```
WSID: UMBRA231
TIMESTAMP: 2001 4 18 8 7 21 550

      ∇R←AFE B
[1]   ⍝ RETURN ERROR MSG(S) FOR ERROR(S) B
[2]    R←'' ⋄ B←,B
[3]   L1:→(0=1↑B)/L3
[4]    R←R,(5↑(⍕1↑B),'.'),⊠[1000]⌊7 25 0,-1↑B
[5]   L2:→(0=⍴B←1↓B)/0
[6]    R←R,⎕R ⋄ →L1
[7]   L3:R←R,(5↑'0.'),'NO ERROR - OPERATION SUCCESSFUL'
[8]    →L2
      ∇  2001-04-18 8.02.54
      ∇Y←S ASC C;T
[1]   ⍝ Workspace: MATHPACK  FUNCTION: ASC
[2]   ⍝ Arguments: F ← sine(Y), C ← cosine (Y)
[3]   ⍝ Results: Y ← Angel in radians
[4]   ⍝ Functions Called: NONE
[5]   ⍝ Called by: ++GENERIC MATHPACK routine++
[6]   ⍝ Adopted from routine: MATHPACK, by G. Schneider, 12/15/1976, CPV/APL-C02
[7]   ⍝
[8]   ⍝ Unambiguously computes angle (in radians) from sine and cosine values.
[9]   ⍝ Resolves quadrent ambiguity.  Arguments may be any size or rank but must conform.
[10]  ⍝
[11]   Y←(○2)|(-×T-0.5)×(¯1○¯1⌈S⌊1)-○T←(×¯1⌈C⌊1)∊0 ¯1
      ∇  2001-04-18 8.02.54
      ∇CLEAN
[1]   ⍝ Workspace: UMBRAPHILE  FUNCTION: CLEAN
[2]   ⍝ Arguments: NONE
[3]   ⍝ Results: NONE
[4]   ⍝ Functions Called: NONE
[5]   ⍝ Called by: CLINE
[6]   ⍝ Adopted from routine: CENTERLINE, by G. Schneider, 1/28/1977, CPV/APL-C02
[7]   ⍝
[8]   ⍝ This routine deletes the global variables X,Y,SIND,COSD,MU,LW,XPRIME,YPRIME and C
[9]   ⍝      when they are no longer needed to conserve memory space
[10]  ⍝
[11]   0⍴⎕EX 10 6⍴'X     Y     SIND  COSD  MU    L2    XPRIMEYPRIMEB     C     '
      ∇  2001-04-18 8.02.54
      ∇CLINE;RF;AL;W;E2;S1;B;C;COSD1;SIND1;BB;Y1;PHI1;LAMDAE;A;H;LL2;N
[1]   ⍝ Workspace: UMBRAPHILE  FUNCTION: CLINE
[2]   ⍝ Arguments: NONE (Besselian elements and computed values passed as globals)
[3]   ⍝ Results: NONE (Data passed as globals)
[4]   ⍝ Functions Called: RED, CLEAN
[5]   ⍝ Called by: DOCLINE
[6]   ⍝ Adopted from routine: CENTERLINE, by G. Schneider, 1/28/1977, CPV/APL-C02
[7]   ⍝
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[8]  ⍝ This routine implements the core algorithm for computing the centerline
[9]  ⍝      circumstances of a total or annular solar eclipse from the Besselian
[10] ⍝      elements representing the geometry⍝ position⍝ and velocity of the moon's shadow.
[11] ⍝      The formulae employed are derived from: 'Cannon of Solar Eclipses'  by J. Meeuse
[12] ⍝      with only minor modifications.
[13] ⍝
[14] ⍝ Adopted astronomical constants (updated from 1984 IAU values):
[15] ⍝      Earth flattening factor:  ÷298.257
[16] ⍝      Earth equatorial radius: 6378.140 km
[17] ⍝      Ratio of mean solar dat/mean siderial day: 1.002738
[18] ⍝
[19]  OH←0   ⍝ Altitude bov mean sea level.  For generic CLINE run set to zero.
[20] ⍝
[21] ⍝ Compute topocentric shadow geometry
[22]  SIND1←SIND×W←÷(OH÷RF←20925656)+(1-(E2←(2×AL)-AL×AL←÷298.257)×COSD*2)*0.5
[23]  B←(X×SIND×MUP×S1←○÷10800)-YP
[24]  C←XP+((Y×SIND)+12×tanf2×COSD)×MUP×S1
[25]  COSD1←(1-AL)×W×COSD
[26] ⍝
[27] ⍝ Determine which points are for the shadow above the horizon
[28] ⍝ Criterion: Quantity BB must be positive
[29] ⍝ Invoke function RED to eliminate points below horizon
[30]  RED LOG←1=×BB←1-(X*2)+(Y1←W×Y)*2
[31]  PHI←¯3○((1-E2)*-0.5)×3○PHI1←¯1○(Y1×COSD1)+SIND1×BB←BB*0.5       ⍝ Latitude
[32]  DELTATDEG←360×DELTAT÷86400                                       ⍝ Delta-T in degree
[33]  LAM←(LAMDAE←(○MU÷180)-H←¯1○¯1⌈(X÷2○PHI1)⌊1)-(○÷180)×1.002738×DELTATDEG ⍝ Longitude
[34]  DUR←(120×LL2←12-BB×tanf2)÷N←((A×A←C-BB×S1×MUP×COSD)+B*2)*0.5     ⍝ Duration
[35]  TYP←'T*A'[2+×LL2]          ⍝ Type Code: T=Total, A=Annular, *=Instantaneous
[36]  WID←6378.14×2×LL2÷((BB*2)+(((X×A)-Y×B)*2)÷N*2)*0.5              ⍝ Umbra width
[37]  ECC←2○ALT←(SIND×1○PHI)+COSD×(2○PHI)×2○H      ⍝ Shadow eccentricity and altitude
[38]  AZ←¯3○(((1○PHI)×2○H)-(2○PHI)×tansd)÷1○H      ⍝ Shadow azimuth
[39]  AZD←(180×1=×X)+90+(÷○÷180)×-¯3○(((1○PHI)×2○H)-(2○PHI)×tansd)÷1○H ⍝ Shadow azimuth Deg
[40] ⍝
[41] ⍝ Delete global variables no longer needed
[42]  CLEAN
     ∇  2001-04-18 8.02.55
     ∇CLINEPREP;I;T;N;D
[1]  ⍝ Workspace: UMBRAPHILE  FUNCTION: CLINEPREP
[2]  ⍝ Arguments: NONE (Inputs from files and dialog arrays)
[3]  ⍝ Results: NONE (Updated dialog result arrays and globals)
[4]  ⍝ Functions Called: FROM, DLOG, READBESSEL, SFGETFILE (kernal)
[5]  ⍝ Called by: DOCLINE or LOCAL∆NOON
[6]  ⍝ Implementation: APL/68000 by G. Schneider, 4/22/1993, sofTouch APpLications
[7]  ⍝
[8]  ⍝ This routine determines the time span and interval for computing Besselian
[9]  ⍝ elements from an UMBRAPHILE data file, and invokes READBESSEL to create
[10] ⍝ vectors of the Besselian elements for those Universal Times.
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[11] ⍝
[12]  Abort←'Y'                          ⍝ Initialize user abort code status
[13]  NUM⍙FIELDS←⍎,CLINE⍙R[7 8 9;7+⍳14]  ⍝ UT Start, UT End, Increment
[14] ⍝
[15] ⍝ If invoked to compute circumstances for local noon, don't query user for coords
[16]  →(FROM 'UMBRAPHILE⍙LOCALNOON')/CP0
[17] ⍝
[18] ⍝ Invoke CLINE dialog to get centerline run parameters from user
[19]  →0×⍳1≠40 150 45 150 DLOG 'CLINE'   ⍝ Exit if user Canceled dialog
[20] CP0:→ER1×⍳0=⎕NC 'BesselFile'       ⍝ Branch to error condition 1
[21] ⍝
[22] ⍝ Test to see if user requests reading data file
[23]  →CP2×⍳CLINE⍙R[10;5]≠'1'            ⍝ Don't re-read file (user request)
[24] ⍝
[25] ⍝ Put up file requestor dialog to locate UMBRAPHILE data file
[26] CP1:→0×⍳0=⍴BesselFile←'Get Data' SFGETFILE 'TEXT' ⍝ Exit if user Canceled
[27] CP2:Abort←'N'                      ⍝ Set user abort code to No
[28]  N←(3⍴100)⊤NUM⍙FIELDS               ⍝ Base 100 3-vectors for times
[29] ⍝
[30] ⍝ Determine UTs for all instants where Besslian elements are needed
[31]  UT←(T[2],T[2]+I×⍳⌊(-/T←24 60 60⊥N[;2 1])÷I←24 60 60⊥N[;3])÷3600
[32]  N←READBESSEL UT ⋄ →0 ⍝ Create Besselian elements and exit
[33] ⍝
[34] ER1:EBOX 'No data file has previously been read, please select...',⎕R ⋄ →CP1
      ∇  2001-04-18 8.02.55
      ∇CLINEWINDOW;R
[1]  ⍝ Workspace: UMBRAPHILE  FUNCTION: CLINEWINDOW
[2]  ⍝ Arguments: NONE
[3]  ⍝ Results: NONE
[4]  ⍝ Functions Called: NEWWINDOW (kernal), DOCLINE, DISPOSEINDOW (kernal), TEXTOUT (kernal)
[5]  ⍝ Called by: UMBRAPHILE⍙CENTERLINE
[6]  ⍝ Implementation: APL/68000 by G. Schneider, 4/22/1993, sofTouch APpLications
[7]  ⍝
[8]  ⍝ This routine creates a new window to display centrline circumstances, computes
[9]  ⍝ the circumstances, and displays them.
[10] ⍝
[11]  'Centerline Circumstances' NEWWINDOW 12 40 0 340 558 1 1116 1 0 0 50 50 50 50 3
[12]  WATCH ⋄ R←DOCLINE ⍝ Set watch cursor and compute centerline circumstances
[13]  D←⍎(Abort='Y')/'DISPOSEWINDOW 12 ⋄ →0' ⍝ If user aborted during DOCLINE dispose of window and exit
[14]  12 TEXTOUT R ⍝ Output formated table of centerline circumstances to window
[15]  ARROW ⍝ Display arrow cursor
      ∇  2001-04-18 8.02.56
      ∇CLTIMESWINDOW;R
[1]  ⍝ Workspace: UMBRAPHILE  FUNCTION: CLTIMESWINDOW
[2]  ⍝ Arguments: NONE
[3]  ⍝ Results: NONE
[4]  ⍝ Functions Called: NEWWINDOW (kernal), DOCLTIMES, DISPOSEINDOW (kernal), TEXTOUT (kernal)
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[5]  ⍝ Called by: UMBRAPHILE∆CENTERLINECONTACTS
[6]  ⍝ Implementation: APL/68000 by G. Schneider, 7/14/1999, sofTouch APpLications
[7]  ⍝
[8]  ⍝ This routine creates a new window to display centrline circumstances, computes
[9]  ⍝ the circumstances, and displays them.
[10] ⍝
[11]  'Centerline Contacts' NEWWINDOW 17 45 5 345 515 1 1116 1 0 0 50 50 50 50 3
[12]  WATCH ⋄ R←DOCLTIMES ⍝ Set watch cursor and compute centerline circumstances
[13]  D←⍎(Abort='Y')/'DISPOSEWINDOW 17 ⋄ →0' ⍝ If user aborted during DOCLINE dispose of window and exit
[14]  17 TEXTOUT R ⍝ Output formated table of centerline circumstances to window
[15]  ARROW ⍝ Display arrow cursor
      ∇  2001-04-18 8.02.56
      ∇D COUNTER M;T;I
[1]  ⍝ Workspace: UMBRAPHILE  FUNCTION: COUNTER
[2]  ⍝ Arguments: D← Duration (MM,SS), M←Mid Eclipse (HH MM SS.ff)
[3]  ⍝ Results: NONE
[4]  ⍝ Functions Called: ERASERECT (kernal), DS
[5]  ⍝ Called by: TIMER
[6]  ⍝ Implementation: APL/68000 by G. Schneider, 4/22/1993, sofTouch APpLications
[7]  ⍝
[8]  ⍝ Update the running timers in the Timer window
[9]  ⍝
[10]  T←(24 60 60⊥M)+¯0.5 0 0.5×60 60⊥D
[11]  T←(0.001×CT)-T
[12]  T←'- +'[2+×T],'2Q⎕:⎕ZI3,ZF4.1,X2' ⎕FMT⍉24 60 60⊤|T
[13]  ERASERECT 74 146 151 287
[14]  147 90 DS T[1;]
[15]  147 120 DS T[2;]
[16]  147 150 DS T[3;]
      ∇  2001-04-18 8.02.56
      ∇R←T1 DELTATIME T2
[1]  ⍝Delta Time in secs from D H M S ms
[2]   R←0.001×-/0 24 60 60 1000⊥2 0↓T1,[1.5]T2
      ∇  2001-04-18 8.02.56
      ∇Y←O DLOG X;L;P;T;C;D
[1]  ⍝ Workspace: DEVELOP  FUNCTION: DLOG  Copyright: 1988-1999 sofTouch APpLications
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[4]  ⍝ Use by individuals with prior concent from sofTouch APpLications is granted.
[5]  ⍝ Complete documentation is available in the DEVELOP workspace user's guide,
[6]  ⍝ (internal sofTouch APpLications document).
[7]  ⍝
[8]  ⍝ Arguments: X ← Dialog design array root name, O ← Dialog placement vector
[9]  ⍝ Results: Y← Dialog exit code
[10] ⍝ Functions Called: DIALOG (kernal), MAKEDIALOG (kernal), NUMFIELDS
[11] ⍝ Called by: ++ generically available utility function ++
[12] ⍝ Implementation: APL/68000 by G. Schneider, sofTouch APpLications
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⍝
⍝ This routine handles the display processing and interpretation
⍝ of predefined dialogs.
⍝
 P←'(((4⍴30 10)+4⍴0)+(⌊≠',X,'∆P[;1 2]),⌈≠',X,'∆P[;3 4])'
 D←⍎(0=⎕NC X,'∆R')/X,'∆R←',X,'∆D' ⋄ L←⍎X,'∆R'
L1:Y←⍎X,'∆R←L[;1],',P,' DIALOG ',X,'∆P MAKEDIALOG 0 1↓',X,'∆R'
 EXIT∆FIELD←Y[;7]='1' ⋄ D←⍎(C←'1'=,1 ¯1↑¯2 7↑Y)/X,'∆R←L'
 →L1×⍳0=⍴⍴((T[;1]='1')/⍳1↑⍴T)NUMFIELDS T←⍎X,'∆R' ⋄ →0×Y←~C ⋄ Y←⍴0⍴⍎X,'∆R←L'
 ∇  2001-04-18 8.02.56
 ∇R←DOCLINE;F;K
⍝ Workspace: UMBRAPHILE  FUNCTION: DOCLINE
⍝ Arguments: NONE
⍝ Results: R ← Formated table of centerline circumstances (vector with embedded CRs)
⍝ Functions Called: CLINEPREP, CLINE, WATCH, TC
⍝ Called by: CLINE
⍝ Adopted from routine: CENTERLINE, by G. Schneider, 1/28/1977, CPU/APL-C02
⍝
⍝ This routine invokes CLINEPREP and CLINE to compute the centerline circumstances
⍝      of the eclipse for the Univrsal Times desired, then formats the results as
⍝      a table to be displayed.  Tabulation will fit inan 80 column window.
⍝
 R←⍳0             ⍝ Initialize result table to empty vector
 CLINEPREP        ⍝ Prepare Besselian elements from user supplied parameters
 →0×⍳Abort='Y'    ⍝ If user aborted in CLINEPREP then exit without going on
 WATCH            ⍝ Put up WATCH cursor when busy computing centerline circumstances
 CLINE            ⍝ Compute the centerpline circumstances of the eclipse
 K←180÷○1         ⍝ Conversion constant K ← degrees/radian
⍝
⍝ Format the centerline circumstance for display/output
 F←'ZI2,X1,ZI2,X1,ZI2,X2' ⍝ HH MM SS
 F←F,',P⎕+⎕M⎕−⎕F9.4,X1,⎕( ⎕,ZI3,X1,ZI2,X1,ZF4.1,⎕)  ⎕,P⎕+⎕M⎕−⎕ZF8.4'
 F←F,',X1,⎕( ⎕,ZI2,X1,ZI2,X1,ZF4.1,⎕)⎕'
 F←F,',2F6.1,F5.1,F6.1,F6.3,X1'
 LAM←(¯360×LAM>180)+LAM←K×(○2)|−LAM
 R←F ⎕FMT(TC UT),LAM,(TC|LAM),(K×PHI),(TC|K×PHI),|DUR,WID,(K×¯1○ALT),AZD,[1.5]ECC
 R←R,TYP
 R[;22 47]←'− +'[2+×LAM,[1.5]PHI]
 R←FNAME,⎕R,'HH MM SS  LONGITUDE                 LATITUDE               DUR s  W km ALTd AZIMd ECCEN t',⎕R,,R,⎕R
 ∇  2001-04-18 8.02.57
 ∇OUT←DOCLTIMES;CLIST;CCNT;Z;OUT;MTME;C;HDR;E
⍝ Workspace: UMBRAPHILE  FUNCTION: DOCLTIMES
⍝ Arguments: NONE
⍝ Results: R ← Formated table of centerline contacts (vector with embedded CRs)
⍝ Functions Called: DOCLINE, NUMFIELDS, SETWTITLE (kernel), ALERT (kernel)
⍝ Called by: CLINE
⍝ Adopted from routine: CENTERLINE, by G. Schneider, 7/14/1999, CPU/APL-C02
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[7]  ⍝
[8]  ⍝ This routine invokes DOCLINE to compute the centerline circumstances
[9]  ⍝      of the eclipse for a series of UTs, then formats the results as
[10] ⍝      a table to be displayed in a text window.
[11] ⍝
[12]  CLIST←DOCLINE ⍝ Get a formatted list of centerline circumstances
[13]  →E1×ι0=⍴CLIST ⍝ Check existance of centerline
[14]  MTME←¯1 0↓2 0↓(⎕R ⎕BOX CLIST)[;ι8]                ⍝ List of MAX eclipse times
[15]  CLIST←(¯1 0↓2 0↓⎕R ⎕BOX CLIST)[;(21+ι13),46+ι11] ⍝ List of Cline Coords
[16]  CLIST←(' '∨.≠CLIST)/CLIST                         ⍝ Remove blank spaces
[17] ⍝
[18]  LOCAL∆R[10;5]←' ' ⋄ CCNT←0 ⋄ OUT←0 113⍴''         ⍝ Initialize
[19] C1:→E1×ι0=⍴Z←CLIST[CCNT←CCNT+1;]                  ⍝ Do next CLINE location
[20]  LOCAL∆R[6 5;7+ι30]←2 30↑')' ⎕BOX Z               ⍝ Put Lat/Long into LOCAL dialog
[21]  LOCAL∆R[8;7+ι30]←30↑'0'                           ⍝ Set altitude to sea level
[22]  Z←5 6 8 NUMFIELDS LOCAL∆R                         ⍝ Convert to numeric with error check
[23]  R←¯1 0↓⎕R ⎕BOX DOLOCAL                            ⍝ Get and reformat local circumstances
[24]  E←17⍴1 ⋄ E[11+ι5]←pflag ⋄ E[8]←~0∊pflag ⋄ R←E⍀R  ⍝ Expand/pad for path limit contacts
[25]  R[11+ι5;5+ι16]←0 ¯16↓(16×R[11+ι5;]^.=' ')⌽R[11+ι5;5+ι16],5 16⍴'--:--:--.- ---.-'
[26]  OUT←OUT⍪113↑⎕DBR,,0 4↓R[11+ι5;]                  ⍝ Iteratively build output text table
[27]  ('Centerline Contacts ',MTME[CCNT;])SETWTITLE 17 ⍝ Update window title (compute status)
[28]  →C1×ιCCNT<1↑⍴CLIST                                ⍝ Loop for next location
[29]  ('Centerline Contacts')SETWTITLE 17               ⍝ Restore fixed window title
[30]  OUT←MTME,' ',OUT                                  ⍝ Prepend MAX times
[31]  C←':'∨.≠OUT ⋄ C[3 6]←0 ⋄ OUT←C/OUT                ⍝ Eliminate colons and extra spaces
[32]  HDR←'UT MAX 1ST CNCT ALT.  2ND CNCT ALT.  MID ECL. ALT.  3RD CNCT ALT.  4TH CNCT ALT.'
[33]  OUT←HDR,⎕R,,OUT,⎕R ⋄ →0
[34] E1:1 ALERT 'No Topocentric Centerline',⎕R,'at Times Specified' ⋄ Abort←'Y'
      ∇  2001-04-18 8.02.57
      ∇R←DOLOCAL;D
[1]  ⍝ Workspace: UMBRAPHILE  FUNCTION: DOLOCAL
[2]  ⍝ Arguments: NONE
[3]  ⍝ Results: NONE
[4]  ⍝ Functions Called: DLOG, SFGETFILE (kernal), LOCAL, EBOX
[5]  ⍝ Called by: LOCALWINDOW
[6]  ⍝ Implementation: APL/68000 by G. Schneider, 4/22/1993, sofTouch APpPications
[7]  ⍝
[8]  ⍝ This routine invokes LOCAL to compute the centerline circumstances
[9]  ⍝      of the eclipse for the Univrsal Times desired, then formats the results as
[10] ⍝      a table to be displayed.  Tabulation will fit inan 80 column window.
[11] ⍝
[12]  →IN0×ιFROM 'UMBRAPHILE∆CENTERLINECONTACTS'
[13]  →0×R←ι1≠0 0 5 5 DLOG 'LOCAL' ⍝ Display nad process the Local Circumstanced dialog
[14] IN0:
[15]  T←360 100 100⊤|NUM∆FIELDS[1 2] ⍝ Convert Latitude and Longitude to dd mm ss
[16]  Latitude←(×NUM∆FIELDS[1])×T[;1]
[17]  Longitude←-(×NUM∆FIELDS[2])×T[;2]
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[18]  MSLM←NUM∆FIELDS[3] ⍝ Altitude above mean sea level in meters
[19] ⍝
[20] ⍝ Test to see if user requests reading data file
[21]  →ER1×ι0=⎕NC 'BesselFile'  ⍝ Branch to error condition 1
[22]  →CP2×ιLOCAL∆R[10;5]≠'1'   ⍝ Don't re-read file (user request)
[23] CP1:→0×R←ι0=⍴BesselFile←'Get Data' SFGETFILE 'TEXT' ⍝ Exit if user Canceled
[24] CP2:N←(3⍴100)⊤NUM∆FIELDS  ⍝ Base 100 3-vectors for times
[25]  R←LOCAL ⋄ →0 ⍝ Compute Local circumstancs and exit
[26] ⍝
[27] ER1:EBOX 'No data file has previously been read, please select...',⎕R ⋄ →CP1
[28]  →
      ∇  2001-04-18 8.02.57
      ∇X DS T
[1]  ⍝ Workspace: DEVELOP  FUNCTION: DS  Copyright: 1988-1999 sofTouch APpLications
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[5]  ⍝ Complete documentation is available in the DEVELOP workspace user's guide,
[6]  ⍝ (internal sofTouch APpLications document).
[7]  ⍝
[8]  ⍝ Arguments: T ← text, X ← Cursor position (X,Y) pixels
[9]  ⍝ Results: NONE
[10] ⍝ Functions Called: MOVETO, DRAWSTRING
[11] ⍝ Called by: ++ generically available utility function ++
[12] ⍝ Implementation: APL/68000 by G. Schneider, sofTouch APpLications
[13] ⍝
[14] ⍝ Output textstring at specified position in current graphport
[15] ⍝
[16]  MOVETO X ⋄ DRAWSTRING T
      ∇  2001-04-18 8.02.58
      ∇A EBOX M;T∆D;T∆R;T∆P;R;Q
[1]  ⍝ Workspace: DEVLOP  FUNCTION: EBOX  Copyright: 1988-1999 sofTouch APpLications
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[5]  ⍝ Complete documentation is available in the DEVELOP workspace user's guide,
[6]  ⍝ (internal sofTouch APpLications document).
[7]  ⍝
[8]  ⍝ Results: NONE
[9]  ⍝ Arguments: A ← Horizontal placement of dialog (pixels), M← Error message
[10] ⍝ Functions Called: DLOG
[11] ⍝ Called by: ++ generically available utility function ++
[12] ⍝ Implementation: APL/68000 by G. Schneider, sofTouch APpLications
[13] ⍝
[14] ⍝ This routine displays a short⍝ supplied⍝ error message in a simple
[15] ⍝ dialog box providing an [OK] button to dismiss it.
[16] ⍝
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```
[17]  T⍙D←((2 7⍴' SD    ')⍪' BE  1 '),R←⎕R ⎕BOX M,⎕R,'OK'
[18]  T⍙P←3 4⍴0 0 16,R,20 0 32,R,3,R,30,30+R←⌈7.5×1↓⍴R ⋄ Q←⍙,(0 1=×⎕NC 'A')≠⎕BOX 'A←4⍴0 A←4⍴¯2↑A'
[19]  ⎕CC 35 ⋄ R←((4⍴0,-Q[2])+Q←A+20,Q,20,2+Q←⌊0.5×494-⌈≠T⍙P[;4])DLOG 'T'
      ∇  2001-04-18 8.02.58
      ∇Y←FMTHMS X
[1]  ⍝ Workspace: UMBRAPHILE  FUNCTION: FMTHMS
[2]  ⍝ Arguments: X ← time as HH MM SS
[3]  ⍝ Results: Y ← Formated text string of time
[4]  ⍝ Functions Called: NONE
[5]  ⍝ Called by: TIMER
[6]  ⍝ Adopted from routine: CENTERLINE, by G. Schneider, 1/28/1977, CPV/APL-C02
[7]  ⍝
[8]  ⍝ Formats HH MM SS time vector to text string as HH:MM:SS.F
[9]  ⍝
[10]  Y←'2Q⎕:⎕ZI3,ZF4.1' ⎕FMT 1 3⍴(2↑X),X[3 4]+.÷1 1000
      ∇  2001-04-18 8.02.58
      ∇R←FNAME;N
[1]  ⍝ Workspace: UMBRAPHILE  FUNCTION: FNAME
[2]  ⍝ Arguments: NONE
[3]  ⍝ Results: R ← Name of data file without path
[4]  ⍝ Functions Called: NONE
[5]  ⍝ Called by: DOCLINE
[6]  ⍝ Implementation: APL/68000 by G. Schneider, 4/22/1993, sofTouch APpLications
[7]  ⍝
[8]  ⍝ Return name of the BesselFile without path
[9]  ⍝
[10]  R←(N⍳⌈/N←+\':'=BesselFile)↓BesselFile
      ∇  2001-04-18 8.02.58
      ∇Y←FROM X
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[7]  ⍝
[8]  ⍝ Arguments: X ← Function name to test
[9]  ⍝ Results: Y ← 1 if true, 0 if false
[10] ⍝ Functions Called: None
[11] ⍝ Called by: ++ generically available utility function ++
[12] ⍝ Implementation: APL/68000 by G. Schneider, sofTouch APpLications
[13] ⍝
[14] ⍝ This function tests the calling tree to see if it has been invoked by a
[15] ⍝ function of a specified name.
[16] ⍝
[17]  Y←0≠⍴⎕SS(⎕R,⎕SI;⎕R,X,'[')
      ∇  2001-04-18 8.02.58
```

```
      ∇INFO;T
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[7]  ⍝
[8]  ⍝ Arguments: NONE (global  apid  is application identifier)
[9]  ⍝ Results: NONE
[10] ⍝ Functions Called: FONTSIZE
[11] ⍝ Called by: ++ generically available utility function ++
[12] ⍝ Implementation: APL/68000 by G. Schneider, sofTouch APpLications
[13] ⍝
[14] ⍝ Provides general information to user for contacting sofTouch APpLications.
[15] ⍝ Clears MAIN window and posts contact message in 16 point font.
[16] ⍝
[17]  ⎕CC 1 ⋄ 1 FONTSIZE 14
[18]  T←apname,'  c 1994-2001',(2⍴⎕R),'sofTouch APpLications',⎕R
[19]  T←T,'7742 E. Oakwood Circle ',⎕R
[20]  T←T,'Tucson, AZ 85750 USA',2⍴⎕R
[21]  T←T,'Phone:  1-520-296-5296',⎕R
[22]  T←T,'e-mail: gschneider@mac.com',2⍴⎕R
[23]  T←T,'World Wide Web Home Page:',⎕R
[24]  T,'http://balder.prohosting.com/stouch/UMBRAPHILE.html',⎕R
[25]  ⍞←'by Glenn Schneider' ⋄ ⎕CC 0 1 1
      ∇  2001-04-18 8.02.59
      ∇Y←V LAGRANGE F;I;C;X
[1]  ⍝ Workspace: MATHPACK  FUNCTION: LAGRANGE
[2]  ⍝ Arguments: F← F[X;Y], V ← point of evaluation
[3]  ⍝ Results: Y ← Interpolated value
[4]  ⍝ Functions Called: NONE
[5]  ⍝ Called by: ++GENERIC MATHPACK routine++
[6]  ⍝ Adopted from routine: MATHPACK, by G. Schneider, 12/15/1976, CPV/APL-C02
[7]  ⍝
[8]  ⍝ This routine performs a Lagrangian interpolation on a 2D data set to
[9]  ⍝ evaluate the value of a point V(X) in the tabulated function F[X;Y]
[10] ⍝
[11]  Y←I←0
[12]  X←F[;1]
[13]  F←F[;2]
[14] L1:C←(⍴F)⍴1
[15]  C[I←I+1]←0
[16]  Y←Y+F[I]×(×/V-C/X)÷×/X[I]-C/X
[17]  →(I≠⍴X)/L1
      ∇  2001-04-18 8.02.59
      ∇R←LOCAL;MTEX;OUT;D;UTrange
```

```
[1]  ⍝ Workspace: UMBRAPHILE  FUNCTION: LOCAL
[2]  ⍝ Arguments: NONE (Besselian elements and computed values passed as globals)
[3]  ⍝ Results: NONE (Data passed as globals)
[4]  ⍝ Functions Called: LOCALIN, READBESSEL, TIMECORR
[5]  ⍝ Called by: DOCLOCAL
[6]  ⍝ Adopted from routine: LOCAL, by G. Schneider, 1/28/1977, CPU/APL-C02
[7]  ⍝                                       Revised: 7/14/1999
[8]  ⍝                                       Revised: 9/18/2000
[9]  ⍝
[10] ⍝ This routine implements the core algorithm for computing the local
[11] ⍝      circumstances of a total or annular solar eclipse from the Besselian
[12] ⍝      elements representing the geometry⍝ position⍝ and velocity of the moon's shadow.
[13] ⍝      It also formats the results in a small text matrix for subsequent display.
[14] ⍝      The formulae employed are derived from: 'Cannon of Solar Eclipses'  by J. Meeuse
[15] ⍝      with only minor modifications.
[16] ⍝
[17]  LH←LOCALIN,2⍴⎕R ⋄ II←0 ⍝ Get the latitude and longitude forthe site in question
[18]  →0×R←⍳1=⍴UTrange←READBESSEL⍳0 ⍝ Get UT ranges for Besselian elements, exit if not valid
[19] ⍝ Compute the circumstances of the eclipse for a given place based on initial guess UT
[20] ⍝ Initial guess for UT is based on midrange of UTs for Beselian elements
[21]  CT←TIMECORR ¯1.5 ¯0.02 0 0.02 1.5+T0+0.5×+/UTrange
[22] ⍝
[23] ⍝ Iteratively converge until time correction is zero
[24] LP1:CT←TIMECORR CT ⋄ CT←CT[⍋CT]
[25]  →(10≠II←II+1)/LP1
[26] ⍝
[27] ⍝ Apply Limb Contact Corrections
[28]  MTEX←'MAX'                              ⍝ Times wrt Dynamical Center tagged as MAX
[29]  →FMTLOCAL×⍳'1'≠LOCAL∆R[12;5]           ⍝ If no limb correction format output
[30]  CT[2 4]←CT[2 4]+(CIIOFF,CIIIOFF)÷3600 ⍝ Apply CII and III Correctionss
[31]  CT[3]←0.5×+/CT[2 4]                    ⍝ Define MID eclipse wrt corrected times
[32]  MTEX←'MID'
[33] ⍝
[34] ⍝ Format the computed local circumstances for output
[35] FMTLOCAL:CTimes←⍉24 60 60⊤(3600×CT)-DELTAT
[36]  OUT←'X1,ZI2,⍞:⍞,ZI2,⍞:⍞,ZF4.1' ⎕FMT CTimes
[37]  OUT←OUT,' ',('- +'[2+×ALT]),'M⍞0⍞ZF4.1' ⎕FMT ALT×÷○÷180
[38]  OUT←pflag⌿(⎕BOX '1ST 2ND ',MTEX,' 3RD 4TH'),' ',OUT
[39]  Durs←⍉24 60 60⊤3600×-/2 2⍴CT[5 1 4 2]
[40]  D←'ZI2,⍞:⍞,ZI2,⍞:⍞,ZF4.1' ⎕FMT Durs
[41]  D←(^/2 2⍴pflag[5 1 4 2])⌿('*' ⎕BOX 'PENUMBRAL DURATION =*UMBRAL DURATION ='),D
[42]  R←⎕R,LH,(,D,⎕R),,'MAXIMUM MAGNITUDE = ',(,'F5.3' ⎕FMT mag),(2⍴⎕R),'Cnt  hh:mm:ss.f  Alt°',⎕R,,OUT,⎕R
[43]  R←R,'Limb Corrections Are ',(('1'≠LOCAL∆R[12;5])/'NOT '),'Applied.',⎕R
      ∇  2001-04-18 8.03.00
      ∇R←LOCALIN
[1]  ⍝ Workspace: UMBRAPHILE  FUNCTION: LOCALIN
[2]  ⍝ Arguments: NONE (uses globals)
```

```
[3]  ⍝ Results: R← Formated text for Lat, Long, Alt and globals
[4]  ⍝ Functions Called: NONE
[5]  ⍝ Called by: LOCAL
[6]  ⍝ Adopted from routine: CENTERLINE, by G. Schneider, 1/28/1977, CPU/APL-C02
[7]  ⍝
[8]  ⍝ This routine does a unit conversion and formatting of the topocentic
[9]  ⍝ location of a site in question for the purpose of determining local circumstances.
[10] ⍝
[11]  lam←(360 60 60⊥Longitude)÷3600×÷○÷180 ⍝ Longitude
[12]  PHI←(360 60 60⊥Latitude)÷3600×÷○÷180 ⍝ Latitude
[13]  DELTAT←0
[14]  R←7↓LOCAL∆R[11;]
[15]  R←R,⎕R,'LATITUDE:  ','+-'[1+¯1∊×S],,'ZI3,⎕° ⎕,ZI2,⎕'' ⎕,F4.1,⎕'''' ⎕' ⎕FMT 1 3⍴|S←Latitude
[16]  R←R,⎕R,'LONGITUDE: ','+-'[1+¯1∊-×S],,'ZI3,⎕° ⎕,ZI2,⎕'' ⎕,F4.1,⎕'''' ⎕' ⎕FMT 1 3⍴|S←Longitude
[17]  R←R,⎕R,'ALTITUDE:  ',(⍕MSLM),' meters'
      ∇  2001-04-18 8.03.00
      ∇R←LOCALWINDOW A
[1]  ⍝ Workspace: UMBRAPHILE  FUNCTION: LOCALWINDOW
[2]  ⍝ Arguments: NONE
[3]  ⍝ Results: NONE
[4]  ⍝ Functions Called: DOLOCAL, NEWWINDOW (kernal), FONTSIZE (kernal), WATCH (kernal), TEXTOUT (kernal), ARROW (kernal)
[5]  ⍝ Called by: UMBRAPHILE∆LOCALCIRCUMSTANCES
[6]  ⍝ Implementation: APL/68000 by G. Schneider, 4/22/1993, sofTouch APpLications
[7]  ⍝
[8]  ⍝ This routine creates a new window to display local circumstances, computes
[9]  ⍝ the circumstances, and displays them.
[10] ⍝
[11]  R←DOLOCAL ⍝ Query for location and return formated local circumstances
[12]  →0×⍳1=⍴R  ⍝ If canceled by user then exit
[13]  R←¯1↓R    ⍝ Trailing ⎕R not needed for text window
[14] ⍝
[15] ⍝ Create new window (10) for local circumstances, use site name for title
[16] L0:(⎕DBR 7↓LOCAL∆R[11;])NEWWINDOW 10,(300 30 488 230+4⍴A),1 116 1 0 0 50 50 50 50 3
[17] ⍝ Output local circumstane text to window
[18]  10 FONTSIZE 10 ⋄ WATCH ⋄ 10 TEXTOUT(1+(1↓R)⍳⎕R)↓R ⋄ ARROW
      ∇  2001-04-18 8.03.00
      ∇LOCAL∆NOON
      ∇  2001-04-18 8.03.00
      ∇R←MAKETABLE
[1]  ⍝ Workspace: UMBRAPHILE  FUNCTION: TABLEWINDOW
[2]  ⍝ Arguments: NONE
[3]  ⍝ Results: R ← Formated exposure table
[4]  ⍝ Functions Called: LOCALWINDOW, TABLE
[5]  ⍝ Called by: TABLEWINDOW
[6]  ⍝ Implementation: APL/68000 by G. Schneider, 4/22/1993, sofTouch APpLications
[7]  ⍝
[8]  ⍝ Query for location and create exposure sequence table
```

```
[9]  ⍝
[10]  R←LOCALWINDOW 0 ⍝ Get the topocentric location for the observation
[11]  →0×⍳1=⍴R ⍝ Exit if canceled by user
[12]  R←Durs[2;2 3]TABLE CTimes[3;] ⍝ Create the exposure sequence table
      ∇  2001-04-18 8.03.00
      ∇R←A MCREATE B;CODE;DATA;⎕IO
[1]  ⍝ CREATE FILE NAME B. IF A SPECIFIED, SET TYPE.
[2]   ⎕IO←1
[3]   R←1 ⎕SVO 'DATA DAT*'
[4]   CODE←FILEPROC
[5]   DATA←CODE
[6]   (,B)⌹[1000]6 1 ⋄ B←⌹[1000]6 3
[7]   DATA←B
[8]   DATA←L0 0 0 0 0
[9]   R←DATA
[10]  R←(R≠¯65536)×-R
[11]  →(0=⎕NC 'A')/0
[12]  (,A)⌹[1000]6 1 ⋄ A←2 ⎕DR 4↑⌹[1000]6 3
[13]  DATA←1 0 0 0,A
[14]  R←DATA
[15]  R←(R≠¯65536)×-R
      ∇  2001-04-18 8.03.01
      ∇I←MENUCHECK;T
[1]  ⍝ Workspace: DEVLOP  FUNCTION: PROCESSMENU  Copyright: 1988-1999 sofTouch APpLications
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[7]  ⍝
[8]  ⍝ Results: I ← Menu Selection Code
[9]  ⍝ Arguments: NONE
[10] ⍝ Functions Called: GETMENU (kernal), CHECKITEM (kernal)
[11] ⍝ Called by: ++ generically available utility function ++
[12] ⍝ Implementation: APL/68000 by G. Schneider, sofTouch APpLications
[13] ⍝
[14] ⍝ This routine polls for a menu event and passes the event code back as a result.
[15] ⍝ It also updates the MENU∆STATES array which keps track of active menu items and
[16] ⍝ provides check marks on the item lists.
[17] ⍝
[18]  →0×⍳9≥1↑I←GETMENU ⋄ I[1]←I[1]-9 ⋄ →L1×⍳(1↓⍴MENU∆STATES)<T←1+(1↓MENU∆STATES[I[1];])⍳1
[19]  MENU∆STATES[I[1];T]←0 ⋄ CHECKITEM(I[1]+9),(T-1),0
[20] L1:MENU∆STATES[I[1];I[2]+1]←1 ⋄ CHECKITEM(I[1]+9),I[2],1
[21]  MENU∆STATES[;1]←0 ⋄ MENU∆STATES[I[1];1]←1
      ∇  2001-04-18 8.03.01
      ∇I←MENUDELAY X;P;D
[1]  ⍝ Workspace: DEVLOP  FUNCTION: MENUDELAY  Copyright: 1988-1999 sofTouch APpLications
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[7]  ⍝
[8]  ⍝ Results: NONE
[9]  ⍝ Arguments: X ← Wait time (seconds) for menu polling
[10] ⍝ Functions Called: MENUCHECK , REFRESH, DRAWPICTURE (kernal)
[11] ⍝ Called by: PROCESSMENU
[12] ⍝ Implementation: APL/68000 by G. Schneider, sofTouch APpLications
[13] ⍝
[14] ⍝ This routine repetitively calls for a checks for menu events,
[15] ⍝ refreshes the main display window, and passes back an item number
[16] ⍝ for a menu processing request.
[17]  P←0
[18] L1:→(0≠+/I←MENUCHECK)/0 ⍝ If no menu selection event then exit
[19]  D←⍎(I←REFRESH)/'INFO ⋄ →0' ⍝ If menu selection event refresh scren and exit
[20]  →(X≥P←P+⎕DL 0.1)/L1 ⍝ Check again with 0.1 second delay
      ∇  2001-04-18 8.03.01
      ∇R←MREAD A;⎕IO;NAM1;NAM2
[1]  ⍝ READ FILE A[1], STARTING AT A[2], A[3] BYTES
[2]  ⍝ IF A[2] -VE, CURRENT POSITION.  IF A[3] -VE, WHOLE REMAINING FILE
[3]   ⎕IO←1 ⋄ A←3↑A,¯1 ¯1
[4]   NAM1←'⍝⍝MF',⍕A[1] ⋄ NAM2←NAM1,'SV' ⋄ →(0≠⎕NC NAM2)/⎕CL+1 ⋄ R←38 ⋄ →0
[5]   ⍎NAM2,'←6,A[2 3],0 0'
[6]   →(4=⎕DR R←⍎NAM2)/0
[7]   R←(R≠¯65536)×-R
      ∇  2001-04-18 8.03.01
      ∇R←A MTIE B;⎕IO;NAM1;NAM2;PRMS
[1]  ⍝ OPEN FILE NAME B ON TIE NUMBER A.  A[2] IS NON ZERO IF RESOURCE FORK
[2]  ⍝ A[3] IS ACCESS PERMISSIONS (0=DEFAULT, 1=RO, 2=WO, 3=RW)
[3]   ⎕IO←1 ⋄ A←3↑A ⋄ PRMS←¯2↑A ⋄ A←|1↑A
[4]   NAM1←'⍝⍝MF',⍕A ⋄ NAM2←NAM1,'SV'
[5]   R←1 ⎕SVO NAM2,' DAT*'
[6]   ⍎NAM1,'←FILEPROC'
[7]   ⍎NAM2,'←',NAM1
[8]   (,B)⌹[1000]6 1 ⋄ B←⌹[1000]6 3
[9]   ⍎NAM2,'←B'
[10]  ⍎NAM2,'←L3 0 0 ,PRMS'
[11]  R←⍎NAM2
[12]  R←(R≠¯65536)×-R
      ∇  2001-04-18 8.03.01
      ∇R←MUNTIE A;⎕IO;NAM1;NAM2
[1]  ⍝ CLOSE FILE ON TIE NUMBER A
[2]   ⎕IO←1 ⋄ A←1↑A
[3]   NAM1←'⍝⍝MF',⍕A ⋄ NAM2←NAM1,'SV' ⋄ →(0≠⎕NC NAM2)/⎕CL+1 ⋄ R←38 ⋄ →0
```

```
[4]   ⍎NAM2,'←7 0 0 0 0'
[5]   R←⍎NAM2
[6]   ⍎NAM2,'←8 0 0 0 0'
[7]   A←⎕EX ⎕BOX NAM1,' ',NAM2
[8]   R←(R≠¯65536)×-R
      ∇  2001-04-18 8.03.01
      ∇R←B MWRITE A;⎕IO;NAM1;NAM2
[1]  ⍝ WRITE TO FILE A[1], STARTING AT A[2]
[2]  ⍝ IF A[2] -VE, CURRENT POSITION.
[3]   ⎕IO←1 ⋄ A←2↑A,¯1
[4]   NAM1←'∆∆MF',⍕A[1] ⋄ NAM2←NAM1,'SV' ⋄ →(0≠⎕NC NAM2)/⎕CL+1 ⋄ R←38 ⋄ →0
[5]   ⍎NAM2,'←B'
[6]   ⍎NAM2,'←4,A[2 ],0 0 0'
[7]   R←⍎NAM2
[8]   R←(R≠¯65536)×-R
      ∇  2001-04-18 8.03.02
      ∇Y←NOON
[1]  ⍝ Workspace: UMBRAPHILE  FUNCTION: NOON
[2]  ⍝ Arguments: NONE (data obtained from Besselian element file)
[3]  ⍝ Results: Y← UT of local noon on centerline
[4]  ⍝ Functions Called: NONE
[5]  ⍝ Called by: UMBRAPHILE∆LOCALNOON
[6]  ⍝ Adopted from routine: CENTERLINE, by G. Schneider, 1/28/1977, CPV/APL-C02
[7]  ⍝
[8]  ⍝ This routine implements computes the UT of local noon for a point
[9]  ⍝ on centerline by iterative approximation.
[10] ⍝
[11] CP0:→ER1×⍳0=⎕NC 'BesselFile'       ⍝ Branch to error condition 1
[12] CP2:UTM←0.5×+/READBESSEL⍳0 ⍝ First estimate for mid-eclipse
[13]  OFF←¯1 0 1 ⍝ Offest values for numerical differencing
[14]  UTT←UTM+OFF ⍝ UT Test values from differences
[15] LP1:D←READBESSEL UTT ⍝ Get Besselian Elements for Test times
[16] ⍝ Iterate until X=0
[17]  I←¯1 0+(×X)⍳1
[18]  I←I-4=¯1↑I
[19]  F←X[1↑I]÷-/X[I]
[20]  OFF←0.1×OFF
[21]  UTT←OFF+UTM←UTT[1↑I]+|F×-/UTT[I]
[22]  →LP1×⍳OFF[3]≠1E¯7
[23]  Y←UTT[2] ⋄ →0
[24] ER1:EBOX 'No data file has previously been read, please select...',⎕R
[25]  →0×⍳0=⍴BesselFile←'Get Data' SFGETFILE 'TEXT' ⍝ Exit if user Canceled
[26]  →CP2
      ∇  2001-04-18 8.03.02
      ∇Y←NOW
[1]  ⍝ Workspace: UMBRAPHILE  FUNCTION: NOW
[2]  ⍝ Arguments: NONE
```

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[3]  ⍝ Results: Y ← U.T. from system clock with optional offset
[4]  ⍝ Functions Called: NONE
[5]  ⍝ Called by: TIMERWINDOW
[6]  ⍝ Implementation: APL/68000 by G. Schneider, 4/22/1993, sofTouch APpLications
[7]  ⍝                                  Revised: 6/24/1999
[8]  ⍝
[9]  ⍝ Get the system clock time and apply optional UT offset
[10] ⍝
[11]  Y←24 60 60 1000⊤+/((1 ¯1)[1+¯1∊×UToff],1)×24 60 60 1000⊥|UToff,[1.5]3↓⎕TS
    ∇  2001-04-18 8.03.02
    ∇Y←N NUMFIELDS D;R;I;Z
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[4]  ⍝ Use by individuals with prior concent from sofTouch APpLications is granted.
[5]  ⍝ Complete documentation is available in the DEVELOP workspace user's guide,
[6]  ⍝ (internal sofTouch APpLications document).
[7]  ⍝
[8]  ⍝ Arguments: X ← Dialog result array (name∆R), N ← Bit vector for numeric fields
[9]  ⍝ Results: Y ← Interpreted numeric values
[10] ⍝ Functions Called: EBOX
[11] ⍝ Called by: ++ generically available utility function ++
[12] ⍝ Implementation: APL/68000 by G. Schneider, sofTouch APpLications
[13] ⍝
[14] ⍝ This routine handles processes dialog result arrays to extract and
[15] ⍝ return numeric values from numeric fields.  Error checking for valid
[16] ⍝ numeric values is performed.
[17] ⍝
[18]  →(0=ρ,N)/0,Y←,L/⍳0 ⋄ R←,(0 7↓D[N;]),'⋄' ⋄ R←⎕SS(R;'+';' ')
[19]  R←⎕SS(R;'-';'¯') ⋄ Y←⍳I←0 ⋄ R←'⋄' ⎕BOX R ⋄ Z←⎕ERX ER
[20] L1:→((' '^.=R[I;]),(~^/R[I;]∊'0123456789.E+¯- '),1≠ρ,⍎R[I←I+1;])/BL,ER,ON
[21]  NUM∆FIELDS←Y←Y,⍎R[I;] ⋄ →(I≠ρN)/L1 ⋄ →0
[22] ER:160 EBOX ⎕DBR ''' ',(7↓D[N[I];]),' '' INVALID  ',⎕R,'NUMERIC ENTRY   '
[23]  Y←I ⋄ →0
[24] BL:160 EBOX 'BLANK NUMERIC ',⎕R,'FIELDS NOT ALLOWED' ⋄ Y←I ⋄ →0
[25] ON:166 EBOX '''',((⎕DBR 7↓D[N[I];]),''' ENTER'),⎕R,'ONLY ONE NUMBER '
[26]  Y←I
    ∇  2001-04-18 8.03.02
    ∇OUTPUTHI N
[1]  ⍝ Workspace: UMBRAPHILE  FUNCTION: OUTPUTHI
[2]  ⍝ Arguments: N ← Duration in seconds
[3]  ⍝ Results: NONE
[4]  ⍝ Functions Called: ERASERECT (kernal), ARBOUT (kernal), DS, FORECOLOE, ERASERECT
[5]  ⍝ Called by: TIMER
[6]  ⍝ Implementation: APL/68000 by G. Schneider, modified 6/20/1999, sofTouch APpLications
[7]  ⍝
[8]  ⍝ Send specified output signal, repetitively, through selected serial port for the
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[9]  ⍝ specifed duration.  For electromechanical interface line is held high via a
[10] ⍝ control word of '00'X (Outputval = 1).
[11] ⍝
[12] ⍝ Generate a string of output characters of required length for duration at 9600 Baud
[13]  HIGH←(⌊0.5+Charspersecond×N)⍴⎕AV[Outputval]
[14]  FORECOLOR 3↑1000 ⋄ ERASERECT 172 69 197 190 ⋄ 70 195 DS 'EXPOSING.' ⍝ Display red exposing message
[15]  Port ARBOUT HIGH ⍝ Send output character stream through serial port
[16] ⍝ Replace 'EXPOSING' message with 'WAITING' message.
[17]  FORECOLOR 0 1000 0 ⋄ ERASERECT 172 69 197 190 ⋄ 70 195 DS 'WAITING.' ⋄ FORECOLOR 3⍴1
      ∇  2001-04-18 8.03.03
      ∇PROCESSMENU;I;M;T;D;N;ET
[1]  ⍝ Workspace: DEVLOP  FUNCTION: PROCESSMENU  Copyright: 1988-1999 sofTouch APpLications
[2]  ⍝ This is a proprietary function developed by and belonging to sofTouch APpLications
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[5]  ⍝ Complete documentation is available in the DEVELOP workspace user's guide,
[6]  ⍝ (internal sofTouch APpLications document).
[7]  ⍝
[8]  ⍝ Results: NONE
[9]  ⍝ Arguments: NONE
[10] ⍝ Functions Called: MENUDELAY, SETWTITLE (kernal), INFO, ALERT (kernal), SETPORT (kernal)
[11] ⍝ Called by: ++ generically available utility function ++
[12] ⍝ Implementation: APL/68000 by G. Schneider, sofTouch APpLications
[13] ⍝
[14] ⍝ This routine responds to menu selection events and invokes primary functions as
[15] ⍝ requested by the user.
[16] ⍝
[17]  M←⎕ERX ER0 ⍝ Set up error trapping
[18] ⍝
[19] ⍝ Menu processing loop
[20] L1P:ARROW ⍝ Display arrow cursor
[21]  →((1=⍴,I)∨0=+/I←MENUDELAY 0)/L1P ⍝ Loop until a menu item is selected for processing
[22] ⍝
[23] ⍝ Process th menu item, parse name for executiuon and prepare window title
[24]  D←((N←¯1+D⍳⎕R)↑D),':',T←(2×'/'=1↑T)↓T←(⎕R ⎕BOX D←⍎M←MENU∆LIST[I[1];])[1+I[2];]
[25]  →L1P×⍳'-'=1↑T ⍝ Loop if just a menu delimiter
[26] ⍝('UMBRAPHILE')SETWTITLE 1 ⍝ Refresh application name in main window
[27]  D←0⍴⍎(N↑M),'∆',⎕SS(T;(' ';'-');'') ⍝ Execute the requested function
[28]  INFO ⋄ →L1P ⍝ Updatethe main window and loop
[29] ⍝
[30] ⍝ Error Procesing
[31] ER0:→(1 13=1↑⎕LER)/WF,IR ⋄ 2 ALERT 'UNANTICIPATED ERROR:',⎕R,⎕ERM ⋄ →RS
[32] IR:1 ALERT 'HARD INTERRUPT SIGNALED',⎕R,'CURRENT PROCESSING ABORTED'
[33] RS:SETPORT 1 ⋄ D←⎕HC 0 ⋄ INFO ⋄ →L1P
[34] WF:3 ALERT 'NOT ENOUGH MEMORY (',(⍕⌈⎕WA÷1024),'K)',⎕R,'TO CONTINUE.' ⋄ M←⎕ERX 0
      ∇  2001-04-18 8.03.03
      ∇C PTEX T;I
```

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[1]  ⍝ Workspace: DEVELOP  FUNCTION: DS  Copyright: 1988-1999 sofTouch APpLications
[2]  ⍝ This is a proprietary function developed by and belonging to sofTouch APpLications
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[5]  ⍝ Complete documentation is available in the DEVELOP workspace user's guide,
[6]  ⍝ (internal sofTouch APpLications document).
[7]  ⍝
[8]  ⍝ Arguments: C ← XY pixel locations, T ← Matrix of text strings
[9]  ⍝ Results: NONE
[10] ⍝ Functions Called: DS
[11] ⍝ Called by: ++ generically available utility function ++
[12] ⍝ Implementation: APL/68000 by G. Schneider, sofTouch APpLications
[13] ⍝
[14] ⍝ Output text strings at specified position in current graphport
[15] ⍝
[16]  I←0 ⋄ C←((0.5×⍴,C),2)⍴C
[17] L1:C[I;]DS ⎕DBR T[I←I+1;] ⋄ →(I≠1↑⍴T)/L1
      ∇  2001-04-18 8.03.03
      ∇Range←READBESSEL UT;D
[1]  ⍝ Workspace: UMBRAPHILE  FUNCTION: READBESSEL
[2]  ⍝ Arguments: UT ← Universal Times for which Besselian elements are required
[3]  ⍝ Results: UT range for valid Beselian elements
[4]  ⍝ Functions Called: MTIE (kernal), TRANSLATE (kernal)
[5]  ⍝ Called by: CLINEPREP, LOCAL, NOON, TIMECORR
[6]  ⍝ Implementation: APL/68000 by G. Schneider, 4/22/1993, sofTouch APpLications
[7]  ⍝ Update: Force null display AND ⎕R convert on file read to circumvent APL68K bug
[8]  ⍝
[9]  ⍝ This routine creates Besselian elements from the coefficients of polynomial
[10] ⍝ representations of the elements in an UMBRAPHILE data file.
[11] ⍝
[12]  D←1 MTIE BesselFile ⍝ Open the specifed data file
[13]  0⍴D←MREAD 1         ⍝ Read the data in the file (null display needed for bug in APL68K)
[14]  D←0 TRANSLATE D     ⍝ Translate from ASCII to APL
[15]  D←'⋄',⎕R ⎕BOX ⎕SS(D;('=';'E-';'-';⎕AV[139]);('←';'E¯';'¯';⎕R)) ⍝ Special character substitutions
[16]  D←⍎(,~∨\D=';')/,D   ⍝ Assign values by name for each parameter
[17]  D←MUNTIE 1          ⍝ Close file
[18] ⍝
[19] ⍝ Evaluate polynomials, Note: series coefficients are for TDT, not UT
[20]  →0×⍳0=⍴,UT ⍝ If vector of UTs not specified then exit
[21] ⍝
[22]  TDT←UT-DELTAT÷3600  ⍝ Terrestrial Dynamical Time
[23]  T←(TDT-T0)+DT←(1|TDT)÷3600 ⍝ T in hours
[24]  X←XCOEF+.×⍉T∘.*¯1+⍳⍴XCOEF
[25]  Y←YCOEF+.×⍉T∘.*¯1+⍳⍴YCOEF
[26] ⍝
[27]  →((4↑DTYPE)^.='TRIG')/BES1 ⍝ Express SIND, COSD as pr USNO or Espenak
[28] ⍝
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[29] ⍝ SIND and COSD derived as per Espenak before 1996
[30]  D←DCOEF+.×⍉T∘.*¯1+⍳⍴DCOEF
[31]  SIND←1○D×○÷180
[32]  COSD←2○D×○÷180
[33] ⍝
[34] BES1:⍝ SIND and COSD as per USNO
[35]  SIND←SINDCOEF+.×⍉T∘.*¯1+⍳⍴SINDCOEF
[36]  COSD←COSDCOEF+.×⍉T∘.*¯1+⍳⍴COSDCOEF
[37] ⍝
[38]  MU←mu←(MUCOEF[⍳¯1+⍴MUCOEF]+.×⍉T∘.*¯1+¯1↓⍳⍴MUCOEF)+(SOURCE^.='USNOAA')×DT×¯1↑MUCOEF
[39]  l1←l1COEF+.×⍉T∘.*¯1+⍳⍴l1COEF ⍝ Umbra
[40]  l2←l2COEF+.×⍉T∘.*¯1+⍳⍴l2COEF ⍝ Penumbra
[41]  XP←((1↓X)-¯1↓X)÷60×-/⌽2↑T     ⍝ First derivitive of X per hour
[42]  YP←((1↓Y)-¯1↓Y)÷60×-/⌽2↑T     ⍝ First derivarive of Y per hour
[43]  tansd←3○(○÷180)×(1 ¯1)[1+¯1∊×SD]×(90 60 60⊥|SD)÷3600 ⍝ Tanget of solar declination
[44]  MUP←mup←MUP×÷○÷180 ⍝ First derivative of mu in degrees per hour
[45] ⍝
[46] ⍝ Numerical differentiation
[47]  TDT←TDT-0.05 ⋄ T←(TDT-T0)+DT←(1|TDT)÷3600 ⍝ T in hours
[48]  X1←XCOEF+.×⍉T∘.*¯1+⍳⍴XCOEF
[49]  Y1←YCOEF+.×⍉T∘.*¯1+⍳⍴YCOEF
[50]  TDT←TDT+0.05 ⋄ T←(TDT-T0)+DT←(1|TDT)÷3600 ⍝ T in hours
[51]  X2←XCOEF+.×⍉T∘.*¯1+⍳⍴XCOEF
[52]  Y2←YCOEF+.×⍉T∘.*¯1+⍳⍴YCOEF
[53]  XP←(X2-X1)÷0.05×60
[54]  YP←(Y2-Y1)÷0.05×60
      ∇  2001-04-18 8.03.04
      ∇RED N
[1]  ⍝ Workspace: UMBRAPHILE  FUNCTION: RED
[2]  ⍝ Arguments: N ← Bit vector. 1 mean pont above horizon, 0 means point below horizon
[3]  ⍝ Results: NONE (Data passed as globals)
[4]  ⍝ Functions Called: NONE
[5]  ⍝ Called by: CLINE
[6]  ⍝ Adopted from routine: CENTERLINE, by G. Schneider, 1/28/1977, CPU/APL-C02
[7]  ⍝
[8]  ⍝ Given Besselian element values and ancillary derived data as vectors:
[9]  ⍝       SIND,COSD,MU,l2,XP,YP,B,C,COSD1,SIND1,Y1,BB and UT
[10] ⍝       reduce those vectors by eliminating points for which the sun is below horizon
[11] ⍝
[12]  SIND←N/SIND,0⍴Y←N/Y,0⍴X←N/X ⋄ UT←N/UT
[13]  YP←N/YP,0⍴XP←N/XP,0⍴l2←N/l2,0⍴MU←N/MU,0⍴COSD←N/COSD
[14]  BB←N/BB,0⍴Y1←N/Y1,0⍴SIND1←N/SIND1,0⍴COSD1←N/COSD1,0⍴C←N/C,0⍴B←N/B
      ∇  2001-04-18 8.03.04
      ∇Y←REFCOR D;C;I
[1]  ⍝ Workspace: UMBRAPHILE  FUNCTION: REFCOR
[2]  ⍝ Arguments: D ← vector of solar altitudes in degrees
[3]  ⍝ Results: Y ← correction for refraction
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[4]  ⍝ Functions Called: TIMECORR
[5]  ⍝ Called by: DOCLINE
[6]  ⍝ Adopted from routine: CENTERLINE, by G. Schneider, 1/28/1977, CPU/APL-C02
[7]  ⍝ Note: Uses Global: reftable, which are tabulated correction values
[8]  ⍝
[9]  ⍝ This routine implements a correction for atmospheric correction for the topocentric
[10] ⍝ location of the moon's shadow based on tabulated values of a mean model atmosphere.
[11] ⍝ Corrections for unrefractd solar elevations of up to 15 degrees are made
[12] ⍝ (above which they are completely negligable). Tabular fit are done by
[13] ⍝ Lagrangian interpolation.
[14] ⍝
[15]  C←1.000019705 ¯1.634543468E¯6 5.773484261E¯8 ¯1.103925605E¯9 1.196362663E¯11
[16]  Y←⍳I←0
[17] L1:→(D[I←I+1]>15)/D15
[18]  Y←Y,D[I]LAGRANGE reftable ⋄ →L1×⍳I≠⍴D ⋄ →0
[19] D15:Y←Y,(C,¯6.924605194E¯14 1.664721715E¯16)+.×⍉D[I]∘.*0,⍳6 ⋄ →L1×⍳I≠⍴D
      ∇  2001-04-18 8.03.04
      ∇Y←REFRESH
[1]  ⍝ Workspace: DEVLOP  FUNCTION: PROCESSMENU  Copyright: 1988-1999 sofTouch APpLications
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[5]  ⍝ Complete documentation is available in the DEVELOP workspace user's guide,
[6]  ⍝ (internal sofTouch APpLications document).
[7]  ⍝
[8]  ⍝ Results: NONE
[9]  ⍝ Arguments: NONE
[10] ⍝ Functions Called: GETEVENTS
[11] ⍝ Called by: MENUDELAY
[12] ⍝ Implementation: APL/68000 by G. Schneider, sofTouch APpLications
[13] ⍝
[14] ⍝ This routine checks for menu events.  Specifically modified for UMBRAPHILE
[15]  Y←∨/(2↑,GETEVENTS)^.=2 5⍴11 3 11 5 11 7 11 8 11 11
      ∇  2001-04-18 8.03.05
      ∇R←SETPORTPARMS TTEX
[1]  ⍝ Workspace: UMBRAPHILE  FUNCTION: SETPORTPARMS
[2]  ⍝ Arguments: TTEX ← Extra text to put in dialog
[3]  ⍝ Results: 0 if reprogrammed, 17 if not reprogrammed.  Global Tflg←1 if OK
[4]  ⍝ Functions Called: DLOG SETCOMMS (kernal)
[5]  ⍝ Called by: menu handling via PROCESSMENU
[6]  ⍝ Implementation: APL/68000 by G. Schneider, revised 6/21/1999, sofTouch APpLications
[7]  ⍝
[8]  ⍝ Run the UMBRAPHILE Camera Controller for solar eclipse photography
[9]  ⍝
[10] S1:R←0 ⋄ →(0=Tflg←0 DLOG 'TEST')/0 ⍝ Display and process the serial TEST dialog
[11]  Testexpdur←NUM∆FIELDS[1] ⋄ Loopdelay←NUM∆FIELDS[2] ⋄ Tduration←NUM∆FIELDS[3]
[12]  →(2≠' '+.≠Outputchar←2↑7↓TEST∆R[27;])/ERR1 ⍝ Check control char is 2 digits
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[13]  →(~^/Outputchar∊Hex←'0123456789ABCDEF')/ERR1 ⍝ Check control char is Hex
[14] ⍝ Set up bit assignments for com port specified values
[15]  Port←('1'=TEST∆R[2 3;5])/1 2
[16]  Duplex←('1'=TEST∆R[5 6;5])/0 1
[17]  Translation←('1'=TEST∆R[8 9;5])/0 1
[18]  Parity←('1'=TEST∆R[11 12 13;5])/0 1 2
[19]  Stopbits←('1'=TEST∆R[15 16;5])/1 2
[20]  Xonoff←('1'=TEST∆R[18 19 21 22;5])/0 1 2 4
[21]  Databits←('1'=TEST∆R[23 24;5])/7 8
[22]  Outputval←1+16 1+.×(¯1+⍳16)[Hex⍳Outputchar]
[23]  2 ALERT 'OK when ready to reprogram',⎕R,(TTEX/'and test'),' selected port.'
[24]  Bitsperchar←Parity+Stopbits+Databits ⍝ Compute data rate in bits per second
[25]  Charspersecond←9600÷Bitsperchar ⍝ Compute data rate in character per second
[26] ⍝ Turn on error checking and try to reprogram port
[27] S2:Z←⎕ERX ERR2 ⍝ Error code 17 will occur if port is not available
[28] S3:CLOSESERIAL Port ⍝ Close the selected Port
[29]  Port SETCOMMS 9600,Duplex,Translation,Parity,Stopbits,Xonoff,Databits
[30]  →R←0 ⍝ If no error set no error code and exit
[31] ⍝
[32] ⍝ Error processing
[33] ERR1:3 ALERT 'Test Character Must Be',⎕R,'Specified as 2 Digit Hexidecimal' ⋄ →S1
[34] ERR2:Z←⎕ERX 0 ⋄ →(⎕LER^.=R←1↑17,S3)/0 ⍝ Set not reporgrammed error code and exit
      ∇  2001-04-18 8.03.05
      ∇R←SETUP;C;STEXT;INDX
[1]  ⍝ Workspace: UMBRAPHILE  FUNCTION: SETUP
[2]  ⍝ Arguments: NONE
[3]  ⍝ Results: 0 if OK, 1 if unable to program serial port
[4]  ⍝ Functions Called: SETPORTPARMS
[5]  ⍝ Called by: UMBRAPHILE∆RUNCONTROLLER
[6]  ⍝ Implementation: APL/68000 by G. Schneider, 6/21/1999, sofTouch APpLications
[7]  ⍝
[8]  ⍝ Shell to setup the serial port parameters for the controller.
[9]  ⍝
[10] ⍝ Disable the display of the serial port test parameters in the TEST dialog
[11]  STEXT←TEST∆P[INDX←27+⍳9;]
[12]  TEST∆P[INDX;]←0
[13]  R←SETPORTPARMS 0 ⍝ Get port parameters and reset the port.
[14]  TEST∆P[INDX;]←STEXT ⍝ Re-enable display of test parameters
      ∇  2001-04-18 8.03.05
      ∇SETUPMENUS;S;T;I
[1]  ⍝ Workspace: DEVLOP  FUNCTION: SETUPMENUS  Copyright: 1988-1999 sofTouch APpLications
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[5]  ⍝ Complete documentation is available in the DEVELOP workspace user's guide,
[6]  ⍝ (internal sofTouch APpLications document).
[7]  ⍝
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[8]  ⍝ Results: NONE
[9]  ⍝ Arguments: NONE (Uses global MENU∆LIST)
[10] ⍝ Functions Called: SETMENU (kernal), DELETEMENU (kernal), DRAWMENUBAR (kernal)
[11] ⍝ Called by: ++ generically available utility function ++
[12] ⍝ Implementation: APL/68000 by G. Schneider, sofTouch APpLications
[13] ⍝
[14] ⍝ This routine sets up the menus to be processed later by PROCESSMENU
[15] ⍝
[16]  1 SETEVENTMAP(9⍴1),2,4⍴1+I←S←0
[17] L1:(I+9)SETMENU T←⍎MENU∆LIST[I←I+1;] ⋄ S←S⌈1↑⍴⎕AV[14]⎕BOX T ⋄ →L1×⍳I≠1↑⍴MENU∆LIST
[18]  DELETEMENU 2 3 5 6 7 ⋄ DRAWMENUBAR ⋄ MENU∆STATES←((1↑⍴MENU∆LIST),S)⍴0
      ∇  2001-04-18 8.03.05
      ∇R←A SFGETFILE B
[1]  ⍝ SET UP OPEN DIALOG BOX. B IS TYPE (EMPTY IF ALL)
[2]   →(0≠⎕NC 'A')/⎕CL+1 ⋄ A←'Open'
[3]   →(2=⍴⍴B)/⎕CL+1 ⋄ B←(1,⍴B)⍴B ⋄ →(0≠×/⍴B)/⎕CL+1 ⋄ B←0 4⍴' '
[4]   B←((1↑⍴B),4)↑B
[5]   A⌹[1000]16 1
[6]   B⌹[1000]16 2
[7]   R←⌹[1000]16 4
      ∇  2001-04-18 8.03.06
      ∇R←A SFPUTFILE B
[1]  ⍝ PUT UP SF PUT DIALOG, RETURN FILE NAME.
[2]  ⍝ A IS PROMPT TEXT, B IS DEFAULT FILE NAME
[3]   A⌹[1000]16 1
[4]   B⌹[1000]16 3
[5]   R←⌹[1000]16 5
      ∇  2001-04-18 8.03.06
      ∇STARTUP;D
[1]  ⍝ Workspace: UMBRAPHILE  FUNCTION: STARTUP
[2]  ⍝ Arguments: NONE
[3]  ⍝ Results: NONE
[4]  ⍝ Functions Called: ASCKEY (kernal), SETUPMENUS, UMBRAPHILE∆ABOUTUMBRAPHILE, WATCH(kernal)
[5]  ⍝                   PROCESSMENU, DISPOSEWINDOW, UMBRAPHILE∆QUIT
[6]  ⍝ Called by: ⎕LX (Function auto-executes when workspace is loaded)
[7]  ⍝ Implementation: APL/68000 by G. Schneider, 4/22/1993, sofTouch APpLications
[8]  ⍝
[9]  ⍝ This is the TOP level function for UMBRAPHILE.  Initialization, and set up
[10] ⍝ processing control.
[11] ⍝
[12]  ' ' ⋄ ASCKEY ⍝ Set ASCII character translation mode for keyboard inputs.'
[13]  INFO ⍝ Display info window with contact information
[14]  SETUPMENUS ⍝ Setup the UMBRAPHILE menus
[15]  APID←'UMBRAPHILE' ⍝ Application ID (used by generic sofTouch APpLications functions)
[16]  UMBRAPHILE∆ABOUTUMBRAPHILE ⍝ Display the 'splash' screen as application starts
[17]  WATCH ⍝ Put up WATCH cursor for remainder of application initialization
[18]  PROCESSMENU ⍝ Main Loop/Wait State for menu processing
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[19] ⍝
[20] ⍝ When done, dispose pending window and quit
[21]  DISPOSEWINDOW 11
[22]  UMBRAPHILE∆QUIT
      ∇  2001-04-18 8.03.06
      ∇R←D TABLE M
[1]  ⍝ Workspace: UMBRAPHILE  FUNCTION: TABLE
[2]  ⍝ Arguments: M is UT of Mid-Eclipse  (Hour, Minute, Second)
[3]  ⍝            D is Duration of Eclipse: Contact III - Contact II (Min,Sec)
[4]  ⍝ Results: R ← Formated exposure table
[5]  ⍝ Functions Called: WATCH (kernal), DLOG, ALERT (kernal)
[6]  ⍝ Called by: MAKETABLE
[7]  ⍝ Implementation: APL/68000 by G. Schneider, 4/22/1993, sofTouch APpLications
[8]  ⍝                                    Revised: 6/24/1999, 6/25/1999
[9]  ⍝
[10] ⍝ Run the UMBRAPHILE Camera Controller for solar eclipse photography
[11] ⍝
[12]  →ER3×⍳(2×DRNUM)≠(⍴DRSEQII,DRSEQIII) ⍝ Inconsistant Number of Exposures
[13] ⍝
[14]  DURMS←D ⋄ MID←M ⍝ Duration of totality, and UT of mid-eclipse, respectively
[15]  H←'' ⋄ WATCH
[16] ⍝
[17]  EXPDUR←DRNUM⍴DREXP ⍝ Initial Exposures for pre CII Diamond Ring
[18] ⍝ Remainder 1/2 Film-Roll Logorithmically Spaced with Maximum of EXPMAX
[19]  NEQUAL←(NUMEXP÷2)-⍴EXPDUR ⍝ Number of equally spaces exposures to mid-eclipse
[20]  BASE←(MAXEXP÷MINEXP)*÷¯1+NEQUAL ⍝ Logorithmic base for exposure durations
[21]  EXPDUR←EXPDUR,MINEXP×BASE*¯1+⍳NEQUAL ⍝ Increasing exposure durations min to max
[22]  EXPDUR←EXPDUR,⌽EXPDUR ⍝ Replicate in reverse order from mid-eclipse to CIII
[23] ⍝ Half Duration in Seconds
[24]  HD←0.5×D←60 60⊥D
[25] ⍝
[26] ⍝Times of Exposures in Seconds W.R.T. Mid-Eclipse
[27] ⍝Expouses 1-4 Taken at (Contact II) + DRSEQ Seconds
[28] ⍝Exposure 5 Taken at (Contact II) + OFFSET Seconds
[29] ⍝
[30]  DRSEQII←DRSEQII[⍋DRSEQII]
[31]  DRSEQIII←DRSEQIII[⍋DRSEQIII]
[32]  EXTIME←DRSEQII,(D×(÷¯1+2×NEQUAL)×¯1+⍳2×NEQUAL),D+|DRSEQIII
[33]  SC←|(-D÷2)+|SM←EXTIME-D÷2
[34]  EXUT←24 60 60⊤EXTIME+(24 60 60⊥M)-HD
[35] ⍝
[36] ⍝ Format exposure sequence table for display
[37]  UT←'2ZI2,ZF5.2' ⎕FMT⍉EXUT ⍝ UT of Exposure Starts
[38]  T←UT,'F8.3' ⎕FMT EXPDUR   ⍝ Duration of Exposures
[39]  T←('M⎕-⎕F7.2,⎕ ⎕' ⎕FMT EXTIME),' ',T
[40]  T←('I2,M⎕-⎕F8.2,M⎕-⎕F9.2' ⎕FMT(NUMEXP⍴⍳NUMEXP),(SC××N,⌽N←(0.5×⍴EXTIME)↑EXTIME),[1.5]SM),' ',T
[41]  R←H,¯1↓,(TIMETABLE←T,'F8.2' ⎕FMT÷EXPDUR),⎕R
```

```
[42]  EXPUT←⍉EXUT[1 2;]⍪(⌊EXUT[3;]),[0.5]⌊0.5+1000×1|EXUT[3;]
[43] ⍝
[44]  ⎕CC 1 ⍝ Clear main display window
[45] ⍝ Error processing
[46] ⍝ Check to make sure that there are no overlapping exposures
[47]  DELTAS←0.001×¯1↓-≠1 0⌽1 1∘.×24 60 60 1000⊥⍉EXPUT
[48]  →ER2×⍳0∊DELTAS>¯1↓EXPDUR ⍝ Issue error message ER2⍝ and exit with erroe code
[49] ⍝ Verify that the solenoid duty cycle does not exceed MAXDCYC o/o
[50] ⍝ Note: In future release make this a user specified parameter.
[51]  →0×⍳~(MAXDCYC÷100)∨.≤RDS←(¯1↓EXPDUR)÷DELTAS ⍝ If OK exit, otherwise issue diagnostic
[52]  MDS←100×+/EXPDUR÷Z←0.001×|-/24 60 60 1000⊥⍉EXPUT[1 36;] ⍝ Mean Duty Cycle
[53]  M←⎕DBR 'Mean Solenoid Duty Cycle = ',(5 1⍕MDS),'∘/∘ for ',(5 1⍕Z),' seconds.'
[54]  EXCEEDED←0.001×-/24 60 60 1000⊥⍉2 4⍴¯1⊖(RDS>0.01×MAXDCYC)/[1]¯1 0↓EXPUT
[55]  DCEX←100×(+/(RDS>0.01×MAXDCYC)/RDS)÷+/RDS>0.01×MAXDCYC ⍝ Time exceeded
[56]  M←(⎕DBR(⍕MAXDCYC),'∘/∘ Solenoid Duty Cycle Exceeded: ',(5 1⍕EXCEEDED),'∘/∘ for ',(5 1⍕DCEX),' seconds.'),⎕R,M
[57]  WARNING∆R←4 70↑WARNING∆R ⋄ WARNING∆R[1 2;7+⍳63]←2 63↑⎕R ⎕BOX M ⍝ Issue warning and exit with error
[58]  →0×⍳0 DLOG 'WARNING' ⋄ WATCH ⋄ WARNING∆R←4 70↑WARNING∆R ⋄ R←,1 ⋄ →0
[59] ER2:2 ALERT 'MAXEXP = ',(⍕MAXEXP),' too long,',⎕R,'must be < exposure spacing.' ⋄ R←,1
[60] ER3:1 ALERT 'DRNUM = ',(⍕DRNUM),', Not consistent with',⎕R,'DRSEQII + DRSEQIII exposures.' ⋄ R←,1
      ∇  2001-04-18 8.03.07
      ∇R←TABLEWINDOW
[1]  ⍝ Workspace: UMBRAPHILE  FUNCTION: TABLEWINDOW
[2]  ⍝ Arguments: NONE
[3]  ⍝ Results: R ← Formated exposure table
[4]  ⍝ Functions Called: MAKETABLE, NEWWINDOW, FONTSIZE, WATCH, TEXTOUT, ARROW
[5]  ⍝ Called by: UMBRAPHILE∆RUNCONTROLLER
[6]  ⍝ Implementation: APL/68000 by G. Schneider, 4/22/1993, sofTouch APpLications
[7]  ⍝
[8]  ⍝ Set up new window (19) for the exposure sequence table, and display table
[9]  ⍝
[10]  →0×⍳1=⍴R←MAKETABLE ⍝ Make the exposure squence table
[11] ⍝ Create new window with header in title bar
[12]  ('T-cont   T-mid   T+CII  UT of EXP   DURAT 1/DURAT')NEWWINDOW 19 38 299 491 640 1 1116 1 0 0 50 50 50 50 3
[13]  19 FONTSIZE 10 ⍝ Use 10 point font for exposure sequence table display
[14]  WATCH ⋄ 19 TEXTOUT R ⋄ ARROW ⍝ Output table to window
      ∇  2001-04-18 8.03.07
      ∇R←TC X
[1]  ⍝ Workspace: CONVERSIONS  FUNCTION: TC
[2]  ⍝ Arguments: X ← Array of decimal value (eg., time, declination, etc.)
[3]  ⍝ Results: R ← Conversion to base 360 60 60 (eg., HMS, DMS, etc.)
[4]  ⍝ Functions Called: NONE
[5]  ⍝ Called by: CLINE
[6]  ⍝ Adopted from routine: CENTERLINE, by G. Schneider, 1/28/1977, CPU/APL-C02
[7]  ⍝
[8]  ⍝ This function converts decimal values, in arrays of any rank or axial extent,
[9]  ⍝      to base 360 60 60, that is into a representation in units of degrees,
[10] ⍝      minutes, seconds (for example).  The last axis of the result array has
```

```
[11] ⍝      a length of 3, results are ordered on the first axis.
[12] ⍝
[13]  R←⍉360 60 60⊤X×3600
      ∇  2001-04-18 8.03.07
      ∇Y←TIME N
[1]   Y←⌊N[1 2 3],24 60 60 1000⊤86400000×1|N[3]
      ∇  2001-04-18 8.03.07
      ∇tau←TIMECORR TIME
[1]  ⍝ Workspace: UMBRAPHILE  FUNCTION: TIMECORR
[2]  ⍝ Arguments: TIME ← Etimated Universal Time of Contacts
[3]  ⍝ Results: tau ← Time plus delta correction
[4]  ⍝ Functions Called: READBESSEL
[5]  ⍝ Called by: DOCLINE
[6]  ⍝ Adopted from routine: CENTERLINE, by G. Schneider, 1/28/1977, CPU/APL-C02
[7]  ⍝
[8]  ⍝ This routine implements the core algorithm for computing the local topocentric
[9]  ⍝      circumstances of a total or annular solar eclipse from the Besselian
[10] ⍝      elements representing the geometry⍝ position⍝ and velocity of the moon's shadow.
[11] ⍝      The formulae employed are derived from: 'Cannon of Solar Eclipses'  by J. Meeuse
[12] ⍝      with only minor modifications.
[13] ⍝
[14]  cc←÷○÷180
[15]  S←0.994953+¯0.0016778 2.1E¯6+.×2○2 4×PHI
[16]  C←1.0016871+¯0.0016892 2.1E¯6+.×2○2 4×PHI
[17]  h←1.567794E¯7×MSLM ⍝ Elevation above MSL, meters → Earth Radii
[18]  RSP←(S+h)×1○PHI ⍝ Rho × Cosine(Phi')
[19]  RCP←(C+h)×2○PHI ⍝ Rho × Sine(Phi')
[20] ⍝
[21] ⍝Prediction of a solar eclipse at a given place
[22]  s1←1○○÷10800 ⍝ Sine of 1 arc minute
[23] ⍝
[24]  D←READBESSEL TIME
[25] ⍝
[26]  H←(○÷180)×mu-(lam÷○÷180)+360×1.00274×DELTAT÷86400
[27]  psi←RCP×1○H
[28]  eta←(RSP×COSD)-(RCP×2○H)×SIND
[29]  ls←(RSP×SIND)+(RCP×2○H)×COSD
[30] ⍝
[31]  ALT←¯1○((1○PHI)×SIND)+(2○PHI)×COSD×2○H
[32]  S←REFCOR cc×ALT  ⍝ Correction for atmospheric refraction for low solar altitudes
[33]  psi←S×psi
[34]  eta←S×eta
[35]  ls←S×ls
[36] ⍝
[37]  psip←(MUP×s1)×RCP×2○H
[38]  etap←(MUP×s1)×psi×SIND
[39] ⍝
```

```
[40]  u←X-psi
[41]  v←Y-eta
[42]  up←XP-psip
[43]  vp←YP-etap
[44]  L1←l1-ls×tanf1
[45]  L2←l2-ls×tanf2
[46]  n←((up*2)+vp*2)*0.5
[47] ⍝
[48] ⍝Determine Contact Times
[49]  sinus←((u×vp)-up×v)÷n×L1[1],L2[2],1,L2[3],L1[4]
[50]  pflag←1>|sinus
[51]  us←¯1○sinus×pflag
[52]  mtau←((u×up)+(v×vp))÷n*2
[53]  utau←(((-L1[1],L2[2]),0,L2[3],L1[4])×2○us)÷n
[54]  tau←utau-mtau
[55]  tau←TIME+tau÷60
[56] ⍝
[57]  DELTA←|((u×vp)-up×v)÷n
[58]  mag←(L1[3]-DELTA[3])÷L1[3]+L2[3]
[59]  rat←(L1-L2)÷L1+L2
[60] ⍝
[61] ⍝  npa←1 1 1 1 1×¯3○up÷vp ⍝ Position Angle N of Contact
[62] ⍝  ppa←npa+us ⍝ Position Angle P of Contact
[63] ⍝  zpa←¯3○q←ls÷eta ⍝ Position Angle Z of Contact (REQ QUAD)
[64]  mag←0.5×+/((L1-|((u×vp)-up×v)÷n)÷L1+L2)[2 3]
      ∇  2001-04-18 8.03.08
      ∇R←TIMEINMS X
[1]  ⍝ Arguments: X ← Array of decimal time values
[2]  ⍝ Results: R ← Conversion to base 4 60 60 1000 (HH MM SS millisecond)
[3]  ⍝ Functions Called: NONE
[4]  ⍝ Called by: TIMER
[5]  ⍝ Adopted from routine: CENTERLINE, by G. Schneider, 1/28/1977, CPV/APL-C02
[6]  ⍝
[7]  ⍝ This function converts decimal values, in arrays of any rank or axial extent,
[8]  ⍝      to base 24 60 60 1000, that is into a representation in units of hours,
[9]  ⍝      minutes, seconds and msec.  The last axis of the result array has
[10] ⍝      a length of 3, results are ordered on the first axis.
[11] ⍝
[12]  R←24 60 60 1000⊤⍉X
      ∇  2001-04-18 8.03.08
      ∇TIMER;D
[1]  ⍝ Workspace: UMBRAPHILE  FUNCTION: TIMER
[2]  ⍝ Arguments: NONE
[3]  ⍝ Results: NONE
[4]  ⍝ Functions Called: SETPORT (kernal), FONTSIZE (kernal), DS, ERASERECT (kernal)
[5]  ⍝                   FMTHMS, TIMEINMS, SETWTITLE (kernal), FORECOLOR (kernal), COUNTER
[6]  ⍝                   OUTPUTHI, INVERTRECT (kernal), ERASERECT (kernal), ALERT (kernal)
```

```
[7]  ⍝ Called by: TIMERWINDOW
[8]  ⍝ Implementation: APL/68000 by G. Schneider, 4/22/1993, sofTouch APpLications
[9]  ⍝                                   Revised: 6/24/1999
[10] ⍝
[11] ⍝ Setup and iteratvely update information in timer and sequence table windows, while
[12] ⍝ calling for control word output through serial port.
[13] ⍝
[14]  SETPORT 14 ⋄ I←1 ⍝ Timer window id is 14
[15]  14 FONTSIZE 20 ⍝ Write the clocks and time info in big font (size 20)
[16]  2 20 DS 'UT Next Ex  ∆T Next Ex' ⍝ Clock headers
[17]  2 90 DS '∆T Con 2 ='   ⍝ Clock 1 counts down (or away from) CII
[18]  2 120 DS '∆T Mid   ='  ⍝ Clock 2 counts down (or away from) mid-eclipse
[19]  2 150 DS '∆T Con 3 ='  ⍝ Clock 3 counts down (or away from) CIII
[20] ⍝ Update/Display timing information
[21]  ERASERECT 27 1 43 131 ⋄ 2 42 DS FMTHMS EXPUT[1;] ⋄ E←EXPDUR
[22]  T←TIMEINMS EXPUT ⍝ Convert time format to HH MM SS msec
[23]  D←⎕ERX L9 ⍝ Set up local error trapping to allow user abort from timer loop
[24] ⍝ Main TIMER loop
[25] L1:R←T[1]-CT←24 60 60 1000⊥C←NOW ⍝ Compute time offset from UT
[26] ⍝ Update window header with UT and time of next exposure
[27]  ('U.T. = ',(,FMTHMS C),'  -  Next ',,'ZI2,⎕ / ⎕,F5.3' ⎕FMT 1 2⍴I,1↑E)SETWTITLE 14
[28]  ERASERECT 27 157 43 287 ⋄ 158 42 DS FMTHMS 24 60 60 1000⊤R⌈0
[29] ⍝
[30]  →WARN×⍳10=⌊0.001×R ⍝ If only 10 seconds to totality...
[31] ⍝
[32] L2:DURMS COUNTER MID ⍝ Update the running timers
[33]  →L1×⍳1=×1↑R  ⍝ If not time to start a new exposure then loop
[34] ⍝
[35] ⍝ It's time to start a new exposure
[36]  ⎕AV[136] ⍝ Issue ingle audio alarm when starting new exposure
[37]  OUTPUTHI E[1] ⍝ Send control word through serial port for duration of expsoure
[38]  T←1↓T ⋄ E←1↓E ⍝ Drop first element of time and duration vectors (next exposure)
[39] ⍝
[40] ⍝ Invert the line just executed in the exposure sequence table display
[41]  SETPORT 19 ⋄ INVERTRECT(2+12×I-1),0,(2+12+12×I-1),326 ⋄ SETPORT 14
[42]  →0×⍳(1+NUMEXP)=I←I+1 ⍝ If last exposure then exit
[43]  ERASERECT 27 1 43 131 ⋄ 2 42 DS FMTHMS EXPUT[I;] ⍝ If not update time and loop
[44]  →L1
[45] ⍝
[46] WARN:⍝ Flash message to remove filters from camera and audio alarm
[47]  FORECOLOR 3↑1000 ⋄ 60 220 DS '→ FILTERS OFF ← ' ⋄ FORECOLOR 3⍴1
[48]  10⍴⎕AV[136] ⋄ D←⎕DL 1 ⍝ sound audible alarm 10 times, wait 1 second
[49]  →L2 ⍝ Go To TOTALITY...
[50] ⍝
[51] ⍝ Error/Interrupt handling
[52] L9:D←⎕ERX 0 ⋄ D←⎕LER
[53]  Z←⍎(13=1↑D)/'1 ALERT ''Hard Interrupt Detected'',⎕R,''Controller Terminated''⋄ →0'
```

```
[54]  1 ALERT 'Program Error Detected',⎕R,'Report UMBRAPHILE Diagnostic'
[55]  ⎕PW←132
      ∇  2001-04-18 8.03.09
      ∇TIMERWINDOW
[1]   ⍝ Workspace: UMBRAPHILE  FUNCTION: TIMERWINDOW
[2]   ⍝ Arguments: NONE
[3]   ⍝ Results: NONE
[4]   ⍝ Functions Called: NEWWINDOW, TIMER, DISPOSEWINDOW
[5]   ⍝ Called by: UMBRAPHILE∆RUNCONTROLLER
[6]   ⍝ Implementation: APL/68000 by G. Schneider, 4/22/1993, sofTouch APpLications
[7]   ⍝
[8]   ⍝ Create new window (14) for Timer and start Timer function
[9]   ⍝
[10]  '' NEWWINDOW 14 38 2 270 294 1 16 1 0 0 50 50 50 50 1
[11]  TIMER ⋄ DISPOSEWINDOW 14
      ∇  2001-04-18 8.03.09
      ∇UMBRAPHILE∆ABOUTUMBRAPHILE
[1]   ⍝ Workspace: UMBRAPHILE  FUNCTION: UMBRAPHILE∆ABOUTUMBRAPHILE
[2]   ⍝ Arguments: NONE
[3]   ⍝ Results: NONE
[4]   ⍝ Functions Called: NEWWINDOW, SETPORT, DRAWPICTURE, DISPOSEWINDOW
[5]   ⍝ Called by: STARTUP and menu handling via PROCESSMENU
[6]   ⍝ Implementation: APL/68000 by G. Schneider, 4/22/1993, sofTouch APpLications
[7]   ⍝                                Modified:  9/18/2000
[8]   ⍝
[9]   ⍝ Display the 'splash' scren for UMBRAPHILE
[10]  ⍝
[11]  'UMBRAPHILE  SHAREWARE  by  sofTouch APpLications' NEWWINDOW 12 38 0 340 510 1 16 1 0 0 50 50 50 50 0
[12]  SETPORT 12 ⋄ DRAWPICTURE IPIC ⋄ DRAWPICTURE IPIC
[13]  D←180 140 180 146 DLOG 'OK' ⋄ SETPORT 11 ⋄ DISPOSEWINDOW 12
      ∇  2001-04-18 8.03.09
      ∇UMBRAPHILE∆CENTERLINE
[1]   ⍝ Workspace: UMBRAPHILE  FUNCTION: UMBRAPHILE∆CENTERLINE
[2]   ⍝ Arguments: NONE
[3]   ⍝ Results: NONE
[4]   ⍝ Functions Called: CLINEWINDOW
[5]   ⍝ Called by: NONE (Invoked by menu handler)
[6]   ⍝ Implementation: APL/68000 by G. Schneider, 4/22/1993, sofTouch APpLications
[7]   ⍝
[8]   ⍝ This is a cover function by name to invoke the CENTERLINE routines in UMBRAPHILE
[9]   ⍝ using standard sofTouch APpLications menu handling
[10]  ⍝
[11]  CLINEWINDOW
      ∇  2001-04-18 8.03.09
      ∇UMBRAPHILE∆CENTERLINECONTACTS
[1]   ⍝ Workspace: UMBRAPHILE  FUNCTION: UMBRAPHILE∆CENTERLINECONTACTS
[2]   ⍝ Arguments: NONE
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[3]  ⍝ Results: NONE
[4]  ⍝ Functions Called: CLTIMESWINDOW
[5]  ⍝ Called by: NONE (Invoked by menu handler)
[6]  ⍝ Implementation: APL/68000 by G. Schneider, 7/14/1999, sofTouch APpLications
[7]  ⍝                                Modified:  9/18/2000
[8]  ⍝
[9]  ⍝ This is a cover function by name to invoke the CENTERLINE routines in UMBRAPHILE
[10] ⍝ using standard sofTouch APpLications menu handling
[11] ⍝
[12]  CLTIMESWINDOW
      ∇  2001-04-18 8.03.09
      ∇UMBRAPHILE∆GETSETTINGS;F;D;X;E;I;T;N
[1]  ⍝ Workspace: DEVLOP  FUNCTION: WSNAME∆GETSETTINGS  Copyright: 1988-1999 sofTouch APpLications
[2]  ⍝ This is a proprietary function developed by and belonging to sofTouch APpLications
[3]  ⍝ Distribution and reproduction for commercial use is prohibited.
[4]  ⍝ Use by individuals with prior concent from sofTouch APpLications is granted.
[5]  ⍝ Complete documentation is available in the DEVELOP workspace user's guide,
[6]  ⍝ (internal sofTouch APpLications document).
[7]  ⍝
[8]  ⍝ Results: NONE
[9]  ⍝ Arguments: NONE
[10] ⍝ Kernal Functions Called: SFGETFILE, MTIE, MREAD, MUNTIE, ARROW, ALERT, AFE, WATCH
[11] ⍝ Called by: PROCESSMENU and ++ generically available utility function ++
[12] ⍝ Implementation: APL/68000 by G. Schneider, sofTouch APpLications
[13] ⍝
[14] ⍝ This routine restores all dialog design and position arrays which were
[15] ⍝ previously saved in a user specified file.
[16] ⍝
[17] L0:→0×⍳0=⍴F←,'RESTORE' SFGETFILE 'UmbR' ⋄ WATCH ⍝ Note: File type for UMBRAPHILE is: UmbR
[18]  →ER×⍳0≠E←1 0 1 MTIE F ⋄ →ER×⍳X←0=1↑0⍴1↑T←MREAD 1 ⋄ →ER×⍳0≠E←MUNTIE 1
[19]  X←⎕SS(T;'⋄') ⋄ I←0
[20] L1:D←⎕R ⎕BOX X[I]↓(¯1+X[1+I←I+1])↑T ⋄ N←1 0↓¯1 0↓D
[21]  E←⍎('←'∊D[1;])/D[1;],'N' ⋄ →L1×⍳I≠¯1+⍴X ⋄ ARROW ⋄ →0
[22] ER:D←⍎X/'E←T' ⋄ 1 ALERT AFE E ⋄ ARROW
      ∇  2001-04-18 8.03.10
      ∇UMBRAPHILE∆HELP;P
[1]  ⍝ Workspace: DEVLOP  FUNCTION: WSNAME∆HELP  Copyright: 1988-1999 sofTouch APpLications
[2]  ⍝ This is a proprietary function developed by and belonging to sofTouch APpLications
[3]  ⍝ Distribution and reproduction for commercial use is prohibited.
[4]  ⍝ Use by individuals with prior concent from sofTouch APpLications is granted.
[5]  ⍝ Complete documentation is available in the DEVELOP workspace user's guide,
[6]  ⍝ (internal sofTouch APpLications document).
[7]  ⍝
[8]  ⍝ Results: NONE
[9]  ⍝ Arguments: NONE
[10] ⍝ Kernal Functions Called: NEWWINDOW, SETPORT, FONTSIZE, TEXTOUT, DISPOSEWINDOW
[11] ⍝ Non-Kernal Functions Called: DLOG
```

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[12] ⍝ Called by: PROCESSMENU and ++ generically available utility function ++
[13] ⍝ Implementation: APL/68000 by G. Schneider, sofTouch APpLications
[14] ⍝
[15] ⍝ This routine responds saves all dialog design and position arrays
[16] ⍝ to a user specified file for later restoration.
[17] ⍝
[18]  (APID,'/HELP')NEWWINDOW 12 38 0 340 510 1 16 1 0 0 50 50 50 50 1
[19]  SETPORT 12 ⋄ FONTSIZE 10
[20]  12 TEXTOUT HELP1
[21]  P←230 400 230 405 DLOG 'OK' ⋄ DISPOSEWINDOW 12 ⋄ SETPORT 11
      ∇  2001-04-18 8.03.10
      ∇UMBRAPHILE∆LOCALCIRCUMSTANCES;D
[1]  ⍝ Workspace: UMBRAPHILE  FUNCTION: UMBRAPHILE∆LOCAL∆CIRCUMSTANCES
[2]  ⍝ Arguments: NONE
[3]  ⍝ Results: NONE
[4]  ⍝ Functions Called: LOCALWINDOW
[5]  ⍝ Called by: NONE (Invoked by menu handler)
[6]  ⍝ Implementation: APL/68000 by G. Schneider, 4/22/1993, sofTouch APpLications
[7]  ⍝
[8]  ⍝ This is a cover function by name to invoke the CENTERLINE routines in UMBRAPHILE
[9]  ⍝ using standard sofTouch APpLications menu handling
[10] ⍝
[11]  D←⍴LOCALWINDOW ¯250 20
      ∇  2001-04-18 8.03.10
      ∇UMBRAPHILE∆LOCALNOON;T∆R;R
[1]  ⍝ Workspace: UMBRAPHILE  FUNCTION: UMBRAPHILE∆LOCALNOON
[2]  ⍝ Arguments: NONE
[3]  ⍝ Results: NONE
[4]  ⍝ Functions Called: DOCLINE, UMBRAPHILE∆LOCALCIRCUMSTANCES
[5]  ⍝ Called by: menu handling by PROCESSMENU
[6]  ⍝ Adopted from routine: CENTERLINE, by G. Schneider, 1/28/1977, CPU/APL-C02
[7]  ⍝
[8]  ⍝ This routine computs the local circumstances of an eclipse for the local
[9]  ⍝ noon point.  For eclipses )above th pole≠ this may actually be the point
[10] ⍝ of local midnight.
[11] ⍝
[12]  T∆R←CLINE∆R ⍝ Save the CLINE dialog result arra
[13] ⍝
[14] ⍝ Compute the UT for local noon and update the CLINE dialog entries
[15]  CLINE∆R[7 8;7+⍳14]←2 14⍴14↑,'ZI2,ZI2,F4.1' ⎕FMT 1 3⍴24 60 60⊤3600×NOON
[16]  CLINE∆R[9;7+⍳14]←14↑'000000'
[17]  CLINE∆R[10;5]←' '
[18]  R←DOCLINE      ⍝ Compute the centerline circumstances for the location of local noon
[19]  CLINE∆R←T∆R    ⍝ Restore the CLINE dialog result array
[20]  →0×⍳Abort='Y' ⍝ Exit if user canceled
[21]  R←⎕R ⎕BOX R    ⍝ Partition into text matrix
[22] ⍝
```

```
[23]  T∆R←LOCAL∆R   ⍝ Save the LOCAL dialog result array
[24] ⍝
[25] ⍝ Update the Lat, Long, in the LOCAL dialog aray for UT of local noon
[26]  LOCAL∆R[5;7+⍳14]←14↑(' '≠T)/T←R[3;46+⍳11]
[27]  LOCAL∆R[6;7+⍳14]←14↑(' '≠T)/T←R[3;21+⍳12]
[28]  LOCAL∆R[10;5]←' '
[29]  LOCAL∆R[11;7+⍳14]←14↑'Noon-Centerline'
[30]  UMBRAPHILE∆LOCALCIRCUMSTANCES  ⍝ Compute local circumstances for point of local noon
[31]  LOCAL∆R←T∆R ⍝ Restore the LOCAL dialog result array
      ∇  2001-04-18 8.03.10
      ∇UMBRAPHILE∆NOON
      ∇  2001-04-18 8.03.10
      ∇UMBRAPHILE∆QUIT
[1]  ⍝ Workspace: UMBRAPHILE  FUNCTION: UMBRPHILE∆QUIT
[2]  ⍝ Arguments: NONE
[3]  ⍝ Results: NONE
[4]  ⍝ Functions Called: ALERT
[5]  ⍝ Called by: STARTUP and menu handling by PROCESSMENU
[6]  ⍝ Implementation: APL/68000 by G. Schneider, 4/22/1993, sofTouch APpLications
[7]  ⍝
[8]  ⍝ This function terminates UMBRAPHILE
[9]  ⍝
[10]  2 ALERT 'So Long from UMBRAPHILE',⎕R,'by sofTouch APpLications'
[11]  ⍎')SICLEAR'
      ∇  2001-04-18 8.03.11
      ∇UMBRAPHILE∆RUNCONTROLLER
[1]  ⍝ Workspace: UMBRAPHILE  FUNCTION: UMBRAPHILE∆RUNCONTROLLER
[2]  ⍝ Arguments: NONE
[3]  ⍝ Results: NONE
[4]  ⍝ Functions Called: DLOG, SETUP, ALERT (kernal),TABLEWINDOW, TIMERWINDOW, DISPOSEWINDOW (kernal)
[5]  ⍝ Called by: menu handling via PROCESSMENU
[6]  ⍝ Implementation: APL/68000 by G. Schneider, revised 6/21/1999, sofTouch APpLications
[7]  ⍝
[8]  ⍝ Run the UMBRAPHILE Camera Controller for solar eclipse photography
[9]  ⍝
[10] RC0:→0×⍳0=0 DLOG 'APPLETALK'      ⍝ Display and process the APPLETALK dialog
[11]  TEST∆R[2 3;5]←APPLETALK∆R[2 3;5]  ⍝ Set the test port to the specifed port
[12]  →(0=SETUP)/RC1 ⍝ Attempt to up the selected serial port, jump over error if OK
[13]  1 ALERT 'UNABLE TO ACCESS SELECTED',⎕R,'PORT, PLEASE CHECK/RESELECT...'
[14]  →RC0  ⍝ Allow user to try again with a different port specification
[15] RC1:APPLETALK∆R[2 3;5]←TEST∆R[2 3;5] ⍝ Set the specified port to the test port
[16]  →(~Tflg)/0                            ⍝ If the user cancelled then exit
[17]  →0×⍳1=⍴TABLEWINDOW ⍝ Set up the exposure index table
[18]  →ER×⍳0=0 0 10 0 DLOG 'NOW' ⍝ Query for a system clock offset from U.T.
[19]  UToff←(×S)×(LN),¯1↑1000×N←,100 100 100⊤|S←NUM∆FIELDS ⍝ Compute the UT offset for the clock
[20]  TIMERWINDOW ⋄ →0 ⍝ Create the Timer window
[21] ⍝ Error Handling
```

```
[22] ER:→0
     ∇  2001-04-18 8.03.11
     ∇UMBRAPHILE∆SAVESETTINGS;N;L;T;F;E;D;I
[1]  ⍝ Workspace: DEVLOP  FUNCTION: WSNAME∆SAVESETTINGS  Copyright: 1988-1999 sofTouch APpLications
[2]  ⍝ This is a proprietary function developed by and belonging to sofTouch APpLications
[3]  ⍝ Distribution and reproduction for commercial use is prohibited.
[4]  ⍝ Use by individuals with prior concent from sofTouch APpLications is granted.
[5]  ⍝ Complete documentation is available in the DEVELOP workspace user's guide,
[6]  ⍝ (internal sofTouch APpLications document).
[7]  ⍝
[8]  ⍝ Results: NONE
[9]  ⍝ Arguments: NONE
[10] ⍝ Kernal Functions Called: SFPUTFILE, WATCH, MCREATE, MTIE, MWRITE, MUNTIE, ARROW, ALERT, AFE
[11] ⍝ Called by: PROCESSMENU and ++ generically available utility function ++
[12] ⍝ Implementation: APL/68000 by G. Schneider, sofTouch APpLications
[13] ⍝
[14] ⍝ This routine saves all dialog design and position arrays
[15] ⍝ to a user specified file for later restoration.
[16] ⍝
[17] L0:→0×⍳0=⍴F←,'UMBRAPHILE SETTINGS FILE NAME' SFPUTFILE '' ⋄ WATCH ⋄ T←⍴I←0 ⋄ N←VMAT 'R∆'
[18] L1:T←T,'⋄',N[I;],'←',(⍕⍴⍎N[I;]),'⍴',⎕R,(⎕R ⎕BOX⍎N[I←I+1;],⎕R),⎕R ⋄ →L1×⍳I≠1↑⍴N
[19]  →ER×⍳0≠E←'UmbR' MCREATE F ⍝ Note: File type for UMBRAPHILE is: UmbR
[20]  →ER×⍳0≠E←1 MTIE F ⋄ →ER×⍳0≠E←T MWRITE 1 ⋄ →ER×⍳0≠E←MUNTIE 1 ⋄ ARROW ⋄ →0
[21] ER:1 ALERT AFE E ⋄ ARROW
     ∇  2001-04-18 8.03.11
     ∇UMBRAPHILE∆SAVEWINDOW;D;M;WT;OK;Z;T∆R;T∆P;W
[1]  ⍝ Workspace: UMBRAPHILE  FUNCTION: UMBRAPHILE∆SAVEWINDOW
[2]  ⍝ Arguments: NONE
[3]  ⍝ Results: NONE
[4]  ⍝ Functions Called: GETEVENTMAP (kernal), GETWTITLE (kernal), DLOG, MCREATE (kernal)
[5]  ⍝                   MTIE (kernal), TRANSLATE (kernal), GETWIN (kernal), MWRITE (kernal)
[6]  ⍝                   MUNTIE (kernal), ALERT (kernal)
[7]  ⍝ Called by: menu handling via PROCESSMENU
[8]  ⍝ Implementation: APL/68000 by G. Schneider, revised 6/21/1999, sofTouch APpLications
[9]  ⍝
[10] ⍝ Save the content of a specified text window to an ASCII file
[11] ⍝
[12]  M←⎕ERX NEXT ⍝ Set up local error trapping
[13]  WT←'' ⋄ I←10 ⋄ OK←⍳0 ⍝ Initialize iteration loop
[14] S1:Z←GETEVENTMAP I ⍝ Get the event mapping for the first possible window
[15] ⍝ If window is not in use error trapping will go to NEXT
[16]  OK←OK,I ⋄ WT←WT,(GETWTITLE I),⎕R ⍝ Vectors of in-use windows, and window titles
[17] NEXT:→(20≠I←I+1)/S1 ⍝ Test for next possible window
[18]  M←⎕ERX 0 ⍝ Turn off error checking
[19]  →(0=⍴,OK)/ERR1 ⍝ If no text windows open generate alert and exit
[20] ⍝ Build and execute dialog to query for which window to print
[21]  T∆R←(((⍴OK),7)⍴' RE1 11'),⎕R ⎕BOX ¯1↓WT
```

```
[22]  T∆R←((⍴OK),28⌈1↓⍴T∆R)↑T∆R ⋄ T∆R[1;5]←'1'
[23]  T∆R←((28⌈1↓⍴T∆R)↑' SD    SELECT WINDOW TO SAVE'),[1]T∆R
[24]  T∆P←0 0 16 200,[1](0,(⍉0 16∘.+20×⍳⍴OK),200)[;2 1 3 4]
[25]  Z←0 DLOG 'T'
[26]  W←('1'=1↓T∆R[;5])/OK ⍝ See which window the user selected and get it's number
[27]  Z←'TEXT' MCREATE FN←'' SFPUTFILE '' ⍝ Create new text file through requestor dialog
[28]  Z←5 MTIE FN ⍝ Open the TEXT file
[29]  Z←(1 TRANSLATE(GETWTITLE W),⎕R,GETWIN W)MWRITE 5 ⍝ Write the title and content out as ASCII
[30]  Z←MUNTIE 5 ⋄ →0 ⍝ Close the file and exit
[31] ⍝ Error handing
[32] ERR1:2 ALERT 'There are no open windows',⎕R,'to save.'
      ∇  2001-04-18 8.03.11
      ∇UMBRAPHILE∆TESTSERIALPORT;Z;D;NLOOPS;LOOPCOUNT
[1]  ⍝ Workspace: UMBRAPHILE  FUNCTION: UMBRAPHILE∆TESTSERIALPORT
[2]  ⍝ Arguments: NONE
[3]  ⍝ Results: NONE
[4]  ⍝ Functions Called: DLOG, SETPORTPARMS, ALERT (kernal), OUTPUTHI
[5]  ⍝ Called by: menu handling via PROCESSMENU
[6]  ⍝ Implementation: APL/68000 by G. Schneider, revised 6/21/1999, sofTouch APpLications
[7]  ⍝
[8]  ⍝ Run the UMBRAPHILE Camera Controller for solar eclipse photography
[9]  ⍝
[10] RC0:→0×⍳0=0 DLOG 'APPLETALK'      ⍝ Display and process the APPLETALK dialog
[11]  TEST∆R[2 3;5]←APPLETALK∆R[2 3;5]  ⍝ Set the test port to the specifed port
[12]  LOOPCOUNT←¯1+Loopdelay←1          ⍝ Initialize the Loop counter
[13]  ⎕CC 1
[14]  →(0=SETPORTPARMS 1)/RC1   ⍝ Attempt to up the selected serial port, jump over error if OK
[15]  1 ALERT 'UNABLE TO ACCESS SELECTED',⎕R,'PORT, PLEASE CHECK/RESELECT...'
[16]  →RC0 ⍝ Allow user to try again with a different port specification
[17] RC1:APPLETALK∆R[2 3;5]←TEST∆R[2 3;5] ⍝ Set the specified port to the test port
[18]  →(~Tflg)/0                            ⍝ If the user cancelled then exit
[19] ⍝ Use MAIN text window for serial port test status
[20]  'SERIAL PORT TEST'
[21]  '('' Apple '' + ''.'' TWICE to Interrupt)',⎕R
[22]  '   Test Duration: ',(⍕Tduration),' seconds.'
[23]  '   Exposure Time: ',(⍕Testexpdur),' seconds.'
[24]  '   Time Between Exposures: ',(⍕Loopdelay),' seconds.'
[25]  '   Number of Exposures:    ',⍕NLOOPS←1⌈⌊Tduration÷Testexpdur+Loopdelay
[26]  Z←⎕ERX ERR1 ⍝ Turn on local error trapping to allow user interruption
[27] T1:⎕CC 0 8 6 ⋄ 'Exposure: ',⍕1+LOOPCOUNT  ⍝ Post updated status message to scren
[28] ⍝ Send control chracater stream over port, wait, repeat if required
[29]  ⎕AV[136] ⍝ Issue ingle audio alarm when starting new exposure
[30]  OUTPUTHI Testexpdur ⋄ D←⎕DL Loopdelay ⋄ →(NLOOPS≠LOOPCOUNT←LOOPCOUNT+1)/T1
[31] ⍝ Turn off error checking, indicate test completion and exit
[32]  Z←⎕ERX 0 ⋄ ⎕CC 1 ⋄ 2 ALERT 'Serial Port Test',⎕R,'COMPLETED' ⋄ →0
[33] ⍝ Error handling
[34] ERR1:Z←⎕ERX 0 ⋄ ⎕CC 1 ⋄ 2 ALERT 'Serial Port Test',⎕R,'INTERRUPTED' ⋄ →0
```

```
      ∇  2001-04-18 8.03.12
      ∇Y←VMAT T
[1]   ⍝ Workspace: DEVELOP  FUNCTION: VMAT  Copyright: 1988-1999 sofTouch APpLications
[2]   ⍝ This is a proprietary function developed by and belonging to sofTouch APpLications
[3]   ⍝ Distribution and reproduction for commercial use is prohibited.
[4]   ⍝ Use by individuals with prior concent from sofTouch APpLications is granted.
[5]   ⍝ Complete documentation is available in the DEVELOP workspace user's guide,
[6]   ⍝ (internal sofTouch APpLications document).
[7]   ⍝
[8]   ⍝ Arguments: T← Substring to check
[9]   ⍝ Results: Y← List of variables
[10]  ⍝ Functions Called: NONE
[11]  ⍝ Called by: ++ generically available utility function ++
[12]  ⍝ Implementation: APL/68000 by G. Schneider, sofTouch APpLications
[13]  ⍝
[14]  ⍝ Return list of variables whose names end in specified substring
[15]   Y←((⎕BOX ⎕DBR,⌽(⎕NL 2),' ')[;⍳⍴T]^.=T)⌿⎕NL 2
      ∇  2001-04-18 8.03.12
      ∇P←WS;D
[1]    D←⍎(P←1000<⍴RA)/'⎕EX ⎕BOX''PMRA PMDEC MAG BSNO'''
      ∇  2001-04-18 8.03.12
```

Toolbox Functions

ALERT
ARBOUT
ARROW
ASCKEY
CHECKITEM
CLOSESERIAL
DELETEMENU
DIALOG
DISPOSEWINDOW
DRAWMENUBAR
DRAWPICTURE
DRAWSTRING
ERASERECT
FONTSIZE
FORECOLOR
GETEVENTMAP
GETEVENTS
GETMENU
GETWIN
GETWTITLE
HELP
HIDECURSOR
INPUT
INVERTRECT
LINE
MAKEDIALOG
MOVE
MOVETO
NEWWINDOW
OUTPUT
PEEK
PRINTJOB
RESTOREMENUBAR
SETCOMMS
SETEVENTMAP
SETMENU
SETPORT
SETRUN
SETWTITLE
TEXTOUT
TRANSLATE
WATCH

```
Dialog Design Arrays
--------------------

APPLETALK   7 4
1   0   0  16 200  SD    Select Serial I/O Port
2  20   0  36 210  RE1   1 Modem Port (Pre G3 Laptops)
3  20 220  36 430  RE11  2 Printer Port (G3 Laptops)
4  60   0  76 500  SD  1 Selected Port Must *NOT* Be In Use By Another Application, or by AppleTalk.
5  90   0 106 500  SD  1 Verfify AppleTalk (Control Panel) Assignment, or Disable (in Chooser).
6 120   0 136 200  BE  1 WAIT! - Let Me Check
7 120 290 136 490  BE  11OK - I'M Sure, Go Ahead.

CLINE       12 4
 1   1 78  17 147  SD  1 HHMMSS
 2  41 78  57 147  SD  1 HHMMSS
 3  81 78  97 147  SD  1 HHMMSS
 4  17  5  33  80  SD  1 Start Time
 5  57  5  73  80  SD  1 End Time
 6  97  5 103  80  SD  1 Increment
 7  17 81  33 131 1EE    000000
 8  57 81  73 131 1EE    230000
 9  97 81 113 131 1EE    000500
10 125  0 142 120  CE 1  Read Data File
11 157  5 174  65  BE  1 CANCEL
12 157 75 174 135  BE  11OK

LOCAL       14 4
 1   1  81  17 154  SD  1 ±DDMMSS.f
 2  41  81  57 162  SD  1 ±DDDMMSS.f
 3  17   5  33  69  SD  1 LATITUDE
 4  57   5  73  75  SD  1 LONGITUDE
 5  17  81  33 157 1EE    -154555.0
 6  57  81  73 157 1EE    +291311.0
 7  95   5 111  80  SD    ALTITUDE
 8  95  81 111 125 1EE    0
 9  95 130 111 180  SD    METERS
10 157   5 173 120  CE 1  Read Data File
11 127   5 143 162  EE    MVUU LODGE, ZAMBIA
12 183   5 198 240  CE    Apply Limb Contact Corrections
13 216   5 233  65  BE  1 CANCEL
14 216 170 233 230  BE  11OK

TEST        38 4
 1   0   0  16 200  SD    Select Serial I/O Port
 2  18   0  34 215  RE1   1 - Modem (Pre G3 Laptops)
 3  18 220  34 430  RE11  2 - Printer (G3 Laptops)
 4  40   0  56 300  SD  1 Select Duplexing Mode (Default = HALF)
```

```
 5  58   0  74 210  RE2   0 -  FULL
 6  58 220  74 290  RE21  1 -  HALF
 7  80   0  96 430  SD  1 Select Character Translation (Default = ASCII)
 8  98   0 114 210  RE31  0 - ASCII
 9  98 220 114 285  RE3   1 - APL
10 120   0 136 430  SD  1 Select Parity (Default = NONE)
11 138   0 154 100  RE41  0 - NONE
12 138 105 154 209  RE4   1 - EVEN
13 138 220 154 290  RE4   2 - ODD
14 160   0 176 430  SD  1 Select Number of Stop Bits (Default = 1)
15 178   0 194 210  RE51  1 - 1
16 178 220 194 265  RE5   2 - 2
17 200   0 216 430  SD  1 Select Xon/Xoff Handshaking (Default = NONE)
18 218   0 234  80  RE61  0 - NONE
19 218  85 234 214  RE6   1 - Input to Mac
20 218 215 234 360  RE6   2 - Output from Mac
21 218 365 234 480  RE6   4 - H/W + Sums
22 240   0 256 420  SD  1 Select Number of Data Bits (Default = 8)
23 258   0 274 210  RE7   1 - 7
24 258 220 274 430  RE71  2 - 8
25  40 325  56 465  SD  1 SERIAL OUT CHARACTER
26  58 370  74 455  SD  1 Hexidecimal
27  58 345  74 362  EE    00
28  80 325  96 465  SD  1 TEST EXPOSURE DURATION
29  98 390 114 450  SD  1 Seconds
30  98 345 114 380 1EE    0.25
31 120 325 136 465  SD  1 DELAY BETWEEN EXPS.
32 138 390 154 450  SD  1 Seconds
33 138 345 154 380 1EE    1.75
34 160 325 176 465  SD  1 LENGTH OF TEST
35 178 390 194 450  SD  1 Seconds
36 178 345 194 380 1EE    20.0
37 280   0 296 200  BE  1 CANCEL - Leave as is
38 280 290 296 480  BE  11OK - Do it.

WARNING     4 4
1  0   0 16 410  SD  1 10°/° Solenoid Duty Cycle Exceeded: 24.6°/° for 21.8 seconds.
2 30   0 46 410  SD  1 Mean Solenoid Duty Cycle = 6.7°/° for 140.8 seconds.
3 60   0 76 200  BE  1 CANCEL - Exit Controller
4 60 210 76 410  BE  11OK - Run Controller Anyway
```