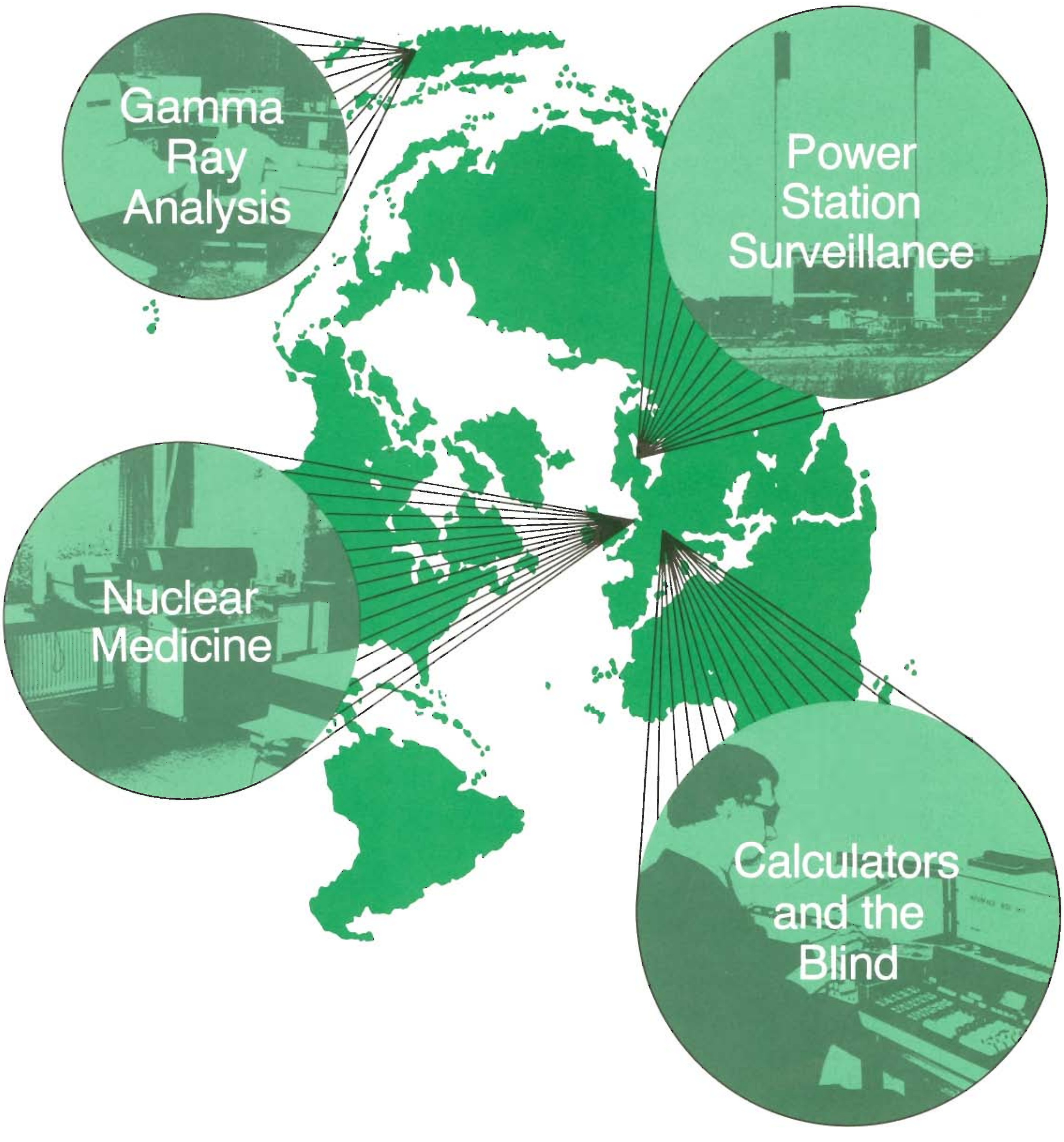
HEWLETT-PACKARD

KEYBOARD

VOL. 6 NO. 6



OVERVIEW

This is the first international issue of *KEYBOARD*, with all items originating in countries other than the U.S.A. The universal applicability of programmable calculators was emphasized when we read through all of the articles and decided they are equally appealing to users, both throughout the U.S.A. and in other countries. Certainly the same wide range of programmable calculator uses applies in all parts of the world, interlinked by a common mathematical bond.

We would like to learn your thoughts on having an international isue of *KEYBOARD* once a year, which is now the tentative plan.

Of special interest to many readers is the article by Karel Vrána of Prague, Czechoslovakia, which won the other-countries branch of the 1974 Calculator System Application Contest. The prize is a HP-45 pocket calculator. The article describing the use of HP calculators by the blind starts on Page 1.

The Crossroads column by John Nairn is not included in this issue, in keeping with the international motif, but it will be resumed in the next issue.

Judging from letters we receive, the Programming Tips are probably as consistently popular as any *KEYBOARD* material. We would like to receive for possible publication any techniques of general interest that you develop. Address them to the closest field editor or send them directly to Loveland.

A B Sperry

**APPLICATIONS INFORMATION
FOR HEWLETT-PACKARD CALCULATORS
PUBLISHED AT P.O. BOX 301,
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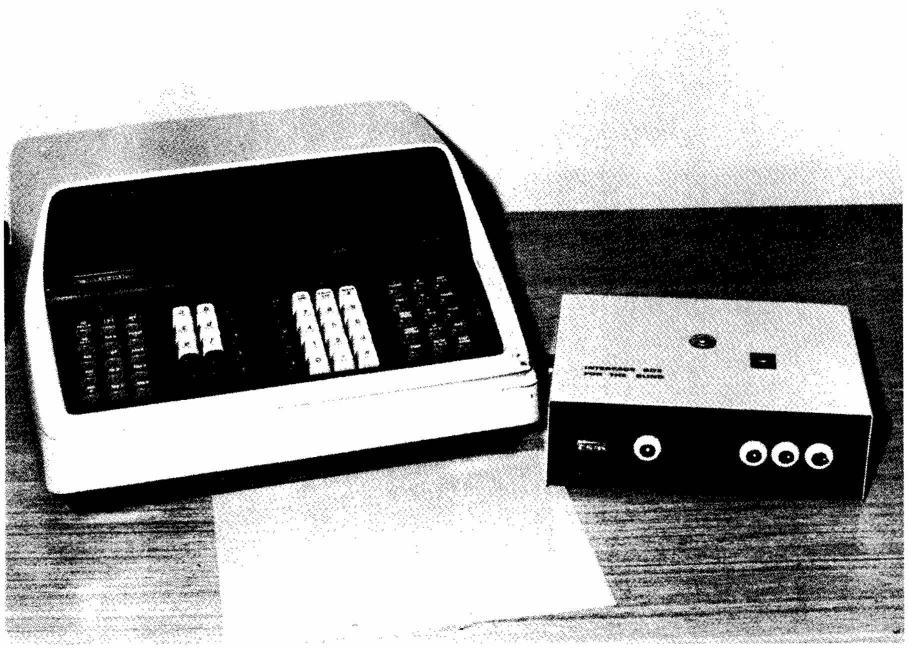
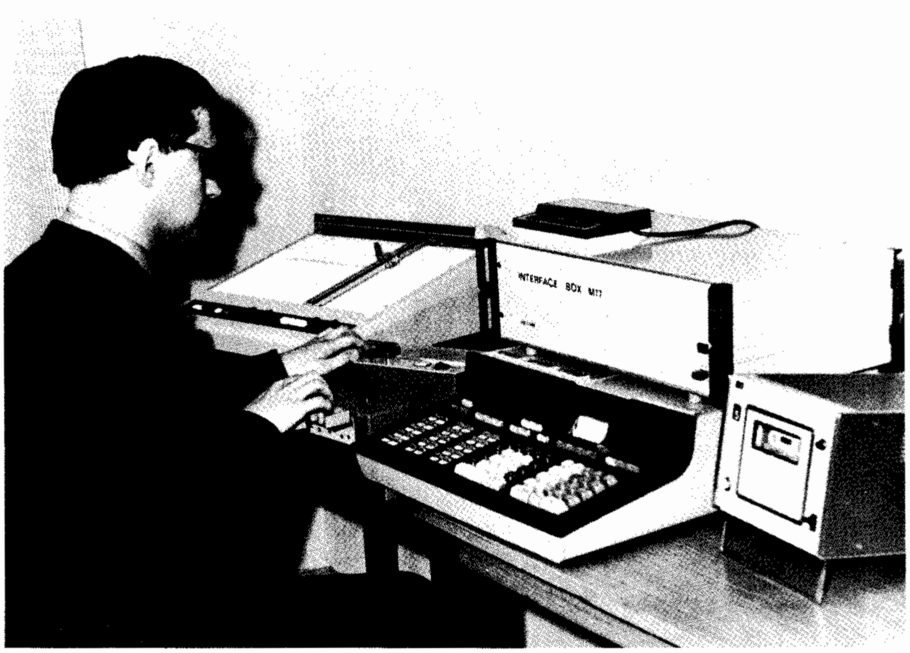
HP Calculators Used by the Blind

by Karel Vrana



The 9100B with interface box for the blind.



The 9820A and audiodisplay.

SUPPLEMENTARY DEVICE TO THE HP 9100A/B CALCULATOR

In the Development Workshops of the Czechoslovak Academy of Sciences in Prague an apparatus has been developed enabling blind mathematicians to work with the HP 9100A/B Calculator. With it, the blind are able to read the contents of the X, Y and Z registers, as well as the programmed instructions stored in the memory. Upon request, or if so programmed, the results or desired program steps appear in a small window in the form of 6-point embossed characters. The apparatus outputs the characters sequentially at a rate controlled by the blind operator. Their size and format is identical with standard Braille letters.

Arbitrary alphanumeric commentaries in Braille can also be stored in the memory. All commentaries are introduced by the FMT instruction followed by 1, or another keystroke, if 1 is not convenient. These instructions put the calculator out of normal function until the end of the commentary. These two keystrokes prevent the following instructions from being carried out by the calculator, which just outputs signals for the supplementary device. In the device they are transformed into sequentially embossed Braille letters readily readable by the blind so that they need not learn any new alphabet. The end of the commentary is marked by the Braille full stop which automatically switches the calculator to its normal function.

The device can be easily attached to the calculator by a cable, via the signal connector of the calculator, in the same manner as all other HP peripherals. The device does not interfere with any other HP peripherals attached to the calculator simultaneously with the exception of the printer, which can be used only alternately with the supplementary device for the blind as the print signal actuates both devices if they are switched on.

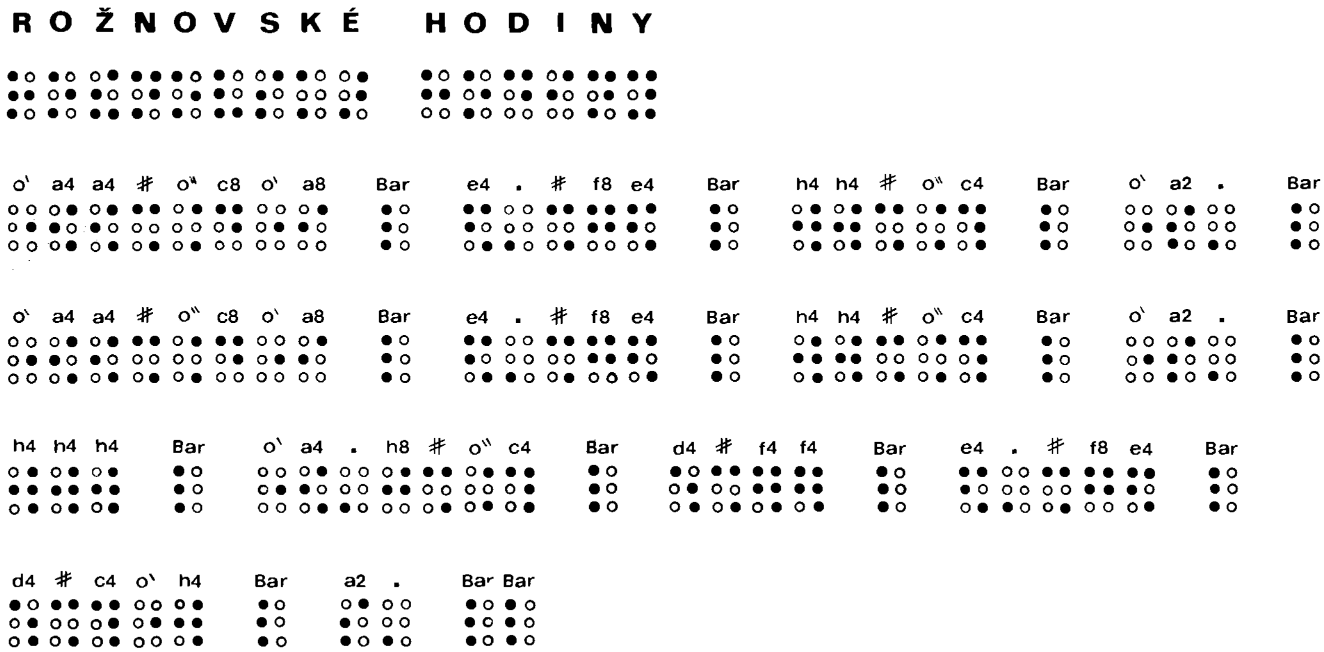
The unit has been made in several experimental versions. The selected version will be evaluated in the school for the blind in Prague. An operating and programming manual in Braille has been prepared for this purpose.

In the near future the possibilities of the device are supposed to enlarge. Nowadays dimensions of the unit are 24 cm x 8 cm x 18 cm. The power supply is built in.

AUDIODISPLAY — AN INTERFACE FOR THE BLIND

The audiodisplay represents, according to the author's knowledge, the simplest solution which makes it possible for the blind to read the numerical data from the display of the HP 9800 Calculator Series.

This apparatus can be realized economically, which follows from the fact that the price of the box in which the whole apparatus is contained surpasses the price of all other components. The dimensions of the apparatus are 23 mm x 105 mm x 160 mm, the size of the interface cards of other equipment.



Braille musical notation.

The audiodisplay is placed in an interface slot of the calculator. Each calculator of this series has 4 such slots.

Upon commands the audiodisplay produces a series of tones which sequentially expresses the individual digits of the display, including the negative sign and the decimal comma.

At the beginning of this miniproject a normal Morse alphabet was tried but the early experiments showed that it was more advantageous to use what we called the "binary Morse alphabet".

Each digit is expressed by means of 4 sequential tones, to which a weight of 8, 4, 2 and 1 was set. If the above mentioned value is contained in the particular digit, then the appropriate tone is high; otherwise it is low. Thus each digit is expressed as a sequence of 4 tones which is illustrated in the table which follows. Here the low tones are represented by low-positioned horizontal lines, the high ones by the horizontal lines positioned higher. The expression of the negative sign and the decimal comma is also in this table.

The rate of release of the individual digits is controlled by the blind operator by pressing the RUN PROGRAM key. Each pressing of this key releases one digit.

The starting command for the audiodisplay is activated by pressing a UDF key which is dedicated to this purpose.

Thus a program is released and, thanks to the IEX function, first of all it effectuates the statements contained in the display or a line or lines and then produces the software analysis of the numerical result and sequentially transmits the individual digits in the above described code.

Although this audiodisplay can be applied to various calculators of the HP 9800 Series, the explanation here has been confined to just the HP 9820A Calculator, as this is sufficiently illustrative.

Because of the parameter passing feature of the 9820 Calculator, the program does not use any alphabet or R-registers and, after the program ends, the result of the operation returns back in its original form.

The end of the transmission is signaled by a sound which is easily distinguished from the above mentioned tones. As the character of these tones is dependent on the display content, it is possible to use it for ascertaining other important information about the state of the display; for instance, the appearance of NOTES or finding the end of the load or of the recording process. If the function of the audiodisplay is not required, it is possible to switch it off by an easily accessible switch.

The program for the audiodisplay was elaborated and debugged by a blind student, adept in the programming profession, Jaroslav Kučera.

Table 1. Binary Morse Alphabet

	Weight of			
Digit	8	4	2	1
1	—	—	—	—
2	—	—	—	—
3	—	—	—	—
4	—	—	—	—
5	—	—	—	—
6	—	—	—	—
7	—	—	—	—
8	—	—	—	—
9	—	—	—	—
0	—	—	—	—
.	—			
—	——			

TRANSCRIPTION FROM BRAILLE TO STANDARD MUSICAL NOTATION

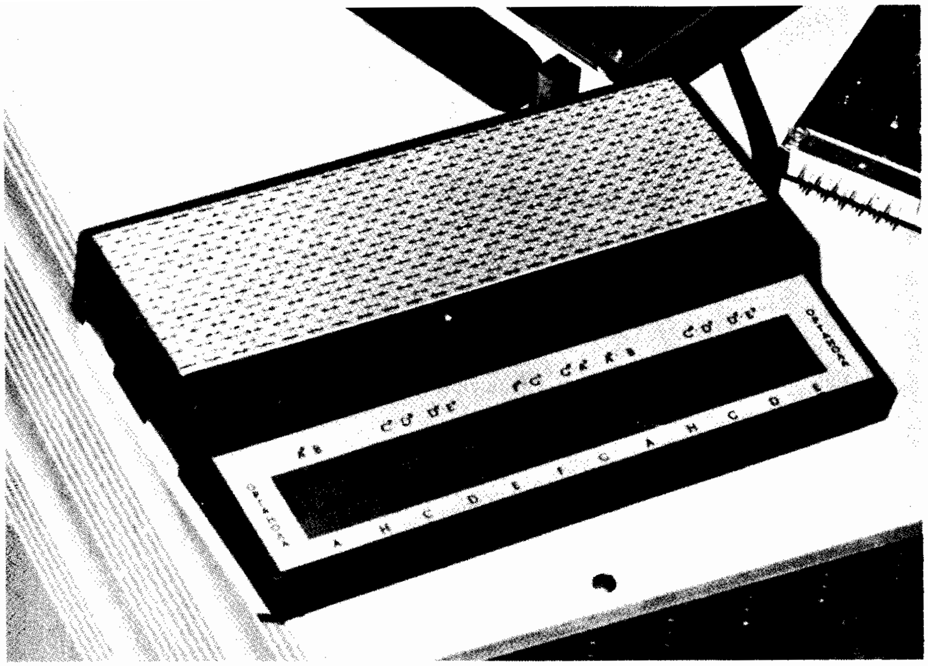
A program for the HP 9820A Calculator has been developed which transforms Braille musical notation (tactile notation used by blind musicians) into black-and-white standard notation.

The input information can be introduced into the 9820 Calculator either through the calculator keyboard or — if a special interface is available — directly from the keyboard of a typewriter for the blind (in this case, however, the input part of the program has to be modified).

The program enables the adjustment of the height and width of the page, the adjustment of the dimensions of the left-hand and right-hand margins, and the setting of the desirable number of lines per page. It also calculates the optimum number of symbols (notes, rests, prefixes, bar lines, etc.) per line and, at the same time, on accepting this number of notes it proceeds to accept further notes up to the nearest bar line, as is usual in standard musical notation, and then calculates the distance between the notes, so that the notes will be drawn evenly distributed along the whole line, never splitting a bar.

The program announces a new page when the operator is to change the paper and also permits ending the composition anywhere on the line after reception of the Braille symbol used for ending, in accordance with conventions of Braille notation.

The special part of the program, together with a special interface which makes possible the control of the electronic musical toy, called Organola, enables the automatic transformation of the Braille musical notation into audible music. In this way the blind operator can very easily verify the correctness of the input data. Another way of verification is possible by means of the tape typewriter



The Organola.

which was also interfaced to the calculator and is currently used by the blind. It is used not only for the verification but also as the display for the presentation of the results and commentaries.

It is appropriate to consider that this program is meant as a demonstration program only and that it will be developed further in the future to be convenient for practical applications.

This work also makes evident that the proposed way of musical notation transcription, after further improvements, can be useful not only for the blind musicians, but also for seeing musicians, musical composers, and editors. It also proves — because the program has been worked out by a blind student of the musical school for the blind in Prague, Jiří Mojžíšek — that the programming of the 9820 Calculator can be carried out by the blind. It is, however, necessary for the interfacing apparatus, which made this work possible, to undergo further improvements. The work in this field continues.

The author uses this opportunity for expressing his thankfulness to Hewlett-Packard for the steady and efficient support, as well as to the Management of the Development Workshop of the Czechoslovak Academy of Sciences for their support and understanding.

CURRICULUM VITAE

Mr. Vrána received his Dipl. Engineer degree in 1958 from the Technical University. He also lectured at a technical college on the secondary school level in the branch of radio engineering.

He has worked on the solution of optical character recognition problems as the head of a development team at the Communications Research Institute and later at the Communications Computing and Checking Centre. His work resulted in the construction of a transitorized reading machine, the CZ13T, and later a transfluxorized reading machine that reads printed (also handprinted) numerals and some letters written into preprinted rasters.

In 1966 he joined the Development Workshops of the Czechoslovak Academy of Sciences, where he is presently engaged in solving various interfacing problems, such as interfacing HP calculators with tape readers, tape punches, teleprinters, typewriting machines, measuring instruments, tape recorders, apparatuses for the blind, and other machines.

Mr. Vrána writes articles for professional journals and papers for international conferences and meetings on character recognition problems and devices for the blind, translates books and technical articles, has had three patents granted for his inventions, and lectures and leads diploma works.

Analysis of Gamma Camera Imaging Data Using a Programmable Calculator

By Dr. D.H.I. Feiglin

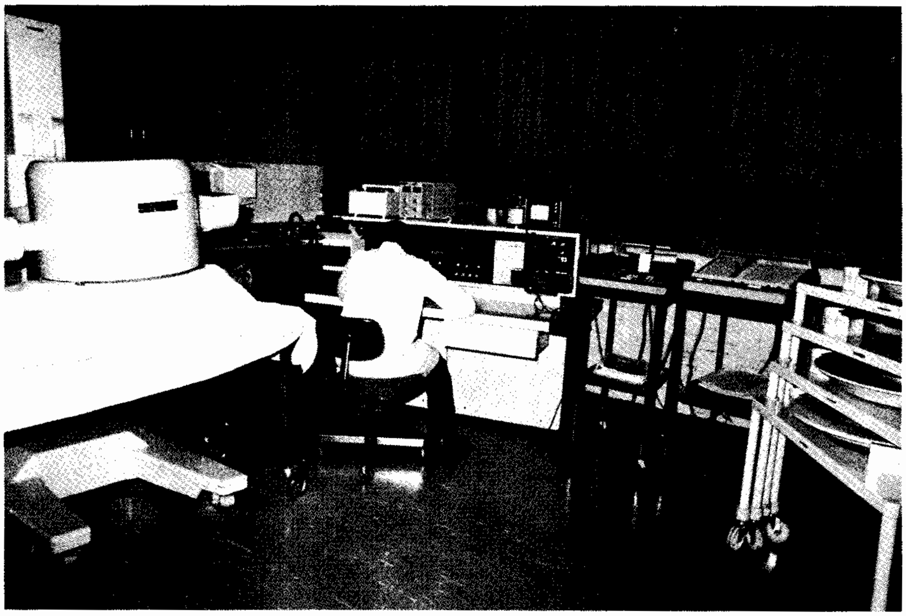


Figure 1a. Gamma scintillation camera with 9820 Calculator and 9862 Plotter. The Toshiba GCA 102 Gamma Camera head is seen overlying a patient. Electronic processing of the signals is performed in the console (at which technician is seated). The calculator system is interfaced to the camera by means of a 11203A BCD Interface Card and is seen in the center. Lead collimators (on trolleys) which can be attached to the camera head are seen on the extreme right.

Figure 1b. Close-up view of 9820 Calculator and 9862 Plotter adjacent to gamma camera console.

Diagnostic Nuclear Medicine involves the use of gamma ray emitting radionuclides (radioisotopes), particularly technetium 99m, which are introduced into patients generally by an intravenous injection. The radionuclide is often chemically attached to an organ specific pharmaceutical and thus allows visualization of organ morphology and function by appropriate detection of gamma rays. The most common detector used is called a gamma scintillation camera (Figure 1a,b) and the general method of recording the data obtained is on some form of photographic film (Figure 2).

The sequence of events is not unlike an X-ray, but differs in that with radiological procedures the X-rays originate outside and are passed through the patient to be collected on a film; nuclear medical procedures involve the source of gamma rays introduced into the patient from which they then originate. Radiation doses are often less than for corresponding radiological procedures.

As a result it is possible to follow the handling of a radionuclide by a specific organ, i.e., kidney, infer from the results the presence or absence of a disease process and, if a disease process is present, determine the degree of involvement.

DATA PROCESSING

The gamma scintillation camera system is arranged so that within its field of view, determined by lead collimators, each gamma ray detected has a specific X and Y coordinate which corresponds uniquely with its site of origin (1).

By selecting a specified perimeter which encloses or incorporates part of an organ (areas of interest) and recording all detected gamma rays with coordinates falling within this area at predetermined sequential time intervals, it is possible to quantitate by means of a time-activity curve the organ's functioning ability. Often for ease of management the "area of interest" chosen is rectangular.

COMPUTER SYSTEM USAGE

A number of systems employ laboratory computers to process this information, of which a Hewlett-Packard Scintigraphic Data Analyzer configured around the HP 2100S Processor is one example.

These systems usually take each individual detected gamma ray and by means of fast analogue-to-digital conversion turn the X and Y coordinate voltages into a binary value, which then increments the specified core address by one or is recorded on some mass storage device. Under certain circumstances where large levels of activity are encountered, such as cardiac dynamic studies, peak levels of 100,000 recorded counts per second may be approached. The analogue-to-digital conversion must be able to handle this input rate.

A matrix array size is specified prior to the start of the test and is in general either 32 x 32, 64 x 64 or 128 x 128, respectively (occupying that number of words in core), allowing discrete square areas of 8, 4 and 2mm sides to be determined on a standard size gamma camera, so that detected gamma rays further apart than these lengths will appear to have different X and/or Y coordinates (Figure 3). By suitable display the areas of interest can be selected via operator-computer interchange; e.g., light-pen, teletype.

At present, the cost of complete scintigraphic computer systems in Australia is often beyond departmental reach, particularly after a gamma camera system is purchased.

Although a computer system will allow this matrix development and subsequent matrix operations which will allow facilities for reducing noise levels, subtraction studies, ratio studies (1), a large use is in fact for development of time-activity studies and their subsequent analyses after selecting suitable areas of interest.

PROGRAMMABLE CALCULATOR USAGE

To enable this situation when a computer was not available, the possibility of interfacing a HP 9820A Calculator to a Toshiba GCA 102 high performance gamma camera was investigated and found to be feasible.

SYSTEM DESCRIPTION

1. HP 9820A Calculator total 173 registers
2. Read-Only Memories:
   Peripheral Control I
   Peripheral Control II
   Mathematics
   User Definable Block
3. 11203A BCD Interface Card
4. HP 9862A Calculator Plotter
5. Toshiba GCA 102 Gamma Camera

With this system the gamma camera is used, by means of a HP 1331A Display Oscilloscope, to select areas of interest electronically by means of manual control on the gamma camera. The number of counts recorded in each area of interest (in this case, a maximum allowable number of two) is displayed on two 6-digit scalers.

As the 11203A interface can only transfer 9 digits, by means of suitable switching on the gamma camera, the appropriate left- or right-adjusted 5 figures from one scaler and 4 from the second scaler (depending on counts obtained) are transmitted to the HP 9820A Calculator.

The Peripheral Control II ROM was used for this purpose as there was a 90-millisecond delay (including reading time and gamma camera resetting time) as opposed to using the Peripheral Control I ROM where a delay of twice this time was encountered. Where rapid sampling (> 4 or 5/sec) is required the PCII is obviously preferable so as to minimize data loss. Modification of the system is underway to minimize delay with the PCII to about 20 milliseconds.

Although the PCII allows curve plotting, the problem of alphanumeric output on the plotter is best solved using PCI.

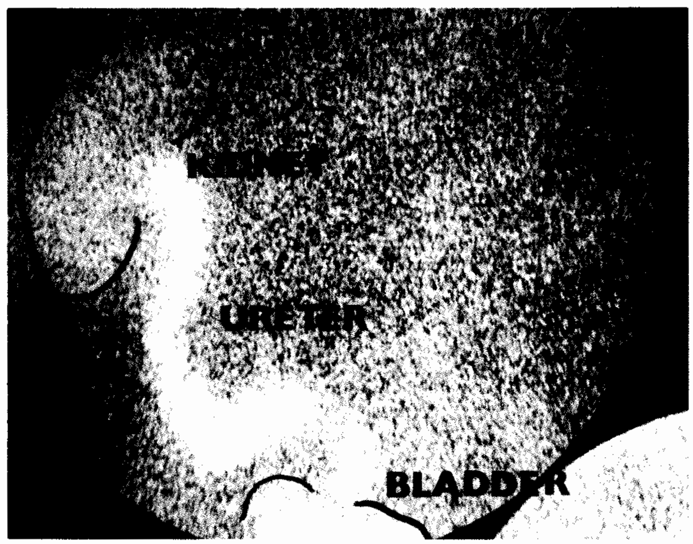


Figure 2. Polaroid print taken during study of a patient who had a kidney transplant. The kidney is seen in the top left-hand corner with the ureter seen well outlined and some activity is seen in bladder. A series of similar prints are taken at short time intervals (1 minute) over a specified time period (20 minutes). "Areas of interest" are selected around kidney and bladder so that the recorded activity per unit time reflects the function of those organs. This procedure can be performed with any organ(s) in the body.

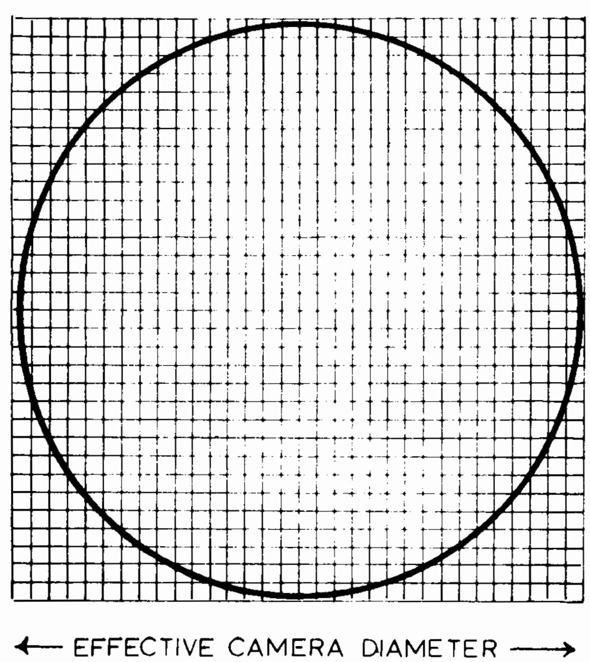


Figure 3. A 32 x 32 matrix is shown. The area "seen" by the gamma camera is in the circle. All scintillations occurring in one area will appear on data analysis to have the same X and Y coordinates.

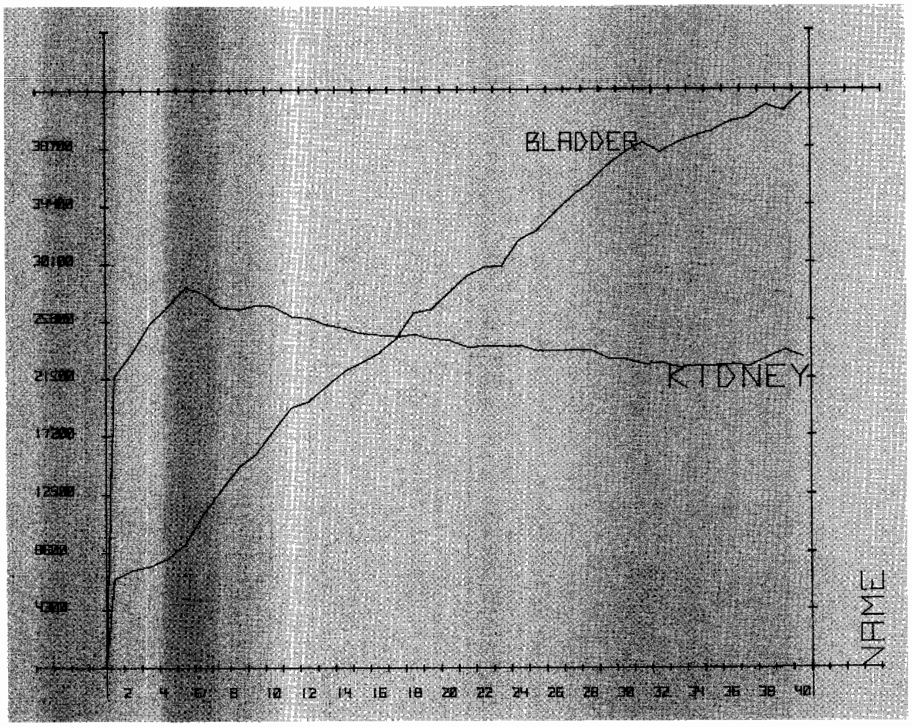


Figure 4. Graphic output of data obtained from a renal transplant study.

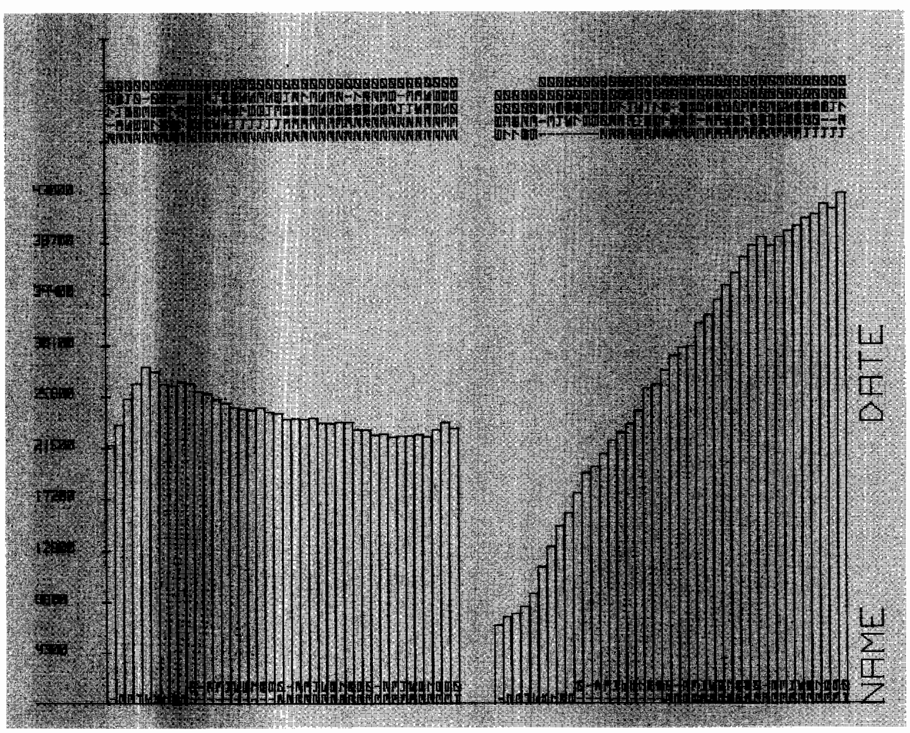


Figure 5. Histogram output of same data.

Programs were configured with the PCI in ROM area 1 and PCII in area 3 with the Mathematics ROM in area 2. Unfortunately with this configuration the User Definable Block cannot be used; so when necessary the User Definable Block replaced the PCI in ROM area 1.

There are, of course, unlimited possiblities in the data processing but a standard preliminary input is to sample data at preset time intervals determined by switching on the gamma camera. Storage of packed 9-digit data occurs in successively higher registers.

Unpacking the data from a 9-digit figure into a 5- and a 4-digit value is a simple programming procedure and the data is then printed, stored on magnetic cards, and plotted, allowing immediate quantitative analysis and subsequent rapid diagnosis (Figure 4, 5).

Simple ratios of one area to the other at selected time interval values (of unpacked data from the same register) make it easy to compare with previous studies (and their corresponding ratio values) and, hence determine if change in the function of the organ has occurred and if it has, whether it is significant. The system is used most frequently in renal investigations, particularly in the assessment of kidney function in patients who have had a kidney transplant.

Studies in assessing cerebral, cardiac, hepatic and thyroid blood flows and function can also be performed.

FUTURE DEVELOPMENTS

It is proposed to interface the HP 9862A Calculator Plotter to a HP 1331 Display Oscilloscope to allow for rapid visualization of results that may not need hard copy as plotted on the HP 9862A.

CONCLUSION

The system cost is only a fraction of that of larger computer systems, yet allows a considerable number of operations to be performed. It is more flexible than a simple multichannel analyzer, although it does suffer from some data loss at rapid sampling rates. The use of the PCII minimizes this.

(1) Analysis of Gamma Camera Imaging Data by a Small Digital Computer
L.M. Dugdale and D.H.I. Feiglin
Australasian Radiology 17,2 (1973)

CURRICULUM VITAE

Dr. D. Feiglin is a Director of Nuclear Medicine at Prince Henry's Hospital, Melbourne, Australia. He has a B. Sc. degree in Mathematics and has a keen interest in computer and data processing applications to Nuclear Medicine.

HP-65 Wins Gold Medal at Leipzig Fair ...

Hewlett-Packard's HP-65 was selected as an outstanding product and awarded a gold medal at the Leipziger FRUHJAHRSMESSE 1974. Products receiving gold medals are evaluated for technical contributions and for product appeal.

The fair exhibited the latest in technical products and was very well attended by an audience that saw not only the prize-winning HP-65, but also the larger programmable Series 9800 Calculators.

It is certainly an exciting event to have HP's latest scientific pocket calculator receive such recognition at a major technical exhibition.

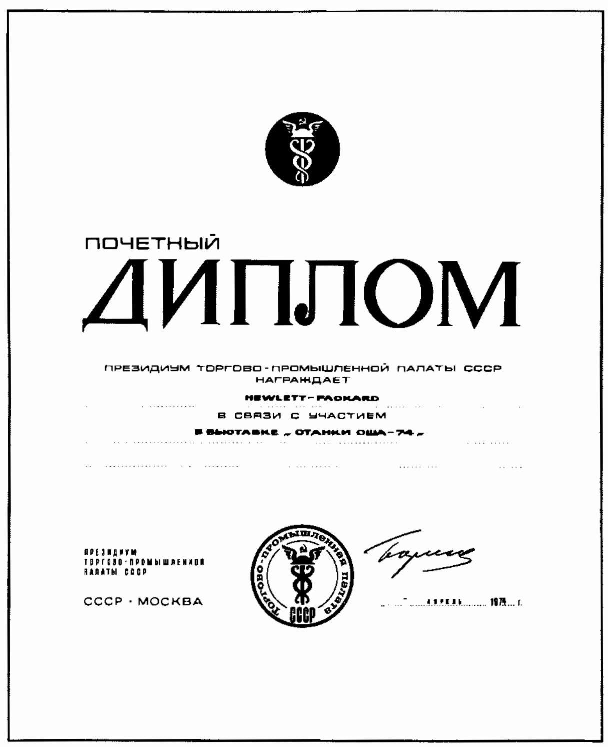
... and in Moscow We Receive a Diploma

Stanki 74 was the first U.S. machine tool show to be held in Russia (April 10-19, 1974). Over 80 U.S. companies were present. Several thousand visitors from all parts of the U.S.S.R. and other eastern countries came to see what the HP engineer can offer in the tool and machine tool area.

Hewlett-Packard's booth attracted over a thousand visitors. The exhibit receiving the most attention was the system demonstrating how a HP 9830A with a tape reader, tape punch and X-Y plotter will prepare, verify and edit tapes for NC tooling machines.

Visitors to the booth were impressed by the flexibility of the system and the ability to program, on their own, efficient software.

Because of the contributions our calculators are making to the mechanical industry, the U.S.S.R. Chamber of Commerce awarded Hewlett-Packard the diploma shown in the picture.



Surveillance of Oil-Fired Power Stations

by Mr. Hans Bergström,

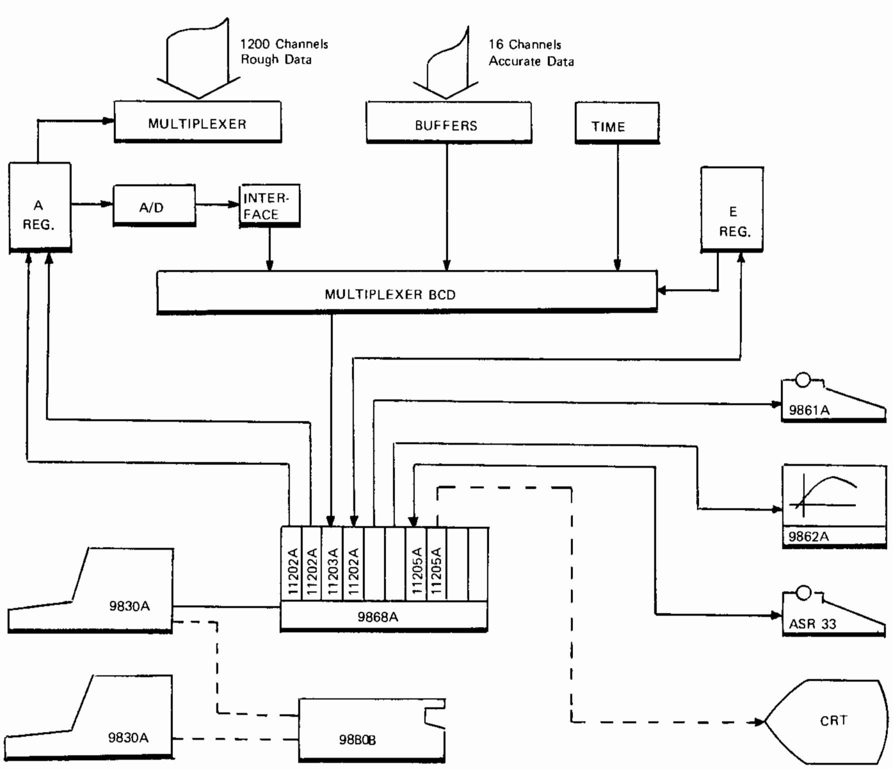


Figure 1

The Karlshamn Plant is the largest oil-fired plant in Scandinavia and, with its highly automated running procedures, represents a great step forward in the Swedish power supply industry. To give you some idea of the size of the Karlshamn Plant, here are some specifications.

- Power output capacity: Three identical units producing 340,000 kW each (a total of 1,020,000 kW) with provision for two extra 60,000 kW power units.
- Site area: 600,000 meters square.
- Smoke stacks: Three stacks 140 meters high.
- Steam production: 1,000 metric tons/hr/unit.
- Fuel consumption: 70 tons/hr/unit.
- Turbine shaft: 35 meters long, 3,000 rpm.
- Generator: Three at 376,000 kVA each.
- Operating personnel: Nine persons per shift.
- Total plant personnel: 125 persons.

The Karlshamn Power Plant is an impressive application for the 9830A Calculator System. The system is required to collect data from various measuring points in each power unit — power fluctuations, temperature variations, etc. — and store this data in matrix form on tape. It also is required to produce weekly, monthly and yearly reports on such things as statistical power variation, routine controls, and to plot out power plant efficiency curves and temperature variation curves.

System Configuration

- 9830A Calculator (Opt. 275, Opt. 272)
- 11271B Plotter ROM
- 11270B Matrix ROM
- 11205A TTY Interface
- 9861A Typewriter
- 9862A X-Y Plotter
- 9865A Cassette Memory
- 9868A Expander Box
- 11202A ASCII Interface (three each)
- 11203A BCD Interface
- 3490A Digital Voltmeter

There may be possible additions at a later stage of the 9880B Mass Memory System, an extra 9830A Calculator, and a CRT.

System Operation

The system operation can be divided into four different sections:

1. Cooling Rates for Cleaning of Boilers/Fire Boxes

Temperatures and pressures in the boilers are measured and fed to the 9830. Calculations are carried out using steam tables and formulas, and a cooling factor is determined. Data is printed on the typewriter and the calculated results output to the plotter. From the results obtained the precise time at which the boiler should be cleaned, due to an increase in cooling, can be calculated. This means less down time, regular planned maintenance, and consequently a large financial saving. There is a tremendous saving in manpower for the collection of data, which is in the order of 50 - 200 personnel.

2. Efficiency Surveillance

The second section deals with the efficiency of the individual boilers. Power output data is collected and used together with the fuel consumption figures. Calculated results are then plotted out on a Mollier diagram. In this way the points at which heat losses are occurring can be quickly and effectively located and corrected, normally impossible without a data system.

3. Statistical Reporting

The type of data collected is, for instance, MW energy delivered, volume of water used, and fuel consumption. This data is collected over a determined period; statistical calculations are carried out to provide efficiency information and cost of operation figures.

4. General Calculations

In an operation of this size, obviously a large amount of work is spent in routine calculations. This job is also carried out on the 9830 Calculator with considerable time saving.

This system is now installed and running. The software, which incidentally was written by the user, Mr. Hans Bergström, took approximately 6 - 12 months to develop. The system was sold in strong competition with the traditional minicomputer companies. Although these companies could produce a similar system, they were far too high in price and were much too fast for the application in question.

As a final important point, the system can be used in virtually all power stations, as the type of data and calculations are international.

Figure 1 shows the block diagram of the system. Possible future expansions are connected with dotted lines. The advantage of having a second calculator is that when intermediate results are wanted, the surveillance does not need to be interrupted.

Figure 2 represents the plotter output of the cooling rates; e.g., as long as the two diagonals in the graph do not overlap each other too much, the cooling rate is acceptable.

Figure 3 shows the type-out of the relay conditions in the multiplexers. It can be seen that relay No. 2 shows an irregularity.

CURRICULUM VITAE

Mr. Bergström studied 5 years at the Technical High School at Eskistuna, where he specialized in Heat and Power Engineering.

From 1960 to 1964 Mr. Bergström worked at Stallaval as a Turbine Construction Engineer. In 1964 he joined the Sydkraft Company, the administrative organization of which the Karlshamn Power Plant is part.

He still works for Sydkraft in the Instrument Department of the power plant, where he is in charge of service.

The programs for this surveillance system are all developed by Mr. Bergström. He also has many contacts with the Institute of Technology of the Lund University, which helps him with solving the power station problems.

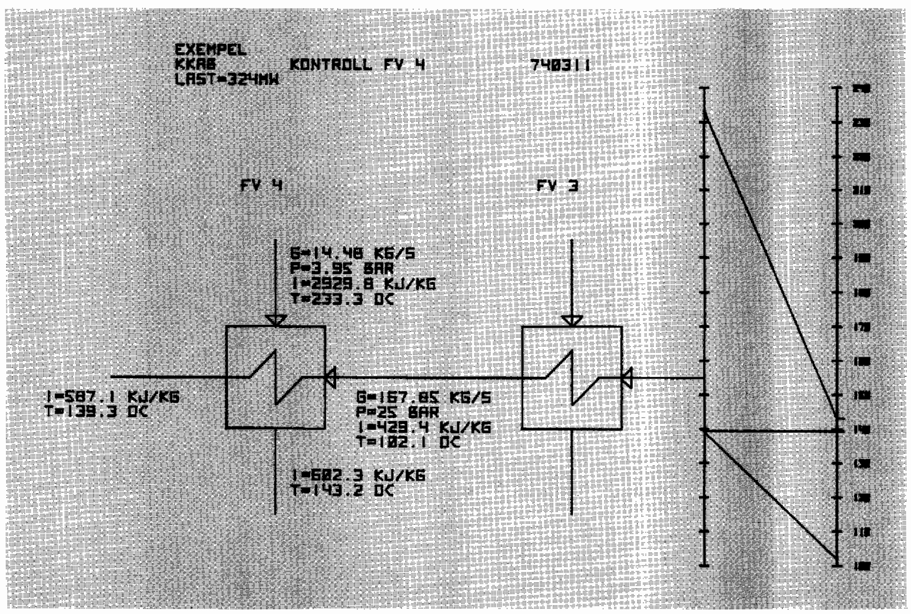


Figure 2

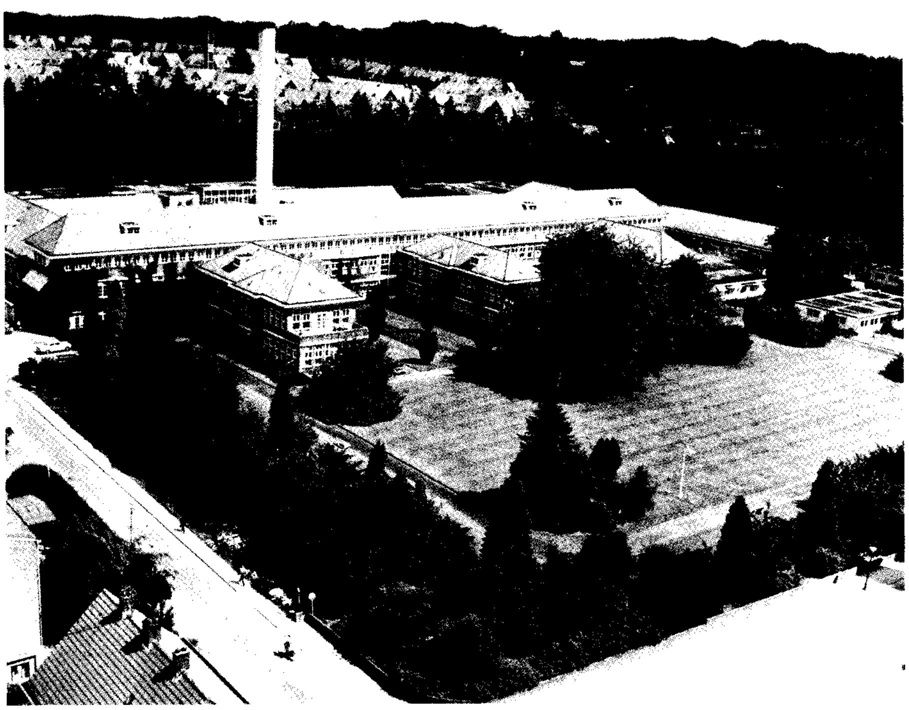
```
ADRESSKORTPROV  KKAB    Höm             Datum 740507
Kort typ 441 615 53 och 441 615 300
Kort nr 20
-------------------------------------------------------------

Rel nr 0
 518   518   518    519    518  /5= 518.2   /4= 129.6
Rel nr 1
 1019      1019     1019      1018      1018     /5= 1018.6  /4= 254.7
Rel nr 2
 1204      1046     910    801    705  /5= 933.2    /4= 233.3
Rel nr 3
 2055      2055     2055      2055      2055     /5= 2055.0  /4= 513.8
Rel nr 4
 2576      2576     2576      2577      2576     /5= 2576.2  /4= 644.1
Rel nr 5
 3104      3104     3103      3103      3103     /5= 3103.4  /4= 775.9
Rel nr 6
 3619      3620     3620      3620      3619     /5= 3619.6  /4= 904.9
Rel nr 7
 4145      4146     4145      4144      4145     /5= 4145.0  /4= 1036.3
Rel nr 8
 4649      4649     4648      4650      4649     /5= 4649.0  /4= 1162.3
Rel nr 9
 5174      5175     5174      5175      5174     /5= 5174.4  /4= 1293.6
```

Figure 3

9830A In Nuclear Medicine

by Dr. Ph. D.M.H. Palsma



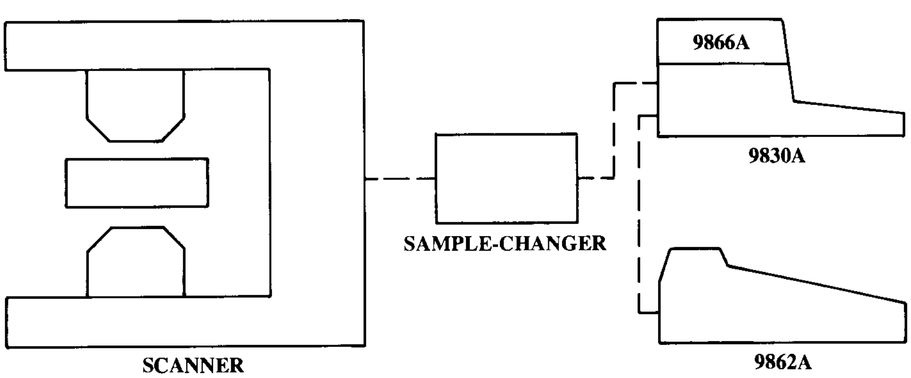


Figure 1. Block Diagram of System.

In the medical world, nuclear medicine is one of the applications where a semi on-line HP 9830A Calculator System offers a number of advantages.

This can be seen in the Municipal Hospital of Arnhem in Holland. In the Nuclear Medicine Department of this hospital a calculator-based system is used to perform isotope scans of the cerebrum, lung, kidney, spleen, liver, thyroid, osseous structures, etc.

Radioactive material is delivered to the organ, mostly by intravenous injection or orally. After a certain amount of time one can see how the radioactivity is spread over that organ. Deviations in this spread enable the specialist to localize pathological areas.

The radioactivity is measured using a step-scanner. This scanner was specially developed by Dr. L.H.M. van Stekelenburg of the radiological service in Arnhem. This department is part of TNO, the Central Organization for Applied Scientific Research in the Netherlands.

Until recently the data retrieved from the scanner was used in calculations, output on a simple digital printer. Operating in this way, however, took quite some time before the final results were available.

Initially, the use of a computer was considered as a means of automating and speeding up the system. However, because of the price and the rather complicated programming and operation involved, this idea was discarded.

Using a 9830A Calculator appeared to be the best alternative solution. A system as shown in Figure 1 could process data and perform calculations rapidly and relatively inexpensively.

The system in Figure 1 operates as follows. The step-scanner scans the upper and lower side of the patient simultaneously within a limited area. The operator can change the area, the step length, and the sample time.

The radioactivity within that area is measured and the data, retrieved from the scanner, is then converted from analog to digital information. This is done in the Siemens sample-changer. After being processed in the sample-changer, the data is stored on the tape cassette, calculations are made, and the final data is printed out.

The big advantage is that up to this point the whole system operates on-line. For practical reasons it is useful to plot the final figures at a later state, i.e., when all the data for all the patients that have been scanned in one day is stored on the tape cassette.

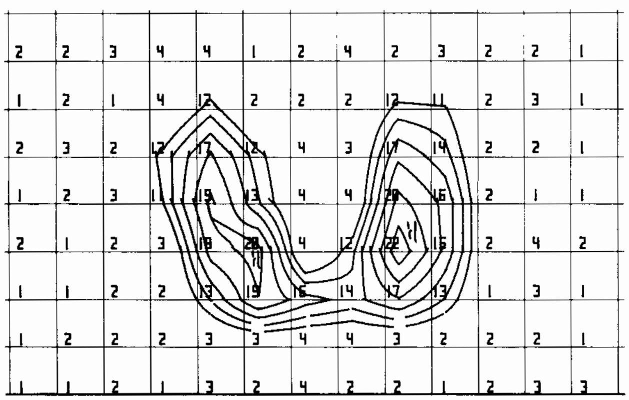


Figure 2. Scan of a Thyroid.

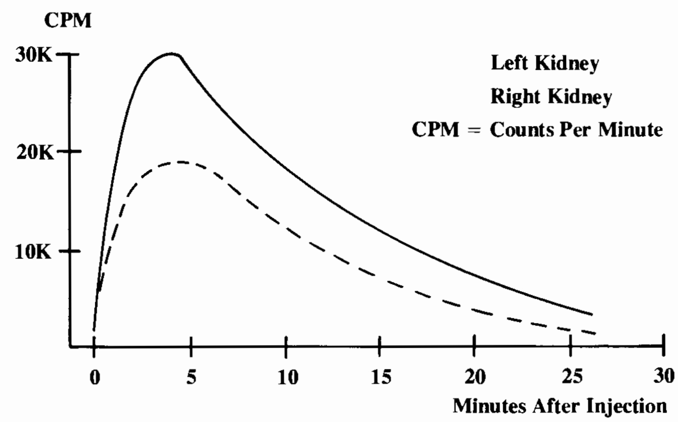


Figure 3. Renogram.

Figure 2 shows such a plot. It represents an isocount line plot of a thyroid. This isocount line plot enables the specialist to localize possible pathological areas. For example, when the radioactivity shows some decreases on certain areas, something might be wrong. If such decreases in radioactivity are there, it is important for the specialist to know whether it is a significant decrease or whether it is just a difference because of a standard deviation that will occur during each measurement of a radioactive process. This decision now is supported by the calculations made by the 9830 Calculator.

For example, to distinguish significant radioactive differences with respect to the environment, the measured counts are processed in such a way that the numbers in the isocount line plot are not equal to the number (N) of the counts measured in each area in the sample time, but equal to $\sqrt{2N}$. Thus, two numbers (N_1 and N_2) of counts, measured in adjacent areas, are significantly different if $N_1 - N_2$ equals 1 (65% accuracy) or 2 (95% accuracy) for all levels of N. In this way one can see easily whether there is a significant difference in radioactivity between one measured area and the environment (from a measuring point of view).

The system is also used for on-line calculations of the ^{131}I-uptake of the thyroid by measuring the ^{131}I-activity of the patient's neck after swallowing a dose of $NA^{131}I$.

Furthermore, the system is used for plotting a renogram (see Figure 3). This is the graphical representation of the radioactivity of the kidney as a function of time. In addition to this, calculations of some characteristics of a renogram can be made in the near future: steepness of the leading slope, the time when highest point of curve is reached, value of the highest point, and time constant of the down slope.

Another important future application is that with some minor modifications the system can be used for radioimmunoassay (RIA) as well.

CURRICULUM VITAE

Dr. Ph. D.M.H. Palsma graduated at the University of Utrecht (Holland), where he studied physics and medical physics from 1947 to 1961. In that period he served two years in the Royal Dutch Air Force, where he worked in the Meteorology Department. After graduating, he joined the Municipal Hospital of Arnhem where he initially was involved in cardiac output with Dye-Dilution Methode. After that, in 1964, Dr. Palsma started in the isotope laboratory of that hospital. His main activity since has been isotope scans of different organs, as described in the above article.

programming tips

MORE ON AVAILABLE MEMORY (9830A)

Our thanks go to Prof. Daniel G. Maeder, Versoix, Geneva, Switzerland, for the following programming tip:

After reading the note contributed by Bob McCoy on page 21 of *KEYBOARD,* Vol. 5, No. 4, it came to my mind that the suggested shortcut — namely, pressing LIST , any available SPECIAL FUNCTIONS key instead of LIST 9999 — is worth much more than the little note lets one think. In fact, LIST, SPECIAL FUNCTIONS key, leaves the main program counter unchanged, whereas, after the conventional LIST 9999 one has to FETCH again the program line on which one had worked last. For someone who made it a habit to check the available memory after every program line change, the possiblity of continuing the editing on the neighboring program lines without FETCH is very desirable. It also helps to save paper if one edits a program in the PRT ALL mode, by avoiding useless LIST and FETCH printing.

RECTANGULAR TO POLAR COORDINATES (9820A/9821A)

Jan Honců, Jablonec nad Nisou, Czechoslovakia, sent us the following programming tip:

The program line below converts from rectangular to polar coordinates, expressing the resulting angle in the range from −180 degrees to +180 degrees. The polar magnitude is returned to the Y register and the angle to X.

This line saves 20 keystrokes compared to the tip published in *KEYBOARD,* Vol. 6, No. 3.

```
1:
((0≤Y)-(0>Y))
ACS (X/(√(XX+YY)
→Y))→X⊢
```

Examples

```
X COORD =
        1.000
Y COORD =
       19.000
MAGNITUDE =
       19.026
ANGLE (DEG) =
       86.987

X COORD =
      -19.000
Y COORD =
        1.000
MAGNITUDE =
       19.026
ANGLE (DEG) =
      176.987
```

```
X COORD =
      -19.000
Y COORD =
       -2.000
MAGNITUDE =
       19.105
ANGLE (DEG) =
     -173.991

X COORD =
       19.000
Y COORD =
       -1.000
MAGNITUDE =
       19.026
ANGLE (DEG) =
       -3.013
```

LETTERING SYNTAX (9820A/9821A)

We are obligated to Mr. Jan Kuncar of Prague, Czechoslovakia, for this programming tip.

The syntax of the "letter" statement described in the 9820A PC I Operating Manual,

LTR X, Y, hwd

can be generalized to the following form:

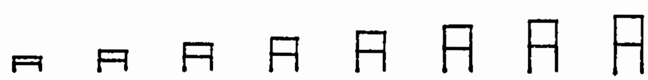
LTR X, Y, E

where E is an arbitrary expression. The sign and decimal point of the value E do not affect the results. The three most significant digits are interpreted as h, w, d, respectively. When h or w is zero, height or width of the character, respectively, is also zero. The value of d is taken modulo 4, i.e., 0, 4, and 8 have the same effect. A missing character is interpreted as zero (e.g., LTR 0, 0, 72 is interpreted as LTR 0,0,72.0).

Examples

The following program will plot a series of "A" characters of increasing height:

```
0:
SCL 0,10,0,10;1→
A→Z;FXD 0⊢
1:
LTR A+.8→A,7,10Z
+3.1;DSP Z;DSP ;
DSP ;PLT "A";IF
(Z+1→Z)≤9;JMP 0⊢
2:
DSP "END";END ⊢
```

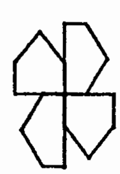


Each of the following lines has the same effect ($\sqrt{30}$ = 5.4772 ...):

```
LTR 5,5,543;PLT
"E"⊢
LTR 5,5,547;PLT
"E"⊢
LTR 5,5,5.47;
PLT "E"⊢
LTR 5,5,√30;PLT
"E"⊢
LTR 5,5,-√30;
PLT "E"⊢
```

The following program plots the "D" characters from the same point in all directions:

```
0:
SCL 0,10,0→Z,10⊢
1:
LTR 3,3,870+Z;
DSP Z;DSP ;PLT "
D";IF (Z+1→Z)<9;
JMP 0⊢
2:
DSP "END";END ⊢
```



ARCTG IN THE 0° TO 360° RANGE (9830A)

Our thanks go to Ing. Stanislav Milacek of State Res. Inst. for Machine Design, Bechovice, Czechoslovakia, for this useful programming tip.

The phase of a complex number from X and Y components in any range (e.g., 0 to ±180 or 0 to 360 degrees) can be calculated easily by the algorithm described in the sample program shown below. Note that the 'security' coefficient k = 1E-98 in Line 70 fits the Y/k value, which must be smaller than the numeric range of the calculator.

```
10 DEG
20 INPUT X,Y
30 PRINT X;Y;FNA1;FNA2;FNA3
40 GOTO 20
50 END
60 DEF FNA(I)
70 A=ATN(Y/(X+1E-98* NOT X))
80 B=180*(X<0)*(SGNY+ NOT Y)
90 GOTO I OF 100,110,120
100 RETURN A
110 RETURN A+B
120 RETURN A+B+360*((A+B)<0)
```

Example

1	0	0	0	0
1	1	45	45	45
0	1	90	90	90
-1	1	-45	135	135
-1	0	0	180	180
-1	-1	45	-135	225
0	-1	-90	-90	270
1	-1	-45	-45	315

ELIMINATING RND PREDICTABILITY (9830A)

We are indebted to Robert Campanini of BHP. Central Research Laboratories, Shortland, Australia, for this programming tip.

Each time the same seed is set into the random number generator (as is the case when the calculator is switched on or RUN is executed), the sequence of numbers which follows from the function RND is the same.

In applications which require new sequences of numbers each time a program is run (e.g., in generating systems of n random points in two dimensions), the following technique has been found useful:

1. To one of the SPECIAL FUNCTIONS keys of the program the following statements are assigned:
   10 R = RND0
   20 R = RND (−R)
   30 GOTO 20
2. Program variables are initialized by pressing RUN and appropriate SPECIAL FUNCTIONS key.
3. The SPECIAL FUNCTIONS key containing the statements in (1) is pressed.
4. After an arbitrary length of time the STOP button is pressed.
5. The body of the program is executed via the relevant SPECIAL FUNCTIONS keys.

The advantage of this technique is that it is parameter free, i.e., the sequence of random numbers produced is not determined by any input parameter.

STRING VARIABLES (9830A)

T. P. van der Zee of Eindhoven, The Netherlands, submitted the following ideas for streamlining programs using the 9830A Calculator with the String Variables ROM.

In many cases it is necessary to take the value of a string. If the string is non-numeric, Error 76 will occur. A technique has been developed to avoid this.

The first position in the string must always be declared as 0. The input must be given directly behind this position. Then by taking the value of the total string, no error will occur.

Example

```
230 DIM B$[10]
240 B$[1,1]="0"
250 INPUT B$[2,10]
260 A=VAL(B$)
270 END
```

If B$ (2,10) = "125" then A = 125.

If B$ (2,10) = "ABC" then A = 0.

If it is necessary to repeat the request for input in the second case (non-numeric argument), the next sequence applies:

```
370 DIM D$[10]
380 D$[1,1]="0"
390 INPUT D$[2,10]
400 IF D$[2,2]="0" THEN 440
410 A=VAL(D$)
420 IF A=0 THEN 390
430 GOTO 450
440 A=VAL(D$)
450 END
```

A RUN or INIT command erases the contents of the strings. To check whether or not one of these commands has been given, the following special test with the aid of T$ is suggested.

```
540 DIM H$[10],T$[2]
550 T$[1,1]="0"
560 IF VAL(T$)=1 THEN 600
570 DISP "YOUR NAME";
580 INPUT H$[1,10]
590 T$[2,2]="1"
600 PRINT H$[1,10]
610 END
```

As soon as H$ has been input, T$ (2,2) must be declared 1. Because a RUN or INIT command will also erase this information, the name is asked again after a RUN command. After STOP END CONT EXECUTE, the name will be printed immediately. With the aid of this string, it is also possible to check whether or not variables have been erased by a RUN or INIT command.

9820A CALCULATOR USERS CLUB GOES TO SCANDINAVIA

Recently a Users' Club Meeting was held in Stockholm. At this meeting, Bonnie Dykes, coordinator of the club, gave a presentation on the background, policies and activities of the Users' Club. The participants had the chance to actually look over some of the over 600 available programs in the Club's Master Program Library.

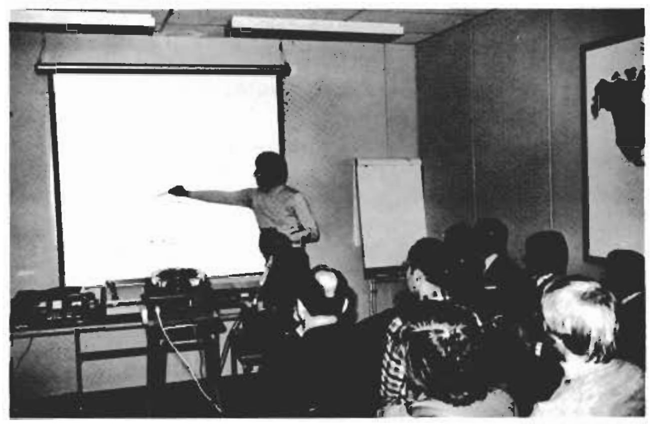
The Swedish State Surveying Department gave an excellent program describing their use of the HP 9820A, plus peripherals to perform many calculations. These calculations varied from mapping out roads in the icy areas of northern Sweden to bringing sunken ships from the darkened depths of the ocean.

Other club members participated in the Surveying Group's demonstration by following carefully prepared instructions to arrive at sample mapping results. In this way, the club members gained valuable tips on preparing programs, cassettes and user instructions which can be easily followed by other users.

The club members toured the Service Department and Demo Rooms where they could ask questions, see, and use any equipment they desired. They also had the opportunity to exchange ideas among themselves and see how other users like themselves utilize the 9820 and peripherals.

Other such club meetings are being scheduled for various locations through the world. If you are interested in participating in the 9820A Calculator Users' Club or desire further information concerning the club's services, you may write directly to the club's headquarters at the following address:

9820A Calculator Users' Club
Hewlett-Packard GmbH
703 Böblingen
Postfach 250
Germany



CZECHOSLOVAKIA USERS' CLUB

There is a theory that one of the best ways to learn is from the experience of others. Putting this theory into everyday practice, the owners of Hewlett-Packard calculators in Czechoslovakia have organized their own Users' Club. This club is sponsored and organized completely by Czechoslovakian calculator owners. Regular meetings are held in different geographical centers, such as Prague or Bratislavia. Attendance is amazingly large — usually betwen 150 and 200 inquisitive calculator users travel from all parts of the C.S.S.R. to hear technical presentations on such subjects as interfacing, advanced programming, peripherals, and applications. The club invites discussions on all Hewlett-Packard calculators from the HP 9100 to the HP 9830. Often the club meetings coincide with the club-sponsored programming courses.

One such HP 9820 programming class was held in Prague last January and was attended by 120 students. All instructors and students were, of course, Czechoslovakian customers. A more recent course in June of 1974, also in Prague, was given to 180 calculator users interested in HP 9830 programming. It would be difficult to find a more active group of calculator users anywhere. For several years now they have expanded and optimized the use of their calculator investments by a very generous exchange of help and ideas.

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