RELATIONAL EXPERT SYSTEM

Version 2.0MU

USER'S MANUAL

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Chapter 0 : FIRST THINGS TO DO

- This chapter explains how to install the RELATIONAL EXPERT SYSTEM (shortened to RES). You will then be shown how to start the RES and how to move around the main menu.

  Details are given on how to change the master password.

  An overview of the RES is given to provide a feel for how this all hangs together.

  After giving you a system overview we will advise what information you need to gather before commencing the necessary data input to build your system.

  If you are installing the RES at this point in time then you should use the green check sheet (titled **RES INSTALLA-TION CHECK SHEET**). This sheet should be found in the front of this manual. The aim of this check sheet is to make sure that you complete **ALL** the steps of the installation process in the **CORRECT** sequence.

  This is a good place to draw your attention to Appendix A. Appendix A explains some of the basics of this expert system shell, and suggests some symbols that may be used when describing your problem network on paper.

Installation

This section explains how to install the RELATIONAL EXPERT SYSTEM (RES) onto your computer. You will need to know how to change the active drive, as well as how to move to other subdirectories. Note that the installation will only work if you have approximately 5.1 Mbytes of free space on your hard disk. You can find this out by typing 'dir' and pressing the 'Enter' key. The amount of free disk space is shown at the end of the list of files.

You may run this installation in two ways. If you wish to have the installation proceed automatically then read the details under the subheading titled **Using defaults**.

If you wish to customise the installation and you are an experienced DOS user then read the details under the subheading **Customising the installation**.

The installation screen looks like this.

```
────────────── RELATIONAL EXPERT SYSTEM Installation Programme ──────────────

   Installing RELATIONAL EXPERT SYSTEM from A: to   C:\RES




         ┌─────────────────────────────────────────────────────────┐
         │      Welcome to the installation programme for the       │
         │               RELATIONAL EXPERT SYSTEM.                  │
         │                                                          │
         │  PRESS 'Enter' TO CONTINUE WITH THE INSTALLATION, OR     │
         │  PRESS 'Esc' TO QUIT.                                     │
         │                                                          │
         │  If you have any problems during this installation please│
         │  telephone 07-398-5614, or if outside OZ 61-7-398-5614.  │
         └─────────────────────────────────────────────────────────┘




              (C) Vince Ladewig 1992, Version 2.0MU
```

Notice that the installation screen above shows **A:** as the drive from which you are doing the installation. This will be **B:** if you are using floppy drive **B** as the source.

The installation always defaults to C:\RES as the destination path for the RES files.

Using defaults

If you wish to do an automatic installation then simply follow these steps :-

1. Turn on the computer or, if the computer is already on, exit any programmes that might be running.

2. Place the disk marked **DISK ONE** in the A: drive. Type A: then press the 'Enter' key. The DOS prompt should now be A:\>.

3. Type **INSTALL** then press the 'Enter' key. The screen should now look like that shown in the introduction to this section. With this screen displayed press the 'Enter' key to begin.

4. Near the end of the installation you will be asked a number of questions. Simply press the 'Enter' key at these points in the installation. When the final message screen (giving you contact telephone numbers) is displayed press any key to continue.

5. The computer will restart when the installation is completed. What happens following this restart depends on how your computer was set up before you installed the RES.

6. A file called **GO.BAT** has been placed in the **C:\RES** subdirectory. The **C:\RES** subdirectory has been placed on your system's **path**. A call to GO.BAT has been added as the last line of your **AUTOEXEC.BAT** file. If you have a menu system that starts up when your computer is turned on then the RES will **NOT** start automatically. You will need to put the RES as an option on this menu system. If your system normally started up and left you at the DOS prompt (e.g. C:\>), then the RES should now start up automatically each time you turn the computer on. The RES can also be started from the DOS prompt by typing **GO** and then pressing the 'Enter' key.

7. Now go to the section titled **Starting Up** and read the details under **How to log on.**

Customising the installation

If you are an experienced DOS user and wish to customise the installation use the following steps as a guide :-

1. Place the disk marked **DISK ONE** in the floppy drive of choice and change to the root directory of that floppy drive.

2. Run **INSTALL.EXE**. The screen should now look like that shown in the introduction to this section.

3. At this point you may edit the **destination path** to that of your choice. Make sure that you have at least 2.1 Mbyte free on the destination drive. When finished with editing the **destination path** press the 'Enter' key to begin.

4. Near the end of the installation you will be asked if you want to update the AUTOEXEC.BAT file and the CONFIG.SYS file. The installation programme modifies your system to allow the opening of 100 files and sets buffers to 40. It is important that your system is able to open at least 100 files. The **destination path** is also made available in a path statement, and **GO.BAT** is called from the AUTOEXEC.BAT (the last line).

5. You may optionally reboot the computer when the installation is completed - necessary for the changes to become effective.

6. A file called GO.BAT has been placed in the **destination path** subdirectory. If the **destination drive** is different to the boot drive then you will need to edit **GO.BAT** to change to this drive. If the subdirectory has also been changed from the default then you will need to make a change in **GO.BAT** to reflect this. Unless you have a menu system that starts up when your computer is booted GO.BAT is called and the RES will startup.

7. Now go to the section titled **Starting Up** and read the details under the subheading titled **How to log on.**

Starting Up

This section explains how a user enters the RELATIONAL EXPERT SYSTEM (RES). The logon process is described under the subheading **How to logon.**

An explanation is then given on how to move around the menus using the **arrow keys** and the 'Esc' key under the subheading **Moving around the menus.**

The RES comes with a preset password. This password needs to be changed after you complete the installation to ensure that no one else can gain access to the RES unless you have set them up. See the details under the subheading **Changing the master password.**

The data bases are manipulated by a set of commonly used commands. These common commands are described in this section under the subheading **Using the data base command menus.**

Once you have set the RES up and experimented with moving around the menus and activating a data base you also need to know how to move around the active data window as you add or edit a record. See under subheading **Editing a data base window** for the details.

Perhaps some of the instructions given will not make a lot of sense at this stage as they are being given a little out of context. Do not be too worried by this, simply refer back to this section if you have any questions when using the RES.

How to logon

When the RES system first starts up you will see the following screen :-

```
═══════════════════════════════════>> Relational Expert System <<═══════════════════════════════
  Tuesday, January 28, 1992.                                          0:40:44



                    ┌────────Security Logon (Esc-Abort)────────┐
                    │Operator :                                │
                    │         .                                │
                    └──────────────────────────────────────────┘




══════════════════════>> Version 2.0 (C) Vince Ladewig 1992 <<═══════════════════════════════════
Use the arrow keys '    ' to position the highlight bar upon a menu item, then
press the 'Enter' key to select that item.  Or you may select a menu item by
typing the first letter of the menu item.  For example, type 'U' for the menu
item 'Utilities' then 'L' to 'Logon'  -  you need to logon to use the system.
The 'Esc' key is used to return back up to a previous menu level.  Press the
'F1' key for context sensitive help.
  Path  E:\RES92\                                              CAPS NUM SCROLL
```

Notice that the cursor is flashing in the box in the middle of the screen. If this is the first time that the RES has been used, i.e. you have just completed the installation then follow these steps to logon :-

1. Type **SYSOP** and then press the 'Enter' key.

2. Next the password screen will be displayed in the same position. Now type **MASTER** then press the 'Enter' key.

You have now logged on as an operator called *SYSOP*, with password MASTER. This will give you a security level of 9. A security level of 0 is the lowest and 9 is the highest. An operators security level limits their use of the RES.

You should now see a screen with the main menu displayed. Now proceed to the next subheading **Moving around the menus**.

If the RES is already up and running and you are a new user of the system then you need to enter your operator name and the password that has been assigned by the RES administrator.

Moving around the menus

The **main menu** is displayed once you have logged on to the RES. The **main menu** is shown below. The highlight bar should be on the item 'RES' (the left most menu item).

```
===============>> Relational Expert System <<===============
 Tuesday, January 28, 1992.                          0:40:44
```

```
+-----------------------------------------------------------+
|     Problems      Reports      Utilities      Quit        |
+-----------------------------------------------------------+
```

```
===============>> Version 2.0 (C) Vince Ladewig 1992 <<=========
Use the arrow keys '    ' to position the highlight bar upon a menu item, then
press the 'Enter' key to select that item.  Or you may select a menu item by
typing the first letter of the menu item.  For example, type 'U' for the menu
item 'Utilities' then 'L' to 'Logon'  -  you need to logon to use the system.
The 'Esc' key is used to return back up to a previous menu level.  Press the
'F1' key for context sensitive help.
  Path  E:\RES92\                                     CAPS NUM SCROLL
```

Now look at your keyboard and find the arrow keys '↑ ↓ → ←'. Press the down arrow ('↓') key and the main menu will now look like this.

```
+-----------------------------------------------------------+
|   Problems          Reports      Utilities      Quit      |
+-----------------------------------------------------------+
     +----------------------+
     | Define Problems      |
     | Generate Space       |
     | Run Enquiry          |
     +----------------------+
```

See how the highlight bar is now on the first item of the submenu. Now press the up arrow ('↑') key and see how the highlight bar cycles through the submenu items. Now press the 'Esc' key to return up to the main menu.

There is another way to get to that submenu and that is by pressing the 'Enter' key when the highlight bar is on the menu item. Try it.

Now press the right arrow ('→') key two (2) times. The menu should now look like this.

```
┌─────────────────────────────────────────────────────────────┐
│   Problems        Reports       Utilities        Quit        │
└──────────────────────────────┬──────────────────────────────┘
                               │ Logon           (Alt-L) │
                               │ Passwords        (Alt-U) │
                               │ Re-index Problem Files   │
                               │ Setup a Printer          │
                               │ View Error File          │
                      •        │ OS Shell         (Alt-O) │
                               └──────────────────────────┘
```

See how the highlight bar is now on the first item of this submenu.

Throughout RES you can obtain explanations of the menu items by pressing 'F1' while the highlight bar is over the item. A 'help' window is displayed. After reading the information, press the 'Esc' key (or any other key) to close the help window and return to the menu.

In summary, you move around the menus using the arrow keys and the 'Esc' key. You may use the first letter of a menu item to activate that item, or press the 'Enter' key when the highlight bar is on the menu item of choice. The 'Esc' key will move you back out of a submenu. Press the 'F1' key to obtain help information about the highlighted menu item.

Changing the master password

Each user of the system needs to be assigned an operator name and security level as well as a password. From the main menu move to the **Utilities** submenu. Move the highlight bar over menu item 'Passwords'. Activate this menu item by pressing 'Enter'. The 'Alt-U' key combination is the shortcut to this item.

The menus will now look like this.

```
┌─────────────────────────────────────────────────────────────┐
│   Problems        Reports      Utilities      Quit           │
└──────────────────────────────┬──────────────────────────────┘
                               │ Logon          (Alt-L)  │
┌──────────────────────────────────────────────────────────────┐
│ Enter   1-Update Password Database, 2-Update Master, [Esc to Abort]  : 2 │
└──────────────────────────────────────────────────────────────┘
                               │ View Error File          │
                               │ OS Shell       (Alt-O)   │
                               └──────────────────────────┘
```

Select **Update Master** by entering the number '2' and then pressing the 'Enter' key. The menus should now look like this.

```
┌─────────────────────────────────────────────────────────────┐
│   Problems        Reports      Utilities      Quit           │
└──────────────────────────────┬──────────────────────────────┘
                               │ Logon          (Alt-L)   │
┌─────────Change Password (Esc-Abort)─────┬─sswords        (Alt-U)   │
│ Password :                              │ -index Problem Files     │
└─────────────────────────────────────────┘tup a Printer            │
                               │ View Error File          │
                               │ OS Shell       (Alt-O)   │
                               └──────────────────────────┘
```

You are now going to enter a new master password. Select a nonsense word of up to **eight (8)** letters or numbers in length. At this point be **VERY CAREFUL**. Enter the new password that you have chosen and then press the 'Enter' key. You will be asked to verify the new password, again enter the password **EXACTLY** as you first entered it, and press the 'Enter' key again. Write this password down somewhere and store it in a safe place away from the computer. If you have any problems, press the 'Esc' key to abort the process and start again.

You have now altered the main system password so that anyone reading this manual will now not be able to enter the RES unless you have set them up to do so.

Using the data base command menus

The RES uses a number of data bases to hold the details of your problems. These data bases are manipulated from a command menu that is displayed at the bottom of a data base window. The command menu used by the RES has a general form as that shown below. Use the left and right arrow keys to move around this menu. To activate a command menu item position the highlight bar on the menu item of choice and press the 'Enter' key. Alternatively, press the first letter of the name of the menu item.

```
Next  Prev  Find  Top . Last  Edit  Add  Copy  Del  + (Open)  - (Close)  Quit
```

Menu item 'Next' is activated by pressing the letter 'N' or by using the left and right arrow keys to move the highlight bar over the menu item and pressing the 'Enter' key. This item will display the NEXT record in the data base. If there is no NEXT record then a beep will sound.

Menu item 'Prev' is activated by pressing the letter 'P'. This item will display the PREVIOUS record in the data base. If there is no PREVIOUS record then a beep will sound.

Menu item 'Find' is activated by pressing the letter 'F'. This item is used to FIND a particular record in the data base, and display it in the window. Having activated the FIND function, you must first select which order you wish to search the data base in. Once the order is selected you may specify the code or number or name you wish to find. If a single match is found for your code or number, then that record will be displayed. If a number of matches are found, then they are all displayed for you to select from. If you did not specify a code or number or name, then all records will be displayed for you to choose from.

Menu item 'Top' is activated by pressing the letter 'T'. This item will display the first record in the data base.

Menu item 'Last' is activated by pressing the letter 'L'. This item will display the LAST record in the data base.

Menu item 'Edit' is activated by pressing the letter 'E'. This item enables you to EDIT (change) the data displayed in the currently active data base window.

Menu item 'Add' is activated by pressing 'A'. This item enables you to ADD new data to the currently active data base window. You can terminate the ADD function at any stage by pressing the 'Esc' key.

Menu item 'Copy' is activated by pressing 'C'. This will COPY the data in the currently active data base window into a new record. At any stage the COPY function may be terminated by pressing the 'Esc' key.

Menu item 'Del' is activated by pressing 'D'. This item will DELETE the record displayed in the currently active data base window from the data base, and then display the next available record after deletion. You are asked to re-confirm when DELETE is chosen.

The RES data bases have more than one data base window. Notice the '+ (Open)' and the '- (Close)' items in the command menu.

Menu item '+ (Open)' is activated by pressing '+'. This opens the NEXT WINDOW out from the currently active window.

Menu Item '- (Close)' is activated by pressing the '-' key, or by pressing the 'Esc' key. This item closes the currently active window and activates the PREVIOUS WINDOW.

Menu item 'Quit' is activated by pressing 'Q'. This menu item QUITs this data base and returns you to the main menu system. You may also use the 'Esc' key to leave a data base.

The Problem Space and Enquiry data bases have some of the above menu items missing, and also some extra menu items that are different. These command menus are explained in more detail in the relevant sections of Chapter 1.

On-line help is available on each command menu item by pressing 'F1', press any key to close the help window.

**Editing in a
data base window**

When you have activated a data window from the command menu (by selecting 'Add', 'Copy', or 'Edit') you will see the cursor in the first editable field of that window. Use the down arrow key to move to the next editable field in the active window. The 'Enter' key will also move you to the next field. The upper arrow key will move you back to the previous field.

Memo fields are a special type of data field that is able to hold about 200 words. You enter a memo field using the 'Enter' key or the down arrow key. To move back out of the memo field you need to use the combination of 'Ctl-PgUp'. To move back into a memo field from a following field use the up arrow key. To move to the next field from a memo field use the key combination of 'Ctl-PgDn'.

You may find that you are unable to reach some of the fields being displayed. This may be because you do not have the security level to edit them, or the particular field may be a display only field.

Use the left and right arrow keys to move the cursor position within a field. The backspace and 'Del' keys work in their usual way. The 'Home' key moves the cursor back to the beginning of the field. The 'End' key will toggle the cursor between the end of the field and the next position after the end of the data in the field. The 'F5' key will clear from the current cursor position to the end of the field. To completely clear a field press the 'Home' key and then press the 'F5' key.

System Overview

This section will provide you with an overview of how the components of RELATIONAL EXPERT SYSTEM (RES) work and interact.

We will firstly take a look at the **RES data bases.**

A brief mention is then made of the **Reports** that are available to help keep track of your problems in the RES.

Under the subheading **Utilities & how to quit** is given details of the housekeeping utilities and how to leave the RES.

RES data bases   These data bases hold the details of your problems how they are linked together, as well as details of what input value combinations result in what results. A log is also kept of your interaction with the RES when trying to solve a problem.

```
=================>> Relational Expert System <<=================
| Tuesday, January 28, 1992.                              0:40:44 |



     _____
    |     Problems       Reports      Utilities      Quit    |
    |_____ _____|
         | Define Problems |
         | Generate Space  |
         | Run Enquiry     |
         |_____|



===================>> Version 2.0 (C) Vince Ladewig 1992 <<===============
|Use the arrow keys '   ' to position the highlight bar upon a menu item, then|
|press the 'Enter' key to select that item.  Or you may select a menu item by |
|typing the first letter of the menu item.  For example, type 'U' for the menu|
|item 'Utilities' then 'L' to 'Logon'  -  you need to logon to use the system. |
|The 'Esc' key is used to return back up to a previous menu level.  Press the  |
|'F1' key for context sensitive help.                                         |
| Path  E:\RES92\                                          CAPS NUM SCROLL    |
```

Menu item 'Define Problems' is activated by pressing 'D'. This item requires a security level of at least 4. This item enables you to record the PROBLEM DEFINITIONS.

Menu item 'Generate Space' is activated by pressing 'G'. This item requires a security level of at least 4. This item enables you to generate a PROBLEM SPACE for a selected problem. The PROBLEM SPACE data base is generated by the RES for you and contains ALL possible combinations of input values for your problem. You then assign a result to each input value combination.

Menu item 'Run Enquiry' is activated by pressing 'R'. This option is selected when you wish to solve a problem, or restart a previous problem. Your interaction with the RES is stored in the ENQUIRY data base.

Reports   The reports provide a print out of the RES data bases in a format that allows you to keep a paper copy of your problem network.   The reports may also help you find logical inconsistencies in your problem network due to spelling errors for example.

```
=========================>> Relational Expert System <<==============
 Tuesday, January 28, 1992.                              0:40:44


          ┌─────────────────────────────────────────────────────┐
          │   Problems        Reports       Utilities      Quit  │
          └──────────────┬──────────────────────────────────────┘
                         │  List Problems │
                         │  Problem Space │
                         │  Enquiry Log   │
                         └────────────────┘




=====================>> Version 2.0 (C) Vince Ladewig 1992 <<==========
Use the arrow keys '     ' to position the highlight bar upon a menu item, then
press the 'Enter' key to select that item.   Or you may select a menu item by
typing the first letter of the menu item.   For example, type 'U' for the menu
item 'Utilities' then 'L' to 'Logon'  -  you need to logon to use the system.
The 'Esc' key is used to return back up to a previous menu level.  Press the
'F1' key for context sensitive help.
  Path  E:\RES92\                                        CAPS NUM SCROLL
```
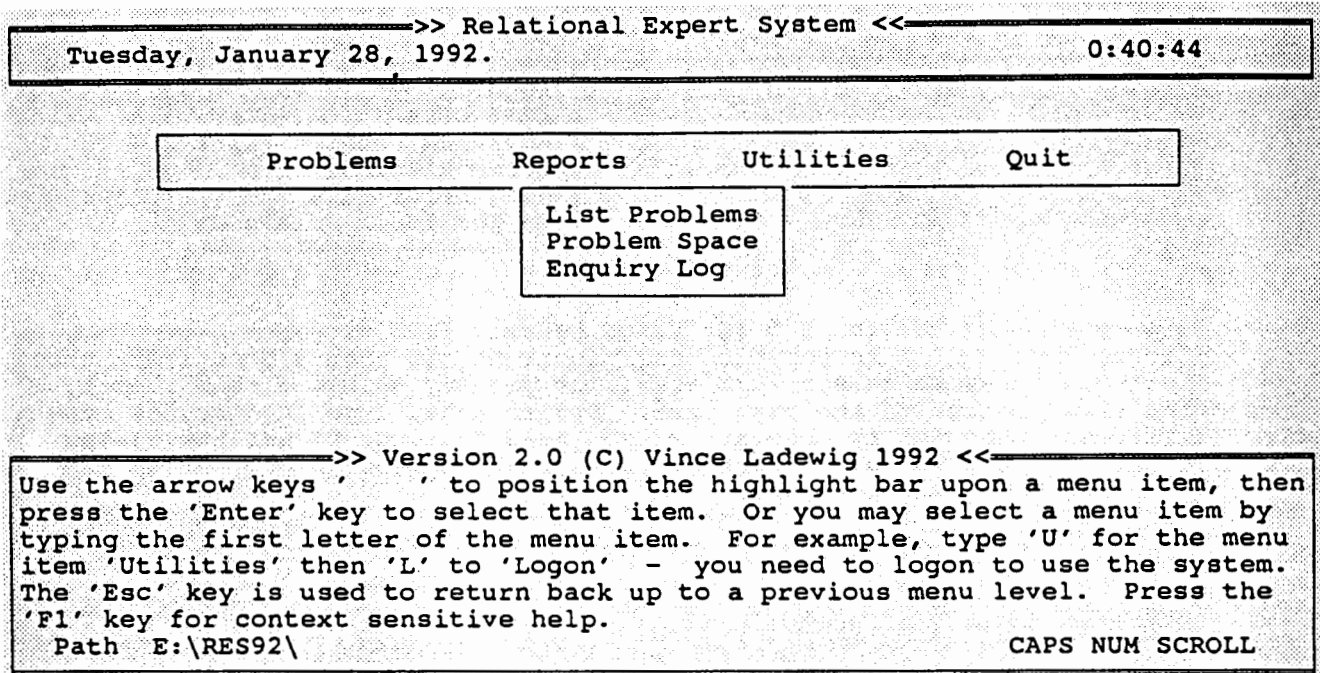
Menu item 'List Problems' is activated by pressing 'L'. This item allows you to view or print a list of your **PROBLEM DEFINITIONS.**

Menu item 'Problem Space' is activated by pressing 'P'. This item allows you to view or print the **PROBLEM SPACE** of you problems.

Menu item 'Enquiry Log' is activated by pressing 'E'. This item will allow you to view or print the **ENQUIRY LOG** of the RES.

**Utilities &
how to quit**

You will rarely need to use the utilities once you have set up the RES. They are mostly housekeeping functions. The Utilities submenu looks like this.

```
════════════════════>> Relational Expert System <<═════════════════════
   Tuesday, January 28, 1992.                                0:40:44


        ┌─────────────────────────────────────────────────────┐
        │   Problems        Reports        Utilities    Quit   │
        └─────────────────────────────────┬───────────────────┘
                    •                      │ Logon          (Alt-L) │
                                           │ Passwords      (Alt-U) │
                                           │ Re-index Problem Files │
                                           │ Setup a Printer        │
                                           │ View Error File        │
                                           │ OS Shell       (Alt-O) │
                                           └────────────────────────┘

════════════════════>> Version 2.0 (C) Vince Ladewig 1992 <<═══════════
Use the arrow keys '     ' to position the highlight bar upon a menu item, then
press the 'Enter' key to select that item.   Or you may select a menu item by
typing the first letter of the menu item.   For example, type 'U' for the menu
item 'Utilities' then 'L' to 'Logon'  -  you need to logon to use the system.
The 'Esc' key is used to return back up to a previous menu level.   Press the
'F1' key for context sensitive help.
  Path  E:\RES92\                                         CAPS NUM SCROLL
```

Menu item 'Logon' is activated by pressing 'L' or the key combination of 'Alt-L'. You logon by entering your **OPERATOR NAME** and **PASSWORD**. Having successfully logged on you then have a security clearance level assigned. You are then able to select those menu items that have a security level less than or equal to your assigned security level.

Passwords are set using the 'Passwords' item on this menu which is activated by pressing 'P', or the key combination of 'Alt-U'. You are only able to edit your own password, unless you have logged on with a security level of 9, then you can update the passwords of **ALL** other users.

Menu item 'Re-index Problem Files' is activated by pressing 'R'. Use this item to repair the indices of the RES data files and the code files.

Menu item 'Setup a Printer' is activated by pressing 'S'. This menu item enables you to define the ESCAPE codes used by your printers and to select which printer to use when printing reports.

Menu item 'View Error File' is activated by pressing 'V'. The ERROR FILE is created by the RES if for some reason it has a system failure. The details written to the error file are useful to the people providing you with technical assistance. If your RES has had a failure you will be asked to activate this menu item and report the message you find.

Menu item 'OS Shell' is activated by pressing 'O', or the key combination of 'Alt-O'. This item requires a security level of 9. This item will allow you to temporarily leave the RES and enter the operating system. When you have finished what you wish to do in the operating system type 'EXIT' at the DOS prompt to return to the RES.

To quit the RELATIONAL EXPERT SYSTEM choose the 'Quit' item from the main menu, or press 'Q'. The Quit submenu looks like this.

```
╔══════════════════>> Relational Expert System <<══════════════╗
║    Tuesday, January 28, 1992.                       0:40:44   ║
╚═══════════════════════════════════════════════════════════════╝

       ┌────────────────────────────────────────────────────┐
       │    Problems        Reports        Utilities    Quit │
       └────────────────────────────────────────────┬───────┘
                                                     │ Yes │
                                                     │ No  │
                                                     └─────┘


╔══════════════>> Version 2.0 (C) Vince Ladewig 1992 <<═══════════╗
║Use the arrow keys '    ' to position the highlight bar upon a menu item, then║
║press the 'Enter' key to select that item.  Or you may select a menu item by ║
║typing the first letter of the menu item.  For example, type 'U' for the menu║
║item 'Utilities' then 'L' to 'Logon'  -  you need to logon to use the system.║
║The 'Esc' key is used to return back up to a previous menu level.  Press the ║
║'F1' key for context sensitive help.                                         ║
║  Path  E:\RES92\                                        CAPS NUM SCROLL      ║
╚═════════════════════════════════════════════════════════════════╝
```

The system requires you to confirm your decision to quit.

Menu item 'Yes' is activated by pressing 'Y'. Select this item to quit the RES. A shortcut to quit the RES is to use the 'Alt-X' key combination.

Menu item 'No' is activated by pressing the 'N' key. This item will return you to the main menu and so leaves you in the RES.

Preparing Your Data

Before you rush into entering your problems into the RES you should spend a little time preparing your problem network on paper. Use large sheets of Butcher's Paper to sketch out each problem with its inputs and results and how they interconnect. Read Appendix A to get a feel for the symbols used. They are only suggested, use whatever symbols you feel comfortable with.

Be prepared to spend the greatest amount of time in this preparation stage, but do not get too bogged down in detail. You can refine the granularity of a problem latter, at this stage you should aim to get a broad, useable model of the knowledge domain into the RES. Test the model and then refine problems, for example some inputs may be more refined by taking their values from the results of another problem (subproblem inputs). Other problems may be better split into two - to cover this a preceding problem, or problems, may need to have extra result values flowing to the new problem(s). The RES has been designed to ensure that the time spent entering your problem network is as little as possible, and that refining it is a simple as possible.

Also give some thought to the order in which you wish to ask the user to supply answers to problem inputs. The RES will only ask as many questions as it needs to achieve a unique result. It is probable that one ordering of the inputs will most often produce a result in the shortest number of questions. The general term **induction** is used to describe this search for the optimum ordering of input questions. There are ways of automating the search for this optimum ordering of the input questions. The next version of the RES will allow you to induce the optimum order of inputs from the results you have assigned to your problem space entries.

You also might consider using a separate data subdirectory for each different problem network. Refer to Chapter 3 for information on how to change your default data directory.

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Chapter 1 : RES DATA BASES

The **Relational Expert System** is comprised of three data bases. These data bases of the **RES** are described in this chapter.

It is advised that you read Appendix A before continuing.

The 'Define Problems' menu item takes you into the **Problem Definition** data base. This data base holds the definitions of the problems, their inputs, the values that inputs may take and the possible results of a problem. It is in this data base that you maintain the network of problems, controlling how inputs are produced, (from a value list or by solving an input subproblem), and what a result leads on to. The problem network is an interlinking structure of problems. The linking is via the inputs (subproblem inputs) and their results (flow results).

The 'Generate Space' menu item opens the **Problem Space** data base. Opening this data base allows you to generate all possible combinations of the input values of a problem. Once the problem space is generated a result value is entered against each possible combination of input values. The **RES** uses the problem space to navigate the problem network. As each input value is obtained directly from a value list, or, as the result of an input subproblem, the **RES** attempts to see if that combination gives a unique result. This result is then used to determine the next problem to look at.

The 'Run Enquiry' menu item is selected when you wish to make an enquiry of the **RES** - when you wish to solve a problem using the expert system. The **Enquiry** data base allows you to enquire of the **RES** about a particular main problem. This data base keeps a record of your interaction with the **RES**.

The **RES** data base submenu looks like this.

```
==========>> Relational Expert System <<==========
 Tuesday, January 28, 1992.                          0:40:44


        ┌────────────────────────────────────────────────┐
        │  Problems      Reports      Utilities     Quit  │
        └──────────────────┬─────────────────────────────┘
                │ Define Problems │
                │ Generate Space  │
                │ Run Enquiry     │
                └─────────────────┘




==========>> Version 2.0 (C) Vince Ladewig 1992 <<==========
Use the arrow keys '    ' to position the highlight bar upon a menu item, then
press the 'Enter' key to select that item.  Or you may select a menu item by
typing the first letter of the menu item.  For example, type 'U' for the menu
item 'Utilities' then 'L' to 'Logon'  -  you need to logon to use the system.
The 'Esc' key is used to return back up to a previous menu level.  Press the
'F1' key for context sensitive help.
  Path  E:\RES92\                                    CAPS NUM SCROLL
```

Define Problems

Menu item 'Define Problems' is activated by pressing 'P', or by moving the highlight bar over the menu item and pressing the 'Enter' key. This item requires a security level of at least 4 in order to be activated.

This menu item allows access to the **Problem Definition** data base of the Relational Expert System. It is this data base that holds the structure of the problem network you are building.

There are four files in this data base. The first is the **PROBLEM** file, which holds the general details about a problem, its name and whether it is a main problem. Also you may enter a comment about the problem.
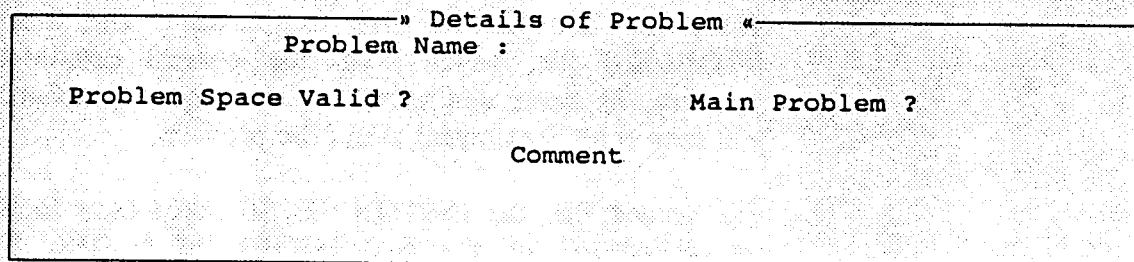
The second file, the **INPUTS** file, is linked back to the first, (is related to), on the field **PROBLEM NAME**. This file holds the names of the possible inputs to the problem. This file records the type of each input as well. An input may be of type **value**, or of type **subproblem**.

The third file is the **INPUT VALUES** file. This file is linked back to the **INPUTS** file. This file stores the allowed values that an input may take (if it is a **value** type of input).

The fourth file holds the possible results of a problem, this is the **RESULTS** file. This file is linked back to the **PROBLEM** file. A result to a problem may be a **final** or **result** type, or its type may be **flow**. A **result** type problem is a end point - the RES proceeds no further, a solution has been reached. A **flow** type result indicates to the RES that it should flow into the indicated problem.

Problem window

When you activate the 'Define Problems' menu item the following window will be open on your screen. This window displays the general details of a particular problem. The records are displayed in alphabetic order of **PROBLEM NAME**.

```
┌───────────────────» Details of Problem «───────────────────┐
│            Problem Name :                                   │
│                                                             │
│  Problem Space Valid ?                    Main Problem ?     │
│                                                             │
│                        Comment                              │
│                                                             │
│                                                             │
└─────────────────────────────────────────────────────────────┘
```

A record in the **PROBLEM** file has the following fields.

The **PROBLEM NAME** field uniquely identifies a particular problem. Each problem needs to have a unique name against which details of problem input and results may be entered. A problem takes certain inputs, and depending on the value of the inputs the problem has a certain result.

The next field is the **VALID SPACE** field. This field is usually maintained by the **RES**. You will need a security level of 8 to edit this field. You will be limited to entering 'YES', or 'NO ' in this field. This field is used to indicate if the problem space of this problem is valid.

The next is the **MAIN PROBLEM** field. Enter a 'YES' or a 'NO ' in this field. To edit this field you require a security level of 8. This field is used to indicate if this problem is a main problem. Only main problems can be enquired of.

The **INPUT COUNT** field is used by the system to keep track of how many inputs you have entered for a particular problem, the maximum number of inputs that any one problem may have is fifteen. You will not see this field on your screen unless you have a security level of 9. To edit this field you require a security level of 9.

The **RESULT COUNT** field is used by the system to keep track of how may results you have entered for a particular problem, the maximum number of results that any one problem may have is ninety nine. You will not see this field on your screen unless you have a security level of 9. To edit this field you require a security level of 9.

The last field is the **COMMENT** field. In this field you may make comment about the problem. This field is a memo field and is able to store two full screens of text, even though you only see a small portion of this field at any one time.
Use the Ctrl<PgUp> key to return to the previous field.

If you select the 'Copy' item from the command menu then after making a copy of the currently displayed **PROBLEM** record you will be asked if you also wish to copy **ALL** of the inputs, input values, and results that are associated with the problem record just copied. This copy function helps you to quickly enter the problem definition for a new problem that is very similar to an existing problem. This copy all function is available only when the first window is active with an **PROBLEM** record on display.

When you select the 'Find' item from the command menu, with the **PROBLEM** file on display, you will be able to search the **PROBLEM** file in Problem Name order.

Problem inputs

The '+' key will open the next window. This window displays the inputs of the problem currently on display in the previous window. The records are displayed in a table format in alphabetical order of INPUT NAME. In the table you will only be able to see those inputs that relate to the problem selected in the previous window. The window for the INPUTS file looks like this.

```
┌─────────────────────────────» Inputs to Problem «──────────────────────────────┐
│ Input  Names │ Order │ Type │ Instructions for Input                           │
├──────────────┼───────┼──────┼──────────────────────────────────────────────────┤
│              │       │      │                                                  │
│              │       │      │                                                  │
│              │       │      │                                                  │
│              │       │      │                                                  │
│              │       │      │                                                  │
│              │       │      │                                                  │
└──────────────┴───────┴──────┴──────────────────────────────────────────────────┘
```

The INPUT file has the following fields.

The first field holds the INPUT NAME. The name of an input must be different to the name of the current problem. It may though have the name of some other problem if this input is a subproblem type. Each problem takes certain inputs. This field is used to store the names of the inputs to a problem.

The next field is used to store the INPUT ORDER. To edit this field you require a security level of 9. Each problem input has an order in which it is evaluated. If you wish that the input questions be asked in a particular order then you need to use this field to order the inputs. The input order default is alphabetic.

The **VALUE COUNT** field is maintained by the **RES**. To see this field you require a security level of 9. To edit this field you require a security level of 9. This field is used to keep track of how may values a particular input may take, the maximum number of input values that a particular input may take is ninety nine.
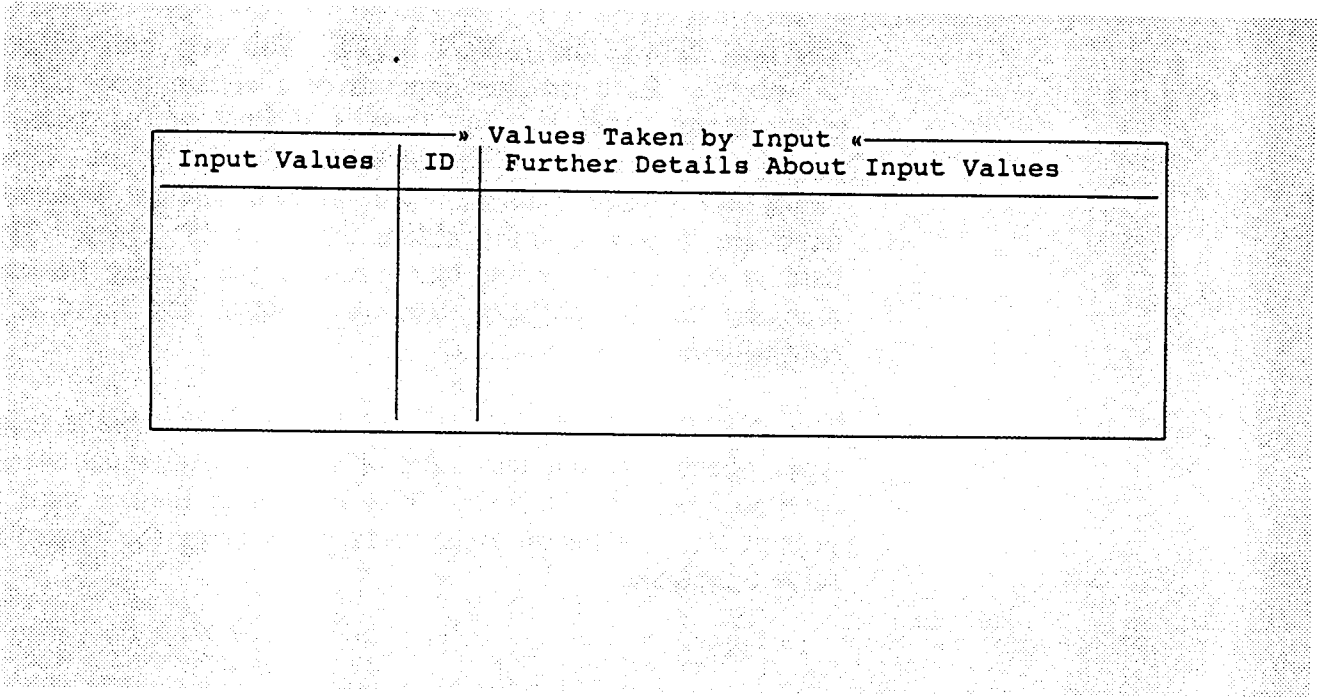
The next field is the **INPUT TYPE**. You may only enter a 'V' or 'S'. Each problem input is of a certain type. Some inputs simply take a value from a defined set of possible values - these are known as **value** inputs or 'V' types. Other inputs take a value from the result values of another problem - these are known as **subproblem** inputs or 'S' types. This field is one of the fields that provides the linking between problems in the problem network - when the input is a **subproblem** input.

The **INSTRUCTION** field is used by inputs that are a **value** type. Each problem input that is a **value** type input should have an entry in this field. This instruction field is used to prompt the user for an input value when using the system to solve a problem.

When you select 'Find' from the command menu with the INPUT file displayed, you will be able to search the INPUT file in Input Name order, in Order of Input Name order, or in Type of Input Name order.

Input values

The '+' key will open the next window. This window displays the list of values that an input may take. The input values are displayed in a tabular format. The records are displayed in INPUT VALUE order. In the table you will only be able to see those input values that are possible for the input highlighted in the previous window. The window for the INPUT VALUES file looks like this.

```
                           ─» Values Taken by Input «──────────────────
   │ Input Values │ ID │  Further Details About Input Values        │
   ├──────────────┼────┼────────────────────────────────────────────┤
   │              │    │                                            │
   │              │    │                                            │
   │              │    │                                            │
   │              │    │                                            │
   │              │    │                                            │
   │              │    │                                            │
```

The INPUT VALUES file has the following fields.

The INPUT VALUE field holds a value that the input may take. Each input to a problem, if it is a value type input, will need to have a list of possible values specified.

The VALUE ID field holds the identifying number of a particular value for the input. To edit this field you require a security level of 9.

The DETAIL field is used to store any further details about a input value. This detail will be displayed to you when you are trying to answer the input instruction displayed to you when making an enquiry of the RES.

Selection of the 'Find' item from the command menu, when the INPUT VALUES file is active, allows you to search in Value of Input order, or in ID of Input Value order.

Result values   The '+' key will open the next window. This window
                      displays the list of results that a problem may take. The
                      results are displayed in a tabular format. The records are
                      displayed in **RESULT VALUE** order. In the table you will
                      only be able to see those result values that are possible for the
                      problem displayed in the first window. The window for the
                      RESULTS file looks like this.

```
                        ─» Result Values of Problem «─
 Result Values │ Id │ Type │ Flow on To │ Explanations About Result Values
               │    │      │            │
               │    │      │            │
               │    │      │            │
               │    │      │            │
               │    │      │            │
               │    │      │            │
```

The **RESULTS** file has the following fields.

The **RESULT VALUE** field holds the result value that a
problem may take.

The **RESULT ID** holds the identifying number of the result.
The **RES** maintains this value. To edit this field you require a
security level of 9.

Each result has a type, this is held in the **RESULT TYPE**
field. Some result values are definitive and are result types,
or type 'R'. Other results are of an intermediate nature and
indicate that another problem needs to be looked at, these
result values are flow types, or type 'F', they indicate that the
result to this problem flows on to another problem.

If the result is a **flow** type then you will need to indicate the name of the problem that this result flows into. The **FLOW PROBLEM** field is used to hold the name of the problem this one flows on to.

It is useful to have an **EXPLANATION** of a result. Each problem result should have an explanation. This explanation is displayed to a user when a problem has reached a result during an enquiry.

Selection of the 'Find' item from the **command menu**, when the **RESULTS** file is active, allows you to search in **Result Value** order, in **ID of Result Value** order, or in **Type of Result Value** order.
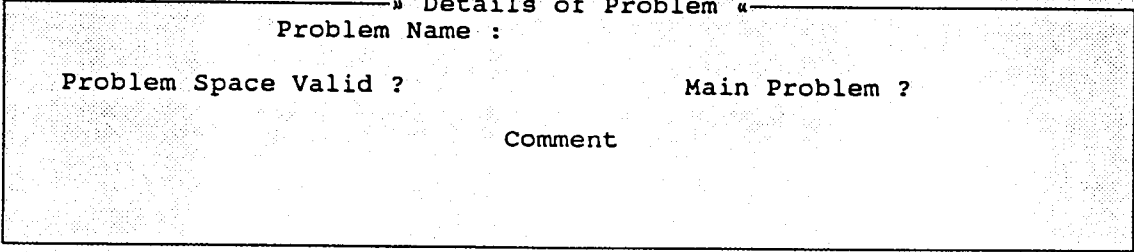
Generate Space

Menu item 'Generate Space' is activated by pressing the 'G' key, or by moving the highlight bar over the item and pressing the 'Enter' key. You will need to have logged on with a security level of at least 4 to move to and activate this menu item.

- This item activates the **Problem Space** data base. It is here that you generate the problem space of a problem and assign results to each entry in the problem space.

Problem details window

When you activate the 'Generate Space' menu item the following window will open on your screen. This window displays the same information that you saw in the first window of the **Problem Definition** data base. The records, as before, are displayed in **PROBLEM NAME** order.

```
┌──────────────────────» Details of Problem «──────────────────────┐
│              Problem Name :                                       │
│                                                                  │
│  Problem Space Valid ?                     Main Problem ?         │
│                                                                  │
│                         Comment                                   │
│                                                                  │
│                                                                  │
│                                                                  │
└──────────────────────────────────────────────────────────────────┘
```

The fields hold the same information as detailed in the last section. You will not be able to add a new problem here, this may only be done in the **Problem Definition** data base. With this window open the 'Find' item from the **command menu** allows you to display records in **Problem Name** order.

The **command menu** of this data base is found at the bottom of the screen. It is slightly different from the usual one and has a submenu on the 'Assign' menu item. The **command menu** looks like this.

```
Next  Prev  Find   Top  Last   Edit   Generate   Assign   + Space   - Problem   Quit
```

The 'Generate' command menu item will, when activated, first ask if you wish to delete the existing problem space. After deletion the RES will then validate the problem network, next it proceeds to order the inputs, (if not already ordered by the user), then to order the values of each input and next to order the result values.

The last stage of the generation process is to generate ALL possible combinations of input values. For example if you have three inputs each capable of taking three possible values then there will be twenty seven entries in the problem space (27 = 3 x 3 x 3). The RES generates an **INPUT CODE** for each combination of input values.

The 'Assign' menu item allows you to assign the result value of the previous record of the problem space to the currently displayed record. This allows you to quickly assign the same result to a group of consecutive problem space entries.

Problem space

The '+' key will open the next window. This window displays ALL combinations of input values that have been generated by the RES. This window displays the **PROBLEM SPACE** file. The records are displayed in **INPUT CODE** order. You will only be able to see the input value combinations that are possible for the problem space of the problem displayed in the previous window. The window for the **PROBLEM SPACE** file looks like this.

```
┌──────────────────────» Problem Space «──────────────────────┐
│                                                             │
│                                                             │
│                                                             │
│                                                             │
│                                                             │
│                                                             │
│          010203040506070809101112131415                     │
│ Input Code :                          Result Value :        │
└─────────────────────────────────────────────────────────────┘
```

The Problem Space has the following editable field.

The **RESULT** field holds the result value recorded against each combination of input values that have been generated for the problem space. Use this field to hold that particular result value that corresponds to the displayed combination of input values.

Selection of the 'Find' item from the command menu when this window is open will display only the problem space of the current problem.
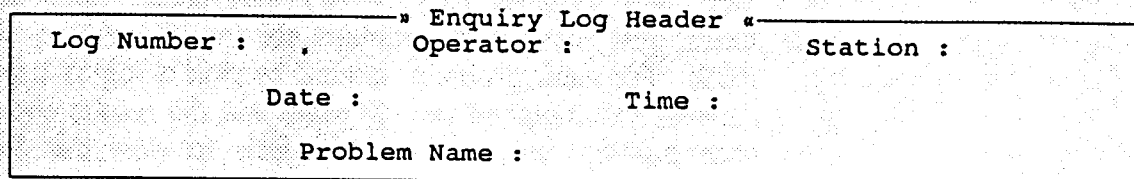
Run Enquiry

Menu item 'Run Enquiry' is activated by pressing the 'R' key, or by moving the highlight bar over the item and pressing the 'Enter' key. You do not need to have logged on to move to and activate this menu item.

This item activates the Enquiry data base. This data base steers you through a problem solving interaction with the RES. For each problem solving session a log is kept of the answers you supplied to each input and the results obtained for each problem solved. You are able to view this log when finished.

Enquiry log

When you activate the 'Run Enquiry' menu item the following window will be open on your screen. This window displays the header details of a problem solving session.

```
┌──────────────────────» Enquiry Log Header «──────────────────────┐
│ Log Number :    ,        Operator :              Station :       │
│                                                                  │
│           Date :                  Time :                         │
│                                                                  │
│              Problem Name :                                      │
└──────────────────────────────────────────────────────────────────┘
```

The only field that you are able to edit is the **PROBLEM NAME** field. An enquiry may only be made upon a main problem. This field is used to hold the name of the main problem of the enquiry. If you wish to see a list of the main problems available press the 'Enter' key or press the down arrow key. The main problem will also need to have a valid problem space to proceed past the first stage.

The other fields are supplied by the RES. The unique identifier of a problem solving interaction with the RES is the **LOG NUMBER** field. The RES automatically increments this field for each new interaction.

The **command menu** differs from the normal in that it does not give you the options of editing or adding to this data base. You 'Begin' a problem solving interaction, or 'Restart' a prior session.

A 'Find' on this window allows you to search on **Log Number**.

The next window may be reached by pressing the '+' key. This window is shown below.

```
┌──────────────────────────» Enquiry Log «──────────────────────────┐
│                                                                    │
│                          ▪                                         │
│                                                                    │
│                                                                    │
│                                                                    │
│                                                                    │
│                                                                    │
│                                                                    │
│                                                                    │
│                                                                    │
│                                                                    │
│                                                                    │
│                                                                    │
│                                                                    │
└────────────────────────────────────────────────────────────────────┘
```
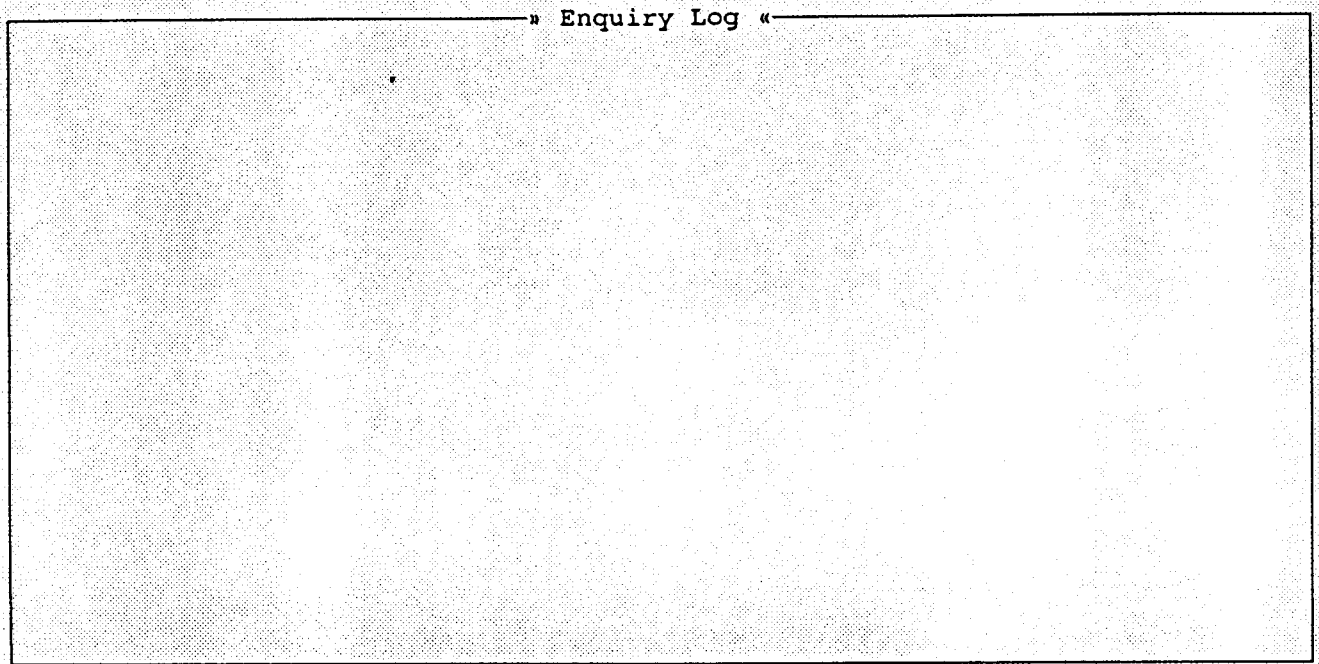
The only field you have access to is the **LINE**. When you begin a session the RES will place you into this window and control the session, asking input questions and checking the validity of your answers. Once a solution has been reached then you are taken out of this interaction mode and placed back at the command menu.

During a session you will be requested to supply the value of an input to a problem. If you do not know the values that this input may take then you may see a list to select from by pressing 'F10' or by pressing the down arrow key. Move the highlight bar to the value of choice and press the 'Enter' key. When you return to the line you will notice that the value chosen is now in the line. Press 'F10' to accept the input value in the line and continue.

A 'Find' on this window allows you to search on **Log Number**.

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Chapter 2 : REPORTS

This chapter describes how to use the report functions of the RES. The **Reports** submenu contains the functions that you will use to view your data bases in a number of different ways. You will be able to send the reports to your screen, or to your printer, or to a disk file. The **Reports** submenu looks like this.

```
═══════════════════════>> Relational Expert System <<═══════════════════════
│    Tuesday, January 28, 1992.                                    0:40:44   │


        ┌──────────────────────────────────────────────────────────────┐
        │     Problems        Reports        Utilities       Quit       │
        └──────────────┬─────────────────────────────┬──────────────────┘
                       │  List Problems              │
                       │  Problem Space              │
                       │  Enquiry Log                │
                       └─────────────────────────────┘




═══════════════════════>> Version 2.0 (C) Vince Ladewig 1992 <<═════════════
│Use the arrow keys '    ' to position the highlight bar upon a menu item, then│
│press the 'Enter' key to select that item.  Or you may select a menu item by │
│typing the first letter of the menu item.  For example, type 'U' for the menu│
│item 'Utilities' then 'L' to 'Logon'   -  you need to logon to use the system.│
│The 'Esc' key is used to return back up to a previous menu level.  Press the  │
│'F1' key for context sensitive help.                                         │
│  Path  E:\RES92\                                           CAPS NUM SCROLL   │
```

The 'List Problems' produces a report for a selected problem or for all problems. The report may be sent to screen, disk or printer.

The 'Problem Space' produces a report listing the problem space for a selected problem or for all problems and may be sent to screen, disk or printer.

The 'Enquiry Log' produces a report detailing the enquiry interaction for a selected problem or for all problems and may be sent to screen, disk or printer.

Each report has a filter that offers you some control over were they go and how they look.

The following fields are common to the report filters.

The **OUTPUT DEVICE** field allows you to choose where to direct your report. Your choices are screen, disk or printer, press the down arrow key on a blank field for a list of choices.

If you are sending your report to a printer then you need to indicate the dimensions of the paper you are using. Field **LINES PER PAGE** and **PAGE WIDTH** allow you to supply these dimensions as the number of lines per page and the width as the number of characters across the page.

If you wish to print the report in compressed mode then enter a 'C' into the **PRINT MODE** field.

If you have elected to send the report to disk then you will need to enter a valid path and filename into the **OUTPUT FILE NAME** field.

Then press 'F10' to begin the printing of the report. Press 'Esc' to leave the report.

Use 'F1' to see the online help for a particular field.

List Problems

The menu item 'List Problems' is activated by pressing the letter 'L', or by moving the highlight bar over the menu item and pressing 'Enter'. You need a security level of at least 1 to activate the item.

· This item allows you to view or print the LIST of PROBLEMS that you have defined. You are able to print all of the problems in the Relational Expert System or only the one of interest.

Preparing the report

After selecting the 'List Problems' item from the Reports submenu the screen looks like this.

```
┌────────────» Problem Definition Report Filter «────────────┐
│                                                            │
│ To print out the definition of a problem you need to       │
│ enter the name of the PROBLEM  [              ]            │
│ Leave blank if you wish to process ALL problems.           │
│                                                            │
│ Send the report to [    ]                                  │
│                                                            │
│ If output is to a PRINTER then enter page details :        │
│ Lines per Page [   ]              Page Width [   ]         │
│                                                            │
│ What print mode [ ] ('N' for normal; 'C' for compressed)   │
│                                                            │
│ If output is to DISK then enter path & filename below :    │
│ [                                                        ] │
│                                                            │
└────────────────────────────────────────────────────────────┘
```

The **PROBLEM NAME** field may be used to limit the report to a particular problem. If you wish to report on all problems then leave this field blank. You may see a list of the available problems by entering a character into the field and then pressing the 'Enter' or the down arrow key. Move the high-light bar to the problem of choice and select by pressing the 'Enter' key.

The other fields have their meaning as explained at the beginning of this chapter.

Then press 'F10' to begin the printing of the report. Press 'Esc' to leave the report.

Use 'F1' to see the online help for a particular field.

Sample output   A sample of the output for the **List Problems** looks like this.

```
Problem Name : L 1 REFLEX   Space Valid ? YES   Main Problem ? NO
Input Count : 01                                Result Count : 03
                            Comment
```

Input Names	Odr	Type
L 1 OR 2 RFX	01	V

Input Values	ID
1 KHZ ONLY	01
2 KHZ ONLY	02
BOTH 1 & 2 K	03

Result Value	ID	Type
BOTH REFLEX	01	F
COCHLEAR	02	F
UNSURE	03	F

```
Problem Name : L 1/2K MTZ   Space Valid ? YES   Main Problem ? NO
Input Count : 02                                Result Count : 06
                            Comment
```

Input Names	Odr	Type
L 1K METZ	01	S

Input Names	Odr	Type
L 2K METZ	02	S

Result Value	ID	Type
COCH & RETRO	01	F
COCHLEAR	02	F
LIKELY RETRO	03	F
NORMAL	04	F
RETRO	05	F
S/N	06	F

Problem Space

Menu item 'Problem Space' is activated by pressing 'P', or by moving the highlight bar over the menu item and pressing 'Enter.' This item requires a security level of at least 1 to be activated.

This item allows you to view or print the PROBLEM SPACE of all problems defined in the Relational Expert System, or to print the problem space of a single problem of interest.

Preparing the report   After selecting the 'Problem Space' item from the **Reports** submenu the screen looks like this.

```
┌─────────────── » Problem Space Report Filter «───────────────┐
│ To print out the problem space of a problem you need          │
│ to enter the name of the PROBLEM   [           ]              │
│ Leave blank if you wish to process ALL problems.              │
│                                                               │
│ Send the report to [   ]                                      │
│                                                               │
│ If output is to a PRINTER then enter page details :           │
│ Lines per Page [  ]              Page Width [  ]              │
│                                                               │
│ What print mode [  ] ('N' for normal;'C' for compressed)      │
│                                                               │
│ If output is to DISK then enter path & filename below :       │
│ [                                                         ]    │
└───────────────────────────────────────────────────────────────┘
```

The field **PROBLEM NAME** may be used to limit the report to a particular problem. If you wish to report on all problems then leave this field blank. You may see a list of the available problems by entering a character into the field and then pressing the 'Enter' or the down arrow key. Move the highlight bar to the problem of choice and select by pressing the 'Enter' key.

The other fields have their meaning as explained at the beginning of this chapter.

Then press 'F10' to begin the printing of the report. Press 'Esc' to leave the report.

Use 'F1' to see the online help for a particular field.

Sample output   A sample of the **Problem Space** looks like this.

```
Problem Name : L 1 REFLEX  Space Valid ? YES   Main Problem ? NO
Input Count : 01                                Result Count : 03

                              Comment
                          .


        Input Name      Value           Input Name     Value

0101 L 1 OR 2 RFX   1 KHZ ONLY

                010203040506070809101112131415
Input Code :    01XXXXXXXXXXXXXXXXXXXXXXXXXXXX   Result Value : COCHLEAR

0102 L 1 OR 2 RFX   2 KHZ ONLY

                010203040506070809101112131415
Input Code :    02XXXXXXXXXXXXXXXXXXXXXXXXXXXX   Result Value : UNSURE

0103 L 1 OR 2 RFX   BOTH 1 & 2 K

                010203040506070809101112131415
Input Code :    03XXXXXXXXXXXXXXXXXXXXXXXXXXXX   Result Value : BOTH REFLEX
```

Enquiry Log

Menu item 'Enquiry Log' is activated by pressing 'E', or by moving the highlight bar over the menu item and pressing 'Enter'. This item requires a security level of at least 1 to be activated.

This item will allow you to view or print the LOG of an ENQUIRY made on the Relational Expert System. You are able to print all logs or just that of a selected interaction with the RES.

Preparing the report

After selecting the 'Enquiry Log' item from the Reports submenu the screen looks like this.

```
┌──────────────» Enquiry Log Report Filter «───────────────┐
│ To print out the enquiry log of a problem you need to     │
│ enter the LOG NUMBER of the enquiry  [      ]             │
│ Leave blank if you wish to process ALL enquiry logs.      │
│                                                           │
│ Send the report to [    ]                                 │
│                                                           │
│ If output is to a PRINTER then enter page details :       │
│ Lines per Page [  ]              Page Width [   ]         │
│                                                           │
│ What print mode [ ] ('N' for normal;'C' for compressed)   │
│                                                           │
│ If output is to DISK then enter path & filename below :   │
│ [                                                     ]    │
└───────────────────────────────────────────────────────────┘
```

The **LOG NUMBER** field may be left blank to print the details of all logs, or you may enter the **LOG NUMBER** of a particular enquiry. You may see a list of available enquiries by entering a character in this field and then pressing the 'Enter' or the down arrow key. A list of the enquiries that have been made on the system are then displayed. Select your choice by pressing 'Enter'.

The other fields have their meaning as explained at the beginning of this chapter.

Then press 'F10' to begin the printing of the report. Press 'Esc' to leave the report.

Use 'F1' to see the online help for a particular field.

Sample output   A sample of the output looks like this.

```
Log Number : 00001    Operator : SYSOP      Station : 000

                       Date : 30/01/1992    Time : 14:23

   Problem Name : R PTA

Enquiry Log Entries
```
```
Problem 'R PTA       ' has'been invoked.
Evaluation of the Inputs to 'R PTA       ' follows -
1>>>>
Input 'R PTA AIR   ' has the following question -
Is the air PTA of the RIGHT ear normal ?
NORMAL
The air PTA of the RIGHT ear is normal.
   --------------------
Input 'R PTA BONE  ' has the following question -
Is the bone PTA of the RIGHT ear normal ?
NORMAL
The bone PTA of the RIGHT ear is normal.
   --------------------
Problem 'R PTA       ' has a result
BOTH air and bone PTAs are normal - continue with testing.
This result is an intermediate result and flows onto Problem 'R TYMPANO '
1<<<<
Problem 'R TYMPANO ' has been invoked.
Evaluation of the Inputs to 'R TYMPANO ' follows -
1>>>>
Input 'R PRESSURE  ' has the following question -
What was the tympanometric pressure of the RIGHT ear?
NORMAL
The pressure was normal.
   --------------------
Problem 'R TYMPANO ' has a result
The pressure is NORMAL, continue and look at the shape of the tympanogram.
This result is an intermediate result and flows onto Problem 'R SHAPE     '
1<<<<
Problem 'R SHAPE     ' has been invoked.
Evaluation of the Inputs to 'R SHAPE     ' follows -
1>>>>
Input 'R CONTOUR    ' has the following question -
What is the contour of the tympanogram of RIGHT ear?
NORMAL
The shape of the tympanogram is NORMAL.
   --------------------
Problem 'R SHAPE     ' has a result
NORMAL tympanometry - continue with testing of RIGHT ear.
This result is an intermediate result and flows onto Problem 'R REFLEXES'
1<<<<
Problem 'R REFLEXES' has been invoked.
Evaluation of the Inputs to 'R REFLEXES' follows -
1>>>>
Input 'R ANY REFLEX' has the following question -
Any stapedius reflexes present at any level of stimulation ?
AT LEAST ONE
Have been able to obtain at least one reflex at either 1KHz or at 2KHz.
   --------------------
Problem 'R REFLEXES' has a result
At least one reflex present - continue testing.
This result is an intermediate result and flows onto Problem 'R SRT/PTA
```

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Chapter 3 : UTILITIES AND QUITTING

. In this chapter the **Utilities** are described. As well instructions on how to exit the RES are given.

The **Utilities** submenu contains functions to 'Logon', modify 'Passwords', 'Re-index Problem Files', 'Setup a Printer', 'View Error File', and to go out to the 'OS Shell'. These are largely housekeeping functions. The security levels of these menu items vary.

The **Quit** submenu will ask you to confirm your wish to leave the RES. A security level of at least 1 is required to quit the RES.

Utilities

The RES housekeeping functions are found in the **Utilities** submenu. Most of these are used infrequently, the exception being the 'Logon' function. The **'Passwords'** function is used to add a new user to the system, to modify an existing user's password, and to delete a user from the system.

The menu item 'Re-index Problem Files' allows you to rebuild the indexes for the RES data bases.

For a report to be printed out properly the RES needs to be told what type of printer you have connected. The menu item **'Setup a Printer'** allows you to select, or define and then select, the printer you have connected to your computer.

If the RES has a system failure an error message is written to an error file. Use menu item 'View Error File' to view this file.

It is sometimes useful to step out of the RES back into the operating system. Menu item 'OS Shell' allows you to do this.

The **Utilities** submenu looks like this.

```
==============================>> Relational Expert System <<==============================
  Tuesday, January 28, 1992.                                          0:40:44


          ┌─────────────────────────────────────────────────────────────┐
          │   Problems        Reports        Utilities        Quit       │
          └────────────────────────────────┬────────────────────────────┘
                                            │ Logon            (Alt-L)    │
                                            │ Passwords        (Alt-U)    │
                                            │ Re-index Problem Files      │
                                            │ Setup a Printer             │
                                            │ View Error File             │
                                            │ OS Shell         (Alt-O)    │



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Use the arrow keys '      ' to position the highlight bar upon a menu item, then
press the 'Enter' key to select that item.   Or you may select a menu item by
typing the first letter of the menu item.  For example, type 'U' for the menu
item 'Utilities' then 'L' to 'Logon'   -   you need to logon to use the system.
The 'Esc' key is used to return back up to a previous menu level.  Press the
'F1' key for context sensitive help.
   Path  E:\RES92\                                            CAPS NUM SCROLL
```

Logon Menu item 'Logon' is activated by pressing 'L' when in the Utilities submenu , or by using the key combination of 'Alt-L' from anywhere in the RES. You logon by entering your OPERATOR NAME and PASSWORD.

There is no security level required to logon. A security level is only assigned after a valid operator name and the corresponding password for that operator is given.

. Once you have successfully logged on you then have a security clearance level assigned. You are then able to select those menu items that have a security level less than or equal to this assigned security level.

Activation of the 'Logon' menu item results in a screen like this.

```
══════════════════════>> Relational Expert System <<══════════════════════
  Tuesday, January 28, 1992.                                    0:40:44


      ┌──────────────────────────────────────────────────────────────┐
      │    Problems        Reports        Utilities        Quit       │
      └───────────────────────────────────┬──────────────────────────┘
                                           │ Logon          (Alt-L)  │
      ┌──────Security Logon (Esc-Abort)────┤ sswords        (Alt-U)  │
      │Operator :                          │ -index Problem Files     │
      └────────────────────────────────────┤ tup a Printer           │
                                           │ View Error File          │
                                           │ OS Shell       (Alt-O)  │
                                           └──────────────────────────┘


══════════════════>> Version 2.0 (C) Vince Ladewig 1992 <<══════════════════
 Use the arrow keys '    ' to position the highlight bar upon a menu item, then
 press the 'Enter' key to select that item.  Or you may select a menu item by
 typing the first letter of the menu item.  For example, type 'U' for the menu  .
 item 'Utilities' then 'L' to 'Logon'  -  you need to logon to use the system.
 The 'Esc' key is used to return back up to a previous menu level.  Press the
 'F1' key for context sensitive help.
    Path  E:\RES92\                                          CAPS NUM SCROLL
```

Passwords

Passwords are entered, modified, and deleted using the 'Passwords' item on the Utilities submenu. The menu item 'Passwords' is activated by pressing 'P', or by using the key combination of 'Alt-U'. No security level is required to move to this menu item, but if you attempt to activate the menu item before you have logged on you will be told to logon, and will be unable to activate this item. You can reach the 'Passwords' menu item but you will be unable to use it until you have logged on.

· Once you have logged on you will then be able to update YOUR own password entry. If you have logged on with a security level less than 9 you will be placed into the Passwords data base. The command menu looks like this.

```
Change Password  Next  Prev  Find  Top  Last  Edit  Add  Delete  ReIndex  Quit
```

When in the Passwords data base use the command menu item 'Change Password' to alter your password. Note that the only other item on the command menu that you are able to activate is 'Quit'.

If you have logged on with a security level of 9, then you are able to add, edit, and delete the operator names and passwords of ALL other users. You are even able to add other operators that have a security level of 9.

Activation of the 'Passwords' item by a user with a security level of 9 will result in a menu display similar to this.

```
┌─────────────────────────────────────────────────────────────┐
│   Problems        Reports       Utilities      Quit          │
└──────────────────────────┬──────────────────────────────────┘
                           │ Logon            (Alt-L)  │
┌──────────────────────────┴────────────────────────────────────┐
│ Enter  1-Update Password Database, 2-Update Master, [Esc to Abort] : 2 │
└───────────────────────────┬───────────────────────────────────┘
                            │ View Error File           │
                            │ OS Shell          (Alt-O) │
                            └───────────────────────────┘
```

If you wish to update the master password for the system operator (SYSOP) then select the 'Update Master' item by entering the number '2' and then pressing the 'Enter' key. The menus should now look like this.

```
┌─────────────────────────────────────────────────────────────────┐
│     Problems          Reports        Utilities        Quit        │
└──────────────────────────────────┬────────────────────────────────
                                   │ Logon              (Alt-L)  │
      ┌───────Change Password (Esc-Abort)───────┐sswords     (Alt-U)  │
      │Password :        •                      │-index Problem Files │
      └─────────────────────────────────────────┘tup a Printer       │
                                   │ View Error File             │
                                   │ OS Shell           (Alt-O)  │
                                   └─────────────────────────────┘
```

You are now given the chance to enter a new master password. The master system operator name is fixed - SYSOP. A password can be up to **eight** (8) letters or numbers in length. At this point be **VERY CAREFUL.** Enter the new password and press the 'Enter' key. The screen changes slightly - the word Password becomes Verify. At this point you need to re-type the new password **EXACTLY** as you first entered it, then press the 'Enter' key again. This is the verification stage. If you have any problems simply press the 'Esc' key to abort the **Update Master** function.

If you have successfully altered you master password then write it down somewhere and store it in a safe place away from the computer.

The other option on the **Passwords** submenu, if you have logged on with a security level of **9**, is the '**Update Password Database**' item. Select this item by entering a '**1**' followed by pressing the '**Enter**' key.

```
┌─────────────────────────────────────────────────────────────┐
│   Problems          Reports         Utilities        Quit    │
└────────────────────────────────┬─────────────────────────────┘
                 .               │  Logon            (Alt-L)    │
┌────────────────────────────────┴─────────────────────────────┐
│ Enter   1-Update Password Database, 2-Update Master, [Esc to Abort] : 1│
└──────────────────────────────┬───────────────────────────────┘
                               │  View Error File              │
                               │  OS Shell          (Alt-O)    │
                               └───────────────────────────────┘
```

You will then be placed in the **Passwords** data base. Use this menu item when you wish to add a new operator, modify the security level or password of an existing operator, or to delete an operator.

To add a new operator select the '**Add**' item from the command menu of the **Passwords** data base. Then edit the active fields. Press '**F10**' to complete the edit, or '**Esc**' to abort the addition. After adding a new operator you must then select the '**Change Password**' item on the command menu. This item allows you to enter and then verify the password you wish to allocate to the new user.

To alter the name of an operator, but keep the password the same use the '**Edit**' menu item. To modify the password of an operator use the '**Change Password**' option on the command menu.

To remove a user use the '**Delete**' menu item on the command menu.

Use the '**ReIndex**' item on the **Passwords** data base command menu to repair the indexes of the **Passwords** data base. Use this option if for some reason you are having troubles logging on to the RES. You should always be able to logon to the RES using the **master password** of the operator **SYSOP**.

The other menu items work as expected. Use '**F1**' for online help about the **Passwords** data base command menu.

Re-index Problem Files

The RES data bases hold the details of your problem network and the enquiries made of it.

The RES sets up indexes to retrieve information from a data base efficiently. Sometimes these indexes get out of step with the data stored in a data base. This might be due to a number of causes, e.g. power failure or hard disk error.

The menu item 'Re-index Problem Files' is activated by pressing 'R'. Use this item to repair the indexes of the RES files. This item requires a security level of at least 1. If for some reason there is a problem entering the RES data bases then select this item to re-index the problem data files. Contact your technical support people if the problem persists.

The re-index screen for the RES data files looks like this.

```
───────────────────────── File Recovery ─────────────────────────
 This module will enable you to purge all deleted records, and/or rebuild
 any  damaged  index  files.    You  may  restrict the recovery process to
 specific files if desired.

  NOTE :- Be sure to have at least  one  backup of your data BEFORE you
          continue with this process.  You may have to restore the data
          files  if  this process fails.  If you do not have any recent
          backups of your data files, press ESC and make some now.


   Selected Files        ┌────▼───┬──────────┬──────────┬──────────┐
                         │►PROBLEM.DAT ◄INPUT.DAT │VALUE.DAT │RESULT.DAT│
  Use ↑↓→← to move       ├────▲───┼──────────┼──────────┼──────────┤
  between Files          │SPACE.DAT │HEADER.DAT│ENTRY.DAT │INLOG.DAT │
  Press S to Select &    ├──────────┼──────────┼──────────┼──────────┤
  Unselect Files.        │RESLOG.DAT│          │          │          │
                         ├──────────┼──────────┼──────────┼──────────┤
  Selected/Unselected    │          │          │          │          │
                         └──────────┴──────────┴──────────┴──────────┘

       Press "Y" or "N" to select:-- Purge Deleted Records  (Y/N)  Y

              Press Esc to Abort or F10 to Continue.
```

If you wish to re-index all of the listed files press the 'F10' key. Do this if you do not know which indexes are causing the problem. The screen will then show you the progress as each data file is scanned and the indexes are re-built.

If you have some idea which indexes are causing the problem, use the arrow keys to move the highlight bar over the files that you do NOT wish to re-index and press the 'S' key to de-select the file. The 'S' key can also be used to re-select a file that has been de-selected. The advantage of doing this is that it takes less time to re-index.

Set up printer

Menu item 'Setup a Printer' is activated by pressing 'S'. This item requires a security level of at least 1. This menu item takes you into a data base of available printers. This data base allows you to define the ESCAPE codes used by your printers and to select which printer to use when printing RES reports.

Use the **down** and **up arrow** keys, or the 'Next' and 'Prev' items from the command menu, to move the highlight bar to the printer of choice. With the highlight bar over your choice use the 'Select' item from the **command menu** to store the printers details in a file called **DBPRINT.DEF**.

If your printer is not on the list of **MODELS** then you will need to add a printer using the 'Add' command menu item. enter the name and model of your printer and press 'F10' to save. 'Esc' will abort the addition.

Next, you need to enter the ESCAPE CODES that are used by your printer when printing normal text and compressed text. To do this activate the 'Items' option of the **command menu** and then select 'Add' to add in at least the codes for **N** (normal) and **C** (compressed) printing.

Ask your technical support people if you are having problems doing this.

View error file

Menu item 'View Error File' is activated by pressing 'V'. This item allows you to view the ERROR MESSAGES that may be produced by the RES. If any RES data base or code data base fails while operating, then in most cases it will write a message to a file called **DBIOERR.OR** before it closes the data base and returns to the menu.

The 'View Error File' displays the file **DBIOERR.OR** on your screen. You should make a note of what is displayed when you select this menu item as it may be useful to your technical support people.

OS shell   Menu item 'OS Shell' is activated by pressing 'O' when in the Utilities submenu, or by using the key combination of 'Alt-O'. This item requires a security level of at least 9. This item will allow you to leave the RES temporarily and enter the **OPERATING SYSTEM**. When you have finished what you wish to do in the **OPERATING SYSTEM** then type 'EXIT' at the DOS prompt to return to the RES.

Quitting

To quit the RES choose the item 'Quit' from the main menu, or press 'Q'. You can also quit RES at any point in the program by using the shortcut key combination 'Alt-X'. In either case the system requires that you confirm your decision to quit. You need a security level of at least 1 to leave the RES.

```
════════════════════════>> Relational Expert System <<═══════════════════════
  Tuesday, January 28, 1992.                                      0:40:44


        ┌─────────────────────────────────────────────────────────┐
        │    Problems          Reports         Utilities       Quit │
        └──────────────────────────────────────────────┬───────────┘
                                                 ┌──────┴──────┐
                                                 │ Yes         │
                                                 │ No          │
                                                 └─────────────┘




════════════════════>> Version 2.0 (C) Vince Ladewig 1992 <<══════════════════
Use the arrow keys '    ' to position the highlight bar upon a menu item, then
press the 'Enter' key to select that item.  Or you may select a menu item by
typing the first letter of the menu item. For example, type 'U' for the menu
item 'Utilities' then 'L' to 'Logon'  -  you need to logon to use the system.
The 'Esc' key is used to return back up to a previous menu level.  Press the
'F1' key for context sensitive help.
  Path  E:\RES92\                                       CAPS NUM SCROLL
```

Menu item 'Yes' is activated by pressing 'Y', or by using the key combination of 'Alt-X'. This item requires a security level of at least 1. Select this item to quit the RES. Pressing 'Alt-X' will also allow you to exit if you have sufficient security level.

Menu item 'No' is activated by pressing 'N'. This item leaves you in the RES, returning you to the main menu of the RES.

Appendix A : SOME TERMINOLOGY

This appendix provides an overview of the three components of the Relational Expert System (RES) shell. Some terms are explained and the concept of a problem network is introduced.

A set of symbols is suggested for use when preparing the problem network on paper. Examples are provided.

RES Overview

An expert system shell is an item of software that allows the gathering and storage of some area of knowledge of an expert in such a way as to allow a non-expert to access and gain benefit from the stored knowledge. The RES has three components that together form the expert system shell.

The RES is different to most expert system shells in that it has implemented the shell as a number of data bases. The elements of an area of expertise are broken down into problems. This may seem, in some cases, an inappropriate use of the word problem. You might prefer the concept of reaching goals, rather then solving problems. It matters little as long as the expert can break down the area of expertise being modelled into discrete subunits. These subunits of knowledge are stored in the RES. The expert then indicates to the RES what to expect when each subunit is manipulated. The RES also stores details of any enquiries made of the system.

The first component of the RES is the **PROBLEM DEFINITION** data base. It is this data base that is used to hold the definition of each problem, or subunit of the area of expertise being modelled. This data base contains information about how the various problems, or subunits interconnect. This data base does not contain any specific details of the expert's knowledge, it contains no details of what to expect when a subunit is manipulated. At this stage the expert has told use about the main problems in general terms but as yet has not provided the detail. This data base tells us something of how the subunits interconnect, but not the details of the conditions required to make an interconnection.

The second part of the RES is used to store the details of what happens when a subunit is manipulated, when a problem has certain conditions applied to it. Consider that a problem may have a number of different inputs to it. An input may be weight, height, home ownership etc. Each input may take a number of possible values - the input, home ownership, may take the values - own, rent, mortgage, and squat say. As long as the expert can tell the RES the main subunits and the values that each input to the subunit may take then the RES can build the **PROBLEM SPACE** data base.

The **PROBLEM SPACE** generates and stores each possible combination of input values. To get a feel for how big a problem space may become consider a problem, or subunit, that has three inputs. Say the first input may have 2 values, the second 4 values, and the third 3 values. The RES will generate 2 x 4 x 3 (24) records, each record corresponds to a unique combination of input values. The RES is exhaustive in its efforts to generate and store all possible combination of input values. Now the RES is ready to store the details of the experts knowledge, how the inputs lead to results, or outcomes. Having generated the problem space the expert now instructs the RES as to what the result should be for each possible combination of input values. It is this detail that completes the modelling of the experts knowledge.

At this point the area of expertise has been modelled.

The third component of the RES is that part which allows a non-expert to benefit from the knowledge that has been captured by the RES. This part allows a user to make an enquiry of the RES. During an enquiry the RES looks at the **PROBLEM DEFINITION** data base to see what the inputs are for the problem being considered. The RES will ask the user for the values that each input has taken. As a value for an input is given the RES looks into the **PROBLEM SPACE** of the problem, or subunit being considered. When enough questions have been asked an outcome to the problem will be found in the **PROBLEM SPACE**. Depending upon what this outcome is the RES may indicate that another problem needs to be solved or that a solution has been reached and no more questions need to be asked.

What is a Problem ?

A problem is identified by its name. Each problem has one or more inputs. An input is identified by its name. An input may be used by more than one problem. An input may take one or more values.

A result of a problem is a value that the problem takes depending upon the values that the problem's inputs have taken. A result may be a solution to the problem or it might indicate that another problem should also be solved, that is that this current problem should connect to another problem, or we might say that this problem result flows into another problem. So there are two types of results, one is a solution, the other is a link to another problem. This link is a flow link. This link allows us to chain forward through the problem network.

The other type of link between problems occurs when an input to a problem has its values supplied by another problem. The result of one problem is linked as input to another problem. This type of input is called a subproblem input. This link allows us to chain backward through the problem network.

We see that a problem network is a collection of problems connected by links that flow forward from the results of one problem into another, and also by links that chain backward into subproblems that need to be solved to provide the input value to a problem.

Figure 1 is a problem with three inputs. Input 1 has three values - Value A, Value B, and Value C. Input 2 has three values also - Value 1, Value 2, and Value 3. The third input, Input 3 has three values - Value X, Value Y, and Value Z. This will give a problem space of size 27 (3 x 3 x 3). The possible results of this problem are Result 1, Result 2, and Result 3. This means that more than one combination of input values will give the same result. For example the triples { V a l u e   A ,   V a l u e   1 ,   V a l u e   X }   a n d {Value C, Value 3, Value Z} when applied as input values to the problem may lead to Result 2.

Figure 2 shows how one of the results might flow into another problem. That result is only an indication to the RES that this other problem needs to be solved - the result does not serve as input to the problem. Result 1, and Result 2 are solutions to the problem - the RES would end the enquiry there.

Figure 3 is a more complex problem network example. All problem links in this example are flow links.

Figure 4 is another example of a more complex problem network but this example shows the backward chaining link, the subproblem input link. Notice how the 'R 1K METZ' problem and the 'R 2K METZ' problem both provide their results as input to the problem 'R 1/2K METZ' problem. This is an example of two subproblem inputs into a problem. When the RES is asked to solve the 'R 1/2K METZ' problem it will see that it has to first solve the input subproblems.

A final comment should be made on the idea of granularity of the problem network. The granularity refers to the number of problems that have been defined to model a particular area of expertise. In general the greater the number of problems used to model the knowledge domain the finer the granularity of the model. The RES allows the you to progressively refine your model - usually after testing it at each level of granularity. This stepwise refinement allows you to start with a fairly coarse model, test it and then add another level of complexity, then test this level and so on until the model has sufficient granularity to satisfy the most discerning or sceptical of experts. Be aware though a higher level of granularity will mean that the user needs to supply more answers to navigate a given problem model.
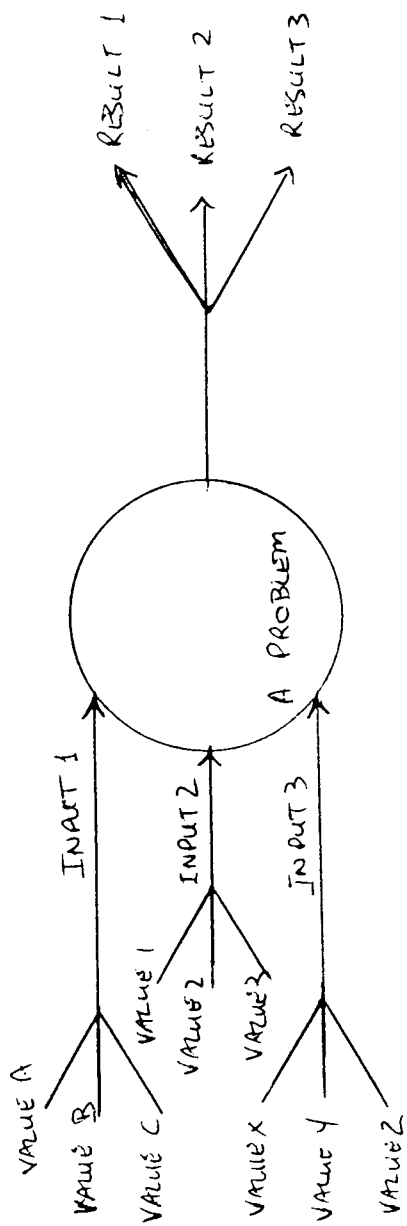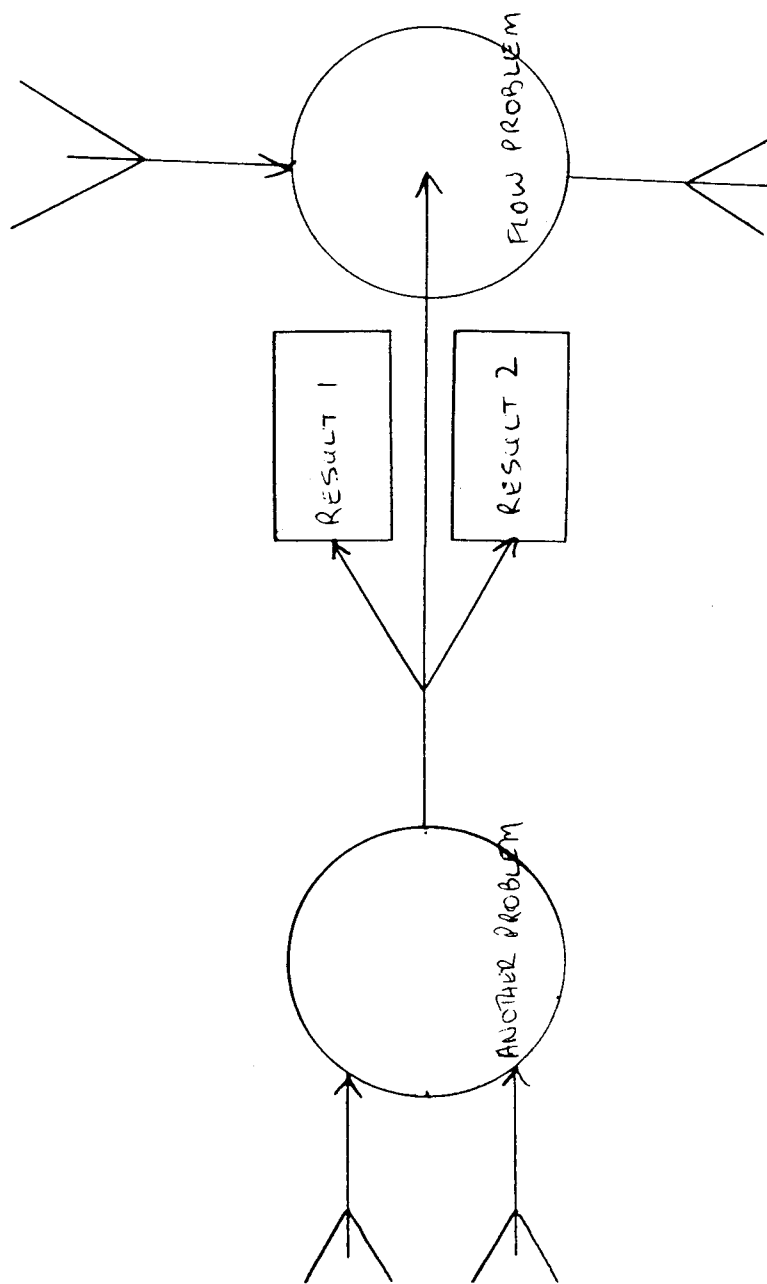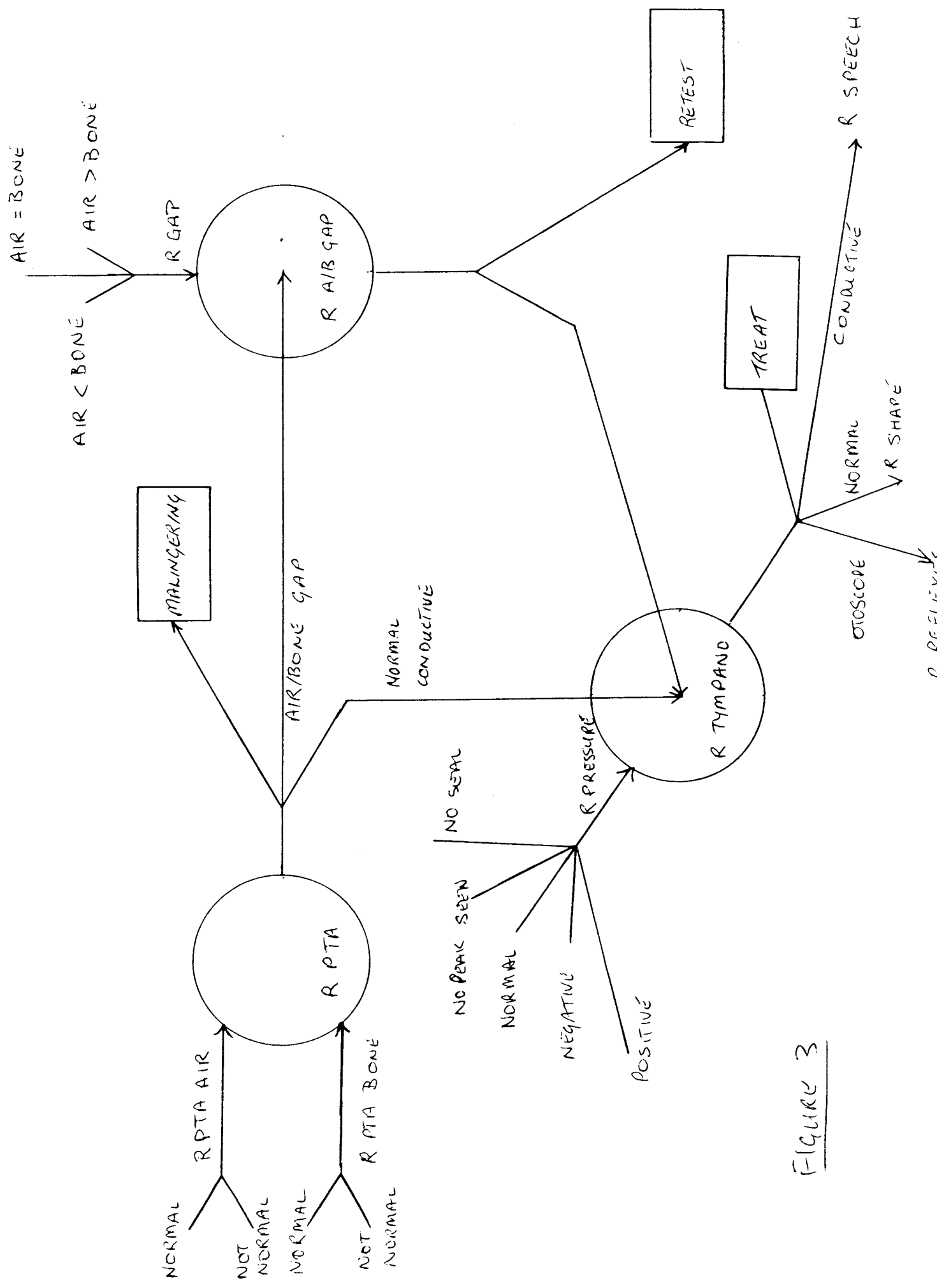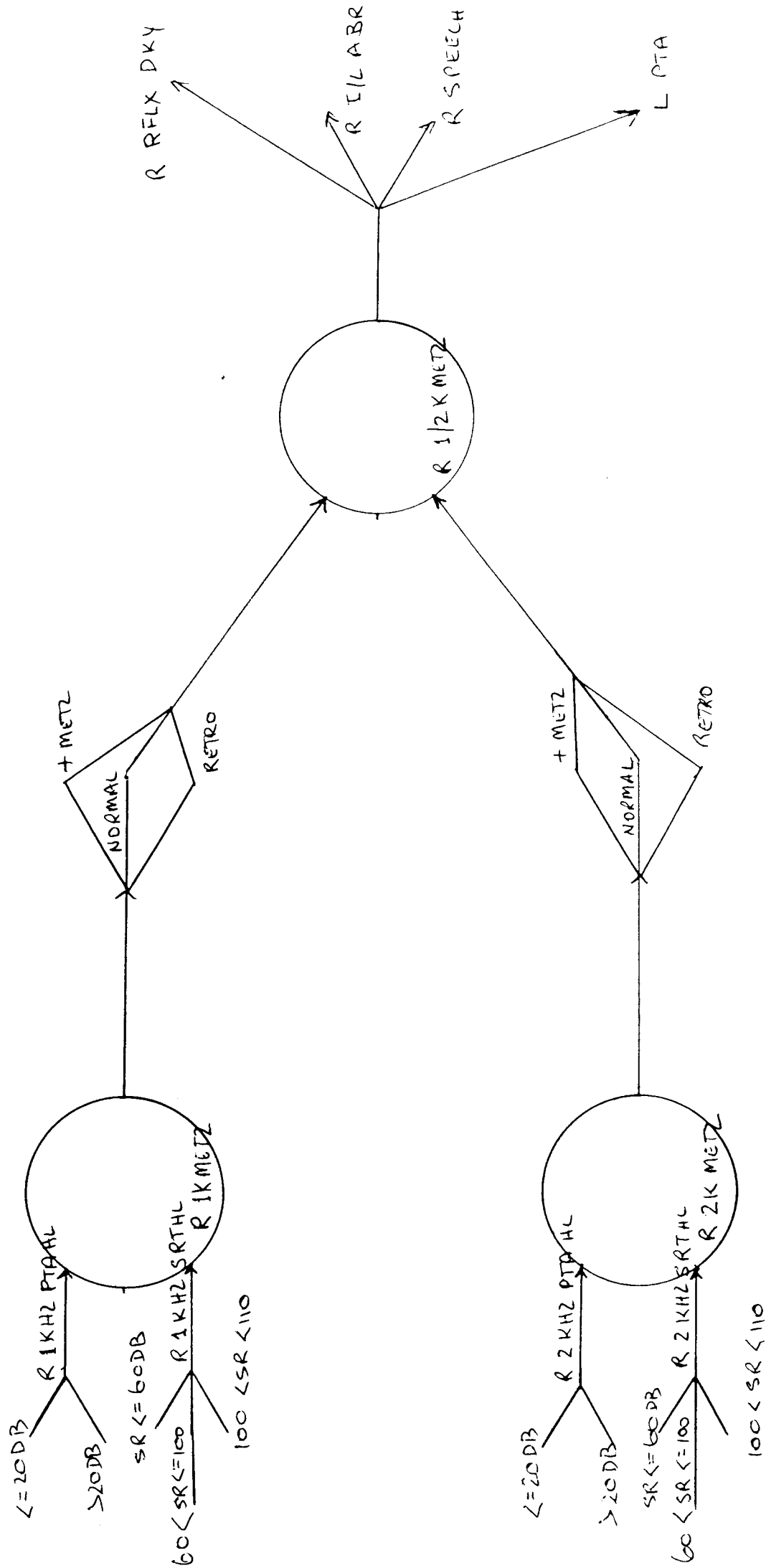
Figure 1

Figure 2

FIGURE 3

AIR = BONE

AIR > BONE

R GAP

AIR < BONE

R AIR GAP

RETEST

R SPEECH

CONDUCTIVE

TREAT

NORMAL

R SHAPE

MALINGERING

AIR/BONE GAP

NORMAL CONDUCTIVE

OTOSCOPE

R PTA

R PTA AIR

NORMAL

NOT NORMAL

R PTA BONE

NORMAL

NOT NORMAL

NO SEAL

R PRESSURE

R TYMPANO

NO PEAK SEEN

NORMAL

NEGATIVE

POSITIVE

FIGURE 3

FIGURE 4