ALGOL X and ALGOL Y

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The birth of IFIP Working Group 2.1 – background

- 1960: ALGOL 60 Report published; *Communications of the ACM* chooses ALGOL 60 as the publication language for algorithms

- 1960−1962: issues arise (ambiguities and errors) that need authoritative resolution; another issue is the complete absence of any I/O facilities

- 1962: ACM requests IFIP to establish a Working Group intended to "assume the responsibility for development, specification and refinement of ALGOL"

The birth of IFIP Working Group 2.1

- March 23, 1962: The IFIP Council decides to establish Working Group 2.1 on ALGOL
- April 2–3, 1962: Rome Conference – authors of the ALGOL 60 Report meet to define revision

> The authors of the ALGOL 60 Report present at the Rome Conference, being aware of the formation of a Working Group on ALGOL by IFIP, accepted that any collective responsibility which they might have with respect to the development, specification and refinement of the ALGOL language will from now on be transferred to that body.

– Revised Report on the Algorithmic Language ALGOL 60

- August 28 & 30, 1962: First meeting of WG2.1, Munich, Germany

Strong personal overlap

- Most of the original ALGOL 60 authors become WG2.1 members (11 out of 13; all except Backus and Perlis)

- Most of the Rome Conference attendees become WG2.1 members (14 out of 16; all except Backus and Franciotti – Landin becomes a member in 1965)

The Revised ALGOL 60 Report is published with the IFIP stamp of approval

The dual miracle of ALGOL 60

- It is a miracle that a diverse international group of computer scientists was able to agree on the design of a major programming language
- It is even more of a miracle that the result was such a simple yet expressive and elegant language, introducing important innovations:
  - declarations & almost strong typing
  - compositional syntax with fully nested lexical scoping
  - (apart from **go to**) compositional semantics

1963/1964: The Working Group finishes designs for Input/Output and for a subset of ALGOL 60 . . .

. . . and goes into "what now?" mode

And now for something completely different

- In 1964 WG2.1 decides to embark on two projects, code-named "ALGOL X" and "ALGOL Y"

1.1. The Working Group 2.1 on ALGOL was set up in 1962 (at the time of the revision of ALGOL 60) by the Technical Committee on Programming Languages (TC2) of the International Federation of Information Processing (IFIP), with the intention of working on a successor to ALGOL 60 (then called ALGOL 6X) which was to be more general and comprehensive, yet simpler, and still intended for scientific calculations. ...

1.2 Preparation of proposals for Input/Output (1) and for subsets of ALGOL 60, (2) now completed, occupied most of the first three meetings of WG2.1.

1.3 At the fourth meeting (Sept. 1964) it was decided to defer the more ambitious generalizations under the heading "ALGOL Y", and to keep to short-term improvements for "ALGOL X" (3).

– Mike Woodger, "ALGOL X, Note on the proposed successor to ALGOL 60".
ALGOL Bulletin 22.3.10, February 1966

ALGOL X versus ALGOL Y

- ALGOL 60 as designed was mainly intended for expressing numerical algorithms – the same application domain as FORTRAN

- ALGOL X was meant to be a full-fledged practical programming language, offering a full complement of facilities for non-numerical computation (ALGOL 58, ALGOL 60, ALGOL X)

- ALGOL Y was meant to be a *metaprogramming* language: a language for (effectively) defining programming languages

Some wishes for ALGOL X

- Not too radically different from ALGOL 60
- Defined much more precisely than ALGOL 60
- Multiprecision numbers and complex numbers
- String variables and functions
- Address variables
- Trees

Saint-Pierre-de-Chartreuse meeting

- WG2.1 holds meeting #6, October 25–29, 1965, in Saint-Pierre-de-Chartreuse, to the north of Grenoble, France
- There are three documents on the table:
  - An informally described, but rather complete, proposal for ALGOL X by Niklaus Wirth, extended with a proposal for adding records by Tony Hoare that was immediately adopted by Wirth
  - A very formal but also very incomplete language description by Aad van Wijngaarden
  - A proposal by Gerhard Seegmüller on minor points

Wirth's proposal

- The following may give an impression of Wirth's document (N. Wirth. *A Proposal for a report on a successor of ALGOL 60*. MR75, Mathematisch Centrum, Amsterdam, October 1965):

For a variable to be of type <u>tree</u> means that only structured values can be assigned to it. A variable of type <u>tree</u> is understood to be the ordered set of zero or more variables whose number and types are dynamically determined by the operations performed on the variable of type <u>tree</u>.

Van Wijngaarden's proposal

- The following may give an impression of van Wijngaarden's document, where W-grammars make a first appearance (A. van Wijngaarden. *Orthogonal Design and Description of a Formal Language*. MR76, Mathematisch Centrum, Amsterdam, October 1965):

Definition 1: t5' is said to be a direct production of t5 iff there exist possibly empty sequences t5'' and t5''' and a t2 and a t3 such that t5 = t5''t2t5'''',t5'=t5''t5'''t5'''', t3=t2 : t5'''.

Definition 2: t5' is said to be a production of t5 iff there exists a set t5(0), t5(1),...,t5(n) such that t5=t5(0), t5(n)=t5' and t5(i) is a direct production of t5(i-1) for all i=1,...,n.

Definition 3: A terminal production of t5 is a production of t5 which is a t4.

WG2.1 likes the Wirth/Hoare proposal

- The substance of the proposed language is extensively discussed; straw votes held over various issues lead to only minor changes

WG2.1 likes van Wijngaarden's method

- Formal Decisions

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2.   Whatever language is finally decided upon by WG 2.1, it will
     be described by van Wijngaarden's metalinguistic techniques
     as specified in MR 76 [25]
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Combining the best of two worlds

- The Working Group sets up a subcommittee, consisting of Hoare, Seegmüller, van Wijngaar-den and Wirth

- The subcommittee is charged with preparing a draft report from the existing material, taking account of the wishes expressed by the Group

- Van Wijngaarden promises to produce a first version, to be circulated to the other subcom-mittee members, whereupon they will meet to draft the commissioned report

A funny thing happened on the way to Warsaw

- At the next WG2.1 meeting there is no joint draft report. Soon after the following appears in the *Communications of the ACM:*

However, at the following meeting of the Group at Grenoble in October, 1965 it was felt that the report did not represent a sufficient advance on ALGOL 60, either in its manner of language definition or in the content of the language itself. The draft therefore no longer had the status of an official Working Document of the Group and by kind permission of the Chairman it was released for wider publication.

– Niklaus Wirth, C. A. R. Hoare, "A Contribution to the Development of ALGOL". *Comm. ACM* **9**:6 (June 1966) pp. 419–432

So *what* had happened?

- Van Wijngaarden did not manage to fulfill his promise to produce and circulate a first version
- Nevertheless, the subcommittee meets as agreed in April 1966 in Kootwijk, the Netherlands, in preparation for the Warsaw meeting of October 1966
- There is an irreconcilable 2 – 2 split in the subcommittee (Hoare/Wirth *vs.* Seegmüller/van Wijngaarden) on the parameter mechanism
- Wirth refuses to attend the Warsaw meeting

Then in Warsaw . . .

- WG2.1 holds meeting #7, October 3 – 8, 1966, held in Warsaw, Poland
- There is one proposal for ALGOL X on the table, by van Wijngaarden, with the title *The SC proposal for ALGOL X* (known as "Warsaw 2")
- The Group decides this will become the basis for a report, to be made public as a WG2.1 working paper in the *ALGOL Bulletin*
- Van Wijngaarden is asked to serve as the editor

Meanwhile

- Wirth continues to work on his design outside the context of WG2.1

- This leads, eventually, to ALGOL W (implementations for OS/360 and MTS around 1968; full language report 1972)

- WG2.1 never rejected this as a proposal for ALGOL X; on the contrary, as far as language design is concerned, it was as good as accepted

Some observations

- Although the Working Group felt that ALGOL X should not be "too radically different" from ALGOL 60, the process is never seen as an evolutionary one – ALGOL X is to be the *successor* to ALGOL 60: a new language, not a (major) revision
- The difference is perhaps more a matter of perception than of substance, but it may, never-theless, be psychologically important

Some observations (continued)

- The possibility does not appear to have been considered at all

- However, it is clear that the official IFIP "stamp of approval" is seen as an impediment to light-weight revision processes

- Each next design iteration, the ambition for ALGOL X is larger, and so is the draft language report

The fate of ALGOL Y

- Charles Lindsey described ALGOL Y as:

  originally conceived as a language which could manipulate its own programs, but in fact degenerating into a collection of features rejected for ALGOL X

- However, the fact is that ALGOL Y was never seriously discussed:
  - Until December 1968 the ALGOL X discussion takes precedence
  - After 1968 the Group appears to have lost its appetite for IFIP-approved Group products

A strong argument for working on ALGOL Y

Why we should work on ALGOL Y is to avoid being laughing-stocks, which we would become if we just stopped working after producing ALGOL X.

– Brian Randall, Informal Minutes of WG2.1 Meeting #8

(Zandvoort, The Netherlands, May 16–20, 1967)

The fate of ALGOL X

- ALGOL X was accepted by WG2.1 in 1968 and named ALGOL 68
- There has been one major revision, accepted in 1973
- ALGOL 68 has never taken flight, but many of its innovations have found their way into several widely used languages
- Most importantly, its compositional type system has influenced the design of C and its successors, as well as Haskell and Python