Brent Hailpern*	(IBM)
	Randy Hudson	(Intermetrics)
	Barbara Ryder*	(Rutgers University)
	Richard L. Wexelblat	(Institute for Defense Analyses)

*Chair of a Program Review Committee (as described below)

APPROACH TO CREATING THE PROGRAM

In order to appreciate the papers presented at this conference and the accompanying Forum on the History of Computing, it is important to understand how the program was developed.

Three fundamental decisions were made at the beginning:

1. there would be invited *and* contributed papers,
2. the scope of the conference would include papers on the early history of specific languages—as in the first HOPL conference—and papers on (a) evolution of a language, (b) history of language features and concepts, and (c) classes of languages for application-oriented languages and paradigm-oriented languages,
3. the conference was not intended to honor anyone.

Invited Speakers

For the invited speakers, the Program Committee used the same types of criteria used for the first HOPL conference, as indicated in the preceding section, but changed the cutoff date to require that "preliminary ideas about the language were documented by 1982 and the language was in use or being taught by 1985." We issued six invitations for people to prepare papers because these languages met the three indicated criteria, that is, compliance with the date, were still in use, and had influence on the computing field):

Alain Colmerauer	Prolog
Jean Ichbiah	Ada (technical development)
Alan Kay	Smalltalk
Dennis Ritchie	C
William Whitaker	Ada (project management)
Niklaus Wirth	Pascal

Each of these people was deemed a key person in the early development of the language; all of them accepted the invitation/request to prepare detailed papers, but subsequently Jean Ichbiah was unable to prepare a paper within the specified conference schedule due to the pressure of other responsibilities and withdrew his participation.

Guidance to Authors and Paper Submission

The Program Committee followed the earlier successful plan from the first HOPL Conference by providing authors with detailed questions to guide them in writing their papers. We used the original questions for early history from the first HOPL Conference, and then developed three new sets of questions to deal with the three new types of papers we expected. Randy Hudson coordinated and edited those four sets of questions; they appear in this book as Appendix B.

A call for papers was issued in December of 1990 (Appendix B) with notification to potential authors that their papers would go through two rounds of refereeing with a major rewrite probably needed between them. Dick Wexelblat served as submissions coordinator, and provided administrative support for the Call for Papers, the distribution of manuscripts (twice), and hosting two Program Committee meetings. In his role as editor of the preprints (Volume 28, Number 3, March 1993 issue of *ACM SIGPLAN Notices*), he also developed the format guidelines used by the authors.

Program Review Committees

Because of the complexity of the paper processing and refereeing, we established four Program Review Committees (PRCs), each serving essentially as a subcommittee of the Program Committee but with additional people serving on each PRC. The PRC scopes corresponded approximately to the types of papers we expected. The chairs of those PRCs were responsible for most of the interaction with the authors and referees on each specific paper. The PRC chairs were:

Early History	Brent Hailpern
Evolution	Bernard A. Galler
Features & Classes	Barbara Ryder
Invited Papers	Michael S. Mahoney and Brent Hailpern

Each of the PRC Chairs also recruited additional people to help with the refereeing and selection. While I would like to list their names, as is often done for conferences, it is not appropriate to do so here because almost all of them were selected because of knowledge of specific language(s) so it would be too easy for the authors to identify their referees!

Paper Selection

In September 1991 the Program Committee gave "conditional acceptance" to some of the contributed papers. The authors were given referees' comments and told that if they complied with a reasonable number of those suggestions the paper would be accepted (i.e., they would not be in competition with one another).

In August 1992 the Program Committee decided which contributed papers met the standards for the conference, and those are printed here, along with the invited papers, which also underwent a similar process of rewrites.

Guidance to Authors on Historiography

In addition to other steps taken to try to achieve high quality, we asked Michael S. Mahoney, a professor with significant expertise and experience in historiography—and specifically the history of computing—to provide guidance to the Program Committee and the authors. He reviewed *all* the papers and provided specific assistance to any author who requested it. His paper "Making History" appears in Chapter 1; another paper, "What Makes History?", was sent to prospective authors and is included as Appendix A.

Language Experts

To assist the authors, each PRC chair assigned a technical expert in the subject to help each author with the paper by reviewing the various drafts. In some sense, these experts are the unsung heroes of the conference, and so it is appropriate to list and thank them.

Language/Topic	*Expert*	*Language Summary*
Ada	Anthony Gargaro	Anthony Gargaro
ALGOL 68	Henry Bowlden	Henry Bowlden
C	William McKeeman	William McKeeman
C++	Jerry Schwarz	Jerry Schwarz
Clu	John Guttag	John Guttag
Concurrent Pascal	Narain Gehani	Charles Hayden
FORMAC	James Griesmer	James Griesmer
Forth	Phil Koopman	Phil Koopman
Icon	David Hanson	David Hanson
Lisp	Gerald Jay Sussman	Gerald Jay Sussman, Guy L. Steele, Jr., and Richard P. Gabriel
Pascal	C. A. R. Hoare	Peter Lee
Prolog	Fernando Pereira	Fernando Pereira
Simulation languages	Philip Kiviat	Philip Kiviat
Smalltalk	Adele Goldberg	Tim Budd

Language Descriptions

We wanted the authors to concentrate on writing a history paper and not on describing the language. Therefore we asked knowledgeable individuals to provide a very short introduction to each language and these "language summaries" appeared in the preprints. Unfortunately, space limitations prevented our including them here. The authors of these language summaries are listed above; the preparation and editing of these language descriptions was coordinated by Michael Feldman.

Reasons for Some Language Absences

In examining the list of papers accepted for this conference, the reader might well wonder about the absence of some obvious subjects. For example, since FORTRAN and COBOL were included in the first HOPL Conference—and remain as major languages—one might have expected papers on their evolution to appear in this conference. The Program Committee decided to invite only papers dealing with the early history of the major languages developed since the first HOPL conference. Therefore, the omission of these subjects, and numerous others, is due to the policy of having contributed as well as invited papers; if people did not submit acceptable papers on an important topic it could not be included in this conference.

FORUM ON THE HISTORY OF COMPUTING

Many SIGPLAN Conferences precede the main paper sessions with a day of tutorials. The Program Committee adapted that practice to provide an afternoon and evening devoted to a Forum on the History of Computing. The intent of the Forum was to sensitize computer scientists to issues and challenges in the history of computing, and to entice some of them to become involved in this work. The Forum activity was chaired by Robert F. Rosin, who assembled a committee to help organize the topics and sessions, invite the participants, and review written material. An introduction by Robert Rosin, the written papers prepared for the Forum, and a transcript of the closing panel are included in this book. Unfortunately, there was not enough room in this volume to include transcripts of the presentations.

The Forum Committee operated under the general guidance and approval of the Program Committee, and consisted of the following people, whose affiliations at the time of the conference are shown:

Chair:	Robert F. Rosin	(Enhanced Service Providers, Inc.)
Members:	Thomas J. Bergin	(American University)
	Michael S. Mahoney	(Princeton University)
	Michael Marcotty	(General Motors; now a consultant)
	Tom Marlowe	(Seton Hall University)
	Jean E. Sammet	(Programming Language Consultant)

PERSONAL COMMENT

It is not common for the Program Chair of a conference to have a paper included in that conference. The Program Committee decided initially that it was reasonable for me to submit a paper, but in order to maintain objectivity and fairness I was kept completely separated from any refereeing or decision

process on my paper, and I don't know any more than any other author as to who the referees were or what general evaluation comments were turned in.

CONCLUSION

The entire Program Committee and its supporting subcommittees have spent literally hundreds—and in some cases thousands—of hours preparing this conference. I am personally very grateful to Tim Bergin and Rick Gibson for the hundreds of hours they have spent in preparing this book. We hope you will find it valuable initially and in the future.

Jean E. Sammet
Program Chair

ACKNOWLEDGMENTS

My special thanks go to Jean Sammet, Program Chair, who coincidentally moved from full-time work to consultancy just about the time the intense effort on the development of the program started. Over the past five years she has spent an immense amount of time on this task, and without her drive, enthusiasm, and high standards, we would not have the high quality of historiography represented by the papers in this volume.

Michael Mahoney, Conference Historian, led the program committee in learning and applying the techniques and methods of historical research. At least one program committee member was heard to say that he or she never realized before how difficult historical research was. In fact, the whole program committee deserves our thanks for developing an outstanding, high quality program.

The preparation of the preprints was more complicated than usual due to the size and variety of material. The efforts by Dick Wexelblat and Janice Hirst in preparing the preprints are greatly appreciated. The work to prepare this book was enormous, and the willingness of Tim Bergin and Rick Gibson to unexpectedly assume this task is greatly appreciated.

The organizing committee worked for approximately one year before the conference. A very visible aspect reflects the work of Dan Halbert, Publicity Chairman. Many of the attendees would not have known of the conference without his efforts; his patience in providing numerous drafts of publicity items satisfied our demands for high standards of presentation even in the ancillary materials.

The results of the efforts of many members of the organizing committee was best seen during the conference itself, though some, like Richard Eckhouse, Conference Treasurer, remained unseen to participants. Our thanks to them all.

Members, Organizing Committee:

Program Chair:	Jean E. Sammet	(Programming Language Consultant)
Treasurer:	Richard Eckhouse	(University of Massachusetts, Boston)
Local arrangements:	Peter S. Mager	(Perception Technology Corporation)
Publications:	Richard L. Wexelblat	(Institute for Defense Analyses)
Recordings:	Mary van Deusen	(IBM)
Registration:	Karen Lemone	(Worcester Polytechnic Institute)
Book exhibits:	James P. Bouhana	(Performance International)
Publicity:	Dan Halbert	(Diqital Equipment Corporation)

Our thanks also go to the National Science Foundation which provided support for speakers, students, and this final book under grant #CCR-9208568.

John A. N. Lee
General Chair