

Rm 217 Brouse Copy

NUMBER 22 & 23

Pascal Users Group

Pascal News

COMMUNICATIONS ABOUT THE PROGRAMMING LANGUAGE PASCAL BY PASCALERS

SEPTEMBER, 1981

Two for one ...



Or one for two?

Return to:

Pascal Users Group
P.O. Box 4406
Allentown, Pa. 18104-4406

Return postage guaranteed
Address Correction requested



ATTN: ROOM 217 BROUSE COPY [81]
UNIV. OF MINNESOTA
UCC : 227EX

MAR 24 1982

POLICY: PASCAL NEWS

(15-Sep-80)

- * Pascal News is the official but informal publication of the User's Group.
- * Pascal News contains all we (the editors) know about Pascal; we use it as the vehicle to answer all inquiries because our physical energy and resources for answering individual requests are finite. As PUG grows, we unfortunately succumb to the reality of:

1. Having to insist that people who need to know "about Pascal" join PUG and read Pascal News - that is why we spend time to produce it!

2. Refusing to return phone calls or answer letters full of questions - we will pass the questions on to the readership of Pascal News. Please understand what the collective effect of individual inquiries has at the "concentrators" (our phones and mailboxes). We are trying honestly to say: "We cannot promise more that we can do."

* Pascal News is produced 3 or 4 times during a year; usually in March, June, September, and December.

* ALL THE NEWS THAT'S FIT, WE PRINT. Please send material (brevity is a virtue) for Pascal News single-spaced and camera-ready (use dark ribbon and 18.5 cm lines!)

* Remember: ALL LETTERS TO US WILL BE PRINTED UNLESS THEY CONTAIN A REQUEST TO THE CONTRARY.

* Pascal News is divided into flexible sections:

POLICY - explains the way we do things (ALL-PURPOSE COUPON, etc.)

EDITOR'S CONTRIBUTION - passes along the opinion and point of view of the editor together with changes in the mechanics of PUG operation, etc.

HERE AND THERE WITH PASCAL - presents news from people, conference announcements and reports, new books and articles (including reviews), notices of Pascal in the news, history, membership rosters, etc.

APPLICATIONS - presents and documents source programs written in Pascal for various algorithms, and software tools for a Pascal environment; news of significant applications programs. Also critiques regarding program/algorithm certification, performance, standards conformance, style, output convenience, and general design.

ARTICLES - contains formal, submitted contributions (such as Pascal philosophy, use of Pascal as a teaching tool, use of Pascal at different computer installations, how to promote Pascal, etc.).

OPEN FORUM FOR MEMBERS - contains short, informal correspondence among members which is of interest to the readership of Pascal News.

IMPLEMENTATION NOTES - reports news of Pascal implementations: contacts for maintainers, implementors, distributors, and documentors of various implementations as well as where to send bug reports. Qualitative and quantitative descriptions and comparisons of various implementations are publicized. Sections contain information about Portable Pascals, Pascal Variants, Feature-Implementation Notes, and Machine-Dependent Implementations.

----- ALL-PURPOSE COUPON ----- (15-Dec-81)

Pascal Users Group
P.O. Box 4406
Allentown, Pa. 18104-4406 USA

****Note****

- We will not accept purchase orders.
- Make checks payable to: "Pascal Users Group", drawn on a U.S. bank in U.S. dollars.
- Note the discounts below, for multi-year subscription and renewal.
- The U. S. Postal Service does not forward Pascal News.

- | | | USA | UK | Europe | Aust. |
|--|-------------|-------|------|--------|--------|
| [] Enter me as a new member for: | [] 1 year | \$10. | #6. | DM20. | A\$8. |
| [] Renew my subscription for: | [] 2 years | \$18. | #10. | DM45. | A\$15. |
| | [] 3 years | \$25. | #15. | DM50. | A\$20. |
| [] Send Back Issue(s) | _____ | | | | |
| [] My new address/phone is listed below | | | | | |
| [] Enclosed please find a contribution, idea, article or opinion which is submitted for publication in the <u>Pascal News</u> . | | | | | |
| [] Comments: | _____ | | | | |

ENCLOSED PLEASE FIND:
CHECK no. _____

NAME _____

ADDRESS _____

PHONE _____

COMPUTER _____

DATE _____

JOINING PASCAL USERS GROUP?

Membership is open to anyone: Particularly the Pascal user, teacher, maintainer, implementor, distributor, or just plain fan. Please enclose the proper prepayment (check payable to "Pascal User's Group"); we will not bill you. Please do not send us purchase orders; we cannot endure the paper work! When you join PUG any time within a year: January 1 to December 31, you will receive all issues of Pascal News for that year. We produce Pascal News as a means toward the end of promoting Pascal and communicating news of events surrounding Pascal to persons interested in Pascal. We are simply interested in the news ourselves and prefer to share it through Pascal News. We desire to minimize paperwork, because we have other work to do.

American Region (North and South America) Join through PUG(USA).

European Region (Europe, North Africa, Western Asia): Join through PUG(EUR) Pascal Users Group, c/o Grado Computer Systems & Software, Weissenburgerstrasse 25, D-8000, Munchen 80, Germany.

United Kingdom Region: join through PUG(UK) : Pascal Users Group, c/o Shetlandtel, Walls, Shetland, ZE2 9PF, United Kingdom.

Australasian Region (Australia, East Asia - incl. India & Japan): PUG(AUS). Pascal Users Group, c/o Arthur Sale, Department of Information Science, University of Tasmania, Box 252C GPO, Hobart, Tasmania 7001, Australia. International telephone: 61-02-202374

RENEWING?

Please renew early (before November) and please write us a line or two to tell us what you are doing with Pascal, and tell us what you think of PUG and Pascal News. Renewing for more than one year saves us time.

ORDERING BACK ISSUES OR EXTRA ISSUES?

Our unusual policy of automatically sending all issues of Pascal News to anyone who joins within a year means that we eliminate many requests for backissues ahead of time, and we don't have to reprint important information in every issue--especially about Pascal implementations!

Issues 1 .. 8 (January, 1974 - May 1977) are out of print.

Issues 9 .. 12, 13 .. 16, & 17 .. 20 are available from PUG(USA) all for \$15.00 a set, and from PUG(AUS) all for \$A15.00 a set.

Extra single copies of new issues (current academic year) are: \$5.00 each - PUG(USA); and \$A5.00 each - PUG(AUS).

SENDING MATERIAL FOR PUBLICATION?

Your experiences with Pascal (teaching and otherwise), ideas, letters, opinions, notices, news, articles, conference announcements, reports, implementation information, applications, etc. are welcome. Please send material single-spaced and in camera-ready (use a dark ribbon and lines 18.5 cm. wide) form.

All letters will be printed unless they contain a request to the contrary.

	Pascal News #22 & 23	September 1981	Index
0	POLICY, COUPONS, INDEX, ETC.		
1	EDITORS CONTRIBUTION		
3	HERE AND THERE WITH Pascal		
3	Summary of Implementations (for PN 15..18)		G. Marshall
4	APPLICATIONS		
4	The FMI Compiler (code)		A. Tanenbaum
38	Options -- Control Statement Option Settings		S. Leonard
39	Treeprint -- Prints Trees on a Character Printer		Freed & Carosso
44	Compress & Recall -- Text compression using Huffman codes		T. Stone
50	ARTICLES		
50	"The Performance of three CP/M based Translators"		Johnson & Sidebottom
54	"A Geographer Teaches Pascal -- Reflections on the Experience"		J. Pitzl
56	"An Extension That Solves Four Problems"		J. Yavner
61	OPEN FORUM FOR MEMBERS		
68	IMPLEMENTATION NOTES		
81	ONE PURPOSE COUPON, POLICY		

APPLICATION FOR LICENSE TO USE VALIDATION SUITE FOR PASCAL

Name and address of requestor: _____
(Company name if requestor is a company): _____
Phone Number: _____
Name and address to which information should be addressed (write "as above" if the same) _____
Signature of requestor: _____
Date: _____

In making this application, which should be signed by a responsible person in the case of a company, the requestor agrees that:

- a) The Validation Suite is recognized as being the copyrighted, proprietary property of R. A. Freak and A. H. J. Sale, and
- b) The requestor will not distribute or otherwise make available machine-readable copies of the Validation Suite, modified or unmodified, to any third party without written permission of the copyright holders.

In return, the copyright holders grant full permission to use the programs and documentation contained in the Validation Suite for the purpose of compiler validation, acceptance tests, benchmarking, preparation of comparative reports and similar purposes, and to make available the listings of the results of compilation and execution of the programs to third parties in the course of the above activities. In such documents, reference shall be made to the original copyright notice and its source.

Distribution Charge: \$50.00

Make checks payable to ANPA/RI in US dollars drawn on a US bank.
Remittance must accompany application.

Source Code Delivery Medium Specification:

- 800 bpi, 9-track, NRZI, odd parity, 600' magnetic tape
 1600 bpi, 9-track, PE, odd parity, 600' magnetic tape

ANSI-STANDARD

a) Select Character Code Set:

- ASCII EBCDIC

b) Each logical record is an 80 character card image. Select block size in logical records per block.

- 40 20 10

Special DEC System Alternates:

- RSX-1AS PIP Format (requires ANSI MAGtape RSX SYSGEN)
 DOS-RSTS FLX Format

Mail Request to:
ANPA/RI
P.O. Box 598
Easton, Pa. 18042
USA
Attn: R. J. Cichelli

Office Use Only

Signed _____
Date _____

Richard J. Cichelli
On behalf of A.H.J. Sale and R.A.Freak

Editor's Contribution

GOOFED AGAIN

Yes as all you loyal Pennsylvanians have noticed in the last issue of PN we managed to mess up the zip code of Allentown PA, and of course the USPS has come down on us like a ton of bricks! Please note that the zip is 18014 not 18170. It has been corrected in the new APC.

THE NEW APC

Speaking of the new APC we have simplified it some more, and added current prices for the UK and Europe, and have modified the reverse side of the coupon to reflect the new foreign editors and their current addresses.

THE LATEST EUROPEAN SOLUTION

Speaking of the European editors, we have two new ones! One for the UK, and one for the Continent. Nick Hushes will be handling all business for Britain, and Hellmut Heher will be in charge of the European Region. Please see the APC for their addresses.

ON CALLING

Please restrict yourself to written correspondence when dealing with PUG. This is strictly a scholarly function. None of the editors (including myself) gets paid. All have a real job that pays their bills, and they owe their office hours to their employer. All PUG work is done on their own time. So please write to the appropriate regional editor. It leaves a documentary trail that can be followed and handled as fast as we can. Honest!

COMBINED ISSUE

This is of course a combined issue. We are doing this to catch up and to beat the postal system and their high rates. If this upsets anyone we are sorry. We are doing our best.

ON BEING THE EDITOR

Anyone who is interested in being the new editor of PN should write to me at the main address (APC).

STANDARDS

Good news from the standard front! 7185.1 was approved by the international committee. More next issue from Jim Miner the Standards Editor.

Here and There With Pascal

Summary of Implementations

THIS ISSUE

The highlight of this issue is the long awaited (from last issue at least!) of Andrew Tanenbaum's EM1 compiler. I think it is really great. Tell us what you think! In the Here and There section Gress Marshall has summarized the past few issues (15 .. 19) implementation notes. Thanx. In addition to the EM1 compiler, the Applications section includes an improved version of the subroutine "options", as well as a tree printing routine, and a set of routines to compress and expand text using Huffman codes. Good work! And finally the articles section has some fine contributions. Many people have asked (on the phone ... see above) about how the various CP/M compilers stack up. Now we have an answer. Also there is an article of the experiences of a novice teaching Pascal. From a geography teacher no less! And finally a probins article by Jonathan Yaxner concerning problems with Pascal and some proposals for their solution.

Hope you like it.

Rick

ALL	#15:101	Pascal I (Derived from Pascal S)	
BESM-6	#15:107		
Burroughs B5700	#15:107		
Burroughs B6700/B7700 (MCP)	#19:113		
CDC 6000	#19:115		
CDC 6000	#15:108		
Cyber 70 and 170	#15:108		
DEC PDP-11	#19:115	UCSD Pascal	
DEC PDP-11	#15:111		
DEC PDP-11	#15:112	UCSD Pascal	
DEC PDP-11	#15:124		
DEC PDP-11 (RSTS)	#15:100	Pascal S	
DEC PDP-11 (RSX-11M/IAS)	#17:86		
DEC PDP-11 (RSX-11M/RT-11)	#15:101	Concurrent Pascal	
DEC PDP-11 (Unix)	#15:111		
DEC PDP-11 (Unix)	#15:100	Pascal E	
DEC PDP-11 (Unix)	#15:103	Modula	
DEC PDP-15	#15:124		
DEC VAX	#17:89		
DEC VAX (Unix)	#19:115		
DG Eclipse	#17:106		
DG Eclipse (AOS)	#15:110	RDOS, DOS)	
DG Eclipse (AOS)	#15:109		
DG Eclipse (RDOS)	#15:108		
DG Nova (AOS)	#15:110	RDOS, DOS)	
Digico Micro 16E	#15:113		
Facom 230-45S	#15:112		
General Electric GEC4082	#15:113		
Golem B (GOBOS)	#17:104		
HP 1000	#19:116		
Honeywell 6000 (GCOS III)	#15:113		
Honeywell Level 6	#15:113		
IBM 3033	#19:120		
IBM 360/370	#15:114		
IBM 360/370	#15:115		
IBM 370	#17:104		
IBM 370	#19:117		
IBM 370	#15:124		
IBM 370	#17:102		
IBM 370/303x/43xx	#19:117		
IBM Series 1	#19:116		
IBM Series 1	#15:114		
ICL 1900	#15:116		
Intel 8080/8085	#15:119		
Intel 8080/8085	#15:118		
Intel 8080/8085	#15:119		
Intel 8080/8085	#17:102		
Intel 8080/8085	#15:117		
Intel 8080/8085 (CP/M)	#17:105		
Intel 8080/8085 (TRS-80)	#15:100		
Intel 8080/8085 (Northstar)	#15:100		
Intel 8086	#15:119		
Intel 8086	#15:103		
MOS Tech 6502 (Apple)	#15:107		
Modcomp II and IV	#15:120		
		Motorola 6800	#15:120
		Motorola 6800	#19:120
		Motorola 6800	#19:121
		Motorola 6800	#17:102
		Motorola 6800 (Flex)	#15:123
		Motorola 68000	#19:121
		Motorola 6809	#15:103
		Motorola 6809 (MDOS09)	#17:102
		Nord 10 and 100 (Sintran III)	#15:121
		Perkin-Elmer 3220	#15:122
		Perkin-Elmer 7/16	#15:121
		RCA 1802	#17:103
		RCA 1802	#15:122
		Siemens 7.748	#15:124
		Sperry-Univac V77	#15:124
		Texas Instruments 990	#17:101
		Texas Instruments 9900	#15:124
		Zilog Z-80	#15:124
		Zilog Z-80	#19:123
		Zilog Z-80	#15:124
		Zilog Z-80	#17:88
		Zilog Z-80	#17:104
		Zilog Z-80 (CP/M)	#17:103
		Zilog Z-80 (TRS-80)	#15:124
		Zilog Z-80 (TRS-80)	#19:124
		Zilog Z80	#15:118
		Zilog Z80	#15:119
		Zilog Z8000	#15:119

Applications

EM1 COMPILER

```
1 #include ".../local.h"
2 #include ".../em1.h"
3
4 (c) copyright 1980 by the Vrije Universiteit, Amsterdam, The Netherlands. Explicit permission is hereby granted to universities to use or duplicate this program for educational or research purposes. All other use or duplication by universities, and all use or duplication by other organizations is expressly prohibited unless written permission has been obtained from the Vrije Universiteit. Requests for such permissions may be sent to
5
6 Dr. Andrew S. Tanenbaum
7 Wiskundig Seminarium
8 Vrije Universiteit
9 Postbox 7161
10 1007 MC Amsterdam
11 The Netherlands
12
13 Organizations wishing to modify part of this software for subsequent sale must explicitly apply for permission. The exact arrangements will be worked out on a case by case basis, but at a minimum will require the organization to include the following notice in all software and documentation based on our work:
14
15 This product is based on the Pascal system developed by Andrew S. Tanenbaum, Johan V. Stevenson and Hans van Steyvers of the Vrije Universiteit, Amsterdam, The Netherlands.
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
```

```
57 f: size of reals in words (2)
58 i: controls the number of bits in integer sets (16)
59 l: insert code to keep track of source lines (-)
60 o: optimize (+)
61 p: size of pointers in words (1)
62 r: check subranges (+)
63 s: accept only standard pascal programs (-)
64 t: trace procedure entry and exit (-)
65 u: treat '-' as letter (-)
66
67 [.....]
68 #ifdef STANDARD
69 label 9999;
70 #endif
71
72 const
73
74 (powers of two)
75 t1 = 128;
76 t2 = 255;
77 t3 = 256;
78 t4 = 16384;
79 t5 = 32767;
80
81 (EM-1 sizes)
82 bytebits = 8;
83 wordbits = 16;
84 wmb = 15; (wordbits-1)
85 minint = -t5w;
86 maxint = t5w;
87 maxintstring = '0000032767';
88 maxlongstring = '2147483647';
89
90
91
92
93
94
95
96
97
98
99
100
101
102
103
104
105
106
107
108
109
110
111
112
```

```
113 p-option. Floating point numbers in EM-1 currently have size 4, but this might change in the future to 8. The default can be overwritten by the f-option. The routines involved with alignment are 'even', 'address' and 'arraysize'.
114
115
116
117
118
119
120
121
122
123
124
125
126
127
128
129
130
131
132
133
134
135
136
137
138
139
140
141
142
143
144
145
146
147
148
149
150
151
152
153
154
155
156
157
158
159
160
161
162
163
164
165
166
```

```
169 type
170 (scalar types)
171 symbol (comma,semicolon,colon,colon2,notary,bracket,ident,
172 intout,charact,realout,longout,stringout,allict,ainsy,
173 plusy,percent,arrow,arrayy,recordy,setsy,filesy,
174 packedy,progy,labely,consty,typesy,varsy,procsy,
175 funcy,beginsy,gotosy,ifsy,whilesy,repeaty,foray,
176 withay,cassey,becomes,staray,divy,mody,alseny,
177 anday,oray,exesy,notay,asy,asy,asy,
178 leay,insy,andsy,eisay,untilsy,ofay,dosy,
179 downtosy,cosy,thensy,rbrack,rparent,period
180 ); (the order is important)
181
182 chartype (lower,upper,digit,layout,tabch,
183 quotech,quotech,odottech,periodch,leasch,
184 greaterch,lparentch,lbracoch,
185 rparentch,rbrackch,rbrackch,comatch,semich,arrowch,
186 plusch,minch,alsh,star,equal,
187 ); (also symbols)
188
189 others
190 );
191
192 standpf (pread,preadln,write,partials,pput,pgot,
193 preat,prewrite,pnes,dispose,ppack,punpack,
194 pmack,prelease,ppage,phalt,
195 ); (all procedures)
196
197 eof,feofn,fabs,fsg,ford,fobr,fprad,fauc,fodd,
198 furmo,fround,fsin,fcos,fexp,fsgt,fin,farctan
199 ); (all functions)
200
201 ); (the order is important)
202
203 libnames (IN, OPL, CLS, VDM,
204 OFS, GETX, END, RDC, END, NDL, NLS
205 ); (see input files)
206
207 CSE, PUTY, WRI, NSI, WAC, WSC, WRS, WSS, WNB,
208 WMB, WVR, WVR, WML, WSL, WSP, WRI, WSI, WLM, PAC,
209 ); (see output files, order important)
210
211 ABS, RND, SIN, COS, EXP, SQRT, LOG, ATN
212 ); (floating point)
213
214 ABI, AML, BCP, BVS, NEWI, SAV, EST, IBI, IBI,
215 ASS, OTO, PAC, WMP, DIS, ARZ, MDI, MDL
216 ); (miscellaneous)
217
218
219
220
221
222
223
224
```

225 rrange= 0..rval; 281 end;

226 bytes 0..lbit;

228 (pointer types)

229 sp= "structure; 284

230 ip= "identifier; 285 fname:ip; (one deeper)

231 l= "labl; 286 (first name: root of tree)

232 bps= "blockinfo; 287 case occur:where of

233 sp= "nameinfo; 288 blok:();

289 rec: ();

290 arec:(w:sttr) (name space opened by with statement)

291 end;

292 blockinfo:record (all info of the current procedure)

293 blk:pp; (pointer to blockinfo of surrounding proc)

294 lc:integer; (data location counter (from begin of proc))

295 lbno:integer; (number of last local label)

296 forwcount:integer; (number of not yet specified forward procs)

297 lchain:ip; (first label: header of chain)

298 end;

300 structure:record

301 size:integer; (size of structure in bytes)

302 sflag:flagset; (flag bits)

303 case form:structform of

304 scalar : (scaino:integer; (number of range descriptor)

305 fconst:ip; (names of constants)

306);

307 subrange:(ain,am:integer; (lower and upper bound)

308 ranetype:ip; (type of bounds)

309 subno:integer; (number of subr descriptor)

310);

311 pointer : (sttype:sp; (type of pointed object)

312 power : (elast:sp; (type of set elements)

313 files : (f:filetype:sp; (type of file elements)

314 arrays,orarray: (type of array elements)

315 inttype:sp; (type of array index)

316 arpos:position; (position of array descriptor)

317);

318 records : (fstfid:ip; (points to first field)

319 tagap:sp; (points to tag if present)

320);

321 variant : (varval:integer; (tag value for this variant)

322 mtrvar:sp; (next equilevel variant)

323 subtag:sp; (points to tag for sub-case)

324);

325 tag : (fstvar:sp; (first variant of case)

326 tfid:sp; (type of tag)

327);

328 end;

329

331 identifier:record

332 idtype:sp; (type of identifier)

333 name:alpha; (name of identifier)

334 link,plink:ip; (see enterid,searchid)

335 next:ip; (used to make several chains)

336 iflag:flagset; (several flag bits)

337 case klass:ideclass of

338 types : ();

339 konst : (value:integer); (for integers the value is

340 computed and stored in this field.

341 For strings and reals an assembler constant is

342 defined labeled '1', '2', ...

343 This '1' number is then stored in value.

344 For reals value may be negated to indicate that

345 the opposite of the assembler constant is needed.)

346 vars : (vpos:position); (position of var)

347 field : (ffoffset:integer); (offset to begin of record)

348 oarrbnd : (); (idtype points to array)

349 proc,func

350 (name pf:kindofpf of

351 standard:(key:stndp); (identification)

352 formal,actual,forward,extra: (lv gives declaration level.

353 pfpos:position; (lv gives instruction segment of this proc and

354 ad is relevant for formal pf's and for

355 functions (no conflict)).

356 for functions: ad is the result address.

357 for formal pf's: ad is the address of the

358 descriptor)

359 pfno:integer; (unique pf number)

360 parhead:ip; (head of parameter list)

361 head:integer (1s when heading summed)

362)

363 end;

364

365

367 labl:record

368 next:ip; (chain of labels)

369 seen:boolean;

370 labval:integer; (label number given by the programmer)

371 labname:integer; (label number given by the compiler)

372 labid:integer (same name only locally used,

373 otherwise dibno of label information)

374 end;

375

376 var (the most frequent used externals are declared first)

377 sy:symbol; (last symbol)

378 sstr; (type,access method,position,value of expr)

379 (returned by inqpr)

380 chchar: (last character)

381 chtype: (type of ch, used by inqpr)

382 val:integer; (if last symbol is an constant)

383 ix:integer; (string length)

384 col:boolean; (true if current ch replaces a newline)

385 newstrng:boolean; (true for strings in " ")

386 idalpha: (if last symbol is an identifier)

387 (same counters)

388 line:integer; (line number on code file (1..n))

389 dibno:integer; (number of last global number)

390 lmax:integer; (deepest level of nesting of ls)

391 level:integer; (current static level)

393 ptrsize:integer;

394 realize:integer;

395 rbase:integer; (file header size)

396 argo:integer; (index in arg)

397 lastpno:integer; (unique pf number counter)

398 oopt:integer; (C-type strings allowed if on)

399 lopt:integer; (longs allowed if on)

400 dopt:integer; (number of bits in sets with base integer)

401 sop:integer; (standard option)

402 (pointers pointing to standard types)

403 realptr,inptr,txtptr,emptyptr,boolptr:sp;

404 charptr,nilptr,stringptr,longptr:sp;

405 (flags)

406 give:line:boolean; (give source line number at next statement)

407 including:boolean; (no LHM's for included code)

408 eof:expected:boolean; (quit without error if true (nextch))

409 main:boolean; (complete programme or a module)

410 inttypedec:boolean; (true if nested in typedefinition)

411 flused:boolean; (true if floating point instructions are used)

412 seconddot:boolean; (indicates the second dot of '...')

413 (pointers)

414 fuptr:ip; (head of chain of forward reference pointers)

415 progrid:ip; (program identifier)

416 ourrproc:ip; (current proc/func ip (see casestatement))

417 top:ip; (pointer to the most recent name space)

418 lastsp:ip; (pointer to nameinfo of last searched ident)

419 (records)

420 b:blockinfo; (all info to be checked at pfdeclaration)

421 e:errrec; (all info required for error messages)

422 f:fsttr; (fsttr for current file name)

423 (arrays)

424 source:fttype; (name of pascal source file)

425 strbuf:array[1..max] of char;

426 lop:array[boolean] of ip;

427 (flags:standard input, true:standard output)

428 rv:array(r:range) of alpha; (reserved words)

429 (reserved words)

430 frv:array(0..idmax) of integer;

431 (indices in rv)

432 rsv:array(r:range) of symbol;

433 (symbol for reserved words)

434 ca:array(char) of chartype;

435 (char type of a character)

436 ca:array(r:parmatch, equal) of symbol;

437 (symbol for single character symbols)

438 lms:array[1..lmax] of array[1..4] of char;

439 (mnemonics of pascal library routines)

440 opt:array('a'..'z') of integer;

441 foroopt:array('a'..'z') of boolean;

442 (for different options)

443 wdef:ip:array[ideclass] of ip;

444 (used in searchid)

445 arv:array(0..maxarg) of

446 record name:alpha; ad:integer end;

447 (here here the external heading names)

448 (files)

```
449  eml:file of byte;  (the EM1 code)
450  errors:file of error;
451  (the compilation errors)
452  (=====)
454  procedure gen2bytes(b:byte; i:integer);
455  var b1,b2:byte;
456  begin
457  if i<0 then
458  if i<minint then begin b1:=0; b2:=7 end
459  else begin i:=i-1; b1:=tda1 - i mod td; b2:=tda1 - i div td end
460  else begin b1:=i mod td; b2:=i div td end;
461  write(eml,b1,b2);
462  end;
464  procedure genct(i:integer);
465  begin
466  if (i>0) and (i<ap_max0) then write(eml,i,sp_fct0)
467  else gen2bytes(sp_ct2,i)
468  end;
470  procedure genclb(i:integer);
471  begin if i<t8 then write(eml,sp_1lb1,i) else gen2bytes(sp_1lb2,i) end;
473  procedure genilb(i:integer);
474  begin lino:=lino+1;
475  if i<ap_nilb0 then write(eml,i,sp_filb0) else genclb(i);
476  end;
478  procedure genlb(i:integer);
479  begin if i<t8 then write(eml,sp_dlb1,i) else gen2bytes(sp_dlb2,i) end;
481  procedure gen0(b:byte);
482  begin write(eml,b); lino:=lino+1 end;
484  procedure gen1(b:byte; i:integer);
485  begin gen0(b); genct(i) end;
487  procedure gen2(b:byte; d:integer);
488  begin gen0(b); genlb(d) end;
490  procedure genident(name:type; var a:alpha);
491  var i,j:integer;
492  begin i:=ldm;
493  while (a[i]=' ') and (i>1) do i:=i-1;
494  write(eml,name,i);
495  for j:=1 to i do write(eml,ord(a[j]));
496  end;
498  procedure genmp(a:libname);
499  var i:integer;
500  begin gen0(op_cal); write(eml,sp_pnm,4);
501  for i:=1 to 4 do write(eml,ord(lanm[i]));
502  end;
504  procedure genpnm(b:byte; fil:ip);
```

```
505  var n:alpha; i,j:integer;
506  begin
507  if fil<ppos.lv<1 then n:=fil.p_name else
508  begin n:=fil.p_name; i:=1; j:=1; i:=fil.p_pno;
509  while i<0 do
510  begin j:=j+1; n[j]:=chr(1 mod 10 + ord('0')); i:=i div 10 end;
511  end;
512  gen0(b); genident(sp_pnm,n)
513  end;
515  procedure genend;
516  begin write(eml,sp_cnd) end;
518  procedure genlin;
519  begin give_lino:=false;
520  if opt['!']<off then if main then gen1(op_lin,e.orig)
521  end;
523  procedure genreg(ad,az,nr:integer);
524  begin
525  if az<wordsize then
526  begin gen1(sp_mes,mesreg); genct(ad); genct(nr); genend end
527  end;
529  (=====)
531  procedure puterr(err:integer);
532  (as you will notice, all error numbers are preceded by 'e' and '0' to
533  ease their renumbering in case of new error numbers.
534  )
535  begin e:=err; write(errors,e);
536  if err>0 then begin gen1(sp_mes,meserror); genend end
537  end;
539  procedure error(err:integer);
540  begin e:=sp_spaces; e:=e-1; puterr(err) end;
542  procedure errid(err:integer; var id:alpha);
543  begin e:=e+id; e:=e-1; puterr(err) end;
545  procedure errint(err:integer; i:integer);
546  begin e:=e+i; e:=e+sp_spaces; puterr(err) end;
548  procedure aspperr(err:integer);
549  begin if e.sp<nil then begin error(err); e.sp:=nil end end;
551  procedure teststand;
552  begin if opt<off then error(-e01) end;
554  procedure enterid(fil: ip);
555  (enter id pointed at by fil into the name-table,
556  which on each declaration level is organized as
557  an unbalanced binary tree)
558  var n:alpha; lip,rip:ip; lleft,again:boolean;
559  begin n:=fil.p_name; again:=false;
560  lip:=top.p_fname;
```

```
561  if lip=nil then top.p_fname:=fil else
562  begin
563  repeat lip:=lip;
564  if lip.p_name<n then
565  begin lip:=lip.llink; lleft:=true end
566  else
567  begin if lip.p_name=n then again:=true; (name conflict)
568  lip:=lip.rlink; lleft:=false;
569  end;
570  until lip=nil;
571  if lleft then lip:=lip.llink:=fil else lip:=lip.rlink:=fil
572  end;
573  fil.llink:=nil; fil.rlink:=nil;
574  if again then errid(+e2,n);
575  end;
577  procedure initpos(var p:position);
578  begin p.lv:=level; p.ad:=0;
579  if def SEGMENTS
580  p.ad:=0
581  #endif
582  end;
584  procedure initf(fp:tp; fd:integer);
585  begin with a do begin
586  asp:=fp; packbit:=false; ak:=fzid; pos.ad:=fd; pos.lv:=level;
587  if def SEGMENTS
588  pos.ag:=0;
589  #endif
590  end end;
592  function newp(kl:ideclass; n:alpha; id:tp; actip:ip);
593  var p:ip; fl:flagset;
594  begin fl:=[];
595  case kl of
596  types,ovrbed: (similar structure)
597  new(p,types);
598  konst:
599  begin new(p,konst); p.value:=0 end;
600  vars:
601  begin new(p,vars); p:=used,assigned; initpos(p,vpos) end;
602  field:
603  begin newp(field); p.p.offset:=0 end;
604  proc_func: (same structure)
605  begin newp(p,proc,actual); p.p.kind:=actual;
606  initpos(p,p_pos); p.p.pno:=0; p.p.parhead:=nil; p.p.head:=0
607  end;
608  end;
609  p.p.name:=n; p.p.klass:=kl; p.p.idtype:=id; p.p.next:=ent;
610  p.p.llink:=nil; p.p.rlink:=nil; p.p.lflag:=f; newp:=p
611  end;
613  function newp(sf:structform; sz:integer);
614  var p:ip; sf:flagset;
615  begin sf:=[];
616  case sf of
```

```
617  scalar:
618  begin new(p,scalar); p.p.scalar:=0; p.p.const:=nil end;
619  subrange:
620  new(p,subrange);
621  pointer:
622  begin new(p,pointer); p.p.dtype:=nil end;
623  power:
624  new(p,power);
625  files:
626  begin newp(files); sf:=[]; with file end;
627  arrays,ovrarr: (same structure)
628  new(p,arrays);
629  records:
630  new(p,records);
631  variant:
632  new(p,variant);
633  tag:
634  new(p,tag);
635  end;
636  p.p.fors:=f; p.p.size:=sz; p.p.sf:=sf; newp:=p;
637  end;
639  procedure initf;
640  var o:char;
641  begin
642  (initialize the first name space)
643  new(top,blk); top.p.occ:=blk; top.p.link:=nil; top.p.fname:=nil;
644  level:=0;
645  (reserved words)
646  rw[0]:='if'; rw[1]:='do'; rw[2]:='of';
647  rw[3]:='to'; rw[4]:='in'; rw[5]:='on';
648  rw[6]:='end'; rw[7]:='for'; rw[8]:='nil';
649  rw[9]:='var'; rw[10]:='div'; rw[11]:='mod';
650  rw[12]:='set'; rw[13]:='and'; rw[14]:='not';
651  rw[15]:='then'; rw[16]:='else'; rw[17]:='with';
652  rw[18]:='case'; rw[19]:='type'; rw[20]:='goto';
653  rw[21]:='file'; rw[22]:='begin'; rw[23]:='until';
654  rw[24]:='while'; rw[25]:='array'; rw[26]:='const';
655  rw[27]:='label'; rw[28]:='repeat'; rw[29]:='record';
656  rw[30]:='down to'; rw[31]:='packed'; rw[32]:='program';
657  rw[33]:='function'; rw[34]:='procedure';
658  (corresponding symbols)
659  rsf[0]:='ifay'; rsf[1]:='doay'; rsf[2]:='ofay';
660  rsf[3]:='toay'; rsf[4]:='inay'; rsf[5]:='oray';
661  rsf[6]:='enday'; rsf[7]:='foray'; rsf[8]:='nilost';
662  rsf[9]:='varay'; rsf[10]:='divay'; rsf[11]:='moday';
663  rsf[12]:='setay'; rsf[13]:='anday'; rsf[14]:='notay';
664  rsf[15]:='thenay'; rsf[16]:='elseay'; rsf[17]:='withay';
665  rsf[18]:='caseay'; rsf[19]:='typeay'; rsf[20]:='gotoy';
666  rsf[21]:='fileay'; rsf[22]:='beginay'; rsf[23]:='untilay';
667  rsf[24]:='whileay'; rsf[25]:='arrayay'; rsf[26]:='constay';
668  rsf[27]:='labelay'; rsf[28]:='repeatay'; rsf[29]:='recorday';
669  rsf[30]:='down toay'; rsf[31]:='packeday'; rsf[32]:='progray';
670  rsf[33]:='functay'; rsf[34]:='proceday';
671  (indices into rw to find reserved words fast)
672  frw[0]:=0; frw[1]:=0; frw[2]:=6; frw[3]:=15; frw[4]:=22;
```



```

673   frm(5):=28; frm(6):=32; frm(7):=33; frm(8):=35;
674   (char types)
675   for c:=chr(0) to chr(maxcharord) do os(c):=others;
676   for c:=0 to 9 do os(c):=digit;
677   for c:=a to z do os(c):=upper;
678   for c:=A to Z do os(c):=lower;
679   os(chr(maxline))::=layout;
680   os(chr(maxtab))::=layout;
681   os(chr(maxfeed))::=layout;
682   os(chr(maxret))::=layout;
683   (characters with corresponding char type in ASCII order)
684   os(chr(tab))::=staboh;
685   os(' ')::=layout;   os('!')::=dqotech;   os('\"')::=qotech;
686   os('\"')::=parantoh; os(')')::=rparantoh; os(';')::=scary;
687   os(',')::=apunctoh; os(';')::=rparantoh; os(';')::=scary;
688   os(':')::=perioch;   os(';')::=scamach;   os(';')::=minoh;
689   os(';')::=smich;    os(';')::=slash;    os(';')::=oolonoh;
690   os(';')::=grateroh; os(';')::=lbrackoh; os(';')::=equal;
691   os(';')::=arrouh;   os(';')::=lbrackoh; os(';')::=rbrackoh;
692   (single character symbols in char type order)
693   os(';')::=parantoh; os(';')::=rparantoh; os(';')::=scamach;
694   os(';')::=lbrackoh; os(';')::=rbrackoh; os(';')::=scamach;
695   os(';')::=smicoloh; os(';')::=arrowh; os(';')::=arrow;
696   os(';')::=slash; os(';')::=slash; os(';')::=slash;
697   os(';')::=slash; os(';')::=slash; os(';')::=slash;
698   os(';')::=slash; os(';')::=slash; os(';')::=slash;
699   end;
701   procedure init3;
702   var p,q:ip; k:kdclass;
703   begin
704   (undefined identifier pointers used by searchid)
705   for k:types to fno do
706   underfip[k]::=newip(k,spaces.all,nil);
707   (standard type pointers, some size are filled in by handleopts)
708   intptr :=newip(scalar.intsize);
709   realptr :=newip(scalar.intsize);
710   longptr :=newip(scalar.intsize);
711   charptr :=newip(scalar.charsize);
712   boolptr :=newip(scalar.boolsize);
713   nilptr :=newip(pointer,0);
714   stringptr :=newip(pointer,0);
715   emptyset :=newip(power.intsize); emptyset^.elset:=nil;
716   textptr :=newip(files,0); textptr^.fltype:=charptr;
717   (standard type names)
718   enterid(newip(types,'integer','intptr,nil));
719   enterid(newip(types,'real','realptr,nil));
720   enterid(newip(types,'char','charptr,nil));
721   enterid(newip(types,'boolean','boolptr,nil));
722   enterid(newip(types,'text','textptr,nil));
723   (standard constant names)
724   q:=nil; p:=newip(const,'false','boolptr,q); enterid(p);
725   q:=p; p:=newip(const,'true','boolptr,q); enterid(p);
726   boolptr^.foont:=p;
727   p:=newip(const,'maxint','intptr,nil); p^.value:=maxint; enterid(p);
728   p:=newip(const,'spaces,chars,nil); p^.value:=maxcharord;

```

```

729   charptr^.foont:=p;
730   end;
732   procedure init3;
733   var j:standpf; p:ip; q:mp;
734   p:=array(standpf) of alpha;
735   ftype:=array(foef..farotan) of sp;
736   begin
737   (names of standard procedures/functions)
738   p[read]:=read; p[readin]:=readin;
739   p[write]:=write; p[writein]:=writein;
740   p[put]:=put; p[putin]:=putin;
741   p[page]:=page; p[pgot]:=got;
742   p[write]:=write; p[reset]:=reset;
743   p[dispose]:=dispose; p[pack]:=pack;
744   p[unpack]:=unpack; p[mark]:=mark;
745   p[release]:=release; p[halt]:=halt;
746   p[for]:=for; p[forin]:=forin;
747   p[abs]:=abs; p[ord]:=ord;
748   p[ord]:=ord; p[ord]:=ord;
749   p[ord]:=ord; p[ord]:=ord;
750   p[ord]:=ord; p[ord]:=ord;
751   p[ord]:=ord; p[ord]:=ord;
752   p[ord]:=ord; p[ord]:=ord;
753   p[ord]:=ord; p[ord]:=ord;
754   p[ord]:=ord; p[ord]:=ord;
755   p[ord]:=ord; p[ord]:=ord;
756   (parameter types of standard functions)
757   ftype[foef]:=nil; ftype[foein]:=nil;
758   ftype[foag]:=nil; ftype[foag]:=nil;
759   ftype[foad]:=nil; ftype[foad]:=nil;
760   ftype[food]:=nil; ftype[food]:=nil;
761   ftype[fofnd]:=nil; ftype[fofnd]:=nil;
762   ftype[foos]:=nil; ftype[foos]:=nil;
763   ftype[foqr]:=nil; ftype[foqr]:=nil;
764   ftype[foctan]:=nil; ftype[foctan]:=nil;
765   (standard procedure/function identifiers)
766   for j:=read to halt do
767   begin new(p,proc,standpf); p^.klass:=proc;
768   p^.name:=p[foef]; p^.p.fkind:=standpf; p^.key:=j; enterid(p);
769   end;
770   for j:=foef to farotan do
771   begin new(p,func,standpf); p^.klass:=func; p^.idtype:=ftype[j];
772   (idtype is used not for result type but for parameter type if)
773   p^.name:=p[foef]; p^.p.fkind:=standpf; p^.key:=j; enterid(p);
774   end;
775   (program identifier)
776   prog:=newip(proc,'main','nil,nil);
777   (new name space for user external)
778   new(blck); q:=occur:blck; q^.allink:=top; q^.fname:=nil; top:=q;
779   end;
781   procedure init4;
782   var c:char;
783   begin
784   (pascal library monom(c))

```

```

785   lnn[ELN]:=e; lnn[EFL]:=e; lnn[CLS]:=c;
786   lnn[VM]:=v;
787   lnn[OPW]:=o; lnn[GRX]:=g; lnn[ROI]:=r;
788   lnn[RDC]:=r; lnn[RDE]:=r; lnn[RDL]:=r;
789   lnn[RLM]:=r;
790   lnn[CMX]:=c; lnn[PTX]:=p; lnn[WRU]:=w;
791   lnn[MSI]:=m; lnn[MSU]:=m; lnn[MSC]:=m;
792   lnn[MSB]:=m; lnn[MSW]:=m; lnn[MSV]:=m;
793   lnn[MSU]:=m; lnn[MSU]:=m; lnn[MSU]:=m;
794   lnn[MSU]:=m; lnn[MSU]:=m; lnn[MSU]:=m;
795   lnn[MSU]:=m; lnn[MSU]:=m; lnn[MSU]:=m;
796   lnn[MSU]:=m; lnn[MSU]:=m; lnn[MSU]:=m;
797   lnn[MSU]:=m; lnn[MSU]:=m; lnn[MSU]:=m;
798   lnn[MSU]:=m; lnn[MSU]:=m; lnn[MSU]:=m;
799   lnn[MSU]:=m; lnn[MSU]:=m; lnn[MSU]:=m;
800   lnn[MSU]:=m; lnn[MSU]:=m; lnn[MSU]:=m;
801   lnn[MSU]:=m; lnn[MSU]:=m; lnn[MSU]:=m;
802   lnn[MSU]:=m; lnn[MSU]:=m; lnn[MSU]:=m;
803   lnn[MSU]:=m; lnn[MSU]:=m; lnn[MSU]:=m;
804   lnn[MSU]:=m; lnn[MSU]:=m; lnn[MSU]:=m;
805   lnn[MSU]:=m; lnn[MSU]:=m; lnn[MSU]:=m;
806   (options)
807   for c:=a to z do begin opt[c]:=0; forceopt[c]:=false end;
808   opt['a']:=true;
809   opt['r']:=floatsize div wordsize; (default real size in words)
810   opt['i']:=maxint div 2;
811   opt['l']:=true;
812   opt['p']:=true;
813   opt['s']:=wordsize div wordsize; (default pointer size in words)
814   opt['t']:=true;
815   opt:=off;
816   (scalar variables)
817   b:=nil;
818   b:=nil;
819   b:=nil;
820   b:=nil;
821   b:=nil;
822   e:=nil;
823   e:=nil;
824   e:=nil;
825   e:=nil;
826   e:=nil;
827   e:=nil;
828   l:=0;
829   d:=0;
830   w:=0;
831   l:=0;
832   g:=0;
833   l:=0;
834   w:=0;
835   l:=0;
836   l:=0;
837   l:=0;
838   l:=0;
839   l:=0;
840   l:=0;

```

```

841   argv[0].ed:=1;
842   end;
844   procedure handleopts;
845   begin
846   opt:=opt['a'];
847   dopt:=opt['d'];
848   lopt:=opt['l'];
849   sopt:=opt['s'];
850   realize:=opt['r'] * wordsize; realptr^.size:=realize;
851   ptrsize:=opt['p'] * wordsize; nilptr^.size:=ptrsize;
852   fsize:=dintsize + 2 * ptrsize;
853   textptr^.size:=fsize + bufsize; stringptr^.size:=ptrsize;
854   if sopt<off then begin dopt:=off; dopt:=off end;
855   else if opt['u']<off then os(' ');
856   if dopt<off then enterid(newip(types,'string','stringptr,nil));
857   if dopt<off then enterid(newip(types,'long','longptr,nil));
858   if opt['o']<off then begin gen(p,mes,mesoptoff); genend end;
859   if ptrsize<wordsize then begin gen(p,mes,mesvirtual); genend end;
860   if dopt<off then fsize:=true; (temporary kludge)
861   end;
863   (=====)
865   procedure trace(tname:alpha; fip:ip; var nandib:integer);
866   var i:integer;
867   begin
868   if opt['t']<off then
869   begin
870   if nandib=0 then
871   begin dibo:=dibo+1; nandib:=dibo; genlb(dibo);
872   gen0(p,rum); write(m,sp_soon,8);
873   for i:=1 to 8 do write(m,ord(fip^.name[i])); genend;
874   end;
875   gen1(sp_srt,0); gen0(sp_lno,nandib);
876   gen0(sp_out); genid(m,sp_pam,tname);
877   end;
878   end;
880   function formof(fsp:sp; form:formset):boolean;
881   begin if fsp=nil then formof:=false else formof:=fsp^.form in forms end;
883   function sincf(fsp:sp):integer;
884   var s:integer;
885   begin s:=0;
886   if fsp<nil then s:=fsp^.size;
887   if s<0 then if odd(s) then s:=s+1;
888   sincf:=s;
889   end;
891   function even(i:integer):integer;
892   begin if odd(i) then i:=i+1; even:=i end;
894   procedure exchange(i1,i2:integer);
895   var d1,d2:integer;
896   begin d1:=i2-1; d2:=i1o-12;

```

```
897   if (d1<0) and (d2<0) then
898     begin gen!(ps_esc,d1); gen!(d2) end
899   end;
901   procedure setop(s:byte);
902   begin gen!(s,even(sizeof(s.asp))) end;
904   procedure s2pemptyset(fap:sp);
905   var i:integer;
906   begin
907     for i:=2 to sizeof(fap) div wordsize do gen!(op_loc,0); a.asp:=fap
908   end;
910   procedure push(local:boolean; ad:integer; sz:integer);
911   begin assert not odd(sz);
912     if sz=wordsize then
913       begin if local then gen!(op_lal,ad) else gen!(op_lae,ad);
914         gen!(op_loi,sz)
915       end
916     else
917       if local then gen!(op_lol,ad) else gen!(op_loe,ad)
918     end;
920   procedure pop(local:boolean; ad:integer; sz:integer);
921   begin assert not odd(sz);
922     if sz=wordsize then
923       begin if local then gen!(op_lal,ad) else gen!(op_lae,ad);
924         gen!(op_sti,sz)
925       end
926     else
927       if local then gen!(op_lol,ad) else gen!(op_loe,ad)
928     end;
930   procedure lexical(m:byte; lv:integer; ad:integer; sz:integer);
931   begin gen!(op_lex,level-lv); gen!(op_mdi,ad); gen!(m,sz) end;
933   procedure loadpos(var p:position; sz:integer);
934   begin with a do
935     if lv<0 then
936       #ifdef SECTIONS
937         if ag<0 then
938           begin gen!(op_lsa,ag); gen!(op_mdi,ad); gen!(op_loi,sz) end
939         else
940           #endif
941           push(global,ad,sz)
942         else
943           if lv=level then push(local,ad,sz) else
944             lexical(op_loi,lv,ad,sz);
945   end;
947   procedure decaddr(var p:position);
948   begin if p.lv=0 then gen!(op_lae,p.ad) else loadpos(p,ptrsize) end;
950   procedure loadaddr;
951   begin with a do begin
952     case ok of
```

```
953     fixed;
954     with pos do
955       if lv<0 then
956         #ifdef SECTIONS
957           if ag<0 then
958             begin gen!(op_lsa,ag); gen!(op_mdi,ad) end
959           else
960             #endif
961             gen!(op_lae,ad)
962           else
963             if lv=level then gen!(op_lal,ad) else
964               begin gen!(op_lex,level-lv); gen!(op_mdi,ad) end;
965         pfixed:=
966         loadpos(pos,ptrsize);
967         ploaded:=
968         ;
969         indexed:=
970         gen!(op_sas);
971         end; [case]
972         sk:=ploaded;
973     end end;
975   procedure load;
976   var sz:integer;
977   begin with a do begin
978     sz:=sizeof(asp); if not packbit then sz:=seven(sz);
979     if asp=all then
980       case ok of
981         cst:
982           gen!(op_loc,pos,ad); [only one-word scalars]
983         fixed:
984           loadpos(pos,sz);
985         pfixed:
986           begin loadpos(pos,ptrsize); gen!(op_loi,sz) end;
987         loaded:
988         ;
989         ploaded:
990           gen!(op_loi,sz);
991         indexed:
992           gen!(op_lsa);
993         end; [case]
994         sk:=loaded;
995     end end;
997   procedure store;
998   var sz:integer;
999   begin with a do begin
1000     sz:=sizeof(asp); if not packbit then sz:=seven(sz);
1001     if asp=all then
1002       case ok of
1003         fixed:
1004           with pos do
1005             if lv<0 then
1006               #ifdef SECTIONS
1007                 if ag<0 then
1008                   begin gen!(op_lsa,ag);
```

```
1009     gen!(op_mdi,ad); gen!(op_sti,sz)
1010   end
1011   else
1012     #endif
1013     pop(global,ad,sz)
1014   else
1015     if level=lv then pop(local,ad,sz) else
1016       lexical(op_sti,lv,ad,sz);
1017   pfixed:=
1018   loadpos(pos,ptrsize); gen!(op_sti,sz) end;
1019   ploaded:=
1020   gen!(op_sti,sz);
1021   indexed:=
1022   gen!(op_sas);
1023   end; [case]
1024 end end;
1026   procedure fieldadr(off:integer);
1027   begin with a do
1028     if (sk=fixed) and not packbit then pos.ad:=pos.ad+off else
1029       begin loadaddr; gen!(op_mdi,off) end
1030   end;
1032   procedure loadheap;
1033   begin if forsof(s.asp,[arrays..records]) then loadaddr else load end;
1035   [.....]
1037   procedure nextoh;
1038   begin
1039     col:=col+input; read(input,oh); e.ohno:=e.ohno+1; ehay:=col+oh;
1040   end;
1042   procedure nextin;
1043   begin
1044     if eof(input) then
1045       begin
1046         if not eofexpected then error(+03) else
1047           begin
1048             if f1used then begin gen!(ps_esc,seeffloat); genend end;
1049             gen!(ps_eof)
1050           end;
1051     #ifdef STANDARD
1052     goto 3999
1053   #endif
1054   #ifdef STANDARD
1055   halt
1056   #endif
1057   end;
1058   e.ohno:=0; e.lino:=e.lino+1; e.linar:=e.linar+1;
1059   if not including then
1060     begin e.orig:=e.orig; gvaline:=true end;
1061   end;
1063   procedure options(normal:boolean);
1064   var o:integer; i:integer;
```

```
1066   procedure goto;
1067   var b:byte;
1068   begin
1069     if normal then
1070       begin nextoh; o:=oh end
1071     else
1072       begin read(am,b); c:=chr(b) end
1073   end;
1075   begin
1076     repeat goto;
1077     if (o='a') and (c='a') then
1078       begin ci:=o; goto i:=0;
1079       if c='.' then begin i:=1; goto end else
1080         if c='-' then goto else
1081           if c[0]<digit then
1082             repeat i:=i*10 + ord(o) - ord('0'); goto;
1083             until not c[0]<digit
1084           else i:=1;
1085           if i>=0 then
1086             if not normal then
1087               begin forceopt[ci]:=true; opt[ci]:=i end
1088             else
1089               if not forceopt[ci] then opt[ci]:=i;
1090           end;
1091           until c='.';
1092   end;
1094   procedure linedirective;
1095   var i,j:integer;
1096   begin i:=0; j:=0;
1097     repeat nextoh until (ch=' ') or eof;
1098     while ch<digit do
1099       begin i:=i*10 + ord(ch) - ord('0'); nextoh end;
1100     while (ch=' ') and not eof do nextoh;
1101     if (ch='*') or (eof) then error(+04) else
1102       begin nextoh;
1103         while (ch='*') and not eof do
1104           begin
1105             if ch='/' then j:=0 else
1106               begin if j=0 then s.fnam:=emptyfnam;
1107                 i:=i+1; if j<fnum then s.fnam[j]:=ch;
1108                 end;
1109             nextoh
1110           end;
1111       if source=emptyfnam then source:=s.fnam;
1112       including:=source<='.';fnam;
1113       i:=i-1; e.linar:=i;
1114       if not including then e.orig:=i
1115     end;
1116     while not eof do nextoh;
1117   end;
1119   procedure putdig;
1120   begin i:=i+1; if i<max then strbuff[i]:=ch; nextoh end;
```

```

1122 procedure indent;
1123 label 1;
1124 var i:integer;
1125 begin i:=0; id:=space;
1126 repeat
1127   if ch>upper then ch:=chr(ord(ch)-ord('A')+ord('a'));
1128   if k<idmax then begin k:=k+1; id[k]:=ch end;
1129   nextch
1130 until ch=y0digit;
1131 [lower0,upper0,digit2, ugly but fast]
1132 for i:=frk[i]-1 to frk[i]-1 do
1133   if rw[i]id then
1134     begin sy:=ray[i]; goto 1 end;
1135 sy:=idmax;
1136 1:
1137 end;

1139 procedure innumber;
1140 label 1;
1141 const lam = 10;
1142 var
1143   i:integer;
1144   is:=packed array[1..lam] of char;
1145   begin ix:=0; sy:=idmax; val:=0;
1146   repeat putdig until ch=y0digit;
1147   if (ch='.') or (ch='e') or (ch='E') then
1148     begin
1149       if ch='.' then
1150         begin putdig;
1151           if ch='.' then
1152             begin seconddot:=true; ix:=ix+1; goto 1 end;
1153           if ch=y0digit then error(+05) else
1154             repeat putdig until ch=y0digit;
1155         end;
1156       if (ch='e') or (ch='E') then
1157         begin putdig;
1158           if (ch='e') or (ch='E') then putdig;
1159           if ch=y0digit then error(+06) else
1160             repeat putdig until ch=y0digit;
1161         end;
1162       if ix>lam then begin error(+07); ix:=lam end;
1163       sy:=nextch; if second:=true; d:=no; val:=val*10+ord(ch)-ord('0');
1164       genidb(dlbn); genid(p_rn); write(am,sp,room,ix);
1165       for i:=1 to ix do write(am,ord(strbuf[i])); genid;
1166     end;
1167   !:if (ch=lower) or (ch=upper) then teststandard;
1168   if sy=idmax then
1169     if ix>lam then error(+08) else
1170       begin ix:=0; second:=false; i:=lam+1;
1171         while ix>0 do
1172           begin i:=i-1; if i:=strbuf[i]; ix:=ix-1 end;
1173           if ix<maxinstr then
1174             while ix<max do
1175               begin val:=val*10 + ord('0') + ord(strbuf[i]); i:=i+1 end;
1176               else if ix<maxlongstr then (dopt:=off) then
1177                 begin sy:=longest; d:=no; val:=0;

```

```

1177   genidb(dlbn); genid(p_rn); write(am,sp,room,ix+1-1);
1178   while ix<max do
1179     begin write(am,ord(strbuf[i])); i:=i+1 end;
1180   genid
1181   and
1182   error(+09)
1183   end
1184 end;

1186 procedure instrng(q:char);
1187 var i:integer;
1188 begin ix:=0; zerostring:=q;
1189 repeat
1190   repeat nextch; ix:=ix+1; if ix<max then strbuf[ix]:=ch;
1191   until (ch=q) or eol;
1192   if ch=q then nextch else error(+10);
1193   until ch<=q;
1194   if not zerostring then
1195     begin ix:=ix-1; if ix=0 then error(+011) end
1196   else
1197     begin strbuf[ix]:=chr(0); if opt=off then error(+012) end;
1198     if (ix=1) and not zerostring then
1199       begin sy:=chr(ord); val:=ord(strbuf[1]) end
1200     else
1201       begin sy:=stringent; dlbn:=dlbn+1; val:=dlbn;
1202         if ix>max then begin error(+013); ix:=max end;
1203         genidb(dlbn); genid(p_rn); write(am,sp,room,ix);
1204         for i:=1 to ix do write(am,ord(strbuf[i])); genid;
1205       end;
1206 end;

1208 procedure incomment;
1209 var stop:char;
1210 begin nextch; stop:='';
1211 if ch='*' then options:=true;
1212 while (ch<>'') and (ch<>stop) do
1213   begin stop:=''; if ch='*' then stop:='*';
1214     if ch='*' then error(+014);
1215     if eol then nextch; nextch
1216   end;
1217 if ch='*' then teststandard;
1218 nextch
1219 end;

1221 procedure insym;
1222 [read next basic symbol of source program and return its
1223 description in the global variables sy, op, id, val and ix]
1224 label 1;
1225 begin
1226   !:same ch of
1227   tabch;
1228   begin e:=chno:=e.chno - e.chno mod 8 + 8; nextch; goto 1 end;
1229   layout;
1230   begin if eol then nextch; nextch; goto 1 end;
1231   lower,upper,indent;
1232   digit:=innumber;

```

```

1233 quotech,dquotech;
1234 instrng(ch);
1235 colonch;
1236 begin nextch;
1237   if ch=':' then begin sy:=colonch; nextch end else sy:=colon1;
1238 end;
1239 periodch;
1240 begin nextch;
1241   if seconddot then begin seconddot:=false; sy:=colon2 end else
1242     if ch='.' then begin sy:=colon2; nextch end else sy:=period;
1243 end;
1244 lessch;
1245 begin nextch;
1246   if ch='<' then begin sy:=less; nextch end else
1247     if ch='>' then begin sy:=less; nextch end else sy:=ltgt;
1248 end;
1249 greaterch;
1250 begin nextch;
1251   if ch='>' then begin sy:=less; nextch end else sy:=ltgt;
1252 end;
1253 lparench;
1254 begin nextch;
1255   if ch='(' then sy:=lparen else
1256     begin teststandard; incomment; goto 1 end;
1257 end;
1258 lbrackch;
1259 begin incomment; goto 1 end;
1260 rparench,lbrackch,rbrackch,comma,semicolon,arrowch,
1261 plusch,minuch,slash,star,equal;
1262 begin sy:=exp(chay); nextch end;
1263 otherch;
1264 begin
1265   if (ch='@') and (e.chno=1) then llineinactive else
1266     begin error(+015); nextch end;
1267   goto 1
1268 end
1269 end (case)
1270 end;

1272 procedure nextf(f:symbol; err:integer);
1273 begin if sy=f then inps else error(-err) end;

1275 function find1(sy1,sy2:sos; err:integer):boolean;
1276 [symbol of sy1 expected. return true if sy in sy1]
1277 begin
1278   if not (sy in sy1) then
1279     begin error(-err); while not (sy in sy1+sy2) do inps end;
1280   find1:=sy in sy1;
1281 end;

1283 function find2(sy1,sy2:sos; err:integer):boolean;
1284 [symbol of sy1+sy2 expected. return true if sy in sy1]
1285 begin
1286   if not (sy in sy1+sy2) then
1287     begin error(-err); repeat inps until sy in sy1+sy2 end;
1288   find2:=sy in sy1;
1289 end;

1291 end;

```

```

1289 end;

1291 function find3(sy1:symbol; sy2:sos; err:integer):boolean;
1292 [symbol sy1 or one of sy2 expected. return true if sy found and skip]
1293 begin find3:=true;
1294 if not (sy in [sy1]+sy2) then
1295   begin error(-err); repeat inps until sy in [sy1]+sy2 end;
1296 if sy=sy1 then inps else find3:=false;
1297 end;

1299 function endofloop(sy1,sy2:sos; sy:symbol; err:integer):boolean;
1300 begin endofloop:=false;
1301 if find2(sy2+[sy1],sy1,err) then nextf(sy,err+1)
1302 else endofloop:=true;
1303 end;

1305 function lastsemicolon(sy1,sy2:sos; err:integer):boolean;
1306 begin lastsemicolon:=true;
1307 if not endofloop(sy1,sy2,semicolon,err) then
1308   if find2(sy2,sy1,err+2) then lastsemicolon:=false;
1309 end;

1311 [.....]

1313 function searchid(fidals: setof id):ip;
1314 [search for current identifier symbol in the name table]
1315 label 1;
1316 var lip:ip; is:ldclass;
1317 begin lastap:=stop;
1318 while lastap<=nil do
1319   begin lip:=lastap^.fname;
1320     while lip<=nil do
1321       if lip^.nameid then
1322         if lip^.kname in fidals then
1323           begin
1324             if lip^.kname+vs then if lip^.vpos.lv<=level then
1325               lip:=lip^.lftag+lip^.lftag+more;
1326             goto 1
1327           end
1328         else lip:=lip^.rlink;
1329       else
1330         if lip^.nameid then lip:=lip^.rlink else lip:=lip^.llink;
1331     lastap:=lastap^.llink;
1332 end;
1333 err:=id(-016,id);
1334 if types in fidals then is:=types else
1335 if vars in fidals then is:=vars else
1336 if const in fidals then is:=const else
1337 if proc in fidals then is:=proc else
1338 if func in fidals then is:=func else is:=false;
1339 lip:=endoflip(is);
1340 1:
1341 searchid:=lip;
1342 end;

1344 function searchsection(fip: ip):ip;

```

```

1345 (to find record fields and forward declared procedure id's
1346 ->procedure pfdclaration
1347 ->procedure selector)
1348 label 1;
1349 begin
1350 while flp<=all do
1351   if flp.name=id then goto 1 else
1352   if flp.name=ec id then flp:=flp.rlink else flp:=flp.llink;
1353   !: searchsection:=flp
1354 end;
1355
1356 function searchlab(flplp: val:integer)::lp;
1357 label 1;
1358 begin
1359 while flp<=all do
1360   if flp.labval=val then goto 1 else flp:=flp.nextlp;
1361   !:searchlab:=flp
1362 end;
1363
1364 procedure oponent(t:twostrut);
1365 var op:integer;
1366 begin with a do begin
1367   case is of
1368   ir: begin op:=op_dif; asp:=realptr; fltused:=true end;
1369   ri: begin op:=op_ofi; asp:=intptr; fltused:=true end;
1370   il: begin op:=op_oid; asp:=longptr end;
1371   li: begin op:=op_odi; asp:=intptr end;
1372   lr: begin op:=op_ofd; asp:=realptr; fltused:=true end;
1373   rl: begin op:=op_ofd; asp:=longptr; fltused:=true end;
1374   end;
1375   gen0(op)
1376 end end;
1377
1378 procedure negate(l1:integer);
1379 var l2:integer;
1380 begin
1381   if a.asp=ntpr then gen0(op_neg) else
1382   begin l2:=l1; gen0(op_loo,0);
1383   if a.asp=longptr then
1384     begin oponent(l1); exchange(l1,l2); gen0(op_dab) end
1385   else (realptr)
1386     begin oponent(l1); exchange(l1,l2); gen0(op_fab) end
1387   end;
1388 end;
1389
1390 function desub(fsp:sp);
1391 begin
1392   if formof(fsp,subrange) then fsp:=fsp.rangetype; desub:=fsp
1393 end;
1394
1395 function nicescalar(fsp:sp):boolean;
1396 begin
1397   if fsp=ll then nicescalar:=true else
1398   nicescalar:=(fsp.for=scalar) and (fsp<=realptr) and (fsp<=longptr)
1399 end;

```

```

1457 function compat(p,q:sp):twostrut;
1458 begin compat:=noeq;
1459 if eqstrut(p,q) then compat:=eq else
1460   begin p:=desub(p); q:=desub(q);
1461   if eqstrut(p,q) then compat:=subeq else
1462   if p.for=q.for then
1463     case p.for of
1464     scalar:
1465       if (p=ntpr) and (q=realptr) then compat:=ir else
1466       if (p=realptr) and (q=intptr) then compat:=ri else
1467       if (p=intptr) and (q=longptr) then compat:=il else
1468       if (p=longptr) and (q=intptr) then compat:=li else
1469       if (p=longptr) and (q=realptr) then compat:=lr else
1470       if (p=realptr) and (q=longptr) then compat:=rl else
1471       ;
1472     pointer:
1473       if (p=ntpr) or (q=ntpr) then compat:=eq;
1474     power:
1475       if p=emptyset then compat:=se else
1476       if q=emptyset then compat:=se else
1477       if compat(p,elset,q,elset) <= subeq then
1478         asp:=flagq.sflag then compat:=eq;
1479     arrays:
1480       if string(p) and string(q) and (p.size=q.size) then
1481         compat:=eq;
1482     files,array,records: ;
1483   end;
1484 end;
1485
1487 procedure checkasp(fsp:sp; err:integer);
1488 var ts:twostrut;
1489 begin
1490   ts:=compart(a.asp,fsp);
1491   case ts of
1492   eq:
1493     if fsp<=all then if withfile in fsp.sflag then asperr(err);
1494   subeq:
1495     checkbad(fsp);
1496   li:
1497     begin oponent(ts); checkasp(fsp,err) end;
1498   ll,rl,lr,lr:
1499     oponent(ts);
1500   eq:
1501     aspemptyset(fsp);
1502   notaq,ri,se:
1503     asperr(err);
1504   end;
1505 end;
1507 procedure force(fsp:sp; err:integer);
1508 begin load; checkasp(fsp,err) end;
1510
1511 function neident(kl:ld:laa; id:sp; ntp:nt; err:integer)::lp;
1512 begin neident:=null;
1513   if sp<=ident then error(err) else

```

```

1401 function bounds(fsp:sp; var fmin,fmax:integer):boolean;
1402 (compute bounds if possible, else return false)
1403 begin bounds:=false; fmin:=0; fmax:=0;
1404   if fsp<=all then
1405     if fsp.for= subrange then
1406       begin fmin:=fsp.min; fmax:=fsp.max; bounds:=true end else
1407     if fsp.for=scalar then
1408       if fsp.foont<=0 then
1409         begin fmin:=0; fmax:=fsp.foont.value; bounds:=true end
1410       end;
1411
1412 procedure genrok(fsp:sp);
1413 var min,max,sno:integer;
1414 begin
1415   if opt['r']<=off then if bounds(fsp,min,max) then
1416     begin
1417       if fsp.for=scalar then sno:=fsp.scalno else sno:=fsp.subrno;
1418       if sno=0 then
1419         begin dbno:=dbno+1; sno:=dbno;
1420         genib(dbno); genl(pe_rom,min); genot(max); genod;
1421         if fsp.for=scalar then fsp.scalno:=sno else
1422         fsp.subrno:=sno
1423         end;
1424       end;
1425   end;
1426 end;
1428 procedure checkbnd(fsp:sp);
1429 var min,max1,min2,max2:integer; bool:boolean;
1430 begin
1431   if bounds(fsp,min,max1) then
1432     begin bool:=bounds(a.asp,min2,max2);
1433     if (bool=false) or (min2<min1) or (max2>max1) then
1434       genrok(fsp);
1435     end;
1436   a.asp:=fsp;
1437 end;
1439 function eqstrut(p,q:sp):boolean;
1440 begin eqstrut:=(p=q) or (p=ll) or (q=ll) end;
1442 function string(fsp:sp):boolean;
1443 var lsp:sp;
1444 begin string:=false;
1445   if formof(fsp,array) then
1446     if eqstrut(fsp,eltype.charptr) then
1447       if speak in fsp.sflag then
1448         begin lsp:=fsp.inctype;
1449         if lsp=ll then string:=true else
1450         if lsp.for= subrange then
1451           if lsp.rangetype=intptr then
1452             if lsp.min=1 then
1453               string:=true
1454             end;
1455         end;

```

```

1513   begin neident:=newip(kl.id,ld,nt); inay end
1514 end;
1516 function stringstrut:sp;
1517 var lsp:sp;
1518 begin (only used when ix and zerostring are still valid)
1519   if zerostring then lsp:=stringptr else
1520   begin lsp:=newip(array,ifcharize); lsp.sflag:=lspeak;
1521   lsp.eltype:=charptr; lsp.inctype:=null;
1522   end;
1523 stringstrut:=lsp;
1524 end;
1526 function address(var lc:integer; az:integer; pack:boolean):integer;
1527 begin
1528   if lc >= maxint-az then begin error(+017); lc:=0 end;
1529   if (not pack) or (az=1) then if odd(lc) then lc:=lc+1;
1530   address:=lc;
1531   lc:=lc+az;
1532 end;
1534 function reserve(s:integer):integer;
1535 var r:integer;
1536 begin r:=address(b.lo,s,false); genreg(r,s,100); reserve:=r;
1537   if b.lo>max then lmax:=b.lo
1538 end;
1540 function arraysize(fsp:sp; pack:boolean):integer;
1541 var sz,min,max,tot,n:integer;
1542 begin sz:=sizeof(fsp.eltype);
1543   if not pack then sz:=sz*8;
1544   if bounds(fsp.inctype,min,max) then (we checked before)
1545     dbno:=dbno+1; fsp.arpos.lv:=0; fsp.arpos.ed:=dbno;
1546     genib(dbno); genl(pe_rom,min); genot(max-min);
1547     genot(max); genod;
1548     a:=max-min+1; tot:=sz*s;
1549     if sz<0 then if tot div sz < 0 n then begin error(+018); tot:=0 end;
1550     arraysize:=tot
1551 end;
1553 procedure treevalk(flplp);
1554 var lsp:sp; i:integer;
1555 begin
1556   if flp<=all then
1557     begin treevalk(flplp.llink); treevalk(flplp.rlink);
1558     if flp.kl=vars then
1559       begin if not (used in flp.iflag) then errid(-+019),flp.name;
1560         if not (assigned in flp.iflag) then errid(-+020),flp.name;
1561         lsp:=flp.idtype;
1562         if not (sorg in flp.iflag) then
1563           genreg(flplp.vpos.ed,ssizeof(lsp,ord(formof(lsp,pointer)))));
1564         if flp<=all then if withfile in lsp.sflag then
1565           if lsp.for=files then
1566             if level=1 then
1567               begin
1568                 for i:=2 to argo do with argo[i] do

```

```

1569     if name=fip.name then ad:=fip.vpos.ad
1570     else
1571     begin
1572     begin
1573     if not (refer in fip.iflag) then
1574     begin gen(op,wrt,0);
1575     gen(top_lal,fip.vpos.ad); genop(CLS)
1576     end
1577     end
1578     else
1579     if level<1 then errid:=(+021),fip.name)
1580     end
1581     end;
1582 end;

1584 procedure constant(fays:soa; var fapisp; var fval:integer);
1585 var signed_min:boolean; lip:lip;
1586 begin signed:=(fays.plusy) or (fays.miny);
1587 if signed then begin min:=signed; insyn end else min:=false;
1588 if find((ident..plusey),fays,+022) then
1589 begin fval:=val;
1590 case of
1591 stringst: fap:=stringst;
1592 charst: fap:=charst;
1593 intst: fap:=intst;
1594 realst: fap:=realst;
1595 longest: fap:=longst;
1596 shortest: fap:=shortst;
1597 ident:
1598 begin lip:=searchid((konst));
1599 fap:=lip.idtype; fval:=lip.value;
1600 end
1601 end; (case)
1602 if signed then
1603 if (fap<intst) and (fap<realst) and (fap<longst) then
1604 error(+023)
1605 else if min then fval:= -fval;
1606 (note: negating the v-number for reals and longs)
1607 insyn;
1608 end
1609 else begin fap:=nil; fval:=0 end;
1610 end;

1612 function outinteger(fays:soa; fapisp; err:integer):integer;
1613 var lip:lip; lval_min_max:integer;
1614 begin constant(fays,lip,lval);
1615 if fap<lip then
1616 if (errtype=charst) then
1617 begin
1618 if bounds(fap,min_max) then
1619 if (lval=0) or (lval>max) then error(+024)
1620 end
1621 else
1622 begin error(err); lval:=0 end;
1623 outinteger:=lval
1624 end;

```

```

1626 (*****
1628 function typid(arr:integer):sp;
1629 var lip:lip; lip:=sp;
1630 newsubrange:=boolean;
1631 begin lip:=nil;
1632 if sp<ident then error(err) else
1633 begin lip:=searchid((types)); lip:=lip.idtype; insyn end;
1634 typid:=lip
1635 end;

1636 function simpletp(fays:soa):sp;
1637 var lip:lip; lip:=sp; lip:=lip; min_max:=integer; lip:=sp;
1638 newsubrange:=boolean;
1639 begin lip:=nil;
1640 if find((ident..parent),fays,+025) then
1641 if sys:=parent then
1642 begin insyn; lip:=top; (decl. const. local to innermost block)
1643 while top<>occur do top:=top.nlink;
1644 lip:=newsp((smallr,wordsize); hip:=nil; max:=0;
1645 repeat lip:=newident((konst,lip,hip,+026);
1646 if lip<nil then
1647 begin enterid(lip);
1648 hip:=lip; lip:=value:=max; max:=max+1
1649 until endofloop(fays,(parent),(ident),comma,+027); (+028)
1650 if max<0 then lip:=size:=bytesize;
1651 lip:=foonst:=hip; top:=lip; nextif((parent,+029);
1652 else
1653 begin newsubrange:=true;
1654 if sys:=ident then
1655 begin lip:=searchid((types,konst)); insyn;
1656 if lip.klasstype then
1657 begin lip:=lip.idtype; newsubrange:=false end
1658 else
1659 begin lip:=lip.idtype; min:=lip.value end
1660 end
1661 else constant(fays,(colon2,ident..plusey),lip,min);
1662 if newsubrange then
1663 begin lip:=newsp(subrange,wordsize); lip:=subno:=0;
1664 if not min_max=(lip) then
1665 begin error(+030); lip:=nil; min:=0 end;
1666 lip:=rangetype:=lip;
1667 nextif((colon2,+031); max:=outinteger(fays,lip,+032);
1668 if min>max then begin error(+033); max:=min end;
1669 if (min=0) and (max<0) then lip:=size:=bytesize;
1670 lip:=min:=min; lip:=max:=max
1671 end;
1672 end;
1673 simpletp:=lip
1674 end;

1675 function arraytp(fays:soa;
1676 atyp:atstructform;
1677 sflag:flagset;

```

```

1681 function element(fays:soa):sp
1682 :sp;
1683 var lip:lip; lip:=sp; min_max:=integer; ok:boolean; sepy:symbol; lip:=sp;
1684 ok:=true;
1685 begin insyn; nextif((break,+034); hip:=nil;
1686 repeat lip:=newsp(atyp,0); lip:=lip; (lip:=lip)
1687 lip:=nil; hip:=lip; (link reversed)
1688 if atyp=charst then
1689 begin sepy:=colon; ok:=yes:=ident;
1690 lip:=newident((currhd,lip,nil,+035);
1691 if lip<nil then enterid(lip);
1692 nextif((colon2,+036);
1693 lip:=newident((currhd,lip,lip,+037);
1694 if lip<nil then enterid(lip);
1695 nextif((colon2,+038); lip:=typid(+039);
1696 ok:=no:=ok and (detub(lip));
1697 end
1698 else
1699 begin sepy:=comma; ok:=yes:=ident..parent;
1700 lip:=simpletp(fays,(comma,break,ofy,ident..packedy));
1701 ok:=bounds(lip,min_max)
1702 end;
1703 if not ok then begin error(+040); lip:=nil end;
1704 lip:=lip;
1705 until endofloop(fays,(break,ofy,ident..packedy),ok,sepy,+041); (+042)
1706 nextif((break,+043); nextif((ofy,+044);
1707 lip:=element(fays);
1708 if lip<nil then sflag:=sflag + lip.sflag + [withfile];
1709 repeat (reverse link) and compute aim;
1710 lip:=lip;
1711 if atyp=charst then lip:=lip;
1712 if atyp=array then lip:=lip;
1713 lip:=lip;
1714 until lip:=nil; (lip points to array with highest dimension)
1715 arraytp:=lip
1716 end;

1718 function typ(fays:soa):sp;
1719 var lip:lip; lip:=sp; min_max:=integer;
1720 sflag:=flagset; lip:=sp;

1722 function fldlist(fays:soa):sp;
1723 (level 2: << typ)
1724 var lip:lip; lip:=sp;

1726 function varpart(fays:soa):sp;
1727 (level 3: << fldlist << typ)
1728 var lip:lip; lip:=sp; lip:=lip; lip:=lip; lip:=lip; lip:=lip;
1729 min_max:=int; var:=integer; lid:=alpha;
1730 begin insyn; lip:=nil; lip:=nil;
1731 lip:=newsp(0);
1732 if sp<ident then error(+045) else
1733 begin lid:=id; insyn;
1734 if sp=colon then
1735 begin lip:=newsp(field,lid,nil,nil); enterid(lip); insyn;
1736 if sp<ident then error(+046) else

```

```

1737 begin lid:=id; insyn end;
1738 end;
1739 if sp=ofy then (otherwise you may destroy id)
1740 begin lid:=id; lip:=searchid((types)) end;
1741 end;
1742 if lip:=nil then (fap:=nil) else (fap:=lip.idtype);
1743 if bounds(fap,int_max) then var:=var-int-1 else
1744 begin var:=0;
1745 if fap<nil then begin error(+047); fap:=nil end
1746 end;
1747 lip:=fap;
1748 if tip<nil then (explicit tag)
1749 begin tip:=fap;
1750 tip:=fap;
1751 nextif((ofy,+048); min:=0; max:=min; head:=nil;
1752 repeat hip:=nil; (for each caselabel list)
1753 repeat var:=var-1;
1754 int:=outinteger(fays,(ident..plusey,comma,colon1,parent,
1755 semicolon,comma,rparent),tip,+049);
1756 lip:=head; (each label may occur only once)
1757 while lip<nil do
1758 begin if lip:=varval then error(+050);
1759 lip:=lip.nvar
1760 end;
1761 var:=newsp(var,0); var:=varval:=int;
1762 var:=newsp(head:=head; head:=var; (chain of case labels)
1763 var:=subst:=hip; hip:=var;
1764 (use this field to link labels with same variant)
1765 until endofloop(fays,(colon1,parent,semicolon,comma,rparent),
1766 (ident..plusey),comma,+051); (+052)
1767 nextif((colon1,+053); nextif((parent,+054);
1768 top:=fldlist(fays,(parent,semicolon,ident..plusey));
1769 if ok:=no then min:=0;
1770 while var<nil do
1771 begin var:=min:=0; hip:=var:=subst;
1772 var:=subst:=top; lip:=hip
1773 end;
1774 nextif((parent,+055);
1775 ok:=min:=0;
1776 until lastsemicolon(fays,(ident..plusey),+056); (+057 +058)
1777 if var>0 then error(+059);
1778 top:=fap:=head:=top:=size:=min:=0; ok:=no; varpart:=top;
1779 end;

1781 begin (fldlist)
1782 if find((ident),fays,(array),+060) then
1783 repeat lip:=nil; hip:=nil;
1784 repeat lip:=newident((field,nil,nil,+061);
1785 if lip<nil then
1786 begin enterid(lip);
1787 if lip:=nil then hip:=fip else lip:=next:=fip; lip:=fip;
1788 end;
1789 until endofloop(fays,(colon1,ident..packedy,semicolon,comma),
1790 (ident),comma,+062); (+063)
1791 nextif((colon1,+064);

```


