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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?

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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.

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| [ ] 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> . |             |       |      |        |        |
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## 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.

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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

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## 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.

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APPLICATION FOR LICENSE TO USE VALIDATION SUITE FOR PASCAL

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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 problems 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	
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DEC PDP-11 (RSX-11M/IAS)	#17:86		
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DEC PDP-11 (Unix)	#15:111		
DEC PDP-11 (Unix)	#15:100	Pascal E	
DEC PDP-11 (Unix)	#15:103	Modula	
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DG Eclipse (AOS)	#15:109		
DG Eclipse (RDOS)	#15:108		
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Intel 8080/8085	#15:119		
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Intel 8080/8085	#15:117		
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Intel 8080/8085 (TRS-80)	#15:100		
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Intel 8086	#15:103		
MOS Tech 6502 (Apple)	#15:107		
Modcomp II and IV	#15:120		
		Motorola 6800	#15:120
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		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 "../h/em1.h"
3
4 { (c) copyright 1980 by the Vrije Universiteit, Amsterdam, The Netherlands.
5 Explicit permission is hereby granted to universities to use
6 or duplicate this program for educational or research purposes. All
7 other use or duplication by universities, and all use or duplication
8 by other organizations is expressly prohibited unless written
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11
12 Dr. Andrew S. Tanenbaum
13 Wiskundig Seminarium
14 Vrije Universiteit
15 Postbox 7161
16 1007 MC Amsterdam
17 The Netherlands
18
19 Organizations wishing to modify part of this software for subsequent
20 sale must explicitly apply for permission. The exact arrangements
21 will be worked out on a case by case basis, but at a minimum
22 will require the organization to include the following notice in all
23 software and documentation based on our work:
24
25 This product is based on the Pascal system
26 developed by Andrew S. Tanenbaum, Johan W. Stevenson
27 and Hans van Steyvenan of the Vrije Universiteit, Amsterdam,
28 The Netherlands.
29
30
31 {if next line is included the compiler is written in standard pascal}
32 #define STANDARD 1
33
34 {if next line is included, then code is produced for segmented memory}
35 #define SEGMENTS 1
36
37 {author: Johan Stevenson Version: 31}
38 {!- : no source line numbers}
39 {%- : no subrange checking}
40 {%- : no assertion checking}
41 #ifdef STANDARD
42 {%- : test conformance to standard}
43 #endif
44
45 program pem(input,em1,errors);
46 { This Pascal compiler produces EM1 code as described in
47 - A.S.Tanenbaum, J.W.Stevenson & H. van Steyvenan,
48 "Description of a experimental machine architecture for use of
49 block structured languages" Informatica rapport 54,
50 - K.Jensen & S.Wirth, PASCAL user manual and report, Springer-Verlag.
51 Several options may be given in the normal pascal way. Moreover,
52 a positive number may be used instead of + and -. The options are:
53 a: interpret assertions (+)
54 o: C-type strings allowed (-)
55 e: type long may be used (-)
56 }
```

```
113 p-option. Floating point numbers in EM-1 currently have size 4,
114 but this might change in the future to 8. The default can be
115 overridden by the f-option. The routines involved with alignment
116 are 'even', 'address' and 'arraysize'.
117
118 boolsize = bytesize;
119 charsize = bytesize;
120 intsize = shortsize;
121 buffsize = 512;
122 maxsetsize = 4096; [t15 div bytesize]
123
124 {maximal indices}
125 lmax = 8;
126 fmax = 14;
127 smax = 72;
128 rmax = 72;
129 lmax = 10;
130
131 {opt values}
132 off = 0;
133 on = 1;
134
135 {for push and pop;}
136 global = false;
137 local = true;
138
139 {set bounds}
140 misetint = 0;
141 maxsetint = 15; {default}
142
143 {constants describing the compact EM1 code}
144 MAGICLOW = 172;
145 MAGICHIGH = 0;
146 memerror = 0;
147 memopsize = 1;
148 memoptimal = 2;
149 memreg = 3;
150 memline = 4;
151 memfloats = 5;
152
153 {ASCII characters}
154 Lab = 9;
155 newline = 10;
156 horlab = 11;
157 formfeed = 12;
158 crret = 13;
159
160 {miscellaneous}
161 memarg = 127; {maximal segment number}
162 memcharord = 127; {maximal ordinal number of chars}
163 memarg = 13; {maximal index in argv}
164 rlim = 34; {number of reserved words}
165 spocess = ;
166 emptyform = ;
167
168
```

```
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 t4 = 256;
78 t8 = 16384;
79 t15 = 32767;
80
81 {EM-1 sizes}
82 bytebits = 8;
83 wordbits = 16;
84 wbit = 15; {wordbits-1}
85 minint = -t15ml;
86 maxint = t15ml;
87 maxintstring = '0000032767';
88 maxlongstring = '2147483647';
89
90 bytesize = 1;
91 wordsize = 2;
92 addrsize = wordsize;
93 punysize = wordsize;
94 shortsize = wordsize;
95 longsize = 4;
96
97 #ifdef SFLDPT
98 floatsize = 4;
99 #endif
100 #ifdef SFLOAT
101 floatsize = 8;
102 #endif
103
104 {Pascal sizes. For ptrsize, realsize and floatsize see handleopt}
105 { EM-1 requires that objects greater than a single byte start at a
106 word boundary, so their address is even. Normally, a full word
107 is also allocated for objects of a single byte. This extra byte
108 is really allocated to the object, not only striped by alignment,
109 i.e. if the value false is assigned to a boolean variable then
110 both bytes are cleared. For single byte objects in packed arrays
111 or packed records, however, only one byte is allocated, even if
112 the next byte is unused. Strings are packed arrays. The size of
113 pointers is 2 by default, but can be changed at runtime by the
```

```
169 type
170 {scalar types}
171 symbol = (comma,semicolon,colon,colon2,notary,brack,ident,
172 intout,charact,realout,longout,stringout,alicut,minary,
173 plusy,percent,arrow,arrayy,recordy,setsy,filesy,
174 packedy,progy,labely,consty,typesy,varsy,procsy,
175 funcy,beginy,gotosy,ifsy,whiley,repeaty,foray,
176 withy,casemy,becomes,staray,divy,mody,alsomy,
177 anday,oray,exory,noty,asy,asy,asy,
178 leay,iny,andy,elasy,untily,ofay,dosy,
179 downtoy,coy,thensy,rbrack,rparent,period
180 ); {the order is important}
181 chartype = (lower,upper,digit,layout,tabch,
182 quotech,quotech,ordtech,perioch,leasch,
183 greaterch,lparentch,lbracoch,
184 ); {different entries}
185 rparentch,lbrackch,rbrackch,comach,semich,arrowch,
186 plusch,minch,alch,star,equal,
187 ); {also symbols}
188 others
189 );
190
191 standpf = (pread,preadln,write,partials,pput,pgot,
192 preat,prewrite,pnes,ppdispose,ppack,punpack,
193 pmack,prelease,ppage,phalt,
194 ); {all procedures}
195 feof,feolin,fabs,fsg,ford,fobr,fpred,fauct,fodd,
196 fsumo,fround,fsin,fcos,fexp,fsgt,fln,farctan
197 ); {all functions}
198 ); {the order is important}
199
200 libnames = (INL,SPL,CLS,VM , {input and output}
201 OFN,GETX,END,DBC,END,ML,ML , {see input files}
202 CRF,FUT,WRI,MSI,WAC,WSC,WRS,WSS,WB ,
203 WSB,WBR,WBR,WML,WML,WSP,WRI,WSE,WLW,PAC ,
204 ); {see output files, order important}
205
206 ABS,END,SEN,COS,EXP,SQT,LOC,ATN {floating point}
207
208 ABI,ABL,BCP,BTS,HEX,S,SAV,EST,IDI,INT ,
209 ASS,OTO,PAC,WSP,DLS,ARZ,MDI,MDL ,
210 ); {miscellaneous}
211
212 structform = (scalar,subrange,pointer,power,files,arrays,arrayy,
213 records,variant,tag); {order important}
214
215 structflags = (speak,withfile);
216
217 identflags = (refer,used,assigned,corag,assigned);
218
219 decluses = (types,ident,vars,field,corbind,proc,func);
220
221 kindofps = (standard,formal,actual,extra,forward);
222
223 where = (blk,rec,urwo);
224
225 strkinds = (out,fixed,pfixed,loaded,ploded,indented);
226
227 tuostruc = (eq,subeq,lr,rl,il,il,lr,rl,se,se,note);
228
229 {subrange types}
230 sgranges = 0..maxint;
231 idranges = 1..lmax;
232 franges = 1..fmax;
```

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:(var: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 : (scalno:integer; (number of range descriptor)

305 fconst:ip; (names of constants)

306 );

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

308 rangetype: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 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 ch:char; (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 id:alpha; (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; (file header size)

395 rsize:integer; (index in arg)

396 lastpfno:integer; (unique pf number counter)

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

398 dopt:integer; (longs allowed if on)

399 lop:integer; (number of bits in sets with base integer)

400 sop:integer; (standard option)

401 (pointers pointing to standard types)

402 realptr,inp:tr,txtptr,emptyst,boolptr:sp;

403 charptr,nilptr,stringptr,longptr:sp;

404

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 intypedec: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 fptr:ip; (head of chain of forward reference pointers)

415 progid:ip; (program identifier)

416 curproc: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 (files: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(l:ldmax) 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  ml:file of byte;  (the M1 code)
450  errors:file of error;  (the compilation errors)
451  (=====)
452  procedure gen2bytes(b:byte; i:integer);
453  var b1,b2:byte;
454  begin
455  if i<0 then
456  if i<minint then begin b1:=0; b2:=7 end
457  else begin i:=i-1; b1:=tda1 - i mod td; b2:=tda1 - i div td end
458  else begin b1:=i mod td; b2:=i div td end;
459  write(ml,b1,b2)
460  end;
461
462  procedure genst(i:integer);
463  begin
464  if (i>0) and (i<sp_max0) then write(ml,i,sp_max0)
465  else gen2bytes(sp_max0,i)
466  end;
467
468  procedure genlb(i:integer);
469  begin if i<td then write(ml,sp_1lb1,i) else gen2bytes(sp_1lb2,i) end;
470
471  procedure genlb2(i:integer);
472  begin lino:=lino+1;
473  if i<sp_max0 then write(ml,i,sp_max0) else genlb(i);
474  end;
475
476  procedure genlb3(i:integer);
477  begin if i<td then write(ml,sp_d1b1,i) else gen2bytes(sp_d1b2,i) end;
478
479  procedure gen0(b:byte);
480  begin write(ml,b); lino:=lino+1 end;
481
482  procedure gen1(b:byte; i:integer);
483  begin gen0(b); genst(i) end;
484
485  procedure gen2(b:byte; d:integer);
486  begin gen0(b); genlb(d) end;
487
488  procedure genident(name:type; var a:alpha);
489  var i,j:integer;
490  begin i:=lino;
491  while (a[i]=' ') and (i>1) do i:=i-1;
492  write(ml,name,i);
493  for j:=1 to i do write(ml,ord(a[j]));
494  end;
495
496  procedure genp(a:libname);
497  var i:integer;
498  begin gen0(sp_max); write(ml,sp_max,i);
499  for i:=1 to 4 do write(ml,ord(lanml[i]));
500  end;
501
502  procedure genpma(b:byte; f:ipip);
```

```
505  var n:alpha; i,j:integer;
506  begin
507  if fip.ppos.lv<1 then n:=fip.name else
508  begin n:=''; j:=1; i:=fip.pfn;
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_pma,n)
513  end;
514
515  procedure genend;
516  begin write(ml,sp_max) end;
517
518  procedure genlin;
519  begin give_lino:=false;
520  if opt['l']<off then if main then gen1(sp_max,orig)
521  end;
522
523  procedure genreg(ad,az,nr:integer);
524  begin
525  if az<wordsize then
526  begin gen1(sp_max,mesreg); genst(ad); genst(nr); genend end
527  end;
528
529  (=====)
530
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  begin e:=err; write(errors,e);
535  if err>0 then begin gen1(sp_max,meserror); genend end
536  end;
537
538  procedure error(err:integer);
539  begin e:=spaces; e:=e-1; puterr(err) end;
540
541  procedure errid(err:integer; var id:alpha);
542  begin e:=id; e:=e-1; puterr(err) end;
543
544  procedure errint(err:integer; i:integer);
545  begin e:=i; e:=spaces; puterr(err) end;
546
547  procedure aspperr(err:integer);
548  begin if a.sp<all then begin error(err); a.sp:=nil end end;
549
550  procedure teststand;
551  begin if opt<off then error(-e01) end;
552
553  procedure enterid(fip: ip);
554  (enter id pointed at by fip into the name-table,
555  which on each declaration level is organized as
556  an unbalanced binary tree)
557  var n:alpha; lip,lip2:ip; lleft,again:boolean;
558  begin n:=fip.name; again:=false;
559  lip:=top.fname;
560
```

```
561  if lip=nil then top.fname:=fip else
562  begin
563  repeat lip:=lip;
564  if lip.name<n then
565  begin lip:=lip.llink; lleft:=true end
566  else
567  begin if lip.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:=fip else lip:=lip.rlink:=fip
572  end;
573  fip.llink:=nil; fip.rlink:=nil;
574  if again then errid(-e02,n);
575  end;
576
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;
583
584  procedure initf(fsp:tp; fad:integer);
585  begin with a do begin
586  asp:=fsp; pookbit:=false; ak:=fmad; pos.ad:=fad; pos.lv:=level;
587  if def SEGMENTS
588  pos.ag:=0;
589  #endif
590  end end;
591
592  function newp(kl:ideclass; n:alpha; id:tp; actip:ip):
593  var p:ip; f:flagset;
594  begin f:=[];
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); f:=used,assigned; initpos(p,vpos) end;
602  field:
603  begin newp(fid); p.offset:=0 end;
604  proc_func: (same structure)
605  begin newp(p,proc,actual); p.pfn:=actual;
606  initpos(p,pfn); p.pfn:=0; p.parhead:=nil; p.head:=0
607  end;
608  end;
609  p.name:=n; p.klass:=kl; p.idtype:=id; p.next:=ent;
610  p.llink:=nil; p.rlink:=nil; p.iflag:=f; newp:=p
611  end;
612
613  function newp(sf:structform; sz:integer):p;
614  var p:ip; sf:flagset;
615  begin sf:=[];
616  case sf of
```

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

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```

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)):=stabsch;
685   os(' '):=space; os('!'):=excl; os('@'):=at; os('#'):=hash;
686   os('$'):=dollar; os('%'):=pcent; os('&'):=amp; os('&#'):=quotech;
687   os('&quot;'):=apost; os('&#39;'):=apost; os('&#39;'):=apost;
688   os('&#39;'):=apost; os('&#39;'):=apost; os('&#39;'):=apost;
689   os('&#39;'):=apost; os('&#39;'):=apost; os('&#39;'):=apost;
690   os('&#39;'):=apost; os('&#39;'):=apost; os('&#39;'):=apost;
691   os('&#39;'):=apost; os('&#39;'):=apost; os('&#39;'):=apost;
692   os('&#39;'):=apost; os('&#39;'):=apost; os('&#39;'):=apost;
693   (single character symbols in char type order)
694   os('&#39;'):=apost; os('&#39;'):=apost; os('&#39;'):=apost;
695   os('&#39;'):=apost; os('&#39;'):=apost; os('&#39;'):=apost;
696   os('&#39;'):=apost; os('&#39;'):=apost; os('&#39;'):=apost;
697   os('&#39;'):=apost; os('&#39;'):=apost; os('&#39;'):=apost;
698   os('&#39;'):=apost; os('&#39;'):=apost; os('&#39;'):=apost;
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,real);
710   longptr :=newip(scalar,longsize);
711   charptr :=newip(scalar,charsize);
712   boolptr :=newip(scalar,booleansize);
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,charptr,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..faroten) 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[ppage]:=ppage; p[ppreset]:=ppreset;
743   p[ppwrite]:=ppwrite; p[ppack]:=pack;
744   p[ppdispose]:=ppdispose; p[ppack]:=pack;
745   p[pprelease]:=pprelease; p[ppack]:=pack;
746   p[ppord]:=ppord; p[ppack]:=pack;
747   p[ppord]:=ppord; p[ppack]:=pack;
748   p[ppord]:=ppord; p[ppack]:=pack;
749   p[ppord]:=ppord; p[ppack]:=pack;
750   p[ppord]:=ppord; p[ppack]:=pack;
751   p[ppord]:=ppord; p[ppack]:=pack;
752   p[ppord]:=ppord; p[ppack]:=pack;
753   p[ppord]:=ppord; p[ppack]:=pack;
754   p[ppord]:=ppord; p[ppack]:=pack;
755   p[ppord]:=ppord; p[ppack]:=pack;
756   (parameter types of standard functions)
757   ftype[foef]:=nil; ftype[foein]:=nil;
758   ftype[fofd]:=nil; ftype[fofr]:=nil;
759   ftype[fofd]:=nil; ftype[fofr]:=nil;
760   ftype[fofd]:=nil; ftype[fofr]:=nil;
761   ftype[fofd]:=nil; ftype[fofr]:=nil;
762   ftype[fofd]:=nil; ftype[fofr]:=nil;
763   ftype[fofd]:=nil; ftype[fofr]:=nil;
764   ftype[fofd]:=nil; ftype[fofr]:=nil;
765   ftype[fofd]:=nil; ftype[fofr]:=nil;
766   (standard procedure/function identifiers)
767   for j:=read to ppord do
768   begin new(p,proc,standpf); p^.klass:=proc;
769   p^.name:=p[j]; p^.pkind:=standpf; p^.key:=j; enterid(p);
770   end;
771   for j:=foef to faroten do
772   begin new(p,func,standpf); p^.klass:=func; p^.idtype:=ftype[j];
773   (idtype is used not for result type but for parameter type if)
774   p^.name:=p[j]; p^.pkind:=standpf; p^.key:=j; enterid(p);
775   end;
776   (program identifier)
777   prog:=newip(proc,'main','all,nil);
778   (new name space for user external)
779   new(blck); q:=occur:blck; q^.allink:=top; q^.fname:=nil; top:=q;
780   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[ORX]:=o; lnn[ROD]:=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[MSV]:=m; lnn[MSW]:=m;
794   lnn[MSU]:=m; lnn[MSV]:=m; lnn[MSW]:=m;
795   lnn[MSU]:=m; lnn[MSV]:=m; lnn[MSW]:=m;
796   lnn[MSU]:=m; lnn[MSV]:=m; lnn[MSW]:=m;
797   lnn[MSU]:=m; lnn[MSV]:=m; lnn[MSW]:=m;
798   lnn[MSU]:=m; lnn[MSV]:=m; lnn[MSW]:=m;
799   lnn[MSU]:=m; lnn[MSV]:=m; lnn[MSW]:=m;
800   lnn[MSU]:=m; lnn[MSV]:=m; lnn[MSW]:=m;
801   lnn[MSU]:=m; lnn[MSV]:=m; lnn[MSW]:=m;
802   lnn[MSU]:=m; lnn[MSV]:=m; lnn[MSW]:=m;
803   lnn[MSU]:=m; lnn[MSV]:=m; lnn[MSW]:=m;
804   lnn[MSU]:=m; lnn[MSV]:=m; lnn[MSW]:=m;
805   lnn[MSU]:=m; lnn[MSV]:=m; lnn[MSW]:=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']:=0;
812   opt['p']:=0;
813   opt['s']:=wordsize div wordsize; (default pointer size in words)
814   opt['t']:=0;
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;
847   opt:=opt;
848   opt:=opt;
849   opt:=opt;
850   realize:=opt['r'] * wordsize; realptr^.size:=realize;
851   ptrsize:=opt['p'] * wordsize; nilptr^.size:=ptrsize;
852   fsize:=d intsize + 2 * ptrsize;
853   textptr^.size:=fsize+bufsize; stringptr^.size:=ptrsize;
854   if opt<off then begin opt:=off; dopt:=off end;
855   else if opt<u then begin opt:=u; dopt:=u end;
856   if opt<off then enterid(newip(types,'string','stringptr,nil));
857   if opt<off then enterid(newip(types,'long','longptr,nil));
858   if opt<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 ftype:=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; genld(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   gen((op_wrt,0); gen0(op,mes,nandib);
876   gen0(op_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<off 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;
900
901   procedure atop(a:byte);
902   begin gen!(a,even(sizeof(a.asp))) end;
903
904   procedure spndemptyst(fsp:sp);
905   var i:integer;
906   begin
907     for i:=2 to sizeof(fsp) div wordsize do gen!(op_loc,0); a.asp:=fsp
908   end;
909
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;
919
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_lae,ad)
928     end;
929
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;
932
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;
946
947   procedure decaddr(var p:position);
948   begin if p.lv=0 then gen!(op_lae,p.ad) else loadpos(p,ptrsize) end;
949
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         p:=pos;
966         loadpos(pos,ptrsize);
967         p:=pos;
968         ;
969         indexed;
970         gen!(op_sas);
971         end; [case]
972         ok:=loaded;
973     end end;
974
975   procedure load;
976   var sz:integer;
977   begin with a do begin
978     sz:=sizeof(asp); if not packbit then sz:=even(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         p:=pos;
986         #ifdef SECTIONS
987           begin loadpos(pos,ptrsize); gen!(op_loi,sz) end;
988         loaded:
989           ;
990         p:=pos;
991         gen!(op_loi,sz);
992         indexed:
993           gen!(op_lsa);
994         [case]
995         ok:=loaded;
996     end end;
997
998   procedure store;
999   var sz:integer;
1000   begin with a do begin
1001     sz:=sizeof(asp); if not packbit then sz:=even(sz);
1002     if asp=all then
1003       case ok of
1004         fixed:
1005           with pos do
1006             if lv<0 then
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   p:=pos;
1018   loadpos(pos,ptrsize); gen!(op_sti,sz) end;
1019   p:=pos;
1020   gen!(op_sti,sz);
1021   indexed:
1022     gen!(op_sas);
1023   end; [case]
1024 end end;
1025
1026   procedure fieldadr(off:integer);
1027   begin with a do
1028     if (ok=fixed) and not packbit then pos.ad:=pos.ad+off else
1029       begin loadaddr; gen!(op_mdi,off) end
1030   end;
1031
1032   procedure loadheap;
1033   begin if forall(a.asp,[arrays..records]) then loadaddr else load end;
1034   [.....]
1035
1036   procedure nextch;
1037   begin
1038     col:=col+1; read(input,cb); e:=col; e:=col-1; ch:=col;
1039   end;
1040
1041   procedure nextln;
1042   begin
1043     if eof(input) then
1044       begin
1045         if not eof(input) then error(03) else
1046           begin
1047             if f1used then begin gen!(ps_esc,seeffloat); gen!(d2) end;
1048             gen!(ps_esc,off)
1049           end;
1050     #ifdef STANDARD
1051     goto 3999
1052     #endif
1053   #ifdef STANDARD
1054   halt
1055   #endif
1056   end;
1057   e:=col; e:=col-1; e:=col; e:=col-1; e:=col; e:=col-1;
1058   if not including then
1059     begin e:=col; e:=col-1; e:=col; e:=col-1;
1060   end;
1061
1062   procedure options(normal:boolean);
1063   var o:integer;

```

```

1064   procedure goto;
1065   var b:byte;
1066   begin
1067     if normal then
1068       begin nextch; o:=ch end
1069     else
1070       begin read(a,b); o:=ch(b) end
1071     end;
1072
1073   begin
1074     repeat goto;
1075     if (o='a') and (c='a') then
1076       begin ci:=o; goto i:=0;
1077       if o='.' then begin i:=1; goto end else
1078         if o='-' then goto else
1079           if o=[0-9] then
1080             repeat i:=i*10 + ord(o) - ord('0'); goto;
1081             until o=[0-9] digit
1082           else i:=1;
1083           if i>=0 then
1084             if not normal then
1085               begin forceopt[ci]:=true; opt[ci]:=i end
1086             else
1087               if not forceopt[ci] then opt[ci]:=i;
1088             end;
1089             until o='.';
1090           end;
1091
1092   procedure linedirective;
1093   var i,j:integer;
1094   begin i:=0; j:=0;
1095     repeat nextch until (ch=' ') or eof;
1096     while ch=[0-9] do
1097       begin i:=i*10 + ord(ch) - ord('0'); nextch end;
1098     while (ch=' ') and not eof do nextch;
1099     if (ch='*') or (eof) then error(04) else
1100       begin nextch;
1101         while (ch='*') and not eof do
1102           begin
1103             if ch='/' then j:=0 else
1104               begin if j=0 then e:=e+1; e:=e+1;
1105                 if j=1; if j<=e then e:=e+1; e:=e+1;
1106               end;
1107             nextch
1108           end;
1109         while not eof do nextch;
1110         if source=empty then source:=e; e:=e+1;
1111         including:=source; e:=e+1;
1112         i:=i-1; e:=e+1;
1113         if not including then e:=e+1;
1114       end;
1115     while not eof do nextch;
1116   end;
1117
1118   procedure putdig;
1119   begin i:=i+1; if i<=max then strbuff[i]:=ch; nextch 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<=digit;
1131 [lower=0,upper=1,digit=2, ugly but fast]
1132 for i:=frk-1 to frk-1-1 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<=digit;
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<=digit then error(+05) else
1154             repeat putdig until ch<=digit;
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<=digit then error(+06) else
1160             repeat putdig until ch<=digit;
1161         end;
1162       if ix>lam then begin error(+07); ix:=lam end;
1163       sy:=nextch; fl:=next; r:=next; d:=next; m:=next; val:=next;
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; id:=space; i:=lam+1;
1171         while ix>0 do
1172           begin i:=i-1; id[i]:=strbuf[ix]; ix:=ix-1 end;
1173         if ix<=lam then
1174           while ix<=lam do
1175             begin val:=val*10 + ord('0') + ord(id[i]); i:=i-1 end
1176         else if (ix<=lam) and (dopt<=off) then
1177           begin sy:=longest; d:=next; m:=next; val:=next;
1178         end;

```

```

1177   genidb(dlbn); genid(p_rn); write(am,sp,room,ix+1-1);
1178   while ix<=lam do
1179     begin write(am,ord(id[i])); i:=i-1 end;
1180   genid
1181   and error(+09)
1182   end
1183 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:=chrnext; val:=ord(strbuf[1]) end
1200   else
1201     begin sy:=stringnext; 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:=next;
1211 if ch='*' then options:=true;
1212 while (ch<>next) and (ch<>stop) do
1213   begin stop:=next; if ch='*' then stop:=next;
1214   if ch='*' then error(+014);
1215   if eol then next:=next;
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:=ch; m:=ch; m:=e.ch mod 8 + 8; nextch; goto 1 end;
1229   layout;
1230   begin if eol then next:=next; 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:=colon; 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:=ltay;
1248 end;
1249 greaterch;
1250 begin nextch;
1251   if ch='>' then begin sy:=less; nextch end else sy:=gtay;
1252 end;
1253 lparench;
1254 begin nextch;
1255   if ch='(' then sy:=lparent 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,mulch,slash,star,equal;
1262 begin sy:=next(ch); nextch end;
1263 otherch;
1264 begin
1265   if (ch='@') and (e.ch=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 insym 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 insym 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 insym until sy in sy1+sy2 end;
1288   find2:=sy in sy1;
1289 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 insym until sy in [sy1]+sy2 end;
1296 if sy=sy1 then insym 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:ideless;
1317 begin lastap:=stop;
1318 while lastap<=id do
1319   begin lip:=lastap+.name;
1320   while lip<=id do
1321     if lip=.name then
1322       if lip=.name in fidals then
1323         begin
1324           if lip=.name+vs then if lip=.vs.op.lv<=level then
1325             lip:=lip+.lflg+.lflg+.lflg;
1326           goto 1
1327         end
1328       else lip:=lip+.link
1329     else
1330       if lip=.name then if lip:=lip+.link then lip:=lip+.link;
1331   lastap:=lastap+.link;
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.off; 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.odf; 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 negste(l1:integer);
1379 var l2:integer;
1380 begin
1381   if a.asp=ntpr then gen0(op_neg) else
1382   begin l2:=l1o; 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(lr); 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
1486
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     checkbada(fsp);
1496   il:
1497     begin oponent(ta); checkasp(fsp,err) end;
1498   lr,rl,lr,lr:
1499     oponent(ta);
1500   set:
1499     aspemptyset(fsp);
1501   notaq,ri,se:
1502     asperr(err);
1503   end;
1504 end;
1505
1506 procedure force(fsp:sp; err:integer);
1507 begin load; checkasp(fsp,err) end;
1508
1509
1510 function neident(kl:ldo; id:sp; ntp:nt; err:integer):lp;
1511 begin neident:=null;
1512 if sp<=ident then error(err) else

```

```

1401 function bounds(fsp:sp; var fln,fmx:integer):boolean;
1402 (compute bounds if possible, else return false)
1403 begin bounds:=false; fln:=0; fmx:=0;
1404 if fsp<=all then
1405   if fsp.for= subrange then
1406     begin fln:=fsp.min; fmx:=fsp.max; bounds:=true end else
1407   if fsp.for=scalar then
1408     if fsp.foomat<=0 then
1409       begin fln:=0; fmx:=fsp.foomat.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 dibo:=dibo+1; sno:=dibo;
1420         genib(dibo); 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;
1427
1428 procedure checkbda(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;
1438
1439 function eqstrut(p,q:sp):boolean;
1440 begin eqstrut:=(p=q) or (p=ll) or (q=ll) end;
1441
1442 function string(fsp:sp):boolean;
1443 var l: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 l:=fsp.inctype;
1449       if l=ntpr then string:=true else
1450       if l=ntpr then string:=true else
1451       if l=ntpr then string:=true else
1452       if l=ntpr then string:=true else
1453       if l=ntpr then string:=true else
1454       if l=ntpr then string:=true else
1455       if l=ntpr then string:=true else

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```

1513   begin neident:=newip(kl.id,td,nt); inay end
1514 end;
1515
1516 function stringstrut:sp;
1517 var l:sp;
1518 begin (only used when ix and zerostring are still valid)
1519 if zerostring then l:=stringptr else
1520   begin l:=newip(array,ifcharize); l.sflag:=lspeak;
1521   l:=eltype.charptr; l.inctype:=null;
1522   end;
1523 stringstrut:=l;
1524 end;
1525
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;
1533
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;
1539
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+1;
1544 if bounds(fsp.inctype,min,max) then (we checked before)
1545   dibo:=dibo+1; fsp.arpos.lv:=0; fsp.arpos.ed:=dibo;
1546   genib(dibo); genl(pe_rom,min); genot(max-min);
1547   genot(max); genod;
1548   sz:=max-min+1; tot:=sz*s;
1549   if sz<0 then if tot div sz < 0 then begin error(+018); tot:=0 end;
1550   arraysize:=tot
1551 end;
1552
1553 procedure treealk(flplp);
1554 var l:sp; i:integer;
1555 begin
1556   if flp<=all then
1557     begin treealk(flplp.llink); treealk(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       l:=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 l.sflag then
1565         if l=ntpr then
1566           begin
1567             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 fap:sp; var fval:integer);
1585 var signed_min:boolean; lip:lip;
1586 begin signed:=(faypluss) or (faymin);
1587 if signed then begin min:=aymin; insyn end else min:=false;
1588 if find((ident..pluss),fays,+022) then
1589 begin fval:=val;
1590 case ay of
1591 stringst: fap:=stringst;
1592 charst: fap:=charst;
1593 intst: fap:=intptr;
1594 realst: fap:=realptr;
1595 longest: fap:=longptr;
1596 shortest: fap:=shortptr;
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<intptr) and (fap<realptr) and (fap<longptr) 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; fap:sp; err:integer):integer;
1613 var lip:lip; lval_min_max:integer;
1614 begin constant(fays,lip,lval);
1615 if fap<long then
1616 if extract(doub(fap),lip) then
1617 begin
1618 if bounds(fap,min_max) then
1619 if (lval<min) 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 ay<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,hip:lip; min_max:integer; lnp:lp;
1638 newsubrange:boolean;
1639 begin lip:=nil;
1640 if find((ident..parent),fays,+025) then
1641 if ay<parent then
1642 begin insyn; lip:=top; (decl. const. local to innermost block)
1643 while top<=do 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<8 then lip.size:=bytesize;
1651 lip.foomat:=hip; top:=lip; nextif((parent,+029);
1652 else
1653 begin newsubrange:=true;
1654 if ay<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..pluss),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.range:=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<8) 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,lip1,hip:sp; min_max:integer; ok:boolean; sepy:symbol; lip:lip;
1684 ok:=true;
1685 begin insyn; nextif((break,+034); hip:=nil;
1686 repeat lip:=newsp(atyp,0); lip:=lip.arpos;
1687 lip.min:=hip; hip:=lip; (link reversed)
1688 if atyp=array then
1689 begin sepy:=colon; ok:=ident;
1690 lip:=newident((currhd,lip,ail,+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:=ok and (doub(lip));
1697 end
1698 else
1699 begin sepy:=comma; ok:=((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.lntype:=lip1
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.nlink; hip:=lip; lip:=lip;
1711 if atyp=array then lip.size:=arraysize(hip,speak in sflag);
1712 lip:=hip; hip:=lip;
1713 until lip:=nil; (lip points to array with highest dimension)
1714 arraytp:=lip
1715 end;

1716 function typ(fays:soa):sp;
1717 var lip,lip:sp; ok:=ay.min_max:integer;
1718 sflag:=flagset; lip:=sp;

1722 function fldlist(fays:soa):sp;
1723 (level 2: << typ)
1724 var lip,hip,lip1:sp; lip:=sp;

1726 function varpart(fays:soa):sp;
1727 (level 3: << fldlist << typ)
1728 var lip,lip1: lip,headsp,hip,hip,hip,hip,hip;
1729 min_max:=int_max:=integer; lid:=alpha;
1730 begin insyn; lip:=nil; lip:=nil;
1731 lip:=newsp(0);
1732 if ay<ident then error(+045) else
1733 begin lid:=id; insyn;
1734 if ay<colon then
1735 begin lip:=newsp(field,lid,ail,ail); enterid(lip); insyn;
1736 if ay<ident then error(+046) else

```

```

1737 begin lid:=id; insyn end;
1738 end;
1739 if ay<ofy then (otherwise you may destroy id)
1740 begin lid:=id; lip:=searchid((types)) end;
1741 end;
1742 if lip:=nil then tfap:=nil else tfap:=lip.idtype;
1743 if bounds(tfap,int_max) then var:=var-int-1 else
1744 begin var:=0;
1745 if tfap<nil then begin error(+047); tfap:=nil end
1746 end;
1747 lip:=lip; tfap:=tfap;
1748 if tip<nil then (explicit tag)
1749 begin tip:=tfap;
1750 tip.foomat:=address(of, sizeof(tfap),speak in sflag)
1751 end;
1752 nextif((ofy,+048); min:=0; max:=min; headsp:=nil;
1753 repeat hip:=nil; (for each caselabel list)
1754 repeat var:=var-1;
1755 int:=outinteger(fays(=ident..pluss,comma,colon1,parent,
1756 semicolon,comma,rparent),tfap,+049);
1757 lip:=headsp; (each label may occur only once)
1758 while lip<nil do
1759 begin if lip.varval=lip then error(+050);
1760 lip:=lip.nlink
1761 end;
1762 var:=newsp(varint,0); var:=varval:=int;
1763 var.nlink:=headsp; headsp:=var; (chain of case labels)
1764 var.subst:=hip; hip:=var;
1765 (use this field to link labels with same variant)
1766 until endofloop(fays((colon1,parent,semicolon,comma,rparent),
1767 ident..pluss),comma,+051); (+052)
1768 nextif((colon1,+053); nextif((parent,+054);
1769 top:=fldlist(fays((parent,semicolon,ident..pluss));
1770 if ay<max then min:=0;
1771 while var<nil do
1772 begin var:=min:=0; hip:=var.subst;
1773 var:=var.subst:=top; lip:=hip
1774 end;
1775 nextif((parent,+055);
1776 ok:=min:=0;
1777 until lastsemicolon(fays(=ident..pluss),+056); (+057 +058)
1778 if var>0 then error(+059);
1779 top.fvar:=headsp; top.size:=min:=0; ok:=min:=0; varpart:=top;
1780 end;

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

```



