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INTRODUCTION

When it was decided to hold a seminar on the topic "Computers and the Lawyer" the conveners had in mind that the lawyer should be able to see at least one actual computer at work in order to gain an appreciation of what computers might do to aid the lawyer in his work. It was soon found that to give a full picture of the way in which computers are impinging on areas of interest to the lawyer specialized topics such as the use of computers in the fields of banking, accountancy, land registration, etc., had to be included. The problems posed in accepting the results of this new concept in record-keeping as evidence in court also interested the profession. To cover this wide field nothing less than a long week-end would suffice, and the fact that 191 people were willing to spend a holiday week-end at this seminar is an indication of the level of interest within the legal profession.

The first three papers deal with the general topic of computers and how they work. The first major topic was information retrieval in law. Mr Pope described a working system while the other speakers concentrated on areas of difficulty both in defining the problem adequately so that the computer might be used efficiently and in gaining acceptance by the user of the new techniques required in using the computer.

The bulk of the papers presented on the second day dealt with special areas of interest to lawyers where computers were changing the traditional modes of working. The last day dealt mainly with problems in the acceptance of computer records as evidence. For this topic the seminar was fortunate in having present Professor Rupert Cross, the world-famous authority on problems in evidence, who provided information on the ways in which English law is being modified to meet this particular problem. The other speakers dealt with aspects of the problem in Australia and U.S.A.

The seminar closed fittingly with a paper in which Mr Rose considered data banks and the future. At the informal party which closed the seminar this paper was the one most often the subject of discussion, not simply because it was the most recent, but because of the intrinsic importance of the subject-matter.

It appears probable that computers are going to change patterns of social organization more quickly than any other invention in the history of mankind. By the twenty-first century it is possible to envisage a society in which money is never used. All transactions might be carried out by inserting a magnetized disc in a reader and punching the user's confidential code number before a purchase is made. The exchange of credits would be made at a central data bank in which all relevant details of each person's record are stored in readily accessible form.

The use of computers is certainly going to destroy our present-day concepts of individual privacy. Two sorts of society seem possible. The first, like Orwell's *"1984"* or Packard's *Naked Society,* has its citizens continually under surveillance and forces drab conformity on everyone. The second would reduce the entire society to one large country village, with everyone knowing everyone else's business. Both alternatives are probably unpalatable to the present-day reader, but it may well turn out that in the near future the lawyer must try to decide which path society must take, and frame appropriate statutes.

The detection of crime will in the future be made much more efficient by the computer. If we are not to end up with the situation of 95 per cent of the population being kept in prison by the remaining 5 per cent (q.v. Kinsey) some serious consideration must be given to redefining what constitutes a crime, probably along the lines of the Wolfenden Committee report.

Admittedly these final comments are highly speculative, but it is clear that these are problems to which thought must be given in the near future.

In conclusion the conveners wish to thank all who contributed to the seminar and made it such a success, with particular thanks to the CSIRO, the Basser Computing Department of the University of Sydney and International Computers and Tabulators (Aust.) Pty Ltd, for making their installations available to the seminar.

P. G. Ward

A GENERAL SURVEY

*K. S. Pope**

Introduction

There is at first sight little apparent connection between the law and its processes and the modern, electronic digital computer. On the one hand, our jurisprudence is the outcome of many centuries of legal activity marked by the initial development of the common law, the expansion of case law and the ever-increasing growth of statute law and its derivatives. As the law has developed, so the nature of legal processes has become more involved and more diverse. Rules of procedure have increased in complexity, and outside the realm of "pure" law, there has evolved a pattern of specialist agencies concerned with the regulation and enforcement of the law and legal processes.

The electronic computer, however, has no links with the past. It is essentially the product of a modern technology which draws little on previous experience, and has its origin in concepts developed hardly a quarter of a century ago. Its development has been marked by a degree of empiricism which is in complete contradistinction to many aspects of legal philosophy, which, understandably, have much greater regard for principle than experiment. In the constant search for new computing techniques and new applications for computers, however, almost anything goes, and most principles are little more than current opinion. The rapid development of the computer in our age must inevitably come to be recognized as one of the major characteristics of the second half of the twentieth century, ultimately meaning as much to mankind, possibly, as the creation of the wheel.

Because the law has such deep roots in the past, because it carries out its procedures with dignity and demands respect, the layman assumes that it has solidity and immutability, and in this he finds cause for satisfaction or frustration according to his circumstances. But in this he is wrong. It can be said that lawyers as a whole are now probably more active in the amendment and reform of legal principles and procedures than ever before. It should be noted that we are here using the word "lawyer" in a very wide sense, so as to mean any person professionally concerned with the law or its administration. And in the examination of current legal procedures, in the search for new methods to combat the ever-increasing flood of reported cases and new statutes, the lawyer has stumbled across the computer. In doing so, he has come to recognize that there is, in fact, a strong connection between the nature of many judicial, quasi-judicial and legal administrative processes and the computer.

In what then does this connection lie? It lies in the simple fact that *both the lawyer as a human being, and the computer as a machine, are concerned with the assimilation and processing of information.*

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We do not concern ourselves at this point with precise definitions of "information". These will emerge during the Conference as other speakers develop the themes contained in their papers. But the computer man (who regards himself as a specialist in the processing of information) would probably like you to take judicial notice at this stage, that information is data arranged in a logical, discrete manner – if only because that is the way in which the computer likes to have it arranged.

"Data" means different things to different people. The lawyer, in the wide sense referred to above, does not normally speak of data at all; the information he may be concerned with will consist of such diverse things as –

a sentence in a statute,

a ratio decidendi in a case,

an entry in a register (or the absence of such an entry),

statements by witnesses,

words in documents,

citations in abstracts.

He is much more likely to call these "facts" and not data, but essentially, he is dealing with characters with letters of the alphabet, numerals, symbols, organized in the logical pattern we call language. This is so, whether we are considering judgments handed down, or say, expert evidence on the coincidence of fingerprint characteristics.

To the computer specialist, however, information to be processed by his machine can consist of practically anything you care to make it, provided it can be organized in a logical and discrete manner. It includes all types of data or facts known to the lawyer, and this constitutes the bridge between computer and lawyer, the fact that the machine can assimilate and process the information which is the stock-in-trade of the law.

How the computer can do this, can be understood in outline easily enough. There is no need for the lawyer – any more than any other member of the community – to regard the computer as a mysterious machine controlled by even more mysterious people. The principles on which computer processing is based are not difficult to understand, and the early speakers in the Conference will give an explanation of them.

Once these concepts have been established, it is comparatively easy to define the interest of the lawyer in the application of the computer for legal purposes. We can readily distinguish two major areas in which the use of the computer is of concern:

(1) the recording and retrieval of information relating to substantive law.

(2) the introduction of modern data processing techniques into the clerical procedures associated with the administration of justice and related agencies such as law enforcement and registration, so as to provide speedier and more effective control.

These are not the only subjects of interest, however, as will be seen.

The recording and retrieval of substantive law

Many practising lawyers have long felt dissatisfaction with the existing tools for research into legal problems. Judges and lawyers constantly are required to find the relevant authority, statute or case, to ascertain what the law is or should be. It is undoubtedly easier to find the statute than the case, but because of our heavy reliance on case law we cannot, unfortunately, relieve the searching problem by confining it simply to the more easily found statutes. Hence the dissatisfaction expressed with conventional indexing and abstracting procedures, because of their inability to cope with the increasing complexity of the law and to meet the needs of increasing specialization among lawyers.

Considerable research has been stimulated, therefore, into the use of the computer to provide an information retrieval service for statutes and case law. Work of this kind originated in U.S.A., where it has proceeded under the aegis of the American Bar Foundation, and the Law Schools of the major universities.

Efficient systems for the retrieval of statute law have been set up, and systems have also been developed for retrieval of case law, although their efficiency is less certain. Similar development has begun in other areas outside the U.S.A. Not all this work has proceeded on the same lines. Some systems favour the recording and retrieval of full-text, while others depend upon abstracting or coding, prior to storage by the computer, whether computer-assisted or not. Furthermore, a large field yet to be tackled lies in the recording and retrieval of Statutory Instruments, etc.

The lawyer who is unacquainted with computer processing should not assume that the recording and retrieval of legal information is an easy task for the computer information specialist. It is not, and difficult problems of systems design and programming have had to be overcome for those retrieval systems which are now established. Nor should he assume, moreover, that the present state of development in this area is to be accepted without question, or that all problems in the use of computers for this purpose have been settled. They have not. There are still wide areas which are controversial from the viewpoints of both the lawyer and the computer specialist, as will be demonstrated during the Conference.

The introduction of modern data processing techniques

In its relatively short life the computer has had a spectacular success in its application to clerical procedures.

We must recognize, however, without any disrespect, that the old view that modern business methods have no place in legal offices is only slowly giving way. Nevertheless, the sheer volume of clerical work generated by modern society in all matters which concern the law and its agencies has forced a change of attitude. The computer enthusiast, understandably, has not been slow to suggest ways to exploit the mass volume data processing characteristics of the computer.

Thus the introduction of computer processing into registration procedures has slowly gathered way, with applications such as the registration of births, deaths and marriages leading. This is a comparatively easy one, however. More difficult problems of recording and searching arise in relation to other registers such as those concerned with Titles and Patents, these difficulties arising only partly because of the complex nature of the data to be recorded; the difficulty of establishing efficient amending techniques by programming still remaining.

In this area, however, registration functions are less dramatic than the use of computers in law enforcement agencies. Here the possibility of securing fast, direct access to stored information on demand through on-line communications systems has attracted considerable interest in all countries.

In this environment, the computer can provide a speed of response measured in seconds, and the "fingertip" facility thus provided could prove a powerful tool in the hands of law enforcement bodies. There are many areas of police work where the computer can be used to advantage, not only as regards criminal records and modus operandi records, but also as regards fingerprint identification and crime pattern forecasting.

One must not ignore, however, the heavy demands on the resources of men and money inherent in on-line or real-time systems of this kind. Special attention is being devoted to the role of the computer in law enforcement in the Conference.

Yet the applications of computers for registration and retrieval referred to, only cover a small part of the field of possible applications. We may confidently look forward to their use in other activities such as –

the maintenance of Court records,

the enforcement of fines and orders,

the issue of licenses under the supervision of a judicial or quasi-judicial authority.

Special reference should also be made to the possible use of a computer by the Courts to assist in marshalling of the business of the Courts as regards Calendars, Lists, and so on. Use of the scheduling and queuing techniques available for use on the modern computer could be particularly valuable in an age which has become increasingly critical of delays in bringing cases to trial, and of the organisation of Court business. The possibility of integrating such activities in a general purpose computer system, located within a complex of Courts, with some of the other legal administration duties referred to above (excluding law enforcement) seems sound in principle, and must be accepted as a reasonably close development.

Using the computer for research

We have noted two major areas of interest above, but there are others.

In almost all areas of human activity the computer has proved a powerful tool for research, and it is being taken up for this purpose in law also. (One may observe in passing that it is not always the lawyer who is conducting research of this kind, a matter which ought to cause some concern in legal circles.) The use of computers has drawn attention to a range of mathematical techniques which are either the basis of computer design philosophy or are the more readily applied through computers. As examples, may be quoted the concepts of Boolean algebra, and the use of statistical techniques concerning queuing, selection and probability. It is not always necessary, therefore, to use the computer as such, for research, and one can make use of what we may conveniently call "computer-associated-concepts."

Thus we find that a significant (and very controversial) branch of legal research – the analysis of the logical structure of decisions, and of legislation – has been given great stimulus by the advent of the computer. While the application of logical analysis to law had been urged for many years before computers, the new techniques for analysis provided by the computer have undoubtedly increased interest in this field beyond any point which could have been foreseen earlier. The importance of "jurimetrics" as these studies are called, is controversial, but it seems undeniable that success in the application of logic to law-making must influence the law of the future. Accordingly, this subject also is dealt with in detail in the Conference.

While jurimetrics may not necessarily demand the use of a computer, penal research does. The plea for more information in this field is almost overwhelming. Statistical data is required concerning the habits of offenders, the effects of sentences upon offenders, the influence of environment, rehabilitation, recidivism, the distribution of crime, the relevance of economic factors, and so on. Much of the data required cannot be obtained because the need for recording it was not recognized in the past. Once adequate bases have been established, however, it is only by use of the massive data recording facilities of the computer that the data can be held available to all workers in this field in years ahead.

It is here, of course, that the computer's role in analysis will come to the fore in the interpretation of statistical data to present trends and patterns of activity, to forecast and to simulate.

Problems posed by the computer

All that glitters is not necessarily golden, however. We must observe that the use of computers presents legal problems. These may be small at present, but a greatly increased use of computers within the community at large must be foreseen.

Some problems have already arisen, mainly in the field of evidence. The recognition of computer output as evidence in legal proceedings has already demanded legislative action in both U.S.A. and United Kingdom, and it is reasonable to suppose that further complications will arise in this area with the development of on-line computing facilities available to the public as a whole.

Conflict arises between the established principle by which documentary evidence must be substantiated and the fact that unless special steps are taken, no computer processing can be regarded as absolute in time or place. Identical output can be produced from the same programme and the same data on any computer comparable with one specified, and identical output can be reproduced indefinitely at any later date. In this kind of environment, the relevance of the legal concept of an original document supported by circumstantial evidence relating to the act of creation is often tenuous.

More complex problems can arise in branches of law other than evidence as the use of networks of computers, established as what is known as a "time-sharing" basis, takes effect. Under these conditions the user of a computer may not be aware on which computer (or even computers) his work is being done, and the owner of the network may have no knowledge of the detail of any programme entered into the network once deleted from the memory of that computer in which it was last resident.

While it is too early to classify the legal implications of commercial or other business conducted in this manner, it is clear that questions of vicarious or limited liability will arise.

While these problems arise in the sphere of private law, it is clear that other (and in the long run perhaps more serious) problems will arise in Constitutional Law when computer data banks are established for governmental or private purposes. This development raises questions concerning the rights of individuals as regards the privacy of information recorded about them, and the rights of access to recorded information.

Issues of this nature prompt the reflection that information could become a form of property recognized by the law. But whatever view is taken of this, the problems must be solved at some stage in a manner acceptable to practising lawyers and the public, and they will also be discussed during the Conference.

The Lawyer and the computer specialist

Neither the lawyer nor the computer specialist will feel satisfied with the superficial survey of activity made in the foregoing paragraphs. It may serve to demonstrate the wide fields of interest which exist, but it ignores the major problems in any of them. Nevertheless, two further points must be made in conclusion.

The first is that a strong plea must be entered for lawyers generally to develop an increasing interest in the use of computers within our society. It is not sufficient that this interest should be confined to academic circles, because it is in many of the bread-and-butter activities of legal processes that the impact of the computer will be greatest.

But no plans for the use of computers are ever successful unless there is complete sympathy of understanding between the professional interest concerned on the one hand, and the computer specialist interest on the other. Perhaps one who is a computer man may hazard the statement, with respect, that the nature of our jurisprudence rests, in the long run, on the capabilities of the tools available for legal research and administration. In the present nature of law considerable emphasis is placed upon retrieval of information, and it is in this area in particular that the computer specialist is concerned – and it is in this area incidentally, that he can probably be of most assistance in the short term to the lawyer.

But it is essential that the tools to be used are acceptable to the lawyer, and indeed that he should have played a considerable part in their design. There are significant constraints to computer operations with which a lawyer should be conversant in considering the use of such equipment – particularly since the development of the computer is still very much in its infancy, and it is destined for a very long life. In short, the danger is that lawyers may well find themselves supplied with a tool that does not suit them ideally – which they might have had a hand in developing, but did not.

The second point is probably more significant since it strikes at the very heart of the association between lawyers and computers. It is simply that when computers are to be used for retrieval and for legal research (as opposed to their uses in administration) the computer specialist must recognize the considerable importance of semantics in jurisprudence. Computer systems import logical systems of operation which can tend towards inflexibility. While the computer specialist can offer the lawyer various techniques to assist in the rationalization of research and even retrieval (e.g. computer inquiries in the contextual and co-occurrence properties of synonymous words and string similarities in mis-spellings), it is essential that he appreciates at all times that the subject matter of his study is the living law which will depend, in the last resort, on the skills, understanding and foresight of the human being and not the technological prowess of the computer.

HOW A COMPUTER INSTALLATION FUNCTIONS

*C. H. Gray**

To those unfamiliar to high-speed digital computing, a computer installation may be regarded as having three basic components A, B, and C with lines of communication between A and B and between B and C. At A, instructions and data (collectively defined as a "programme") pass a reading station at a very high speed. At B, this material is critically examined for illegal coding and for data inconsistent with a pre-defined format. Where errors are detected the programme is halted immediately. If error-free, the information is then processed and the results despatched to C. The physical effort in terms of computer time and work space is also sent to C. At C, several pieces of equipment may receive the processed information. The choice to a large extent is dependent on the programme in question but realistically on the facilities available at the computer installation.

This description is an over-simplification. The components A, B and C are not clear cut. The Card Reader (or Paper-tape Station) combines the features of A and B. The various output units at C, e.g. the printers, the graph plotters, the magnetic tape units occupy a large proportion of the computer floor. The lines of communication are lost under a false floor.

Nevertheless a computer installation consists basically of a configuration of input-output devices linked together to form a high-speed data processing unit. It is *not* an oversized monstrous electronic brain as depicted by cartoonists and television script-writers.

Slides illustrate CSIRO's CDC 3200 installation at the National Standards Laboratory, Sydney, in terms of the above description.

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COMPUTER LANGUAGES AND PROGRAMMING

*Dr J. B. Hext**

A programme, in its broadest sense, may be defined as the specification of a sequence of events for achieving some goal. Thus we have a programme for a concert or for a three-day seminar. We open a do-it-yourself kit and find a programme of instructions inside. We follow a knitting pattern, or a recipe, or a musical score – these are all examples of programmes. We note that some of them are written in ordinary English, but others use a special notation.

In computing, a program is a sequence of instructions to a computer for carrying out some task. We may think of a computer as a slave with a calculating machine and a large filing system. Our program tells him what to do. The slave works at a fantastic speed, but is unfortunately rather simple-minded. This means that his instructions must be very carefully worded. There must be no possible ambiguity about them and they must be easy to understand. This raises the need for special programming languages. Programming is the formulation of a program. The starting point is the task to be carried out by the computer. The finishing point is a program which is successfully executed. It is convenient to divide the whole process into four stages:

(1) *Task analysis:* deciding what has to be done.

(2) *Programming:* formulating a program to do it.

(3) *Coding:* writing the program in computer language.

(4) *Execution:* the actual computation.

The term "programming" is sometimes applied to the first three stages together, i.e. "preparing a task for a computer". At other times it is applied to stage (2) only, as in the definitions above. But often it is applied quite wrongly to stage (3) only: you go on a one week so-called "programming course" and you learn a programming language – FORTRAN, say. Unfortunately many people think that this is enough and vast quantities of computer time are wasted as a result. But that's like saying "I know English, therefore I can write recipes" or "I know musical notation, therefore I can write symphonies". There is more to programming than simply knowing a language, as we shall see later.

It may help to illustrate the four stages of computing by a specific example. The task we shall consider is to print a calendar for any year in the range 0 to 9999 A.D.

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Task Analysis

The first stage is to define the task. In many cases this is very easy: the task is well-defined to start with. For example, "prove Fermat's last theorem" is well-defined and so stage (1) is covered at the outset (the only difficulty comes in stage (2) !).

But if a business firm says "let's automate our accounting", that task is far from being well defined. Before embarking on any programming, it is first necessary to find out what exactly their accounting involves. This work is known as "systems analysis". It may take several months and requires skilled and experienced analysts.

In our problem, the analysis is fairly trivial. It may involve a little research into the occurrence of leap years and it will also cover the detailed design of the calendar's lay-out. The summary might be as follows:

Input : a date in the range 0 to 9999 A.D.

Output: twelve pages, each of the form illustrated in Figure 1.

MARCH 1968						
SUN	MON	TUE	WED	THUR	FRI	SAT
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

Figure 1

Output Format for Calendar

Details: January 1st 1967 was a Sunday.
Every 4th year is a leap year,
except that every 100th year is not a leap year,
except that every 400th year is a leap year.
Ignore holidays, phases of the moon, etc.

Programming

The task is now well-defined. The next stage is to decide how to perform it. This calls for a detailed knowledge of available equipment and techniques. In the commercial world it involves decisions on the lay-out of files and the order in which to process them. In science it involves knowledge of numerical analysis or statistics. In other fields it may require completely new techniques.

For the calendar there are two main problems: firstly to calculate on which day of the week January 1st falls, and secondly to devise a method of printing the days of each month in their right positions. The summary of the work might be as follows:

Notation: integer division gives a quotient and a remainder,

e.g. $\frac{60}{7}$ = 8 remainder 4.

Write 60 ÷ 7 for the quotient
and rem (60, 7) for the remainder.

Convention: number the days of the week 0, 1, 2, . . . 6
e.g. Wednesday is day 3.

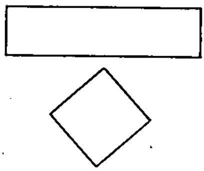
Observation: if today is Sunday, then d days from now will
be day rem(d, 7)
e.g. in 30 days time it will be day rem(30, 7)
= day 2 i.e. Tuesday.

Calculation: assuming that 0 A.D. was not a leap year then
January 1st 0 A.D. was a Sunday.
∴ January 1st n A.D. will be day rem(d, 7)

where d = number of days elapsed
= 365 x number of years
+ 1 x number of leap years
= 365 x n + (n - 1) ÷ 4
− (n − 1) ÷ 100 + (n − 1) ÷ 400

Program flow: each page of the calendar has spaces for 42 days. For a month with s days beginning on day t, the first t positions must be left blank. Idea: let the dates run from (1 − t) to (42 − t) and only print those in the range 1 to s. The sequence of operations to print one page of the calendar can then be presented by the flowchart of Figure 2.

Conventions:



Take specified action

Branch on specified condition

Legend:

day	=	day of week (range 0 to 6)
date	=	day of month (range 1 to length)
length	=	length of month
pos	=	position on page (range 1 to 42)

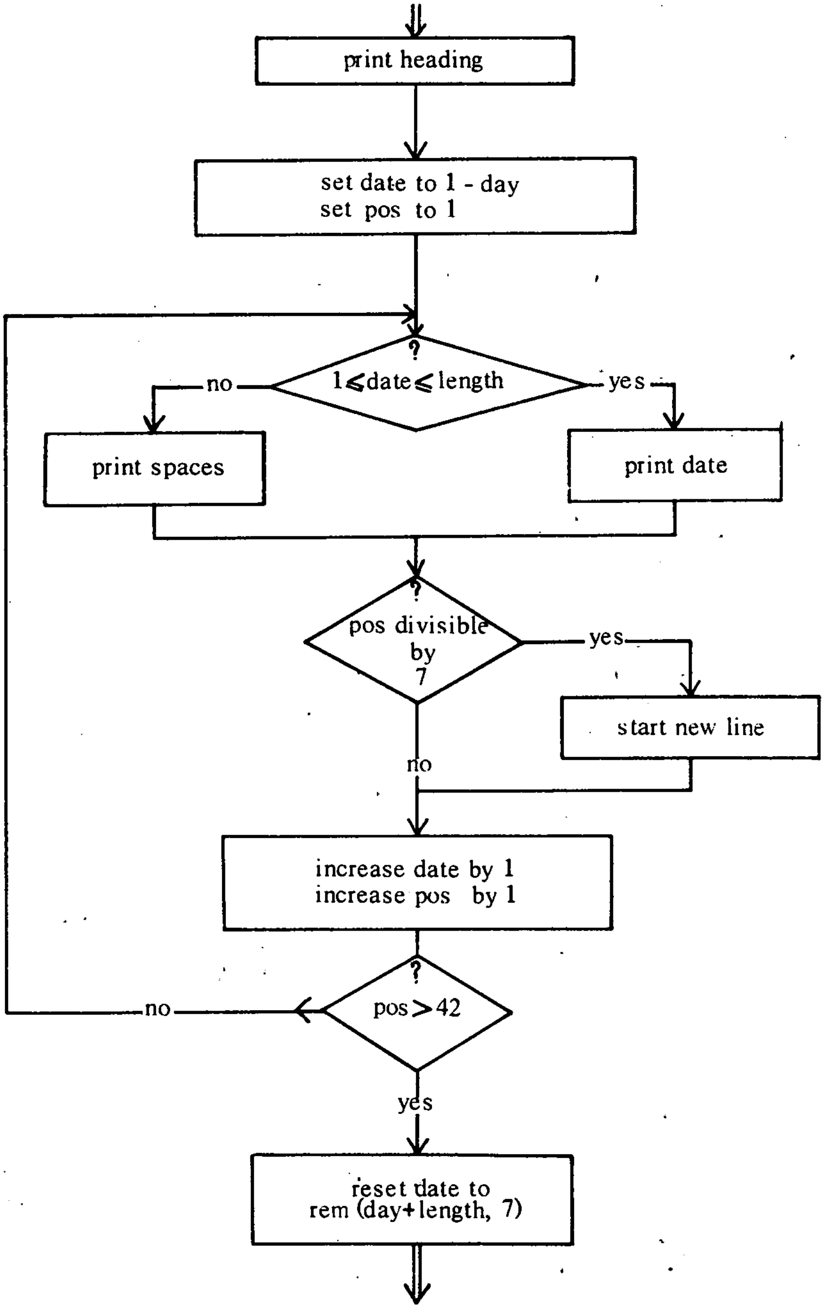


Figure 2

Flowchart for printing month

Coding

It now remains to convert the above analysis into a program which the machine can understand. It is easiest to do this by means of a *programming language.*

The program for printing a calendar is given below. It is adapted from a program written in ALGOL (Algorithmic Language) which has been run on the KDF 9.

Program to print a calendar

```
§ 1    integer year, date, day, pos; Boolean leap year;
       procedure print month (string name, integer length);

§ 2    comment this procedure prints the calendar page for the month
       whose name and length are specified. The variable 'day' specifies on
       which day of the week the month begins;
       page (1); line (18); space (11);
       text (name); number (year, 'ssdddd');
       line (6);
       text ('SUN MON TUE WED THU FRI SAT');
       line (4);
       date: = 1 - day;
       for pos: = 1 to 42 do

     § 3    if date ≥ 1 and date ≤ length
                  then number (date, 'sssdd')
                  else space (5);
            if div (pos, 7) then line (2);
            date: = date + 1 § 3;
       day: = rem (day + length, 7) § 2;
       read (year);
       leap year: = div (year, 400)
                  or div (year, 4)
                        and not div (year, 100);
       day: = rem (year + (year – 1) ÷ 4 – (year – 1)
                  ÷ 100 + (year – 1) ÷ 400, 7);
       print month ('January', 31);
       print month ('February', if leap year then 29 else 28);
       print month ('March', 31);
       print month ('April', 30);
       print month ('May', 31);
       print month ('June', 30);
       print month ('July', 31);
       print month ('August', 31);
       print month ('September', 30);
       print month ('October', 31);
       print month ('November', 30);
       print month ('December', 31);
            page (1) § 1
       The program is followed by the data; e.g.
            1968;
```

Execution

The coded program is now presented to the machine. This is done by means of punched cards or paper tape. The machine's card reader or paper tape reader converts the program into a sequence of electronic pulses, the computer sets to work, and your results come out.

That's how it goes . . . in theory. In practice, as we shall see, things are not quite so straightforward. Before discussing the reality, however, we shall pause to look closer at programming languages, since this subject forms half the title of the lecture.

Computer Language

Our example above uses three languages for programming.

In the initial discussion of stage (2), we used ordinary English: "let the dates run from (1 – t) to (42 – t) and only print those in the range 1 to s". It would be pleasant, of course, if our electronic slave could interpret this as it stands. But it can't. Dates don't run. What does "only print" mean? (It should, of course, be "print only those . . ."). And so on. Our normal English is far too complicated and imprecise.

The second language was that of the flowchart, a pictorial language using boxes, diamonds, lines. These symbols have international recognition, so the flow of the program is clear and unambiguous. The writing inside the boxes is less precise. But the flowchart cannot be read by the computer – it is only an aid to programming and to documentation – and so the imprecision does not matter. In fact it is an advantage because it allows us to give a rigorous specification of the program's flow without worrying too much about the detailed operations.

Thirdly, we had the actual program, adapted slightly for purposes of clarity, but basically in a form acceptable to the computer. This language has a number of special words, such as *integer, Boolean, procedure,* and some special symbols, such as § and := . But apart from these, it uses conventional words and mathematical symbols, so that it is reasonably easy to understand. This is what is commonly meant by a "programming language".

But there is yet one more language involved, a fourth language in the process, one which the programmer does not normally see. It is the language into which your program is translated before it is finally executed. It specifies, one by one, each individual machine operation which is to be carried out. For example, the line

```
date: = 1 - day;
```

involves three operations; fetching the number 1, subtracting the value of day, and assigning the result to date. The machine code for this might be as follows:

```
300 014
356 042
301 044
```

This language is known as machine language. Translation from your programming language to the machine language is carried out automatically by a program called a "compiler". But the machine language is all hidden from view, rather like the "ineffable, effable, effanineffable, deep and inscrutable, singular name" of Old Possum's cats. So you don't need to know anything about it.

The Facts of Life

In theory, as we have seen, a computing task progresses smoothly from task analysis, through programming and coding, to successful execution. It all sounds too good to be true. And it is.

In practice, things go wrong. The systems analysts not only fail to assess the existing system adequately, but they also misjudge what things will be like two years ahead, when the computer is finally installed. Next, the programmers mis-interpret the systems analysts' requirements. Moreover, in writing different sections of the program each fails to realize quite what the others are doing, and so their different parts don't fit together.

When the programs are finally written, they contain errors – commonly known as "bugs". Some of these show up immediately, but others lie hidden for months, or even years. Then some of the original programmers leave without documenting what they have done. Others take over and can't follow what's going on.

Furthermore the business is changing. Programs need altering. It is decided to do not only accounting, but also payroll. And then inventory control. And then a few other things. So these extra jobs get grafted on and the whole system nearly collapses under its own weight. A larger computer is ordered. Programs have to be re-written. More chaos. More agony. And so it goes on. If you estimate that a job will take one year, it will probably take two, and the costs will increase too. All too often, computers do not prove as profitable as was hoped. Sometimes they prove to be a loss.

This may sound gloomy and exaggerated, and yet it is all too common. We are just not used to analysing systems in such detail or writing programs with such precision. We don't have adequate methods of describing the systems or of writing the programs. But still we rub along, and there are many systems doing useful work today.

Perhaps we may conclude with an analogy. A programmer is assigned a task for computing: his job is to program for all situations in advance so that the computer can then handle everything automatically. The law-maker is assigned a task for law coverage: again, his job is to prescribe for all situations in advance, so that the courts can then proceed smoothly in their work.

But does it ever work out like that in practice? Do you ever succeed first time in creating a law that covers all situations? Why do laws constantly have loopholes? Why do they continually need revising? Why are law-makers unable to find a sure-fire technique for producing perfect laws?

If you can answer those questions, then I shall tell you why large-scale computer programs never work first time; they always need debugging and patching up; why they constantly need revising; why there is no sure-fire technique for producing perfect programs.

If you are in any organization that is planning to install a computer, then good luck to you! You will be using a machine of tremendous power and potential. But I would urge of you two things. Firstly, if you go on a one-week "programming course", don't imagine that you will then know how to program. Secondly, when things don't go quite as smoothly as you in your optimism had hoped, have mercy on the programmers responsible. After all, you've been writing laws for 4,000 years and don't yet have it licked; we've only been programming for 20 and still have much to learn.

For further reading

The Scientific American for September, 1966 was a special issue on computing and makes an excellent introduction to the subject. See especially "Programming" by C. Strachey. The issue has been produced as a book "Information" published by Freeman.

INFORMATION STORAGE AND RETRIEVAL

*J. D. Traill**

The legal profession has long been accustomed to problems of legal research. Each practitioner has during the course of his daily work to consult law books, statutes, case reports and articles found in the pages of learned law journals in advising clients of their legal rights or in arguing causes before the courts and tribunals where they practise. Much of a lawyer's time is spent in searching the materials on which to base his opinion and this is not only time-consuming but may be haphazard in its result. What barrister does not recall the occasion when his opponent has produced to the court an authority whose existence his own researches have failed to reveal? Despite the fact that lawyers are overworked the Court lists are congested and justice is frequently delayed to litigants. The purpose of this paper is to examine the use of computers as a scientific tool for assisting the legal profession to ease the burdens which press on all sides by permitting information retrieval of legal materials especially case law.

With the advent of the high speed digital computer the capacity to store vast quantities of documents and information in a relatively small space became a reality. The ultimate limits of the success of computers applied to law will depend on the extent to which law is capable of being analysed and described by scientific method. The more elementary function of information storage and retrieval is of more immediate concern to the barrister and solicitor. Charles S. Rhyne,[1] a former President of the American Bar Association has said:

> "Computers with 'memories' far beyond human capacities are now in use; they can do complex calculations, receive, store, convert and print out information at a speed impossible of achievement by even a large group of men. Man creates the computer and stores the information in the machine's memory. It will always operate by orders from a human mind; the computer will never achieve human reason and thought. For purposes of storing and retrieving information for speed in information processing, the computer exceeds all possible human effort, and for these purposes we of the Law should use it as quickly and as completely as we can."

I would respectfully adopt this statement as an immediate goal which is attainable by the legal profession.

The acceptance of scientific aids in the service of the law has not met with universal acclaim. Carl F. Stover[2] of Stanford Research Institute has voiced the fear that improved electronic systems of legal research may be "to qualify the mediocre and discourage the great". He predicts the foreseeable unemployment of law clerks and the ultimate subjugation of law by technology and concludes:

> "The notion that the majesty and mystery of the human experience, which is the essence in law, can be written into a computer affronts the dignity of man."

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Whatever view one is persuaded to adopt as to the future of computers in law it is clear that as the range of computers, electronic data retrieval systems, micro-film libraries and other scientific devices adapted for use by lawyers become more plentiful the practice of law will change. The scientific quantitative study of the law is not a thing of the future, it is already at hand.

The need for information storage and retrieval

What has been called the "information explosion" is recognizable in the law as in other fields of human activity. As the quality of law reporting has improved so has the quantity of cases reported grown in number. It took almost 60 years from Federation for the Commonwealth Law Reports to reach 100 volumes but in the last seven years 14 volumes of reports have been added. There has been a considerable increase in the number of appellate decisions handed down by the New South Wales Court of Appeal since its creation on 1st January, 1966. Throughout Australia case reports are proliferating. In America the reporting and making available of more than two and a half million appellate decisions of Superior Courts to the nation's lawyers is a problem of gigantic dimensions.

Traditionally, the legal profession uses digests and indexes to assist in legal research. While digests are very useful to practitioners they are not able to keep pace with the rapid development of case law by infrequently published supplements.

There are a number of weaknesses in conventional systems of indexing the most basic of which is the lack of a common terminology. Many publishers use different methods of indexing and frequently references are elusive because the term under which the case is listed is unknown to the searcher. The Australian Digest of Case Law while a useful aid to lawyers is not an easy series to use properly for this reason. Another defect in existing indexes arises from the fact that cases are indexed in accordance with points of law rather than factual situations. The author who indexes the case must select the category into which the case falls and this often calls for an assessment on what is the most likely point of relevance for lawyers. Frequently there are a number of points in a case of substantive or procedural interest and the case is not indexed under each topic. Law indexes can only include a fraction of decided cases and text books only show reference to decided cases, usually as footnotes.

With the ever increasing growth of case law, statutes and regulations, practitioners can presume that the use of their time spent in legal research will become even less efficient than it has been. A barrister operates as counsel when he is engaged in interpreting legal information rather than when his time is spent in the semi-skilled task of searching legal materials. The first question the lawyer must answer is "What kind of service is required?"

Case law is not studied in the abstract. The lawyer needs not only to examine the legal precedents relevant to the fact situation he is analysing but all relevant statutes, regulations and the opinions of learned authors on the question.

A case law retrieval system that is to attain any measure of support by the legal profession must fulfil most or all of the following specifications.

(a) It must be an alphabetical system even if codes are used.

(b) It must have a capacity big enough to accommodate an enormous volume of case reports, judgments and documents.

(c) It should retrieve all relevant information but should not reproduce excessive non-relevant information.

(d) It should be able to handle any size judgment or document in full text.

(e) It should be speedy and not too expensive.

It has already been noted that the main problem in case law retrieval systems is in the indexing. No two indexers classify matters the same way. Some indexes are more complete than others and the legal training of the indexers may vary. The problem is increased when the indexers are removed from each other not only in space but in time. Until the source material is properly organized and the legal information is stored in the computer in a form that will be readily recognized by lawyers retrieval will be of limited value. Searchers who have to rely on indexes prepared by others will always have problems of identification of key words or concepts. Electronic data retrieval systems for case law require a single index for all types of legal case materials whether in contract, tort, at equity or common law. This discarding of the rigid, artificial and limiting classifications of the law by subject matter which is of some use in manual searching represents a long overdue emancipation. It is far more satisfactory to search and retrieve all case law relevant to a problem than to discover only those authorities which happen to have been indexed under the relevant heading.

The main advantages to legal practitioners of the storing of legal materials including case law for instant retrieval by electronic computer may be summarized as follows:

1. Computers have a memory system of incredible scope.
2. They incorporate a filing and indexing system that needs no files.
3. They provide a printing or duplicating service that is extremely quick, and can provide a copy of judgments or documents either in whole or in part. In this respect computers are superior to manual search since the relevant law may be printed once found.

The main disadvantages appear to be:

1. Electronic data retrieval system is not infallible and still requires human supervision.
2. The cost of operating computers may be very high as is the initial cost.
3. There is a danger of retrieving a mass of material that would take too long to assimilate.

Case law projects

It is not the purpose of this paper to give an exhaustive analysis of experimental projects being carried out throughout the world but a discussion of some of them will illustrate the advances that have been made.

It is only since 1960 that the branch of computing which has become known as data processing or information retrieval has emerged. In that year the application of electronic data processing systems to legal research was successfully demonstrated at the American Bar Association convention. A digest of all decided cases over the previous two years in the field of oil and gas law were stored verbatim in a computer. In addition a key word digest of the headnotes in patent law cases of the past 20 years were stored.

Professor John Horty of the University of Pittsburg after early experiments with health legislation for the State of Pennsylvania has stored all American health legislation, the entire statutes of Pennsylvania, the statutes of Pittsburg and some decisions of administrative tribunals. While this represents a vast achievement it is not directed primarily to the storage and retrieval of case law.

The United States Air Force has designed an electronic system called Legal Information Through Electronics –LITE, to retrieve fiscal management and legal information. The LITE project allows the user to trace a line of case precedents by specifying the necessary words or phrases to be retrieved. It uses full texts of case reports, treaties and documents rather than headnotes or abstracts. It allows the searching of key words in context but cannot retrieve a single word root common to several key words. The LITE system does not fail where a precedent case has not been cited but works forward rather than backwards to earlier precedents. The main disadvantages of the LITE system appear to be that search failure results where the searcher fails to specify the exact words of the case report under review. Any negative search results have to be reviewed by the searcher to see if the key words should be altered.

The only commercial venture of any magnitude in supplying legal information retrieval facilities to the legal profession has been established in New York. Law Research Services Inc. at the Sperry-Rand Univac Centre using a High Speed Univac III programmed a library of more than a million cases according to headnotes. This electronic retrieval system permits the computer to test the relevance of 120,000 cases per minute to any legal research problem. The relevant cases are printed in full by a photographic process from microfilm tape searched by the computer and attached to the report of citations. The cost is $25.00 per enquiry. The New York Bar Association has also fostered a scheme to provide financial aid to assist younger members to obtain access to the computers.

In the United States there are over thirty experimental projects on the computerisation of law. The development of photo-electronic scanning devices which convert printed material into suitable form for storing in a computer has made it possible to digest and index case law reports at a very fast rate. We can expect refinements to improve the position but a great deal more work is required before information retrieval of the case law data is economically possible in a country like Australia with its lawyers scattered widely throughout the Commonwealth.

In the United Kingdom Mr C. F. H. Tapper of Magdalen College has been directing research at Oxford into retrieval of legal information from natural language text on the basis solely of word occurrence. Using an I.B.M. System/360 and I.C.T. Atlas the whole text of recent volumes of the All England Reports and the Ministry of Pensions and National Health Industrial Injuries Decisions. Mr Tapper with the backing of the Office for Scientific and Technical Information has carried out a number of useful experiments on case law. In an article on "Retrieving Legal Information"[3] Mr Tapper has said:

> "Legal cases are ideal for retrieval experiments. They appear in the law reports in an apt form. They comprise four parts, a name, a short list of index terms, a short abstract, and the main body of the text. Case-law also incorporates the useful feature of internal reference to other earlier cases. Indeed it is this feature which renders the information problem so peculiarly acute. This latter feature reduces one of the main difficulties of testing retrieval systems, by providing an independent criterion of relevance. It can safely be assumed that a case referred to by a judge in his judgment is relevant to the case in which that judgment is given. The various categories of text then allow retrieval performance to be compared for each. Comparisons can also be made between the two classes of legal cases, and, by employing lawyers to conduct conventional searches, between manual and mechanical searches. So too, variations in search strategy can be made with a view to improving efficiency. And as experience in these methods is gathered, the effects of this can be measured."

The results of these pioneering experiments in retrieval of case law materials seem to indicate that untrained and inexperienced searchers do as well and in many cases significantly better than experienced lawyers with unlimited time in well equipped libraries and their results are significantly quicker.

The first world exhibit on the use of computers, and automatic data processing equipment as aids to the legal profession was held at the Geneva World Conference on World Peace Through Law at Geneva, Switzerland in July, 1967. A number of case law research projects were displayed during that Conference including demonstrations by Project LITE, Law Research Service Inc. (New York), Project OGRE (Southwestern Legal Foundation), CREDOC (Belgian Bar Association) and a project conducted by the University of Montrellier (France). The Centre has continued to publish a monthly journal "Law and Computer Technology" which is devoted to dissemination of technical details of computer projects in law and the examination of the practical use of scientific aids to the legal profession. Mr J. B. Piggot, former President of the Australian Law Council is a member of the editorial committee of this journal.

In Australia there have not yet emerged any serious projects of case law retrieval systems. The Law Council of Australia has appointed a Legal Research Committee which may with assistance produce a sample retrieval program on limited material in the next year. The New South Wales Bar Association has also established a Legal Research Committee which inter alia, is examining the possibilities of the use of electronic devices for the bar. At least there is an awareness amongst some members of the legal profession that this attention of scientific and computer people to the practise of law will yield significant aids to lawyers in providing tools for the better ordering and dissemination of legal information.

Conclusion

In the fields of medical research and diagnosis, in commerce, and in engineering computers are extensively used to sift facts and retrieve information successfully and swiftly. In the field of law it has already been demonstrated that scientific devices can be a useful aid to legal practitioners. If we accept Mr Colin Tapper's assessment that case law is an apt subject for electronic retrieval systems despite the technical problems involved then we can expect to see in the future more sophisticated computer law searching systems developed. There are at present a variety of systems which differ both in what they require from the user to make a search and what they give as a result of that search. For output the systems merely perform document searches, find cases or other materials that contain the information desired. It still has to be assessed by the lawyer. Missing references which the computer fails to retrieve are just as fatal as cases missed by lawyers using manual research techniques. Probably a combination of legal experience and skill will always be required with the results of computer searches. No doubt the question will arise, if it has not already, of the liability of commercial searchers in negligence for failing to reveal a crucial legal precedent.

The ability of electronic information retrieval systems to print out case reports in whole or in part as required may well have a profound effect on the publication of case reports, case study books and other legal source materials in the future. One outstanding problem which requires early attention is the problem of the cost of legal information retrieval systems. Until the demand is aroused the cost may be prohibitive; and the problem of determining what type of service is required will remain unanswered until the cost to the practitioner is reduced to the level that it is economic for him in proportion to the fees he can recover for his services.

Clearly we are only on the threshold of establishing highly technical and complex systems of legal information retrieval in Australia. While due caution should be exercised there is a real risk that the prophets of scientific progress will talk about this but will do nothing. Whatever happens, the techniques of legal research and law libraries available to legal practitioners in the next century will be quite unlike those of the mid-twentieth century.

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INFORMATION STORAGE AND RETRIEVAL FOR LEGAL PURPOSES

*K. S. Pope**

Statute Law

The Role of the Lawyer

The lawyer is essentially reliant on printed words in his profession in a way that no other profession is. In the realm of statute law, he is always concerned with what has been recorded in the past, and cannot experiment as regards what is to happen in the future. There is some truth in the saying attributed to George III that "a lawyer knows no more law than other people, but simply knows better where to find it".

The task of the lawyer in dealing with statute law cannot be analysed in detail except in the broadest sense. There is indeed a widespread need for close dissection of how the lawyer carries out his work in relation to reference to printed text and to his own experience. Some attempt has already been made to do this and a good description of the process involved has been given by Tapper.[1] Essentially, we may regard the lawyer's task generally as demanding three separate functions:

1. Definition of the problem.
2. Retrieval of the correct law.
3. Application of the correct law.

This division of function applies in probably all realms of legal activity, but is most significant in the fields of case law and statute law.

We must also recognize that a very large part of a lawyer's professional competence lies in the experience he has amassed personally which enables him to define, retrieve and apply the law as opposed to carrying out the more mechanical functions referred to above.

The problem confronting the lawyer

If, in fact, George III did make the remark quoted above, he would not have made it so readily today, in view of the tremendous volume of printed words with which the lawyer is now confronted.

It is suspected that the sheer volume of legislation – including, in its widest sense, Government regulations, statutory instruments, etc. – is beginning to defeat the lawyer, and some escape from the routine work of following references and citations comparatively inefficiently must be found. The difficulty, for example, of following the legislative trail relating to an

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amendment in a modern statute is often considerable, and may involve many hours of research. Notice, however, the use of the word "suspected", since precise analysis of the lawyer's work in retrieving statute law awaits completion.

The problem can be demonstrated with reference to statute law by quoting that for the Australian States the total current law in statutes is over seven million words of text, and that about three hundred new statutes are added to the Statute Book every year, bringing an increase of new text of about two million words per year.

Nor is the lawyer the only person concerned with the stifling aspects of new legislation, In the foreword to the Third Edition of the Statutes Revised, 1950, the Lord Chancellor Jowitt wrote–

> "Under modern conditions the public interest is becoming increasingly affected by the unsatisfactory condition of the Statute Book. It is no longer lawyers alone who are mainly concerned in ascertaining the law, but a much wider section of the public, comprising central and local government administrators, representatives of employers and workers, and those of public bodies and private organisations."

The sheer volume of text to be considered by the lawyer in this regard is not the only problem which arises. Under conventional legal office procedures, the lawyer obtains access to relevant law by means of the various indexes, digests, etc. These are the lawyer's tools, and to be effective they must be up-to-date and accurate. The volume of data now confronting the lawyer is such that delays arise in indexing and in producing abstracts or digests.

In addition, the inherent weaknesses of these processes (knowledge of the indexer, lack of compatibility of understanding between indexer and subsequent inquirer) are accentuated by delay and the inevitable inaccuracies which creep in when human beings are confronted with a mass of data, some of which may be conflicting. It is not surprising, in fact, that the results of retrieval are often disappointing in this environment. The effect may well be as Scarman L. J. pointed out in 1965–

> "The result [of six hundred years of continuous legal development] is a body of law often superb in quality, but now studiously repulsive in form."

The approach to the Problem through the computer

Faced with problems of this kind, lawyers in some areas have considered the use of the computer, with its powerful data retrieval facilities, to overcome the difficulties of dealing with statute law. The approaches adopted were initially developed in the USA, but have been taken up and developed in other countries. These computer activities as a whole fall readily into three classes:

1. Those depending on prior indexing or abstracting of the document, followed by up-dating of, and later retrieval from the base index or file of abstracts held on a magnetic file;

2. Those depending on the recording and later interrogation of the full text held within the computer system; and

3. Those concerned with the recording of the identity of a document only in order to serve a system of registration.

Class 3 is essentially an extension of Class 2.

For the purposes of this paper it is not necessary to deal with these Classes in detail. Class 1 is concerned mainly with the field of case law and Class 3 lies obviously in the area of registration systems and citation systems.

With regard to the application of computers in the area of Statute law, Class 2 is of great importance because of the full-text requirement in all searches of law of this kind. The remainder of this paper is accordingly devoted to a description of systems of retrieval demanding full-text responses.

The Pittsburgh Health Law Centre full-text system

Of all the systems applied so far, the most impressive and the most widely developed is that which originated at the Health Law Centre of the University of Pittsburgh under the guidance of Professor John Horty. The value of the contribution made by Horty and his colleagues cannot be over-estimated; the system has been adapted or followed in many other States and also used as a basis by workers in other countries.

The system as originally developed was essentially one of full-text retrieval of Statute Law, and has many interesting features. It has been well described in detail earlier[2], and the principles on which it is based have changed relatively little since the first programs ran on an IBM 650 computer in 1959. Its significant features may be briefly described as follows: The actual text of statutes is transcribed to computer input and passed through standard editing routines which (1) reduce the text to a standard syntax by the recognition and elimination of certain punctuation symbols (e.g. hyphens) which would otherwise cause difficulty, and (2) decide for each word of text whether it is a significant or a common word. Common words (such as "and", "the", "to" and the auxiliary verbs) are defined by the program by reference to a stored table of common words derived from an input common word master file. The decision as to what constitutes a common word is arbitrary to the system, although a statistical count of usage is maintained. (Experience suggests that at least fifty per cent of all text consists of common words.) Each significant word of text is then inspected by a program which determines its positional relationship within its sentence by a count of the number of words it lies from the beginning of the sentence. The position of the sentence within the document is determined by a similar count of sentences.

Common words are taken into account in determining the position of significant words in sentences. After this relationship has been determined, the significant words are written to an output magnetic tape file in character format; together with their associated document identity, sentence number and word count. This output file may be termed the Concordance work file.

The preparation of the Concordance work file must not be taken lightly. The programming problems involved in the recognition of a text word-end and of a sentence-end are not trivial. Furthermore, depending upon the principles which govern the interpretation of Statutes in the particular legal environment in which the scheme is to operate, it may be necessary, in addition, to recognize certain structural characteristics of the text, e.g. titles and headings, which may or may not be of legal significance and whose content may be excluded from the Concordance work file in consequence.

Once this file has been established, it is sorted to sequence of word number within sentence number within document number within alphabetical order, and then applied so as to update a Concordance master file organized identically by insertion of the new word/sentence/document relationship data in its appropriate position in the serial master file.

The initial plain text information which gave rise to the Concordance data is also applied to update a document file containing serially the full text of all documents within the system with preservation of the line relationship of the original text. (In the Horty scheme, a section of a Statute is a document. This choice appears to have been dictated by the initial environment, but there is no reason why sections should not be regarded as sub-documents of statutes as they are in normal usage.) It should be noted that the full-text enters the computer in a format in which each section of a Statute is regarded as consisting of four divisions of text-citation, scope, substantive text, and classification. As the section is prepared for computer input, the text lines are coded according to the division into which they fall by a simple one-digit code. When a word is established during the editing process as a non-common word and written to the Concordance work file, the appropriate code of the line in which it appears accompanies its entry in the Concordance file. The purpose of the device is to enable searches to be restricted if required, to particular divisions of the text.

Searches are carried out by the system in the following manner. Retrieval of relevant documents is determined by the selection of significant words according to a positional relationship within the text specified by the searcher. The searcher must first establish in his mind the class of concepts with which he is concerned and then break this class down into one or more sub-classes. The first sub-class is of single words or combinations or words which he regards as synonymous within the framework of his search and may be regarded as first-level terms in an indexing system. The second sub-class also consists of synonyms, to be regarded as second-level terms. The searcher is required to specify the positional relationship which must exist within sentences between words in each sub-class. This relationship is defined by means of + and - operators which relate to the position of the base-words prescribed.

After the sub-classes, or similar concept work groups have been established, they may be combined or distinguished for retrieval purposes, and the search limits may be framed so as to require that a word, or one of its synonyms, be found in the same sentence with another word, or one of its synonyms, or within a range of n sentences or n documents.

After the computer search of the Concordance master file according to these criteria, the titles of the documents which contain text satisfying the relationships specified can be listed, followed, if requested, by a print of the text of the documents. The searcher can modify the lists in the light of the search results obtained so far, and continue until he is satisfied that the conceptual class has been properly defined in terms of the lists and that retrieval is complete.

Many other facilities are included within the system, and a complete reference can be found in the Search Framing Manual published by the Centre.[3]

The Success of the Pittsburgh System

The rapid success of the system in a traditionally conservative environment has been striking. By 1970, Horty will have recorded on magnetic tape all Federal Statutes, thus bringing together in one centre a virtual compendium of all current Statute Law.[4] Other States have either followed his example or make use of the services of the Pittsburgh Centre. Two examples which represent opposite extremes of application are Ohio and New York. Ohio contracted with the Pittsburgh Centre to put the Ohio Constitution and Revised Code of Statute Law on magnetic tape, provide the necessary programs and train the staff of the Ohio Legislative Service Commission in the use of the system. The Ohio Commission sought the inclusion of all punctuation marks in the text as in the printed Statute, together with indications for upper and lower case.[5] Ohio was influenced by the fact that the Pittsburgh Centre had also prepared and installed similar systems in New York, Pennsylvania and New Jersey.

As an example of the efficiency of the Horty System, outside the results reported by Horty, one of the first searches done by staff of the Ohio Legislation Service Commission after the conversion was to locate all occurrences in the Code and constitution of the term "Justice of the Peace", an office which had been abolished in Ohio in 1957. Three of four Sections of the Code containing references to them were known to exist; the computer system located no less than seventeen which had been overlooked. It was said that "the computer had uncovered in a few minutes seventeen sections of law undetected in eight years of intensive work by experts."

The text file and the Concordance file in the case of Ohio were each contained on three reels of tape, accounting for 18,226 documents in the Pittsburgh sense. In comparison with New York State with a loading of 20,000 Statutes this is trivial. There the Statutes are contained on twenty exchangeable magnetic discs, which, it has been said in somewhat glowing terms, "have enabled the legislation to establish a unique Legal Retrieval Centre that ferrets out obsolete laws, find all laws affecting any particular subject, re-arrange them in logical order and pave the way for their wide-scale modernisation".

Because the work of Horty and his associates probably represents the most effective application of computer-aided retrieval, it will be pertinent to question whether the end of this particular line of development has been reached.

Before considering this, however, it is desirable to comment on particular aspects which could possibly constitute limitations to its application to Statutes of the United Kingdom type. These aspects are considered under the heads of

(1) the nature of the subject matter to be retrieved, (2) the status of the information stored, (3) the need for a legislative trail, and (4) the order of the information held.

The Nature of the Subject Matter

Undoubtedly, a major element in the success of the Horty system in USA is the well-structured nature of its subject matter. Codified statutes tend to precision, and thus give greater control, systems and programwise, over the transcription, editing and storage of the data.

The application of the system to non-codified law such as is contained in the English Statute Book is not straightforward. The following problems have been met by the writer in attempting to convert English statutes for computer application, and they are considered to be serious obstacles to the design of any system based on the Horty techniques:

1. the varying length and format of Statutes, and sections of Statutes;
2. the lack of any logical plan in their division into Parts, Sections and Schedules, not only as between differing legislative authorities but also within the same authority; and
3. the inclusion of schedules of varying purpose and format.

Major discussion of these problems would be out of place here, but the following comments indicate the difficulties involved.

The varying length and format of statutes does not require demonstration. Horty deliberately adopted the section of a statute (code) to be the recording unit known as the 'document'. In general, these sections are relatively short and there are some grounds for the assumption that codified law tends to shorter section lengths than uncodified. English statute law is notoriously badly structured and the logic of the division of a statute parts, sections and schedules is often hard to discern. Furthermore, the practice of incorporating schedules to Acts, which set out substantive law, or may be nothing more than pro forma to give effect to the mechanics of the law, leads to difficulties which cannot be overcome (as is understood to be the case in the Horty system) by not accepting them into the storage. Consider, for example, the *Customs Tariff,* 1966, (Commonwealth of Australia statute No. 134 of 1965). This is a statute which prescribes law relating to the payment of customs dues on the importation of goods into the Commonwealth of Australia, and it falls within an area of law which on the surface would be most suitable for legal information retrieval in view of its complexity. This statute (excluding schedules) has only sixteen pages of text, i.e. about 5,000 words of text to be reduced on editing to less than 2,500 significant words for recording in the Concordance file. Three schedules are included in the Act. The first schedule contains no less than 497 pages, and about 73,000 words; the second schedule 18 pages and 5,000 words; and the third schedule 15 pages and 700 words. Although this statute operates in a very specialized field of law, its characteristics are not unique. Any general decision to omit schedules in this field would inhibit the record of the major part of this Act and many others.

Similar problems relating to the inclusion of schedules may be found on examining the *Town and Country Planning Act, 1947,* and the *Representation of the People Act, 1948,* of the United Kingdom. In these examples the format of the schedule is of particular significance. Conventions concerning the representation of blank areas, under-lining, italics, marginal notes, foot-notes and alternative clauses, can only be established empirically, and there would seem no possibility of reproducing the appearance of the format of the schedule in computer printed output on retrieval.

Mention must also be made of the verbosity of some statutes; the *Uniform Companies Act, 1961,* which applies in the States of the Commonwealth of Australia, for example, contains no less than eight pages of definitions, many of which would not be required for retrieval purposes. If preliminary manual text editing is to be adopted above the level of simple format editing, however, the plain text approach is vitiated in principle; the same applies if programmed editing is used to distinguish these areas and exclude them from the Concordance. Although this latter procedure may be necessary for the exclusion of textual embellishments, such as headings in some environments, it is suggested that it is far too sweeping in its effect to be applied to other parts of the text.

The Status of the Information held

The fundamental purpose of the Horty system is to identify and retrieve particular portions of the text of particular statutes. It is a highly selective and efficient tool. The accuracy of the response within the system is related directly to the degree of precision in the language in which the user couches his search requirements.

One major question arises, however, – is the text file to be maintained simply by the addition of new statutes which add to an ever-increasing file, or is updating in the computer sense to be attempted as the law changes? It will readily be appreciated that unless some action is taken to update the system, it will retrieve obsolete law.

The answer to the update problem where the subject matter is precisely ordered, as in the sections of a code, is to replace sections in their entirety by conventional updating of the file, everwriting or leaving off the obsolete sections. In this way, new sections or revised sections would be added without difficulty; old sections would not be modified by removed. An updating of the vocabulary file is also necessary, however, to conform with the new situation, involving a search for words which refer to obsolete document numbers, so that these references can be withdrawn. The text of the revised section can then be input under normal procedures.

This action requires manual pre-editing of the new text, and strict systems control of the alterations to be made to the two files.

Where statutes of the English type are concerned, the position is further complicated by legislation by reference, by the dependence of the statute system upon amending Acts, i.e. where statute B is an amending Act, and contains clauses or words which are to be deleted from, substituted in, or added to, sections of an earlier statute A. While in these instances, the updating of the text of statute A on the computer text file by programming can be accomplished in theory so as to effect the required deletion, insertion or replacement, in practice severe difficulties will be experienced in effecting alterations of this kind. Again, the Concordance file must be amended because of the effect upon the significance of words in the pre-existing text and the need to vary substantially the word and sentence counts.

These problems are not trivial in view of the size and complexity which this type of legislation can assume. Consider, for example, *The Traffic Acts and Other Acts Amendment Act of 1965.* (Queensland No. 26 of 1965.).

This is an amending Act which effects a major alteration in the existing law relating to powers and duties in State Government and Local Authority spheres, in that it transfers property and assets and creates new offences. It also effects textual amendments in detail to a number of other Acts, and incorporates about 11,000 words of text.

It must, of course, be appreciated that it is not only the non-common words which must be taken into account as being significant in these operations, since removal of even one common word from the text (as in the case of "and" in the example below taken from the *Payroll Tax Assessment Act, No. 2, 1965)* (Commonwealth of Australia) can effect the positional relationship of the significant words and necessitate a recount of words in the text:

"Section 16 of the Principal Act is amended –

(a) by omitting from paragraph (e) of subsection (2A) the word "and" (last occurring); and

(b) by omitting . . ."

The amount of pre-editing required to initiate and control alterations would thus be considerable, and would demand the highest degree of efficiency to maintain the accuracy of the system.

Even where such a system is adopted, however, difficulties remain. What of statute B? Is it now to be included in the text file, thus duplicating the wording now placed in statute A, or excluded from the file? What if statute B should not only amend A, but prescribe new substantive law in addition?Are only the new law sections to be included?

Such questions as these raise matters of principle which are not trivial, either to the would-be users (since they constitute restrictions on the implementation of the system) or to computer personnel associated with it (because of the programming problems involved). They oppose an earlier view[6] that because significance is attached to words by the searcher only at the time of searching there is no necessity of updating or re-organization of the files. Preliminary analysis over a limited field suggests that short term remedies such as the removal of Statute A from the system followed by updating of its text and re-entry into the system are not likely to provide lasting solutions in view of the lack of control over the substance and format of future statutes. Ultimately, if the full-text approach to Statute Law is to be successfully applied on a long-term basis in English legal systems, there must be some interaction between Parliamentary draftsmen and those controlling the computer systems.

The Need for a Legislative Trail

It must also be recognized that it is often necessary to know not only what the law is, but also how it came to be what it is, and often, what it was at a particular point in time. There are at least two ways of meeting the rather exacting requirement to provide a legislative trail. Assuming that the problems of updating referred to earlier could be overcome, and it were decided system-wise to replace obsolete text so as to maintain the text file in a current state only, trailer records could be associated with the statute text records, recording the identity of amendments. This would again present problems of systems design and of programming, and it is not thought that a satisfactory solution has yet been devised.

A second way would be to maintain two text files in parallel, the first containing current law only, and the second the virgin text of all statutes whether repealed, amended or currently in force. Master records would be associated with the statute records on the second file, but recording a comprehensive narrative of changes. Even this, however, is insufficient since it is often a question of some concern (e.g. in cases arising under social service legislation) to know the state of an Act at a given date. This raises problems not only of text, but also of effective dates of operation of the principal Acts and amending Acts, so that a search by virtue of date may be carried out in parallel with a search on text. This problem is rendered more difficult of solution by the various ways (e.g. from date of Royal Assent; by stated effective dates; by Order in Council) in which a statute may be brought into operation, and by the fact that differing sections may be brought into operation at differing dates and in differing ways.

The Order of the Subject Matter

The order of the records held on the magnetic files is of prime importance in relation to the efficiency of searching. Harris and Kent[7] have drawn attention to this aspect and have put forward proposals for further research on search organization where magnetic tapes are used. Those which concern the sequence of records may be summarized as follows:

(a) should the most frequently cited statutes and the most frequently prescribed search words be retained at the head of the text tapes and Concordance tapes respectively?

(b) is the frequency with which searchers nominate the association of particular text words as synonyms of significance, and would the closer association of similar words on the Concordance tape lead to faster searches?

These are important considerations which are related to a magnetic tape environment. The sequence consideration would be of less significance in disc operation, but would be of great value in the design of future systems.

Two other points made by these workers to reduce the time spent on searches concern first the introduction of a relevancy factor into words used in the search whereby searchers would be informed in addition of the frequency of occurrence of a word and its incidence over statutes generally, the lowest relevancy being attributed to words which occur often in many statutes. Properly used, before initiating a search it can be argued that it would reduce search time by enabling possible irrelevancies to be discarded before approaching the computer. The second point made is the possibility of using both a condensed vocabulary list and Concordance and a full list could be considered to provide a search with FAST or FULL search procedures.

These latter points are also of interest, but it is suggested that care must be taken to avoid conditioning the choice of the searcher to any marked degree. The system as a whole is directed only towards retrieval, not association. The searcher generally must know what it is he does not know, or at least be aware of the terms in which to describe it.

Extensions of full-text retrievals outside the immediate area of statute law

Extensions of the full-text retrieval concept have occurred in USA and elsewhere, and they are of interest because of their relevance to statute law retrieval. Rhyne[8] in a survey of projects initiated or planned for making use of a computer for law research identified five projects using full-text recording as a base. Four of these are University Law School projects (Iowa, Stanford, Nebraska and South West Legal Foundation) and the other is sponsored by the American Bar Foundation. The latter project is of particular interest in that it is reported to have applied the full-text approach to over 5,000 reported cases of five Northeast states, with the specific object of enabling a comparison to be made between the efficiency of the West Key Number system, the Oklahoma "point of law" system used for case law retrieval, and a concept thesaurus approach in which a computer constructs and maintains a thesaurus based on the statistical frequency of significant words in the text. This project thus has an affinity with the LITE project[9] and its concentration on case law retrieval is significant.

Two extensions of the full-text concept by workers outside USA should be noted. Harris and Kent of Nottingham University have reported on an adaptation of Horty's system to provide a retrieval service for treaties'. The system includes an extension of the contextual operators to permit negation and to allow for test operators to be applied as conditions attaching to the current first word list. The results reported are not significant. It must be recognized, however, that although the subject-matter of the enquiry is limited, the extension of these methods into the field of public international law could be most valuable.

The work reported by Tapper of Oxford University is of greater importance, not only because of the subject-matter selected, but because of the deliberately experimental nature of the work.[10] It again follows the Horty pattern, but is applied to the field of case law.

Two differing types of case were selected for experimental purposes. One class (general law) is very wide in the nature of its subject-matter, and was chosen so as to maximize the chance of words being used ambiguously and thus resulting in the false selection of data. The second class (industrial injuries) was more restricted so as to maximize the danger of over-recall as the result of imprecision in the search terms. Furthermore, each case selected for entry into the system is recorded with recognition of its division into the standard four sections – name, short list of concepts, short abstract and main body of the text. Preliminary reports of searches have shown that "inexperienced, untrained, unassisted searchers have done as well with mechanical methods as experienced lawyers have done by conventional means".

Publication of the precise results and their statistical significance is awaited, but it is clear that this work will be an important contribution. First, the extension of the logical divisions of reported cases into the recording medium (magnetic tape) will enable comparison to be made between the efficiency of searches on head-notes, short abstracts by the reporter, and the full-text. Secondly, as regards the computer aspects, the use of training techniques in maintaining a glossary of text words could be of great practical use.

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INFORMATION STORAGE AND RETRIEVAL

*Miss J. Gorton**

How can Lawyer A give twice the service to approximately ten times the number of clients as Lawyer B, without labouring twice as hard and twice as long and supporting a proportionately larger staff than Lawyer B?

Lawyer A has a computer as close as his telephone. A brief call enables him to retrieve 95 per cent of the relevant information he needs in less than 15 minutes from the computer files which hold the indexed contents of a legal library. He retrieves his information from files which are constantly edited to reflect changes and amendments and which he can confidently expect to be accurate and up-to-date.

Lawyer B has a library in his office. In up to two days of painstaking research he retrieves less than 50 per cent of the information he needs from his books. He retrieves information as accurate and up-to-date as he keeps his library.

Would it not be more profitable for Lawyer B if he studied the concepts of the system used by Lawyer A in order to be able to emulate his success?

Indexing method concepts

A document may be indexed in one of three ways – with words extracted from the document itself, with words assigned, by an indexer, to describe the document, or with normal text.

(a) Extraction

Descriptive words for indexing a document – often referred to as keywords or descriptors – are extracted from a document by one of two methods.

By the first method, keywords are extracted statistically by machine processing of the text of the document. The text is entered into the computer, which ignores 'trivial' words such as "a", "and", "the", "but", "whereas" and "notwithstanding" and counts the remaining – significant – words. Those of the counted words that occur most frequently in the text are selected as the keywords for indexing purposes. The 'trivial words' list and 'count value' that qualifies a word as a keyword are specified to the computer, by the user, at the time the document text is processed. The count value may be any number.

Consider, for example, machine processing of part III, section 11, sub-section 6 of The *A.C.T. Workmen's Compensation Ordinance 1951-65.* Suppose that those words not underlined are trivial words – to be ignored – and those words underlined are significant words – to be counted. Suppose further

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that the statistical occurrence of a word has been specified as equal to or greater than two, i.e. that the word must have been counted at least twice in the text to be regarded as a permissible keyword. Then, in the text –

> "Where a *workman* receives *medical treatment* on account of an *injury,* his *employer* may cause an *examination* of the *workman* to be *conducted,* in *consultation* with the person who *afforded* the *treatment,* by a *legally qualified medical practitioner* selected by the *employer".*

– the computer will count sixteen significant words in the text and select as keywords "workman", "employer", "medical" and "treatment".

Qualifications of the statistical selection criteria used in the machine processing are possible. For example, if, because of the nature of the ordinance being indexed above, one wished the words "injury" and "examination" to be chosen as keywords when they appear in the text being processed (whether the generally specified statistical criteria are satisfied or not) then these words can be specified to the computer prior to indexing of the document. In such circumstances, the computer assigned keywords for the example cited will be "workman", "employer", "medical", "treatment", "injury" and "examination".

Similarly, it is possible to prevent the computer from choosing as keywords words that appear in the text as significant words and satisfy the general statistical criteria for keyword selection, if, because of the nature of the document being processed, the "stopped" words would be of little or no practical value in the indexing of the text. For example, in sections 194-249 of the *Crimes Act: 1900 of N.S.W.* (which consider malicious injury to property) the word "maliciously" which occurs frequently in the text would probably not constitute a desirable keyword for the indexing of these sections of the act, because it does not assist precise identification.

Elimination of undesirable keywords is achieved by creation of a "stop word" list, against which significant words counted in the text are compared before the keywords are chosen. While it is possible for the words that are to be "stopped" to be added to the "trivial words" list (in which case they are automatically discarded at the time the count of significant words in the text is made) creation of the stop word list is to be preferred. The purpose of the trivial word list is to specify words that are trivial – for indexing purposes – regardless of the document being processed. The addition of stop words, which, while not significant in the document being processed may be of considerable significance in other documents to be processed defeats the purpose of the trivial word list and introduces a requirement for rigidly controlled editing of the trivial word list prior to processing each document. A stop word list, however, is specified for a particular document at the time the document is being processed and is automatically destroyed when the indexing of the document is completed.

The alternative method of extracting keywords from the text of a document requires that an indexer, with a knowledge of the discipline, read the document, note significant words in the text and from these words select as keywords those which, in his judgment, best characterize the document and the contents of the document. The indexing of a document is apt to be less exhaustive, though not necessarily any more or less accurate, when the keyword extraction is performed manually rather than by machine processing of the text.

For example, sub-sections 1 and 2 of section 15 of The A.C.T. Workmen's Compensation Ordinance 1951-1965 read –

(1) "The Minister may appoint any legally qualified medical practitioners residing in or out of the Territory to be medical referees for the purpose of this Ordinance".

(2) "Where the services of a medical referee have been used as a medical practitioner in connection with any case by or on behalf of an employer or workman or by any insurer interested, he shall not act as medical referee in that case".

Where the machine indexing of this text is likely to produce at least six keywords, the indexer will probably be satisfied with extracting only the words "medical" and "referee" as keywords.

(b) Assignment

The assignment method of indexing a document requires that an indexer (necessarily extremely competent in the discipline) analyse the document and arbitrarily assign keywords that, in his judgment, effectively describe the document for indexing for retrieval purposes. Keywords assigned are chosen from a specially compiled thesaurus of index terms. Note that when this method of indexing is employed it is not necessary that the keywords assigned to a document actually occur in the text of the document they index.

For instance, section 6, Sub-section 1 of The *A.C.T. Workmen's Compensation Ordinance 1951-1965* defines various words and terms later used in other Sections of the Ordinance. Conceivably, this could be indexed under the keyword "Interpretations", though the word does not appear anywhere in the text.

(c) Normal Text

This method of document handling, which is still largely experimental, requires that some manual coding of the documents (to identify their classification and source) occur before the text is processed, but does not require that indexing keywords be extracted from the document text or assigned to the document in order that it may be indexed for retrieval. The full text of a document – both significant and trivial words – is processed and stored on the computers files from whence it is retrieved and scanned when a search query is submitted; accuracy of retrieval in this system is usually high, but speed of retrieval can, because of the volume of searching that must be done, be slowed down when full text is searched and file storage requirements are greater than for systems where indexing and text editing occur.

Projected advances in computer technology and programming will eventually eliminate these problems.

Files

Before considering the concepts of indexing as applied specifically to statute law it is necessary to define what is meant, in data processing terminology, by a file. Physically, files can be 1" wide reels of magnetic tape, each approximately 2,400 feet long, or magnetic disk packs that resemble six gramophone records stacked on a vertical central spindle and encased in a plastic cover. Logically, files (as in manual systems) are collections of organized, related facts arranged for reference and retrieval purposes; where the manual systems have filing drawers, and within these drawers identified folders that segregate and keep together related papers, the computer has magnetic tape of disc packs holding logical files, and, within these logical files, records. For example, the complete or partial text of *"The Commonwealth of Australia High Court Procedure Act 1903–1950"* stored on a magnetic tape or disk file, is a logical file and the sections of the statute so stored are records.

One logical file may occupy several physical files, or several logical files may occupy one physical file so that there are, therefore, no physical limitations as to the size of logical file that may be created and/or processed.

Basically, physical files may be searched (accessed) in one of two ways – sequentially or directly. Sequential access requires that every record in the file be searched (from the beginning of the file) until the object record is located and retrieved. Direct access, however, allows a particular record to be located and removed without the entire file being searched. A direct access file can be searched sequentially.

A wide range of storage capacities varying from approximately three million characters to four hundred million characters per physical file and access speeds are available for both sequential and direct access files. User requirements dictate the type, capacity and access speed of the physical file or files selected for any particular system.

Concepts of statute law indexing

Basically, referencing statute law occurs in one of two ways. Either one has a subject interest (such as personal liability) and without knowing the precise statute or statutes concerned attempts to retrieve all pertinent law on the subject *or* one is able to identify the precise statute or statutes applicable in a given situation (such as a workers compensation or divorce action) and attempts to locate within these the particular points relevant to the circumstances of the case in question.

To cater for these two retrieval methods, two computer files are constructed; a subject or keyword file and a statute file (with relevant ordinances, regulations and rules appended to the appropriate individual statute within the file).

The structure of the subject or keyword file (also occasionally referred to as either a dictionary file or an inverted file) is analogous to that of a subject index of the type that appears at the back of a textbook, where the subjects discussed in the book are arranged in some logical order (usually alphabetic) with the pages of the book which mention a subject listed beneath the subject heading in the index; following each of the ordered keywords, such as "injury" or "medical", that serve to identify the record (i.e. subject) with keyword file are listed references to that keyword consisting basically of (a) the statute (b) the part or chapter of the statute and (c) the section of the statute.

Thus, section 11, sub-section 6 and section 15, sub-section 2 of the *A.C.T. Workmen's Compensation Ordinance 1951-1965* which reads –

> "Where a Workman receives medical treatment on account of an injury, his employer may cause an examination of the workman to be conducted, in consultation with the person who afforded the treatment, by a legally qualified medical practitioner.

and

> "Where the services of a medical referee have been used as a medical practitioner in connection with any case by or on behalf of an employer or workman or by any insurer interested, he shall not act as medical referee in that case".

– if indexed under the keywords "medical" and "practitioner" will, conceptually, appear in the subject or keyword file –

Medical	Keyword
A.C.T. Workmen's Compensation Ordinance 1951-1965	Statute I.D.
Section 11-6	Reference
Section 15-2	Reference

Practitioner	Keyword
A.C.T. Workmen's Compensation Ordinance 1951-1965	Statute I.D.
Section 1-6	Reference
Section 15-2	Reference

The structure of the statute file places the statute title first, succeeded by part and section identification, which, in turn, is followed by a list of the keywords that index the section and a list of cases whose decisions in some way affect the law as embodied in that section. This is akin to the structure of a book catalogue card, which displays the book title at the top of the card followed by carefully arranged details that describe the size, composition and subject of the book.

Using the examples previously quoted, for instance, the statute file conceptually appears –

A.C.T. Workmen's Compensation Ordinance 1951-1965	Statute I.D.
Section 11-6	Section I.D.
Medical, Injury, Examination, Practitioner (etc.) Case-court-date; case-court-date (etc.)	Keywords Case List
Section 15-2	Section I.D.
Medical, Referee, Practitioner Case-court-date; case-court-date	Keywords Case List

The logical structure of any file (or files) in statute law indexing and retrieval depends, ultimately, upon the requirements of those interested in using the system – the jurist, the barrister, the solicitor; the file structures discussed above are intended only to illustrate one workable arrangement.

Important considerations in determining file structures are the amount of information a user requires in answer to his question, the response time, i.e. elapsed time from the time a question is submitted to the time the answer is given back, the reasonable exceptions which must be catered for, and the time that will be required to update and maintain the proposed files.

Basically, file search methods fall into two categories – inquiry and batch processing. With inquiry processing questions are dealt with, one by one, as received with each question requiring a separate search of the file; in batch processing, questions are collected, batched and submitted to the computer (as a group) at intervals of perhaps half an hour.

A conflict of interests can arise if files are voluminous and some users request the text of each reference be printed with the citation while others prefer minimum response time and are satisfied with abbreviated citations. Neither demand is unreasonable and attempts must be made to satisfy both sets of requirements.

A possible solution in this dilemma is to split and cross-reference the files, creating an abbreviated keyword or statute file that consists of keywords and citations only, and a full text file that stores the text of each statute. The smaller file is stored on a small direct access physical file from which high speed retrieval is possible; the full text file is stored on a large capacity slower direct access or sequential physical file. Users are allowed the option of specifying whether or not they require full citations.

All questions received are processed as inquiries against the abbreviated file. If only the abbreviated reference is required it is supplied immediately. If, however, the complete text is requested the appropriate cross references are retrieved from the abbreviated file and batched by the computer in its memory. The computer initiates a batch processing search against the full text file when the batch grows to an economic size. The cross-references minimize the time required for the batch processing of the large text file.

Retrieval

The basic retrieval method (whatever the structure or indexing of the files concerned) consists of selecting a request keyword (or keywords) that describes the subject interest, and so combining these into a series of Boolean expressions that the terms of the retrieval search are defined in a search expression, which is then matched against the records in the files.

Keyword selection is usually by consulting a thesaurus – which will be that compiled for the discipline if the assignment method of indexing is used, or which has been constructed by the computer when indexing and filing the text – or by logical decisions (on the part of the selector) as to the probable keywords that would have been used to index the subject of interest.

The purpose of the contextual logic used in construction of a search expression is to simulate human logical capabilities on the computer to arrive ultimately at the same result. Examples of the types of logical operators available for this purpose are:

- possibilities (OR)
- combinations (AND)
- negatives (NOT)
- positives (MUST)

The operators may be used in any combination, with or without match criteria which specify how many of the search terms in the expression must be satisfied for an answer to be acceptable.

The OR operator permits synonyms and equivalents to be searched simultaneously in a single scan of the files. For example, a search of a file for references to 'disease' might be performed with the search expression –

"Medical *OR* Diagnosis *OR* Symptoms *OR* Treatment"

– in order that all relevant references (and not only those indexed under the keyword "medical") may be located.

The *AND* operator permits specification of two or more concepts or keywords which must be satisfied before the reference may be cited in answer to the query. The search expression –

"Medical AND Treatment"

– for instance, allows citation only if the references are indexed under both the keywords "medical" and "treatment" in the files scanned.

A *NOT* operator allows construction of a search expression which instructs the computer to suppress reference citation if the reference, though it satisfies the main search criteria, is not applicable to the subject interest. Consider, for instance, the effect of the search expression –

"Medical *AND* Treatment *NOT* diagnosis".

Any reference indexed under all three of the keywords "medical", "treatment" and "diagnosis" will be discarded, while those references indexed only under "medical" and "treatment" will be cited.

The *MUST* operator permits overriding of all other logic terms in the search expression, allowing exceptions to the general rules to be handled without initiating a special file search using a second or modified expression. The expression –

"Medical *AND* Treatment *NOT* Diagnosis *MUST* Tetanus".

– for instance, will allow citing of references indexed under the keywords "medical", "treatment" *and* "diagnosis" despite the presence of the NOT operator in the expression *if* the reference indexed under these three keywords is also indexed under the keyword "tetanus"; else the NOT operator controls reference citation.

Conclusion

What now?

Currently, some thirty or so computerized legal projects are operating successfully and effectively in the United States, where computers are being used in Federal and State Government legal offices, in law courts and law schools.

At the Health Law Centre of the University of Pittsburg the Statutes of three States, the Federal Health Statutes and a percentage of the Statutes of seven other States and the Federal Government have been indexed and filed on the computer – some twelve million words of text in all. This system has been operative since 1960.

A project undertaken in New York State involves indexing and filing some twenty thousand extant state statute laws using an IBM System/360 computer to do the work. This information will become available to lawyers in the State subscribing to a searching service.

What next?

Certainly the use of computers in all fields of law will increase. The development of faster and/or larger physical files and of the new IBM Programming Language PL/1 with its flexibility and superior character handling abilities will contribute to this increase.

How quickly the use of computers as a tool develops in the legal profession depends upon the interest of lawyers generally in the development of legal resources and improved professional performance.

How can it happen here?

No single laywer, no law firm could or would want to afford a private computer. But a legal data centre in each state (or one large centre from the country) charging a fee for each information retrieval search made and also offering services in other legal areas is feasible. Three possible approaches to the operation of a legal data centre are immediately obvious –

> "The Bar Council and Law Society of a State or of the country could jointly lease a computer and set up and staff such a data centre, possibly in collaboration with a manufacturer such as IBM.
>
> "University law schools could expand their law courses to include programming and systems analysis, lease a computer and operate such a centre – subsidized by the legal profession – for the benefit of lawyers generally.
>
> "A manufacturer such as IBM could, if the demand were sufficient, be persuaded to staff and operate a legal data centre, charging for the services used.
>
> "Never before in the field of judicial conflict has a tool been available that could make so much information readily accessible to so many by the efforts of so few. . . ."

A LIBRARIAN'S POINT OF VIEW

*H. Bryan**

If there is a public image of the librarian an element of conservatism probably looms fairly large in it.

This is quite understandable and not necessarily reprehensible since, let us face it, the library does have a major concern with the preservation of the past. At the same time, however, it also exists to forward the use of this record of the past – to the benefit both of the present and the future.

Though the respective weight given to these complementary aspects of preservation and use varies inevitably as between types of libraries, it is a fair generalization that the library of today is characterized by a much greater concern with use, and certainly with usability, than was its counterpart of yesteryear. For example, the greatest single change in librarianship in my twenty years as a professional librarian, I would suspect, is the dramatically increased interest of university libraries in their patrons.

To the extent that an institution is preoccupied with the record of the past and more especially to the extent it itself has a long history, there is an understandable tendency to rely on existing procedures, particularly when they are the result of continuous development, rest on a detailed and documented formulation of theory and recorded practice, and can be demonstrated to have impressive achievements to their credit.

On this basis alone it would be explicable if librarians were somewhat cautious in their approach to apparently revolutionary changes involved in the application of computer technology.

A further element in any wariness on their part, however, could well be their appreciation of the extent to which the resources of money and staff provided to operate their conventional systems chronically fall short of those needed to provide the service which their patrons need.

But are they unduly wary? What has been or what is the reaction of the librarian to the machine? Does he see it as a menace to his livelihood or a threat to his ideals or does he welcome it with enthusiasm as the solution to his problems of understaffing and the long-sought release of his professionalism from the burden of routine?

The short answer is probably that as a type he sits fairly clearly between these extremes today. However, since most of the noise on the subject is made, naturally enough, by the "progressives", there does seem to be a fairly well established feeling, at least among non-librarians, that he has been rather loth to come to the party.

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In the course of this short paper I want to examine briefly whether librarians have been unreasonably slow to automate their libraries. I propose to do this by illustrating some general statements from our own experience in the University of Sydney Library.

It is certainly true that with the mushrooming application of automation, and especially the application of computers, to an increasing number of areas of modern life, there is an understandable interest in the possibility of similar applications in the field of library practice.

This interest is the more stimulated by a growing realization of the extent to which human progress is dependent on access to information, and of the fact that libraries still comprise easily the largest single source of such information. It is freely admitted that difficulty is experienced in retrieving information from libraries. It is further admitted that this difficulty arises in part from deficiencies in the techniques of processing the information concerned and in part from the sheer inability of libraries to cope with the mass availability of unprocessed information.

Indeed, the commonest assumption on which rests most of a considerable amount of suggestion that the library should automate at an increasing rate is that, in its conventional form, the library cannot cope and cannot ever hope to cope with what is dramatically described as the information explosion.

It is true that the storage and service functions of the library have a major concern with information. This happens not, however, to be their only concern. It is also true that the rate of production of information has increased at a rate that could be described as explosive in the last generation. As some indication of the need to approach our subject carefully, however, it turns out that no accurate measurement has ever been made, as far as I can discover, of the actual annual increase in worthwhile information. A recent study[1] suggests, as a start, however, that the rate of increase of worthwhile published information, whether in monograph or serial form, since World War II may not have exceeded 4 per cent per annum.

Since such a rate of increase in work-load is by no means beyond the resources of any vigorous library, it begins to look as if the information explosion itself could hardly be regarded as a reason for adopting new information processing technologies, provided that, at some time in the past, libraries were in fact sufficiently well supported to give an adequate service.

Librarians are the last to claim that they do provide an adequate service. Interestingly enough their standards in this regard are almost certainly higher than those of their patrons. The point remains, however, that at least in general terms, we have yet to establish that automation is the only or necessarily the best way of achieving improvements we desire. We might try, for example, increasing the library's capacity to render conventionally-based services.

But this is a digression. I think, in fact, that it is possible to discern three levels of sophistication of interest in library automation. There is first, let us face it, a frequently expressed feeling that any change whatever in existing library organization and service can only be a change for the better. More importantly there is a second level of interest which, observing the high incidence of repetitive routine operations in library work, concludes that there must be at least some areas of it that are particularly amenable to computerization.

A third approach develops from the second. This constitutes a conviction that the computer should not only be able to do better or quicker or cheaper (perhaps even all of those at once) what a librarian does now and thus allow him to do more of the same, as it were, but that it should also be able to open new horizons of service, both of itself and through releasing human information processors for other duties.

Let us discard the first, the "any change must be a good change" approach, though perhaps noting as we do so that, while any service institution such as a library must accept and indeed welcome criticism as a stimulus to improved service, it can confidently expect that an overwhelming majority of this criticism will be purely destructive.

Consider now the second and third approaches. The second has resulted in a considerable amount of theorizing and some practical application (some of it very successful) of computers and less sophisticated machines to areas of data processing within libraries. The third approach, which has tended to concentrate on information retrieval, has been characterized, much more than the second, by emotional overtones and woolly thinking and has had considerably less demonstrated success on any real scale of operation. This is not to say, I hasten to add, that it is not where the future lies.

There turn out to be two schools of thought in relation to actual library automation. The first, which corresponds roughly with the third level of interest we have discussed, attaches great importance to the systems approach, and envisages a complete transformation of the conventional library. I have called this elsewhere "boots and all" automation.[2] Perhaps the most detailed theoretical development of a proposal to apply such a transformation – indeed transubstantiation would be an allowable term in the circumstances – to an existing library is still the Library of Congress automation survey.[3] Perhaps the clearest expression of what is felt to be a need not to be constrained either by present library organization or by the existing conventional containerization of information in books and other book-like forms is still to be found in J.C.R. Licklider's book, *Libraries of the Future.*[4]

The second school of thought, which has obvious correlations with the second level of interest we have noted, has been called frequently the "foot-wetting" school. It favours the "piecemeal" approach. This school lays great emphasis on the immediate benefits to be gained by mechanizing one or other of a library's operations involving the mass manipulation of data. The advocates of this school say that the completely automated library is still fantastically in the future because of cost considerations, but that there is no point in doing nothing in the meantime, providing there is an actual demonstrable gain to be made from the particular piece of the "piecemeal" operation a particular library elects to undertake. Moreover, the experience of this "foot-wetting", it suggests, will create both technical capacity and the receptivity that personal acquaintance brings, thus rendering the more likely and the more soon a workable plan for "boots and all" automation.

It is fair to say that advocates of the "foot-wetting" school also often argue a proposition that, with careful planning, systems set up successively to cover separate sections of a library's operations may still be integrated either ultimately or as the situation develops progressively – a kind of "creeping" mechanization, as it were.

It is against this background of variant levels of approach and theories for action, that we come now to the actual and projected application of automation to the University of Sydney Library.

It is necessary to make it clear from the start that, to date at least, we have favoured the "foot-wetting" school, though it could well be argued that about all we have done so far is dampen slightly one little toe nail. I propose, at a later stage, to attempt to justify or at least explain what you may wish to describe either as commendable caution or inexcusable procrastination, depending on which approach to library automation vou favour. Meanwhile, however, let us examine our particular "foot-wetting".

In January, 1963, the University Library moved its main collections, its central service point and its administrative and processing headquarters into the just-completed first stage of the new Fisher Library.

As had been confidently prognosticated, there was an immediate and rapidly swelling increase in reader patronage and service demand. Since the move had not been accompanied by any substantial increase in reader service staff, a situation of crisis rapidly developed in this area. The major difficulty was simple lack of manpower to reshelve the greatly increased number of books used. For example, I calculated that by the beginning of Michaelmas Term only 50 per cent of the undergraduate library stock was effectively usable at any one time, the remaining 50 per cent was in process of being re-shelved or, more accurately, was awaiting re-shelving. Second only to this crisis was the near-breakdown of the main control record of reader service operations, the loan file, again as a result of very substantial increase in work load. Not only did the record fall increasingly behind the operation, but the incidence of human error rose under pressure of work. Both patrons and staff lost confidence in an instrument which failed so noticeably to report the situation correctly. With the need for urgent remedial action apparent, a replacement system was sought which would meet the following criteria:

(a) it should eliminate the failures of the existing system, namely delay and human error;

(b) it should be able to be installed at very short notice;

(c) it should be operable with the existing book records, that is to say, in particular it should accept the absence both of any specific book cards and of any individual book numbers which could be used as "shorthand" book identifications;

(d) it should retain the basic feature of shelf list order filing (in order to reveal immediately the location of any item on loan) but should allow the introduction of up to date pursuit of overdue loans;

(e) finally, and most importantly, it should require no additional staff to handle not only the existing 1963 loan load, but at least an increase in 1964 of the same order of that which had taken place in 1963.

These criteria effectively ruled out *de novo* design and narrowed our search to systems proven in application to work situations comparable with our own. A computer-based system seemed inapplicable to our situation, both because of the lack of time for system design and because such systems as we had heard of would have required the pre-generation of machine readable book cards and machine readable borrowers cards. It was obvious, nevertheless, that only some kind of machine could meet our needs.

A system designed by IBM for Brooklyn College, N.Y. seemed nearest to meeting our requirement and with the active cooperation of the local representatives of IBM this was modified to suit our particular needs and put into operation in March, 1964. Although, I repeat, the computer plays no part in this system, I think it is still worth describing in a little detail.[5]

The total equipment installed was one 026 punch, one 082 sorter and one 077 collator. In addition, two pre-punched decks of numbered transaction cards were required. Each deck comprised sequences 1-1500 for each day of the year. The two decks related to the separate loan files maintained for the Research Library and the Undergraduate Library respectively.

The system depends on self-charging. The borrower writes both book and borrower identification on an 80 column card, the charge card, of which only the last columns (58-80) are numbered for punching. He presents book, charge card and personal identification (in the case of a student this comprises his authority to attend classes) at the charging desk. The library assistant checks the signature on the charge card with that on the identification, and verifies the book details written out by the borrower. He selects the lowest numbered card from the appropriate transaction card deck and inserts this in a pocket at the back of the book. Using a combined number and date stamp he stamps the date due for return and the appropriate transaction number both on the charge card, which he retains, and on a date due slip pasted in the book, opposite the book pocket. As the borrower leaves the building a guard checks the number/date stamp in the book with the transaction card in the book pocket. He also, of course, checks whether inadvertently the borrower is in possession of other items of the Library's property.

Charge cards then have the transaction number, date due, a number of digits of the book's call number and a borrower status code punched into them and are merged in the loan file.

When a book is returned from loan the transaction card is withdrawn from it. If the book is overdue (as shown by the date on the date slip) the appropriate fine is collected on the spot. The transaction card is filed, pending machine clearance of the loan file.

At appropriate intervals the loan file is cleared by machine collating with it the returned transaction cards and extracting the charge cards to which they refer. Any charge cards for books due for return by that date, for which transaction cards are not to hand, indicate overdue loans. A xerox copy is made of each such charge card and this, stapled to an overdue notice, is mailed in a window envelope to the recalcitrant borrower.

The new loan system was an immediate success. In terms of operating costs it was actually no more than comparable in 1964, with what we had estimated that the cost of operating our manual system efficiently would have been, since the cost of machine hire no more than balanced the cost of the extra staff that would have been required for the manual system. Subsequently, however, the economic argument has been all on the side of the machine. The machine room staff of two remained unaltered from 1964 to 1967, whereas the loans handled by the system per year rose from 123,510 in 1964 to 359,565 in 1967.

With experience, a number of sophistications have been introduced into this basically simple system. First the separate daily sequences of transaction cards have been replaced by a single numerical sequence in each of the two file decks, since we have found that we can shorten the sorting time in this way. Second, more and more punch columns have been activated on the charge card to allow the file to be searched under other elements. It is now possible not only to distinguish broad categories of borrower but to machine search the borrowing of individual members of staff. With a similar end in view, a system of individual student numbers is being brought in in association with records maintained by the University Administration. The loan file also distinguishes between books and periodicals and accommodates charge cards for other material which is off the shelf for some reason other than loan; for example books at the bindery or in the closed reserve collection. The most recent refinements are the recording of material reserved by another borrower while on loan and the computer printing of short title lists of material in the Closed Reserve Collection. In order to minimize the manual labour of self-charging, addressograph-type embossed plates have been issued to academic staff borrowers.

There have been two interesting by-products of the system. First, retention of charge cards for returned loans has enabled their later searching under various heads to constitute what has been in effect the first ever survey of borrowing habits in this Library system and probably the first such survey of any significance undertaken in an Australian University Library. The survey has formed the basis of successful work for one candidate for a post-graduate Diploma in Librarianship. Three articles have been published by him on various aspects of it.[6]

Second, mechanizing the loan file has made it possible for the first time for many years to effect an annual clearance of academic staff loans. With the absence of any effective ultimate sanction for academic staff in the matter of library discipline, loans to them tend to drag on months beyond the date due for return. This has a double disadvantage. On the one hand it denies use of books to others, in many cases long after they are actually needed by the original borrower. On the other, the original borrower frequently genuinely forgets his borrowing and is disposed to argue with the record. A borrowing system with too many possibilities for human error places the Librarian at a hopeless disadvantage etc.

Our mechanized system has been modified in recent years to enable an annual print-out, (on an IBM 421 Accounting machine) itemised by borrower and made from the actual charge cards of all loans to academic staff. With this solid evidence the Library has been able to refuse to renew borrowing privileges for the new year until all outstanding loans from the previous year have been accounted for, if necessary by the borrower meeting the replacement costs of items unable to be discovered.

Experience with this admittedly primitive form of non-computer operation has emphasized two points which are of particular pertinence in considering any further, and perhaps more sophisticated, ventures in this direction.

First, the great single advantage of our former manual loan system was that the file was virtually completely up-dated at any one time, or at least, to be more accurate, that all the information in it or awaiting insertion in it was immediately consultable. One could say, I suppose, that it was "on line". Conversely, the greatest single disadvantage of its mechanical successor is the extent to which the file is inaccessible. With an average standing file of the order of 20,000 cards the sorting and collating processes render the file unavailable for manual consultation up to two days out of every week. This, I might say, is apart from mechanical breakdowns which are frequent enough to cause aggravation.

Second, and flowing from the first, any possibility of this kind of interruption to accessibility makes it even more essential that any circulation system which the Library installs must run no risk of dependence on some outside agency.

By and large the file inactivation difficulty is the Library's only serious criticism of the existing system. It is clear, however that, as far as the Library's customers are concerned, there would be virtue in a more sophisticated system which eliminated the need for them to write charge cards for each item borrowed. There is also a limit, now clearly in sight, to the size of the files that can be handled expeditiously enough by unit record equipment.

Such computer-based systems are in operation overseas and one has been reported in Australia. The IBM 357 and other data collection system operate on the twin bases of a machine-readable borrower's card and a machine-readable book card, the latter located permanently in the book. A borrowing is recorded by inserting both cards simultaneously into a remote-access computer terminal and so automatically updating the loan file. In the overseas versions of the operation, the actual record of borrowings is most frequently provided off-line as a daily print out, normally listing, for each transaction, only brief details of borrower's identity number and book identification number.

Let us look at some of the difficulties that would be posed by our Library moving into this area. In the first place, there happens to be great reluctance in the University towards the adoption of a student identification of the type involved. In the second place there is the difficulty of providing machine-readable book cards, a difficulty enhanced, in our case, by the lack of unique book numbers for the huge majority of the stock.

More importantly, perhaps, an off-line output of the kind described has some serious disabilities. If one can imagine it applied to a standing borrowing file of the size of Fisher's, the process of reference to second-line files for final identification of borrower or book (involved in the abbreviated print-out) is too cumbersome seriously to envisage.

For these reasons, we have not assigned the computerisation of the loan file an urgent priority. Recently, however, we have become interested in the feasibility of an on-line version of the data-collection system and, in cooperation with the Basser Computing Department, have sought the equipment to set up a pilot study in one of our Branch libraries.

Our second venture into mechanization to date, and in this the computer has played some part, if only still at a reasonably unsophisticated level, has been the production of a book form catalogue for portion of the Library's holdings.[8]

The Library has had more or less continually under review for at least six years the possibility of providing a more accessible form of catalogue. At present the main record of its holdings is the divided dictionary catalogue on cards housed in Fisher. This is now a fairly large file and it has become increasingly apparent that the combination of greatly increased reader use and a steady rise in library staff work at the catalogue has been causing inconvenience and hence inefficiency. Customer use of the catalogue will probably be readily appreciated, but it may be worthwhile illustrating the degree of library staff involved.

Each year upwards of 30,000 separate order requisitions are lodged with the Library for material recommended for addition to the collections. At some stage or another every requisition must be checked against the catalogue, as the record of material already held. The requisitions must clearly also be checked against the record of items ordered but not yet received. To save time in the ordering process this record is combined with the catalogue, but clearly this involves filing in the catalogue a copy of each final order issued by the Library so that the number of item visits made by Library staff to the catalogue is thus of the order of 60,000 per annum up to this point in the processing pattern.

For a variety of reasons, that it would be tedious to pursue here, it proves necessary to visit the catalogue again in very many cases once a particular item is received and is ready to be catalogued, (for example many items arrive by way of gift or standing order). This amounts to at least 30,000 further item visits. Once the book has been catalogued there is the final problem of filing the actual cards produced. Since for each title there is an average of three cards filed in the author/title catalogue complex we have a further 90,000 item visits. This gives a grand total of some 180,000 such visits per year. To these we must add the regular reference made to the catalogue by the processing staff and more especially by the reference staff in association with enquiries concerning particular items and subjects.

All this produces problems of crowding and queuing. An obvious answer is to provide a catalogue in many copies that can be distributed over the Library.

Three considerations had inhibited us from applying this kind of process to our entire catalogue. First, the cost of producing in some king of book form the catalogue to one million volumes was beyond our means. Second, such a product would require a considerable expenditure of time on editing entries. This staff time was almost certainly not available in Sydney at present even if we had the funds to buy it. Third, the problem of maintaining such a catalogue up-to-date would be a very real factor with a collection growing at the rate of 90,000 volumes per year.

However, if an overall project was out of the question the same considerations might not apply to discrete portions of it. In particular we had been concerned for some time about the degree to which the catalogue appeared to be monopolized by patrons with extremely unsophisticated enquiries. 90 per cent of the users of Fisher are undergraduates and at least the same percentage of enquiries made of the catalogue are limited to simple document retrieval, that is to say discovering the location on the shelves of a particular title to which the enquirer concerned has been specifically referred.

It seemed to us that if these enquirers could be diverted from the main catalogue, pressure in that area would be considerably reduced and, at the same time, less hindrance and frustration would be offered to those with much more complicated enquiries which only the full catalogue could satisfy.

The answer has been the printed Catalogue of the Undergraduate Library, an author list of the special collection of some 80,000 volumes designed to cover most of the day to day requirements of undergraduates. This catalogue appeared in preliminary form for Michaelmas Term 1966. The first substantive edition came out in April, 1967. The second appeared in March, 1968 and future editions are scheduled on a bi-annual basis.

Bearing in mind the strictly limited purpose for which it was designed and with as clearly in mind other criteria of cost and staff similar to those required of our new circulation scheme, the Undergraduate Library Catalogue is very much a utilitarian product. Input is produced on the Library's key punch and is rigorously limited to call number, author and title, edition if other than the first and the last two digits of date of publication if in the 20th century. In every possible case titles are abbreviated to fit a title-a-line pattern.

The catalogue is computer-printed on masters for offset duplication. Both the programming and the actual printing run have been purchased, up to the present, from a commercial D.P. operator.

As a matter of some interest (and perhaps to prove a point) the letterpress title page and preface to the preliminary edition were set by Library staff and printed by hand at the Piscator Press, which is a private press operated in and by the Library.

From our observation this second essay into mechanization has achieved satisfactorily its limited purpose. Certainly the fifty working copies printed of each edition are worn out with use (and naturally at least some abuse) by the time the next appears. Congestion at the main catalogue though still severe has remained tolerable. I know of no way in which we could have met this problem other than by the use of A.D.P.

In keeping with the pragmatic approach which has characterized our other ventures, we are determined to automate or, more strictly, mechanize as soon as possible another area in which the pressure of repetitive mass manual operations continually threatens our service to readers and which has been demonstrated elsewhere to respond to machine applications.

Easily the largest routine data-handling operation in the Library after the circulation system is that involved in recording the receipt and later processing of individual parts of serials. At the present time the Library receives regularly more than 20,000 serial titles. We have no accurate figure of the number of parts involved but, allowing for the probable relative incidence of annuals, quarterlies, monthlies, dailies and irregularly issued titles, there are probably well in excess of 150,000 items checked into the Library in this area in any one year. Moreover, since 1963 the total has doubled and even during the present period of budget restriction the Library can expect to add from 500-1,000 new titles per year. That is to say, each year the total number of parts handled will rise by up to 7,000.

In these circumstances of rapid growth it is only by desperate effort and the continued diversion of staff to the serials area that the task of simply recording the intake can be controlled. What is virtually out of our control is the pursuit of items delivered late or not at all. We thus have a situation very like that which confronted us in the circulation area five years ago.

We know, and I have indeed had the pleasure of investigating this personally overseas, that computer programmes have been successfully devised to control our situation. Systems are in operation today whereby a computer generates in advance a punched card for each serial part that can confidently be expected to arrive within a particular period. Check-in of parts is thus reduced to matching them as they arrive with the appropriate cards and feeding the cards back in to up-date the master file of holdings. The balance of unmatched cards at the end of a period constitutes overdue deliveries which should be pursued. Supplementary programmes advise the Library automatically when a volume is complete for binding and provide regular print-outs of complete or selected holdings.

Only two small problems stand in the way of our moving enthusiastically into such an operation. In the first place, although we have access to detailed programmes from overseas we have been unable so far to find the staff time to assist in the conversion or re-writing of these for our own use nor has time, understandably, been available at either of the computer installations of this campus.

Second, we have the bogey of file conversion. It would be difficult enough if this were a mere punching into machine-readable form of the 20,000 or so title records, with all their detail of existing holdings. Unfortunately, and understandably, in view of the circumstances under which the manual file is created, it will be necessary to perform a double operation, first re-writing our existing records in a standard edited format and then punching these for machine input. To date all we have achieved is to write our own version of the work manual employed in the best overseas demonstration of this kind of project and to design what (subject to scrutiny by a systems analyst) might be our Intermediate Serial Record.

The reason for our slow progress is worth enlarging on in some detail. Basically the point at which we were stuck was that it was clear that somehow we had to find a new member of staff to whom we could entrust the detailed working out, with whichever computer installation seemed the more appropriate, of our project. It has taken us just four years to do this.

Very soon after my appointment in March, 1963, Professor Bennett and I got together on the general question of matching his Department's facilities for technical advice and actual operation with our, as yet ill-defined, needs. At this stage we were both quite sanguine, I think, that I could find an existing member of staff with interest and aptitude for systems work and somehow release him from all other duties. The foolish hope died with the flood of avid readers in to the new Fisher Library and the increased flow of material into the Library both of which more than occupied every available member of staff.

Our next bright idea was to approach the University Research Committee for funds to employ an officer to investigate and develop systems for automating library processes. Briefly the Committee's answer was that our project, while highly commendable, was not research but administrative development and as such must be handled by ordinary staff. If extra staff were required they should be sought as part of the annual appeal which Departments traditionally direct to the Vice-Chancellor towards the close of each year – or did so until Senator Gorton, as he then was, greatly simplified the Vice-Chancellor's problem for him!

Equally briefly, since that date I have sought such extra staff each year and each year I have been forced to admit that they must yield priority to much less interesting needs like more pairs of hands to re-shelve books.

Up to a few months ago I still could not foresee any feasible staff increase which I should not direct to areas other than automation, particularly when for three years all staff increases had been granted on the strict understanding that they were required only to maintain existing systems and not to undertake new developments.

We have now broken this deadlock by actually forcing ourselves to sacrifice another senior position in favour of a full-time Systems Librarian. That this is a real sacrifice is indicated by the fact that it had to be made by the long-suffering Cataloguing Department, which, of all the Departments of the Library, is most feeling the pinch of the slow down in staff increases.

Already, however, our hardly-made decision is paying off. We are well advanced towards our own programmes for a more sophisticated Undergraduate Library Catalogue in separate sequences by author and class number and for a union-catalogue of serial holdings in our Branch and Department libraries.

Meantime we had not been standing absolutely still. Our senior staff had been exposed occasionally to at least the fundamentals of computer operation, by attendance at various courses and I have had the privilege of a visit to the United States on a Carnegie Fellowship specifically to look at library automation. At least some evidence of our growing interest and, at least in some sense, competence, is seen in a number of modest publications in this area.

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We do have plans already beyond our serial project. In particular I see no real difficulty in proceeding to computerize our whole book acquisition area once we can build up our programming strength. Again this kind of proposition has been worked out satisfactorily overseas. I would feel reasonably confident that the size of our operation would render computerization economically acceptable. The benefits which we could expect to enjoy would be, once again, not unlike those effected by our circulation system – up to date information, elimination of manual filing and reduction of human error.

What we have in mind is the creation of a basic machine-readable record at the point of ordering. This would enable a regular print out of all items on order. By dint of successive updatings as items were received and passed through the various processes, such a Processing Information List could further indicate regularly the particular stages items had reached on their path to the shelves. This kind of proposition could also embrace budgetary and other accounting records.

And there, as we see it at present, we really might stop, at least for the time being. If our present automation plans were fully carried out we would be brought to the point where a book had arrived, was about to be catalogued and shelved and the catalogue entries filed. Why, you may ask, do we not anticipate, at least at this stage, automating any further processes? Why do we seem so reluctant to proceed to paddle in the enticing shallows that border the ocean of information retrieval?

A number of schemes have been devised, of various degrees of practicality, whereby the computer is programmed to produce the actual physical catalogue entry. Two points need to be made about these propositions. First, except at some considerable expense, the final product does not allow the degree of variation in type presentation to which library users are accustomed and which could be held to have a real function in assisting legibility and emphasizing the form of the entry. This deficiency has been the cause of an enormous amount of discussion and disquiet.

The second point, however, is much more important. It is that the computer adds absolutely nothing to the retrievability of the information concerning the book which the cataloguer is attempting to record. In such applications indeed, the computer is being employed as no more than a high speed printing and (in some cases) card producing machine with a facility for alphabetically arranging entries. It cannot in some magical way improve the actual index entries which determine ultimate retrievability, but simply reproduces the entries compiled or copied by the human indexer, the cataloguer.

The computer-controlled printing press does, however, achieve two advantages. First, in putting the copy to the computer does certainly enable later manipulation, for example presentation in another order or under other elements of the entry. Second, assuming a book-form rather than a card-form catalogue, there really is an enormous attraction in the thought of being rid for ever of the irksome and error-ridden labour of manual card filing.

Unfortunately there is a money price to pay for these advantages. The very considerable publication costs of regularly updated computer-produced book catalogues have been calculated, in general terms, as being twice those of producing and maintaining card catalogues of the same content.

Now it is clearly possible for the computer to do other than simply mimic at double the cost the manual processes of catalogue production. Cataloguing information clearly can be stored in the computer memory and only retrieved on demand by a programmed search. This, for example, is the core of the present Library of Congress Automation proposals.

Unfortunately again this turns out to be a very expensive proposition. The requirement of instant access precludes the possibility of anything less than expensive "on line" operation in this case of a public catalogue and the cost element is further emphasized in the provision of equipment for file interrogation. I am told that remote access consoles, allowing a considerable degree of dialogue sophistication, may market now at a price comparable with commercial TV receivers, but I consider the possible 3,000 readers at one time in the Fisher Library at present and I wonder how many such channels to a computer catalogue should be provided. Some measure may be given by comparing the 2,700 odd seats in Fisher with about one eighth the number in the Library of Congress and noting that the calculations for the Congress proposals involve only 163 consoles of which 108 were to be available for public use.

This criticism of computerized catalogues has, of course, greatly over simplified the problem. We noted earlier that the vast majority of Fisher Library users have basically uncomplicated problems of library use. I would imagine that for them there is a long future ahead for conventional library treatment, facilitated as it is increasingly by extensive use of reader-operated text-copying devices. But even if we restrict our attention to the genuinely sophisticated interrogator of catalogues, what do we find? In the conventional card catalogue he has at present a random access device in virtually complete display. This is no mean tool. The main limitations on its effectiveness seem to be three in number. Let us consider these in relation to possible improvements under a computerized system. First we have the problem of physical access noted earlier, but even under a computer system this might be paralleled by the problem of queuing to use a console. Second, there is the incidence of human error both in creating the file entries and in filing them. The computer can guarantee to eliminate filing errors and this would be a major contribution, though the cost of it must be set off against that of more effective human checking. However there is little the computer can do about human errors in creating entries. Finally, the effectiveness of the catalogue is limited by the number and design of the headings or descriptors used for particular items of information. The computer can certainly allow access to the file by categories impossible to manual search. For example, as we have seen, proper tagging will enable information of a particular date or from a particular place to be retrieved either absolutely or as a sub-let to some main descriptor. But the computer, again as we have seen, can itself add nothing to the specific filing headings actually determined by the human indexer at the point of cataloguing.

This is the last and perhaps the major point that I would like to discuss about the computer and the catalogue or indeed about information retrieval in general. Let us confine our attention to subject cataloguing, that is the assignment of words or phrases to a book to describe its subject content as a key to later retrieval of the information it contains. Librarianship has behind it at least a hundred years of pretty intensive work on the theory and practice of subject headings. All this experience has resulted in fairly complete agreement that the most accurate indicator of subject content is an assigned heading which does not necessarily correspond with any of the words of the text which it is used to describe. All kinds of other propositions have been tried. For example, the use of key-words extracted from the titles of publications was greatly in vogue about a century ago and the last forty years or more have been great experimentation with such variants as the co-ordinate indexing of basic elements rather than the construction of accurate teams to describe specific complicated concepts.

Difficulties have been found with all these suggestions. The basic problem has always been that, in the end, to avoid inconsistency there has to be imposed a fairly rigid vocabulary control. In the case of genuine subject headings the constraint this brings is at least mitigated by building into any record which uses the term of the vocabulary, an elaborate system of references from rejected to preferred synonyms, between related terms and from the more generaly term to the more specific.

All this means is that subject indexing is perforce a slow and careful task. It is so slow and requires so much thought that while, ideally, each item should be treated absolutely on its merits and each indexer should build its own thesaurus and syndetic framework, there has never been enough money in libraries for this kind of operation and so the unavoidable compromise is made of using published lists of terms, with all their inevitability of immediate obsolescence.

In order to try and avoid this bottleneck two approaches have been made by the proponents of the computer. The first is quite simply recapitulatory. The Keyword in Context Indexes, for example, reflects the indexing of Crestadoro (vintage 1860). Do not misunderstand me. The KWIC method may turn out to be quite satisfactory, at any rate in some subject fields. It may be that librarians have been in error in mistrusting the accuracy with which an author's title reflects his subject – though it would be very easy to produce some nice ridiculous examples. A series of post–KWIC developments record the painstaking rediscovery of the kind of truths about subject indexing mentioned earlier.

A second and most important approach is an attempt to develop direct machine recognition of the subject content, or text, thus replacing the actual intellectual activity of the indexer. I do not think this development has reached a credible stage as yet.

However, even if it is accepted that the computerized catalogue is restricted to human indexing it has been suggested at the same time that it can allow greater depth of indexing. This proposition works on the basis that cataloguers are reluctant to assign more than the minimum number of subject headings for fear of physically bulking the manual catalogue and so reducing its attractiveness to the reader. Since, it is said, the latter consideration does not apply to the computer file, the indexer in a computerized scheme can multiply the number of terms employed.

There seem to be two reasonable comments to make on this point. The first is that if the subject content of a document can be described accurately by a single specific descriptor then any further descriptors are redundant. The question of breaking the document up and describing portions of it with different descriptors is a different matter altogether and leads to the second comment. This is simply that genuine assignment of extra headings either of the whole or an analytical basis requires a proportionate increase in staff time. Given access to funds for this purpose there is no reason why it could not be applied to the conventional situation. The question of bulking still remains and I accept the value of a computer-enabled catalogue which would enable an enquirer to make a preliminary sifting of a mass of entries under a particular?

I think I should apologize for this lengthy account of cataloguing and its relation to information retrieval; particularly since, however boringly extended it is still all too superficial. Appearances to the contrary, I am not an hysterical and intrasigent defender of the existing order of things, but I am perturbed lest we thoughtlessly destroy the work of our most experienced information scientists before we are quite certain that we can handle in some other way the problems with which they have been involved for a very considerable period.

I propose not to consider in any detail in this paper the ultimate possibility that the computer raises of actually lodging in machine store not only the index entries of the document indicators but the actual text content itself. And yet clearly the possibility is there and equally clearly, in the predominantly data-bank literatures, chemistry for example, the possibility is coming rapidly close to reality as real computer costs drop and actual computer speeds rise.

It is important not to forget in this connection that a library exists to record and to transmit not only information but to provide genuine recreation and inspiration as well. The literary form and detailed presentation of at least some of its stock in hand pose difficulties for the most dedicated "boots and all" automater which may well prove insoluble in any practical sense.

Finally, all working librarians and most heavy library users deplore any thought that browsing should disappear completely. Serendipity as well as providing insurance, however crude, against the fallibility of human indexing is also a necessary complement to the congenital inability, or at any rate the stubborn refusal, of many seekers after information to define or even to be aware of, the specific subject of their inquiry.

Whether this paper has provided any kind of answer to the question which it sought to pursue seems up to the reader to decide.

For what it is worth, the author's view is that, in all the circumstances of the inadequate staffing of most libraries and the heavy service demands on many, progress has been probably as rapid as it could and should have been. Certainly there is plenty of evidence (not only in the library field) that the efficiency of any automated effort is directly proportional to the care and skill devoted to its preliminary planning. There is disastrous evidence that where this care and skill is not available, or can not be spared, then no automation is infinitely preferable to any automation.

I am one who firmly believes that science will overcome the difficulties which I see at present in the way of rapid movement towards better information retrieval through automation. At the same time, however, I am responsible for maintaining, as a going concern, a very large service organization working under considerable pressure. I cannot afford to risk the premature espousal of any substitute for our present operations.

If I am forced to a personal prognostication I think I still see a long, though perhaps limited, future for that very personal, portable and practical artifact, the conventional book, and I think it likely that conventional books will still be well served in the future by conventional libraries. I am by no means appalled, however, by the thought that the book as a vehicle of information may be superseded, nor by the fact that this superseding will result in information retrieval organizations which will bear perhaps little reference to libraries as we know them. I will enthusiastically support such developments once I am certain they have reached the point where they genuinely do have something to offer which cannot be achieved as cheaply, as quickly, or indeed at all by conventional means.

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LEGAL EDUCATION METHODS

*M. J. Gallagher**

It has been claimed that the electronic computer has been the most significant technological development for lawyers since the Gutenberg movable type press. However, as with all new technological developments, users have to acquire a thorough understanding of the technology before it will be of maximum benefit to them. Education undoubtedly has a key role to play in the introduction of new techniques.

The computer has had a fast-increasing acceptance in the commercial and scientific areas in the last ten years. As the legal profession is now embarking on the use of computers it is appropriate to look at the results achieved by other computer users to see if their experiences would be of benefit to the legal profession.

Many surveys have been conducted in recent years to ascertain those factors which make a computer installation successful, and, not surprisingly, adequate education has invariably proved to have been a very significant factor. Such a survey has recently been undertaken in Australia.

As the use of computers in industry and commerce increases, those lawyers who deal with legal argument in the private and public sectors will have to become intimately familiar with the concepts, functions, mechanisms and capabilities of computers. Similarly, those legal personnel who implement the use of computers in legal areas will have to be acutely aware of the functions and possible use of computers.

How can the legal profession meet this challenge? Three possibilities immediately spring to mind:

1. Have lawyers and computer systems engineers work together to educate each other.

2. Have computer-trained people study law.

3. Have legal-trained people study computers.

Neither of the first two propositions seems viable as a long-range solution, although the first solution is now being effected at present.

The lawyer is the person who is ultimately responsible for the presentation of his argument in court. In much the same fashion, the whole of the legal profession is responsible for the implementation of computers as a legal tool to be used by its members. It seems reasonable to assume that within the next few years, each member of the legal profession will have an understanding of the computer and its uses.

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Computer Training for Law Students

In the future many law students coming to law school will have learnt about and may even have used computers at school. However, a course in basic computer fundamentals would still seem necessary for all law student^.

Undergraduate and post-graduate courses in computers and computer techniques are now being taught at most Australian universities by computer professionals, but it is desirable that the bulk of any course given to law students should be taught by computer-trained lawyers. This course should be supplemented by legal-oriented topics such as:

1. Computers and the law of evidence.

2. Commercial applications of computers.

It is interesting to note that the powerful arithmetic capability of computers has allowed scientists to undertake research that previously daunted them because of the immense amount of calculation involved. Some research has been done in this area, for example, computers have been used to simulate the outcome of cases. To prepare students for this eventuality, courses in mathematical techniques, such as Simulation and Statistics, could be given, preferably at the post-graduate level.

Computers as an aid in Teaching Law

One of the biggest problems that law teachers have today is persuading law students to go through the tedious process of researching case histories to find a precedent for a hypothetical problem. Theoretically at least, this problem can be solved by allowing students access to a computer with a complete or selected set of indexes to case histories on the computer files. The students could then spend all of their time in reading relevant case histories instead of spending a great deal of time trying to find the relevant cases.

However, the main problem that arises here is that of collecting, collating and selecting the information that is to go into the case history index. It has been suggested that students could be used to do the bulk of this work. The development of sophisticated computer programs would materially assist the selection of relevant cases and the maintenance and up dating of the indexes or Indexes.

Computer-assisted instruction is another technique that is gaining increasing acceptance in all types of educational establishments. This allows a student to sit down at a typewriter remote from the computer and take a course of instruction under the guidance of a computer. The computer alternatively, displays to the students, text to be learnt or references to be researched, and then ascertains that the student has absorbed each section of material before going to the next section. The pace of the instruction can be controlled by the computer according to the students' results and revision may be called for if the students' results warrant it. The beauty of this technique is that the student learns at his or her own pace.

The high cost of the equipment required for this type of instruction has so far precluded widespread acceptance of this technique, but as computer technology improves, this equipment will become cheaper and bring computer-assisted instruction within the reach of all education establishments.

Perhaps the greatest use of a computer is as a means of monitoring students' performance and assisting teaching staff in the controlled use of all types of instructional materials. There exists now a need to determine the nature of the total educational environment in which computers can play a major role.

Training of Qualified Legal Personnel

Conferences, such as the one you are now attending, seem to be the logical answer for the educational needs of qualified legal personnel. This is a well-established form of communication in other countries.

It must be remembered that the computer age is still in its infancy. It is in the interests of the legal profession that its members keep themselves informed on new scientific developments and applications as they are brought into use.

Perhaps the most important area is the education of the people who will take an active role in setting the policies for a computer legal utility.

Conclusion

This paper has attempted to point out the need for computer education in the legal profession, to give some ideas as to how a computer might be used to assist legal instruction.

It is appropriate at this stage, to point out that one does not become a successful barrister merely by listening to lectures given by other successful barristers. Similarly, expertise in the use of computers requires practical experience. There is no easy road to success with a computer, but planning, hard work and research will certainly make the road a lot easier to travel.

PROBLEMS OF COPYRIGHT

*B. Tamberlin**

Copyright is an area of the law where computer technology has and will impose the necessity for continual adjustment. Technology has already outstripped the law in this area and the problem is how can the law adjust to the novel situtuations and social needs created by the computer.

This paper aims to survey some of the copyright problems which have arisen and will arise in the near future as a result of the computer.[1]

"Copyright" is defined by the Oxford Dictionary as "the exclusive right given by law for a certain term of years to an author . . . to print, publish and sell copies of his work." The English Copyright Act, 1911, which applies in Australia, defines "copyright" to mean "the sole right to produce or reproduce the work or any substantial part thereof in any material form whatsoever . . . or if the work is unpublished, to publish the work or any substantial part thereof . . ." s.1.[2]

The main competing social interests which copyright law has to adjust are:

(i) The interests of authors, publishers, and proprietors in controlling the manner and form of the publication and the use which may be made of the work and in obtaining the maximum financial gain; and

(ii) The interest of the public and users in having the cheapest, fullest and fastest access to the latest research results, data and forecasts.

Computer copyright problems centre on the software side of the industry. "Software" might be described in contrast to "hardware" as (i) the collection of programs and routines associated with a computer such as library, banking, payroll and plant control routines or (ii) all the documents associated with a computer. "Hardware" broadly refers to the physical machinery which is instructed by and which processes the software.

Software is big business. One writer in 1966 anticipated that the volume of software business would soon overtake that of hardware. In 1964 the volume of the software business was around $U.S. 1.5 billion and by 1970 it is estimated that computer programming alone would employ 500,000 people.

Two main types of software raise copyright problems. These are data software and program software. The problems are as follows:

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Program Protection

The question here is whether the present law adequately protects computer programs in the various forms in which they are embodied and, if not, whether it should.

There are different types of program.[3] "System Software" is the name given to basic programs needed in every computer simply to make the hardware operate, e.g. a computer which enables a programmer to code a more sophisticated program which is comprehensible to the machine. These more sophisticated programs which take for granted the existence of system software instruct the machine to take detailed steps in the resolution of a particular problem. These programs are known as "application programs".

Computer programs can be set out in different physical forms and different technical languages. For example, in a printed or handwritten form, in symbols, words or figures, in punch-cards or as magnetic patterns on magnetic tape. A considerable number of computer programs would seem to have no problem meeting the requirement of originality since they often embody new and creative methods of using the computer to resolve standard or novel problems. In the United States where the appropriate copyright category is "writings" the position seems to be that original computer programs will be protected where they are embodied in punch-cards or in printed or written forms.[4] However, it seems that programs set out in magnetic tape will not be protected since such programs are not visible to the human eye. A proposed amendment to the present United States law provides that copyright protection will extend to works "in any tangible medium of expression from which they can be perceived either directly or with the aid of a machine or device." This provision would cover computer programs on magnetic tape which are capable of being printed out and rendered visible to the human eye.

Under Australian law the appropriate category for computer programs is "literary work". It seems, on the case-law, that original programs would be protected in printed or handwritten form and in punch-card form. The concept of "literary" work does not necessitate literary merit and the definition includes charts, plans, tables and compilations. See s. 35(1). It makes no difference that the material is in a code form and is merely a collection of letters made up in a mechanical way. See *D. P. Anderson & Co. Ltd* v. *The Lieber Code Company* (1917) 2K.B. 469.

Since the case law on the 1911 Act suggests that literary works capable of protection must be printed or be in writing of some kind it seems that computer programs in the form of magnetized tape could not be protected here. As considerable original work and time must have been spent already in Australia on programs in this form there seems to be a real need for an immediate amendment along the lines of the United States proposal.

In the United States there is a considerable body of opinion which considers that copyright protection of computer programs is not sufficient and that the programs ought to be protected by the patent law.[5]

Fair Dealing

The 1911 Act contains an exception to copyright protection in respect of "any fair dealing with any work for the purposes of private study, research, criticism, review, or newspaper summary:" s. 2 (1) (i).

The computer poses a new problem for the courts as to what uses will amount to a "fair dealing" with material stored in a computer or with a copyright computer program. One very important factor which the courts have looked to is whether the proposed use would compete with the work so as to adversely affect its market value.

Whether there had been a fair dealing will depend on the nature of the material stored. Assume, for example, that part of the material stored is say the contents of several encyclopaedias and there are a number of unauthorized print-outs to private students or researchers of articles in all those works relating to "atomic energy". There will be no need or incentive for any of these users to buy the works since a similar approach can be taken when the need arises to consult other parts of the works. Because a lot of the drudgery will be taken out of this research by computer there will be an increasing tendency to use the computer data rather than purchase, hire or refer to conventional copies of the work. It may be that in such a situation in the case of each individual user of such a service there is a fair dealing but the cumulative effect of these dealings could well be a non-fair dealing. Consequently, in the interests of authors and publishers it may be necessary to judicially define or legislate to modify the idea of fair dealing.

Legislatures will be faced with pressures from users of computer services to widen the concept of fair dealing so that users such as educators, businessmen, industrialists or research scientists can have immediate free access to all the very latest information. However, proprietors will certainly react to these pressures and they will tend to seek to narrow the definition. Too wide a definition of fair dealing might discourage authors or cause them to protect their works by secrecy and as a result education, research, business, and industry could be adversely affected. Secrecy leads to duplication and waste. Too narrow a definition would also deprive these users of the immediate access necessary for them to function at maximum efficiency. The reconciliation of these interests requires a very delicate sense of balance.

Infringement

The problem here is what acts will infringe copyright in data or programs.

In relation to data and programs for example will the process of putting the material into the computer for storage constitute an infringement? Since computer programs and data are often set out in several different computer languages could the rewriting from one "language" to another constitute an infringing "translation"?[6]

Will the acts of processing the data and putting the program into effect constitute an infringement? Will there be still another series of infringing translations and acts as the result is printed at the output stage?

These are the types of problems which the Courts will face in the near future.

Under the present law it seems that infringements would occur throughout the whole process where an operator without authority stores and processes and prints out data. The conversion of say a copyright book into a data form comprehensible to the computer may constitute a reproduction in a material form or it may involve translation. Certainly, the framers of the 1911 Act did not contemplate this problem or this concept of language translation.

Where a substantial part of the data stored is fed out to users there could clearly be a publication which infringes copyright. Hardship could arise from an author's viewpoint where the part of the author's data stored is used by the computer in conjunction with stored data of other authors to produce a composite result which is not capable of identification with any particular author. This situation could arise where the computer is used to analyse a series of scientific abstracts on a particular program. The author's potential market could be considerably diminished by such use.

In relation to computer programs, detection of infringements can be a problem in the situation where the program is "pirated" by a person for use in his own computer. The user of the program may use it solely for his own private purposes. Since programs are often stored in forms incomprehensible to human beings his employees will probably not be aware that copyright is being infringed. There will be no general distribution of the program to the public which will warn the proprietor of the infringement. It has been suggested that realization of this difficulty will induce authors, proprietors and publishers to be reasonable when negotiating user agreements. If they are not reasonable the temptation to infringe becomes greater and no proprietor wants to eat up his time and royalties in law suits.

Licensing and Royalties

Where it is proposed to feed copyright data into a computer and publish material through the computer the calculation and collection of royalties can create difficulties.

Perhaps the greatest advantage of obtaining processed information through a computer is immediate access to the latest material, over a very wide range of sources. If every user of the material had to negotiate with the proprietor as to royalties and control of the publication then use of that material in business, education, industry and research could become hopelessly delayed. The solution may lie in a rigid rate charge on output handled in much the same way as telephone or gas accounts. The computer utility could learn from the other utilities. Alternatively, perhaps authors could require immediate payment on input in which case a lump sum payment could be made.

In the scientific, business, educational and industrial areas there will be extremely strong pressures to avoid the delay of negotiated agreements between users and proprietors.

One difficulty with a rigid rate structure is that the computer enables an infinite variety of highly specialized uses to be made of the stored material. For some users a one line reference or formula may be vital whereas another user may require almost the whole work, or article. How is it possible to equitably rate the two users with a rigid structure? How is it possible to charge on a quantum basis?

Assuming that publication of works will often be made through the computer, publishers will face new problems in estimating how many copies or uses of the work will be made. With the aid of a computer users can be much more selective as to the parts of a work used. For example, assume all the leading historical works on a certain period are stored in a computer's memory. It will be possible for a user to use only the very best parts of each work. This selective power will probably stimulate selective critical reviews for example, that "Chapters 15 and 16 are excellent and the rest are poor", and critical assessments of works on a selective basis, so that users will tend more and more to use many parts from a wider variety of works.

The publisher will have to make his estimates of the degree of use and the likely return in the computer situation in a much more fluid position than in the hardcover situation where buyers either buy the whole work or nothing.

Financial return is not the sole benefit which an author or proprietor seeks from copyright. He also wants to control, for example, the quality, the form, the time and manner of the publication, in order to maintain the accuracy and appearance of its presentation to the public and in order to maintain his reputation. Novelists, poets and dramatists may be most anxious, for example, to avoid having their works used in extract form. Unlike the royalty difficulty the problem of retaining some control for the author is not capable of a rigid solution applicable to all situations. There is a much greater need for author user negotiation in this area. Yet, again this negotiation could lead to intolerable delay.

Whether negotiation as to control is a luxury or not depends to a large extent upon the type of material involved. If the material is of an artistic or literary nature speed is generally not critical. However, where scientific, educational business or industrial data is concerned negotiation is a luxury. The solution may well be that in the case of the latter types of data the author will be required to give up control in return for increased royalties in the interest of immediate access.

Conclusion

New adjustments to copyright law will constantly have to be made as computer technology develops. The approach, it is suggested should be one of gradualism. There should not be any attempt to accommodate future possible developments in this area by creating wide and vague new categories of protection or exception in order to satisfy either proprietor or user interest groups. Rather should the law correct and to a limited extent anticipate anomalies step by step as they arise.[7] As computer technology develops the need for reappraisal of the law will become more and more frequent since computers mean speed and change which in turn require speedy legal adjustment.

REFERENCES

1. The difficulties which computer technology poses to copyright proprietors, publishers, government contractors, and the public generally are discussed in a series of papers delivered at the American Bar Association Copyright symposium in August, 1967. See *15 BULL. CR. SOC. 1.* The problem of copyright protection for computer programs is discussed in a great number of recent articles and notes. The most useful discussions and reference sources I found were: Note, *Copyright Protecting for Computer Programmes,* 64 COLUM L. REV. 1274 (1964) ; Article, Bender, *Computer Programmes: Should they be Patentable,* 68 COLUM L. REV. 240 (1968); Article: Nelson, *The Copyrightability of Computer Programmes,* 7 ARIZ. L. REV. 204 (1966); *Article, Jacobs, Patents, Copyrights and Trade Secrets* in COMPUTERS AND THE LAW, 90 (R. Bigelour ed. (1966); Jacobs, *Patent Protection of Computer Programmes,* 47 J. PAT. OFF. SOC'Y 6, (1965).

2. See Katona, *Legal Protection of Computer Programmes,* 47 J. PAT. OFF. SOC'Y 955 at p. 956 (1965).

3. For useful descriptions in lay terms of computer functioning see Bender, note 1 *supra,* at p. 243 and Note: 64 COLUM.L.Rev. at pp. 1274-1278

4. See the articles and notes on this problem referred to in note 1.

5. Section 106 of the proposed new United States *Patent Act* which is being considered by Congress provides:

   "A plan of action or set of operating instructions, in whatever form presented, to cause a controllable data processor or computer to perform selected operations, shall not be patentable".

6. A programme often undergoes several stages. Initially it appears in abbreviated English and Arithmetic expressions. This written programme is then passed to an operator who prepares punch cards based on the written programme. The instructions are contained in punched holes in the cards. These cards are then put into a machine which places the information as magnetic patterns on recording tape. A further machine then transposes the information into a language comprehensible to the computer but not to the programmer and again stores it on magnetic tape. The programme is then ready to instruct the machine correctly. see Note: 64 COL. L. REV. at pp. 1276-1277, *supra.*

7. As to what computers are capable of, see generally the four articles entitled, *The Boundless Age of the Computer* FORTUNE, April to June 1964 inclusive; Wise *I.B.M.'s Five Billion Dollar Gamble,* FORTUNE, Sept. 1966.

THE REGISTRATION OF COMPANIES

*F.J. O. Ryan**

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*Registrar of Companies

Introduction

The general title under which this paper is being presented prompts me to say at the outset that the application of computers to Companies Office procedures is strictly an administrative one, designed to eliminate certain tedious manual processes or to attain an objective more quickly and more accurately than would be possible by manual methods.

The computer in the A.D.P. system of the Companies Office will not deal directly with the registration of companies as such. It will cover the recording of new companies and new business names and the follow-up of various aspects of this, particularly the lodgment of documents. Details of this will follow but I should perhaps at this stage indicate that the only way in which the system will relate to the registration of companies is indirectly in that reference will need to be made to the listing of companies – "Consolidated Indexes of Companies and Business Names" – (a reference to which appears elsewhere in this paper) to ascertain whether the name required to be registered is in fact available. The computer itself does not undertake this activity because of the complexity in searching in so far as phonetic spellings of names, similar names etc. need to be examined. It is considered that all the computer could do would be to prepare a list of names from which a decision as to the availability of a proposed name could be made.

I should also make the point at an early stage that the Office is still, as it were, only on the threshold of the application of A.D.P. At the time of writing, data collection punching of the relevant information concerning existing companies is still proceeding. It is anticipated that this will be completed in July of this year. Data collection with respect to business names will then commence, June 1969 being the estimated completion date. The system, so far as companies are concerned, will be in operation in December of this year; by July, 1969 it is estimated that the system will be in full production.

Existing Manual System

For a better appreciation of the benefits hoped to be achieved by A.D.P. it seems desirable to give some account of the existing system, the deficiencies of which will become apparent in the course of so doing.

Index and Register of Companies

The main function of the Companies Office is the administration of the Companies Act and the Business Names Act and to make available for public search all documents lodged in connection with companies and business names registered under those Acts.

The day-to-day business of the Companies Office revolves largely around the index and register of companies, (hereinafter called the Companies index). The current index has been kept since 1937 according to the Roneodex Visible Card System and is housed in 89 steel cabinets, each of which contains 18 drawers each having provision for the insertion of 60 cards measuring 8 in x 5 in.

Each cabinet has a depth of 1 ft 5 in and the complete index occupied 56 running feet. The name of each company is typed on the visible portion of the card, which also contains provision for the insertion of:

(i) a reference to the packet† of documents relating to the company;

(ii) the address of its registered office;

(iii) the nominal capital;

(iv) the document number of each Annual Return and the date up to which it is made (on the left hand half of the card); and

(v) the document number of each miscellaneous document, a description of the document and the date of its lodgment (on the right hand half of the card continuing on the whole of the reverse side of the card).

Including cross references to material words in the names of companies, and to the former names of companies it is estimated that the index at present holds 95,000 cards. New cards are added to the index at the rate of 8,000 per year while cards relating to dissolved companies are extracted at the rate of 1,000 per year. During the twelve months ended 31st December, 1967, 136,000 documents were lodged, of which 58,000 were lodged during the months of January and February.

Principal Uses of Index and Register

Reference to Packet number

The index is consulted for this purpose by officers who wish to procure a packet of documents for internal use and by the counter attendants who require packets for production of the documents to members of the public who desire to search them. For either of these purposes an index of names including a reference to packet numbers, as distinct from a combined index and register, would be sufficient.

Search as to availability of name

A name cannot be registered if it so closely resembles the name of a registered company as to be likely to deceive. A search as to the availability of a name involves a search against each material word in a name. Thus, as indicated above, the index includes cross-reference cards of words such as "Investments", "Pastoral", "Finance", "Pharmacy" upon which are entered a reference to the name of companies in which those words form a material part of the name. An index of names alone would be sufficient for this purpose.

† All documents relating to a specific company or business name are filed in separate plastic packets for access (inter alia) by searchers. The file of correspondence which is confidential and for office use only is filed separately.

Register of documents

Prior to the handwritten entry on the index of particulars of documents lodged, the documents are sorted into alphabetical order. This is a time-consuming and tedious business especially during the months of heavy lodgements, January and February. Following the entry of the documents on the register they are sorted into numerical order of packets. A handwritten entry is made on the schedule of each packet in duplication of the entry made on the register. This duplication is justified on the basis that it is a convenience to searchers to be able to see from a glance at the schedule of the packet the nature of the documents it contains, while the entry on the index facilitates the searching of resubmission matters (see below).

Every company is required to hold an annual general meeting in each calendar year and to file a return within one month after the holding of that meeting. Every conpany which has not filed a return for the preceding year by 31st January is in default and the task of sending notices to each defaulting company (approximately 6,000 each year) commences on 1st March. This involves typists in examining each card in the index and preparing a notice containing the name and the address of the registered office of each company which has not lodged a return.

Every company is required within one month after the date of its incorporation to lodge a notice of the address of its registered office, a list of directors, managers and secretaries and a return of allotment of shares. Further, during the life of a company the lodgment of one document frequently raises an obligation to lodge another. Thus the lodgment of a special resolution increasing capital involves the company in an obligation to lodge a notice of the increase; the lodgment of a return of the allotment of shares for a consideration other than cash involves the obligation to lodge a document evidencing the consideration received by the company for the allotment. The file of correspondence of each company is noted as to an obligation of the kind referred to in this paragraph and filed for resubmission at appropriate periods. On the resubmission date the index provides a much more convenient and accessible source of reference than the packet for the purpose of ascertaining whether the outstanding document has been lodged.

Index and Register of Business Names

The index and register of business names (hereinfter called the Business Names index) is also kept according to the Roneodex Visible Card system. It is housed in 93 steel cabinets each of which contains 18 drawers and each drawer having provision for the insertion of 64 cards. The complete index occupies 54 running feet. In addition to the business name, each card provides for the insertion of:

(i) a reference to the packet of documents;

(ii) the address/es of the place/s of business;

(iii) nature of business; and

(iv) on the reverse side, the names of the persons carrying on the business and particulars of changes in those persons.

Including cross reference cards the index at present holds approximately 92,000 cards. New cards are added to the index at the rate of approximately 10,000 per year, while cards relating to business names which have been abandoned are extracted at the rate of approximately 9,000 per year. During the twelve months ended 31st December, 1967, approximately 6,000 statements relating to alteration in registered particulars were lodged.

The purposes served by the Business Names Index are similar to those served by the Companies Index. The registration of each business name, however, must be renewed triennially and the information appearing in the statements of renewal is checked against that shown on the index cards.

In order to ensure that renewal of each registration is effected triennially – a requirement first imposed as from 1st August, 1962 – an Elliott stencil was cut for each registration in existence at that date and a stencil is cut for each new registration effected. Each stencil contains the packet number, the day and month of expiry of the registration, (the year being printed on the renewal form) the business name as registered and the address of the principal or only place of business. The stencils are stored in specially constructed drawers in 36 categories corresponding with the months in the three-year registration period. At the end of each month the stencils relating to the registration due to expire are put through the Elliott Addressograph machine and the particulars appearing on the stencil are printed in two places on notices calling upon the persons carrying on the business to effect renewal.

The Companies and Business Names Indexes have served the office well during their 30 years' existence, the combined index-register function being especially valued. Some misgivings are entertained even now regarding the proposed abandonment of this facility. The principal disadvantages of the existing system are, however, as follows:

(1) As each index comprises a single copy only, the public cannot be permitted access to them. A member of the public who desires to search documents relating to a business name or company which he believes to be registered must accept the statement of the counter attendant that registration has not been effected. Although appropriate checking procedures are put into operation persons have on occasions been misinformed or given documents relating to a registration with a name similar to that in which he is interested. It would be more satisfactory for members of the public to make their own search of the index. This is particularly true of the legal profession which could then discharge its own responsibility as to the accuracy of information obtained in connection with searches.

(2) There is no way in which the accuracy of the recording of documents on the register can be assured other than by a separate check of each entry. This has not been thought feasible with the result that a certain amount of inaccurate recording has had to be accepted.

(3) The annual increase in the number of existing companies results in a corresponding increase in the number which default in the obligation to lodge various documents. Identification of defaulters, particularly in respect to the lodgment of annual returns, the preparation of appropriate default notices and subsequent action is tedious and time-consuming.

(4) Statistical information, for example, as to the type, nominal and issued capital of existing companies can only be obtained by progressively recording by manual means the desired information.

(5) The necessity to sort documents into alphabetical order prior to entry of their particulars in the index has proved to be a serious bottleneck in periods of heavy lodgment.

(6) The introduction of a triennial system of business names registration involves the visual check of the particulars shown in all renewal applications against the particulars recorded on the register to ensure that unrecorded changes in those particulars have not occurred.

(7) The Annual Return of a company includes up-to-date information regarding its capital, the address of its registered office and the name of its directors, managers and secretaries. The index contains particulars as to capital and registered office only, with the result that the other information shown in the return cannot be checked for unrecorded changes without recourse to the lodged documents. This has not been regarded as practicable.

Feasibility Study and Design Report.

A Feasibility Study to investigate the possibility of implementing A.D.P. in relation to the incorporation of companies and the registration of Business Names and associated procedures was commenced in July, 1966. In February, 1967 the team which had conducted the study expressed the opinion that the application of A.D.P. was feasible and recommended that the system outlined in its report be designed in detail and implemented.

The Design Study was somewhat protracted – the Design Report not being submitted until April 1968 – due largely to the fact that many systems problems partly of detail, had still to be solved, not having been covered in the Feasibility Report or covered only in broad outline. In January, 1968, however, data collection punching got under way in respect of companies in anticipation of the completion of programming and commencement and production by about October, 1968. This procedure was accepted in preference to the alternative procedure of having the system programmed and tested prior to data collection commencing. Punching of cards for current transactions for thos companies for which data collection detail had been furnished proceeded concurrently.

Description of Proposed System

Consolidated Index of Companies and Business Names

The principal object of the system is the print-out periodically of a multi-copy and composite index in alphabetical order of name (with appropriate cross references) for all companies currently incorporated (about 70,000) and all business names (about 75,000) having current registrations and appearing on the Register of Names master file on magnetic tape. The consolidated printed index will replace the two separate single copy roneodex card indexes at present in use. It will be used for direct reference by the public as well as for office use. Whilst the system has been designed basically to provide for a monthly reprint of this consolidated index (with a cumulative weekly supplementary index as described below) it is sufficiently versatile to allow for the production of this "monthly" reprint as and when required whether this be less than or more than the monthly interval. The actual reprint of this consolidated index will be produced to meet departmental and other needs. The processing of documents and appropriate follow-up action, however, will be undertaken monthly with the production of other output, whilst the additions to the index in the interim periods will be included in the consolidated weekly supplementary index.

Cumulative Weekly Supplementary Index of New Registrations

This index is intended to be a supplement to the consolidated index described above and it will contain a reference to new companies and business names which enter the system between issues of the consolidated index. It will be produced at weekly intervals on five-ply pre-printed yellow paper (to distinguish it from the main index). It will increase from nothing by about 1,500 entries per week over the period between issues of the main index. Its format and handling will be substantially the same as the main index.

Cumulative Monthly Index of the Dead Register

This will be a cumulative monthly index of companies which have been dissolved and business names which have been cancelled or relinquished in the current calendar year. The index will increase from nothing at the beginning of the year to 18,000 entries at the end in monthly increment of 1,500.

Details to be Recorded on the Master File.

Companies

The following information will be recorded on the Master File with respect to Companies:

> Registration number which is also the "packet" number.
>
> The company type code by which the different types of companies are identified e.g. example proprietary companies, public companies, foreign companies, companies in liquidation, etc.

Address of the registered office

Date of incorporation.

Date of the last Annual General Meeting.

Nominal capital.

Nominal value of issued share capital.

Business Names

The following information will be recorded on the Master File with respect to business names:

Registration number which is also "packet" number.

The address of the principal or only place of business.

The particulars of any other place/s of business.

The nature of business.

The date of registration for new business names registered and the date of expiry for existing registrations.

The names and addresses of each proprietor.

Accounting for Company Documents

The system is designed to record the receipt of certain documents required by the Companies Act to be lodged by companies, to record details from some of them and to issue an initial request to companies and monthly reminders to the department when selected documents are overdue. The accounting for documents aspect of the system consists of the following:

Annual Returns

Each local company will be examined each month by the computer to ascertain whether a first or subsequent Annual Return is overdue according to the terms of the Act and when it is found to be in default a standard letter requesting lodgment will be automatically issued for despatch to the company. When an Annual Return is received the computer will compare the values shown therein for nominal capital and issued capital with values already recorded by the system on the register and draw attention to any discrepancy by producing the standard form of request for lodgment of company documents indicating the nature of the document required and the reason for the request. As indicated on page 86 the identification of defaulters and the despatch of the request for the Annual Return is at present done manually and only once in each year. Under the A.D.P. system the check will be a continuing process which will include additional checks, e.g. of the nominal value of issued share capital. This will enable the Companies Office to request outstanding Annual Returns and other documents sooner than is now the case and so have current information available earlier to satisfy searchers.

New Incorporations

Following the incorporation of a company and its entry on the register the computer will check that each of the following required documents is lodged and a standard letter will issue when the company defaults:

Return of Allotment of Shares

Notice of Situation of Registered Office

Return of Directors, Managers and Secretaries.

Local Company in Liquidation

On a company going into liquidation, the company type code (referred to above under "Details to be recorded on the Master File") will be altered to indicate that the company has gone into liquidation and the name and address of the liquidator and the date of his appointment will be recorded to allow a check to be made that the Liquidator's Statements of Receipts and Disbursements are submitted when due. A check will be made that the Liquidator's Account of Receipts and Disbursements is received both initially and at six monthly intervals thereafter.

Liquidator's Final Accounts and Statements

When a liquidation reaches the state of being finalized the computer will check that the following set of documents is lodged:

Liquidator's Final Acccounts and Statements

Liquidator's Return as to Final Meeting.

Follow up of Request for Lodgment of Documents

In all cases in which a standard letter is produced subsequent monthly remainders will be issued by the computer to the Department until such time as the overdue document arrives. It had been proposed that in the case of default in lodgment of an Annual Return the computer would also print out the documents associated with the prosecution of the company and its officers, that is to say, forms of information, summonses and exhibits such as Certificate of Incorporation and a Certificate as to Directors. This proposal was thought not to be justified by reference to economic considerations and was abandoned during the design stage.

Business Names Renewal Notices

Every month the computer will examine each name currently registered under the Business Names Act and appearing on the register of names master file on magnetic tape and find those whose registration period will expire two months ahead. A business names renewal notice will be issued automatically in each such case. If the registration is not renewed within the space of four monthly runs following the issue of the Renewal Notice it will be automatically cancelled and the business name will be transferred to the dead register. The left hand and centre portions of the Renewal Notice will be completed by the computer from information currently recorded and the right hand section will provide the means by which a proprietor can advise changed particulars if appropriate. The attention of the proprietors will be drawn to s.17 of the Business Names Act which provides a penalty of $200 or imprisonment for three months or both for making a false statement for the purposes of the Act. The form will have a vertical perforation to allow the left hand portion to be later separated and issued as a Certificate of Registration on payment of the prescribed fee.

Statistics

The system will produce totals each month for variation to the register in the following categories:

New company registrations distinguishing various types:

New business name registrations;

Business name renewals;

Companies transferred to the dead register;

Business names transferred to the dead register;

Local companies in liquidation;

Foreign companies in liquidation.

An Annual Report will show the distribution as at the end of December (and at any other time nominated) of companies and business names on the current register, companies being summarized under 15 company types.

Additional Output to be Printed by the A.D.P. System

Edit Error Reports

In addition to ensuring that the system itself is correct, it is also necessary to ensure that the input is correct so that in terms of the system the output will be exactly as it is expected to be. To ensure this, numerous checks known as

Edit Checks will be applied to the input. These checks will be designed to ensure, for example, that:

(i) no alphabetic characters are entered in numeric fields;

(ii) the date is true, i.e. there are not 32 days or 13 months;

(iii) various "blank" fields do not contain information etc;

(iv) that associated parts of the input are processed together.

Any inaccuracies highlighted in these checks will be printed out on the "Weekly Error Report" for investigation and adjustment and the information affected rejected.

Other Error and Exception Reports

Once the input is acceptable it will be processed and it is at this stage that other errors could be highlighted. The processing will be done monthly, in the "updating" run in which the actual procedures programmed will be carried out. Should the results be not as expected for some reason which was not apparent at the input stage, the inconsistency will be printed out together with the reason for this. The contents of the punch card will also be printed out. These reports will differ from the edit error reports in that the input will have been accepted and the processing i.e., matching/checking on previously recorded information will have highlighted inconsistencies.

Monthly Statistics

This report will be printed on single ply stationery in each monthly run and will show under the headings a list of the changes which were made to the register of companies and business names in that run, e.g. number of new companies registered (distinguished by type), new business name registered, business names renewed etc.

Annual Statistics

This report may be printed at the option of the office and will show the break up of companies on the register of companies and business names at that time under the various company types listed as well as the division of the file between companies and business names.

Print Out of Contents of Individual Records on the Register of Names Master File.

The system will provide for a print out on request of the full contents of one or more records on the main magnetic tape master file. Further, it will automatically print out the contents of the record of a company whose classification type changes to permit the subsequent resetting where necessary of special tables in the record which relate to outstanding documents.

Monthly Job Report

Each time the register of names master file is up-dated the new version number of the file will be printed together with the advice of whether or not the consolidated index has been printed in the run. The version number so advised will subsequently be punched into a "header" card accompanying punch data cards intended to up-date that version of the master file, thus providing a control measure to ensure that the correct transaction and master file are matched. The report will be issued monthly.

Weekly Job Report

A report similar to that described in the preceding paragraph will be printed each time the weekly master file is up-dated. It too will show the latest version number which will be shown as a control measure as earlier described and it will also indicate whether the run was a "normal" weekly or "special" weekly run.

Register of Directors, Managers and Secretaries

At the present time it is not possible to ascertain the names of all companies of which any one person is a director, manager or secretary. This information could only be obtained as a result of an examination of the relevant documents lodged by all companies, or alternatively, over a period of 12 months by extracting the relevant information from Annual Returns as lodged.

Following the introduction of the system now proposed, it is intended to consider the feasibility of recording directors, managers and secretaries on the master file of companies. This will enable a print out of a register setting out by reference to the name of a person the names of all companies in which he holds office as a director, manager or secretary. This would be of some practical utility for internal office purposes and, in the event of sufficient public interest, enable copies of the register to be put on sale. Such a record would also be utilized for the follow-up of unrecorded changes in the persons holding the offices mentioned.

THE REGISTRATION OF LAND

*R. J. Maino**

ACKNOWLEDGEMENTS

Information supplied by Mr Artis of the Registrar General's Department of N.S.W., Mr Barr of the firm of solicitors Dawson Waldron and other organizations and Government Departments is gratefully acknowledged.

SYNOPSIS:

This paper contemplates some of the considerations in applying computer to land registration. Existing systems are noted and the difficulty of conversion to a computer system is highlighted. Suggested solutions are reviewed and possible extensions of existing systems are examined with reference to computer systems in allied areas. Mention is made of the acceptance of computers in this field and some of the advantages possible. A bibliography is included.

Introduction

In considering the application of computers to land registration one might be tempted to ask "so what will it achieve?" and "what will it cost?" To answer these questions we must define what we hope to achieve by a system of land registration. That is, we must analyse not only the processes involved and how to use computers but also why land registration is performed what is *currently* achieved by it and perhaps how its purpose could be enhanced if suitable additional facilities were available.

Current Practice

Land registration as we understand it barely exists overseas and computer arrangements of land information systems, though having some relevence have been set up primarily for other reasons. In Australia, there are of course two concurrent systems of land registration and I would like to reflect on these for a moment.

Under the "Old System" in N.S.W. "registration of deeds is a partial and incomplete form of state control The state does not take any responsibility for these instruments, nor does it guarantee that these deeds are valid, but simply says that instruments executed bonafide and for valuable consideration shall take priority from the date of registration and not from the date of execution.

*B. E., Lecturer in Education Department, IBM (Aust.) Ltd.

"Proof of title under the Old System is inconclusive, cumbersome and costly" (reference 2). It may be necessary to search every deed affecting the title for thirty years or more (as well as other records) and this would be repeated for every dealing (purchase, mortgage etc).

The more recent Torrens System is of course based on the South Australian act of 1st July, 1858, sponsored by Sir Robert Torrens. With this system a register is maintained (and guaranteed by the state) of all current instruments, a separate record or certificate of title being kept for each item of land. Under the Real Property act of N.S.W. which first came into force on 1st January, 1863, no dealing with land is valid at law unless entered on the register. In addition to being positive and simple the Torrens System by the use of preprinted forms provides some standardization in the method of presenting information.

A Computer System

Without yet evaluating it let us consider the practicability of mechanizing the current systems of land registration in Australia.

Experience indicates that the information contained in every document in an existing system could be stored in the storage units of a computer complete with references and cross references as they exist now. (Experience also indicates that this would probably not be the most efficient or advantageous approach but this will be examined later.) A computer could store in one of its auxiliary storage units (about the size of a phone booth) probably half a million certificates of title and retrieve any information in seconds or fractions of a second. Enquiry into the system could be by a form on which the appropriate references would be written (in accordance with certain rules) and which would then be passed through an optical reader connected to the computer. Alternatively the more common method would be to enter the enquiry via a typewriter-type keyboard operated by the enquirer or a specially trained operator.

The reply could either be printed out by computer controlled electric typewriter (at more than twice the speed of a fast typist) or a line printer (up to 30 times the speed of a fast typist) or by immediate display of the information on a screen similar to that on a television set (or a combination of these).

Such a system would require little change in existing custom and practices. Registration procedures could continue as now and the information subsequently stored in the computer system. The principle cost of the system would probably be the large capacity storage units. These units are currently in use in this country in similar applications in other fields. Visual display units and typewriters would probably be more economical than current version of optical readers. With a system of this type less space would be required not only for storage of information but also because turnaround of enquiries would be faster and less people would need to be accommodated at a time. It has also been suggested that enquiry terminals could be installed in other departments and even in large firms of solicitors. (Reference 1).

Conversion Problems

While the establishment of such a system should not present any insurmountable difficulties conversion of information from an existing system could prove a mammoth task. As it is unlikely that existing documents would be in a form acceptable to optical reader units all information would have to be keyed in. This would be like completely retyping all existing records.

Other Approaches

Three alternatives appear; firstly the use of the computer merely to compile cross reference indices. Thus only reference information from each document would need to be keyed in. Overall benefits may not be significant however and the physical disposition and maintenance of indices and frequency of production could pose some problems. A second solution would be to keep the indices on a computer with enquiry terminals. It could be difficult to justify the cost of this approach.

The third possibility is to set up a complete system but to condense the information in some way so that only an absolute minimum need be entered into the computer during conversion. This would also enable more efficient use to be made of storage units and also further speed up searches and registrations. Perhaps we should at this stage look at the fundamental requirements of a land registration system.

System Requirements

It would be desirable that such a system provde a reliable, up-to-date record of each item of land from which could be readily extracted:

(1) A precise description and identification of the land.

(2) The registered owner/s.

(3) Identification and definition of all other current registered interests in the land taking "interests" in its broadest sense.

(4) The time at which any changes became effective.

Only the data necessary to provide this information would need to be entered into the system.

Considerable effort would still be required to extract this data from Old System records, but it is readily available for titles under the Torrens System and furthermore many of the instruments would be of standard format and those parts of documents which are common need only be stored once. Further standardization for the future could be investigated.

Instruments which are not current and to which reference will be made infrequently could perhaps be stored at some remote location whilst either in their original form or in a form which can be more readily accessed by the computer.

Impending Dealings

It may be desirable to include in the system a record of impending dealings which may come into force between the time an enquiry is made and the registration of the dealing resulting from that enquiry. An extension of the caveat principle could be considered or a "notice of priority" as has been suggested elsewhere (reference 1).

Other Matters

Although not registered as an interest in the land, items such as water rates, council rates, land tax, writs and orders are a charge against the land and have to be investigated when land dealing is contemplated. Matters such as Public Health restrictions, Council Zoning, Fair Rents rulings, road widening, sewerage connection, water rights, pasture protection and many others also affect the description of the land. An up-to-date record indicating which of these apply to a particular item of land would avoid the need to enquire of all relevant departments. This would reduce the work entailed both in enquiry and reply.

Duplication of Records

Currently, to provide such information departments each keep their own records with much duplication of common information and the maintenance of it. A change of owner has to be notified not once but several times and a change to the records of each department is necessary. One solution would be to have one central set of records shared by all concerned and indeed such a system is practical only with a computer. Brisbane City Council is currently contemplating a system of even broader consideration which it has given the name LUPAC-land use planning and control system. Several similar systems are also in various stages of development overseas.

A Total System

If such records could be incorporated within the land registration system not only could the existance of the various charges and other departmental information be indicated but the actual record of them would be available, providing a truly comprehensive, accurate, up-to-date record of each item of land.

Further extensions of such a system have also been suggested (reference 1). Perhaps the functions of duty payment on contracts could be integrated to automatically indicate impending dealings. Information about owners, for example, that a particular owner is a pensioner (thus affecting rating considerations) could be included but perhaps this is beyond the scope of this paper.

Land information systems currently being developed also include a variety of other information essentially for planning purposes. The street section file of the Alexandria City Council system (Virginia U.S.A.) contains 60 items of information on 20,000 parcels of Land including description, zoning, use, values, ownership and improvements and other information to enable planning for fire equipment, improvement programs, decline in assessed values, maintenance of roads and other facilities, and development of new areas. The metropolitan Data Centre Project, Tulsa, Oklahoma U.S.A. in satisfying the needs of many departments considered the following items for its land file:

> parcel number, address, legal description, grid co-ordinates, adjacent streets, adjacent parcels, Political and Administrative jurisdictions, streets, lot number , situation, map reference, size, zoning, future planning, land easements, water and mineral rights, topography, drainage, soil type and productivity, fish and wildlife, date of last sale and price, rental, building characteristics, utilities connected, waste disposal, civil defence facilities, swimming pool, police information, fire information, public health information, registered personal property at this address (such as guns, automobiles), subsurface structures and improvements, neighbourhood characteristic, proximity to special facilities, owners name and mailing address and ownership conditions, occupants name and classification and permits or licences granted thereto.

It is not suggested that all such information should be included within a land registration system but rather to indicate that it is within the capability of a computer system, and that the practicability and desirability of incorporating such information could well be investigated.

Implementation

In setting up any new system it would be desirable to consult all those who may be affected by it and it would then be opportune to discuss the above considerations. The tremendous effort of converting to a new system would probably necessitate a staged approach, particularly as it would be necessary to maintain existing systems concurrent with the changeover. It is also likely that the initial stages could not be justified on a cost basis by themselves and would need to be considered as part of the overall system.

One approach would be to enter all new registrations into the system as they occurred and to convert existing records over an extended period perhaps simultaneously with dealings. During the changeover period some records would be on the computer and some on the existing system. However as the computer system could be interrogated first at high speed this should not present a problem. Although additional information may not be added until the basic system is complete provision for it should be planned at the design stage.

Other approaches are possible and indeed the success of the system would depend not so much on the approach as the care and effort which went into planning it. Good planning is the keynote of all successful systems. Too often the task of conversion is under-estimated or badly planned.

Acceptance of the System

It is unlikely that users or operating staff would be unduly disturbed by the system provided that their interest was invited and their requirements satisfied. Extensive changes to the existing system in N.S.W. appear to have been readily accepted (reference 2). A danger to be avoided is that of making claims which cannot afterwards be met. With regard to the acceptance of computer records as evidence this would need to be examined in a much wider context. Changes to the various evidence acts in this country have kept pace with new recording media and it is not unreasonable to suggest that further changes would be made if warranted. It is believed that the Civil Evidence Bill introduced into the House of Commons in U.K. made specific mention of the admissability of computer evidence.

Computers are self checking and their accuracy and reliability has been repeatedly demonstrated. However wherever we humans are involved the possibility of error or even fraud exists. Provision should be made for recreating promptly any records which may be destroyed accidentally or otherwise. Entry to the system may also need to be restricted to people with an appropriate key. Just as we have punched card bills and possibly in the future cheques, it has been suggested that the copy of the certificate of title could be a punched card to be used as a key for entry to the system (reference 1). Computers have entered the field of law in the U.K. and U.S.A. particuarly in legal research. The use of computers also rated mention at the Geneva Conference on World Peace through Law.

Evaluation of a Computer System

Whether the cost of an overall computer system of land registration or any lesser proposal is economically justifiable would require a more detailed and specific examination than is possible here. Nevertheless the economic feasibility of computers has been proved in similar situations in other fields. Apart from the reduction in manual effort, some of the points to be considered would be the faster turnaround of transactions and enquiries and the overall saving in space; the fact that registration could occur almost immediately after lodgement; the variety of cross referencing which could be incorporated; the high degree of accuracy and reliability which could be expected under all conditions; provisions for expansion which could be readily built into the system: the reduction which could be effected in enquiries to other departments; the possible elimination of multiple files and the multiple use which could be made of the system; the up-to-the minute accuracy of records and the ability to exchange data in machine readable form with other organizations using competers.

Conclusion

How seriously such a system would be considered perhaps depends on the degree of difficulty being experienced with existing systems. Most of us are reluctant to change to something new irrespective of the apparent advantages unless a situation becomes intolerable or looks like becoming so.

As noted earlier changes have already been made to the system in N.S.W. and came into operation on 23rd January, 1961 and further improvements are still being made. The Registrar General's Department of N.S.W. is currently making use of a computer for the preparation of indices in the Births, Deaths and Marriages Branch and also indices for plan references in the titles office.

It has been stated (reference 1) that "since the introduction of the registration of titles there have been great changes in attitudes towards, and concepts affecting, fee simple land holding and land use; all of these changes have lead to a decrease in the value of the protection given to the proprietor of a registered interest in the land; none has been reflected in effective alterations in the Torrens System." Australia has truly been a pioneer in the area of all land registration and it would be interesting to contemplate what the views of Sir Robert Torrens would be today.

The use of computer is becoming more and more widespread, and while changes in existing systems may not be warranted now, a knowledge of current technology and consideration of its use may be an investment in the future. Certainly it would be desirable to acquire now the knowledge to guide any development. Computer systems must be designed to suit the requirements of people and not vice versa.

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KEEPING COURT RECORDS

*J. Graham**

"Research without an actively selective point of view becomes the ditty bag of an idiot, filled with bits of pebbles, straws, feathers and other random hoardings." – R. S. Lynd, "Knowledge for what" Princeton University Press, 1030.

It is not suggested that any of the papers to be presented at this conference have been written for no other purpose than to add to the sum of human knowledge. But, whereas the more theoretical papers will differ from the kind of research Lynd referred to, this paper will be more pragmatic still. It is hoped that it will show "computers and law" is not merely a vague theoretical concept being sketchily investigated overseas and not being of any immediate concern to the legal practitioner or academic.

It is hoped that it will help to promote the realization that computers are here to stay; and that they have as much a place in the field of administration and practice of law as in any other profession or trade.

For reasons of simplicity and brevity no analysis will be undertaken of the several overseas projects involving the electronic processing of Court records, but it is felt that they could add little more to the theory of the subject than does the following discussion of the projects in present operation and in contemplation here.

Perhaps it should be first established what, for the purposes of this paper, is meant by the terms "Court Records" and "Computers". The word "computer", even to those whose business is data processing by electronic means, sometimes defies anything but a vague definition. And the primary function of a machine may be of little help, since involved mathematical calculations are often performed on electronic devices which are not computers. and machines which are generally accepted as being computers are often used in applications which require no computing process whatever.

For the purpose of this paper then, the word "computer" will include all electronic machines or combinations of them, accepting data in the form of punch cards, paper tape, magnetic tape, signals entered directly from a keyboard, or documents directly read by an electronic scanner; which will process the data in a manner predetermined by a "program", store the data and retrieve, and print or display, all or part, of the stored information as required.

"Court Records" will include all documents, papers, receipts, registers, rolls, certificates, notes and transcripts whether required or not required by legislation, regulation or rules of Court or judicial direction. In short, all papers and documents which are used in the every day running of any properly constituted legal tribunal.

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* Automatic Data Processing Programmer, Department of Justice.

However, no attempt will be made to give individual consideration to all the many classes of records, the object here being to consider, from an administrator's viewpoint, the broad question of processing some of the more important aspects of Court records.

Legal implications will be left for the consideration of the lawyer and no attempt will be made to suggest legal remedies for apparent problems.

The nature of processing

All processing of data, whether it be manual, mechanical or electronic, may be represented by the simple diagram

[input] → [Process] → [output]

If the process is unvarying for all occurrences of the same type of data, and requires no value judgments to be made, or no discretion to be exercised, it becomes automatic in nature and can be logically set out as a series of simple predetermined operations. The work of a magistrate or judge can be represented by the above diagram, thus:

[Application to Court] → [Determination] → [Hearing] (sentence, fine, award)

But the processing step here is, in most cases, not invariable for each individual item of input, there often being as many different sets of processing operations or "programs" as there are items of input data.

In some cases where the determination of an application to the Court is the result of an automatic process, and no element of discretion remains, provision is made to eliminate the judicial intervention of judge or magistrate. Hence, specially endorsed writs, default summonses, and default judgments.

Can then, the processing of default actions be carried out by computer?

It seems appropriate at this point to mention the procedures used in the New South Wales Public Service leading up to the introduction of a computer system. The appendix contains a self-explanatory guide to the conventions applying to the several studies and reports associated with ADP (Automatic Data Processing) system. The main theme of these procedures is to establish feasibility for a contemplated computer project, and while in many cases this can be substantiated solely on economic grounds, other benefits which cannot be measured in this way, can carry just as much weight in the final analysis.

The feasibility of a system can thus be broadly summarized as being dependent upon the ratio of advantages to be gained over and above the disadvantages (generally cost) which will be associated with its implementation, at the time of the study.

Most government departments in New South Wales use the computers of the Treasury A.D.P. Services Bureau for their computer projects. There are no facilities there as yet, for "on line" applications. That is to say no department can tap in to a computer instantly and at any time during the day.

Departments must send their data to the Bureau in the form of cards, or paper tape, have it processed at a prescheduled time, and pick up the printed output later.

As the signing of default judgement is often required immediately upon the filing of the appropriate documents of application, let us assume that the process, however automatic, must be carried out without any time delay. For this to be done by computer would require the hire, or purchase, or the hiring of time, on an on-line computer. If we assume further that anticipated advantages would not justify the cost involved, we can say that although the computer processing of default actions may be technically possible, it would not be a feasible project at this time.

Should the principle which allows the proof of damage by affidavit in undefended District Court actions be extended to proof of liability as well, this would increase the volume of data resulting in judgment by the application of an automatic process.

If also, several Courts were brought under the one roof and suitable computer facilities available, a single system to process the undefended actions of all Courts may then prove to be economical as well as technically feasible. Thus a system not feasible at one point of time may prove to be so at a later date.

While the above example is over-simplified, it should serve to illustrate the principles which govern the contemplation of any computer system whatever the nature of the industry or service for which it is designed.

To answer the earlier question then, we may, for the purpose of this discussion, say that processing default actions by computer is possible, but not at present feasible.

The computer as a guide to the quantum of penalties and awards

Now, let us return briefly to the matter of defended civil actions and criminal trials: The distinction between these and default actions was said to be the automatic nature of the processing of default actions and the variable nature of processing the others. But once liability or guilt had been established, is there then so much difference?

It is true that the severity of sentence or amount of fine or damages may be left to the discretion of Judge or Magistrate, but it is still a discretion to be exercised logically and to be supported by reasoned argument.

Would a completely logical machine, having an accurate memory of the circumstances and decision in all previous similar cases, be of any value here?

To discuss this further would be outside the scope of this paper, but it is a thought which should be kept in mind during the examination of the processing of other Court work.

Computer systems in present use in New South Wales Courts

There are three computer systems at present in operation, two in the study stage, and many others in contemplation.

Those at present in regular use in the Metropolitan District Court, the Licensing Courts and Licenses Reduction Board, and a third small scale project provides Fair Rents Court statistics as required from time to time.

The District Court Project

This was the first use of computer processing in a Court in New South Wales, and, as far as is known, in Australia.

The system is developed from problems associated with the lists of cases set down for hearing, and the inadequacy of the index of actions.

For some time it had been apparent that the increasing volume of plaints entered in this Court was becoming so heavy that one aspect of their processing, the listing of actions set down for hearing, could not be accurately performed within the time allowed by the rules of Court. One list, that of undefended actions, was required by the Court on the return day of the summonses, while defences could still be filed up to the closing of the Court office the day before the return day. With many thousands of actions returnable each month, the haste with which the lists had to be prepared was reflected in the accuracy of lists of defended actions as well. Members of the profession may remember the steady stream of counsel bringing into the undefended Court the files for those actions which had been accidentally omitted from the lists, but not many, it is hoped, may be aware that it was not unknown for an action in a defended non-jury list to be ready to proceed with counsel, litigants and witnesses all present, and for it to be discovered that the action was in fact a jury action, that it had been listed in the wrong list, and that no jurors were available; with the result that the action had to be adjourned.

With something in the vicinity of 60,000 plaints per year in that Court at that time (over 70,000 now), the card index of actions was also anything but satisfactory.

The computer system was designed to capture the information required for lists of actions for hearing and for the index, at the same time as minute sheets, being the record of the entry and progress of plaints, were typed up on the commencement of actions.

This was to be done by typing minute sheets on paper punching typewriters, the paper tape being obtained as an automatic by-product of the manual typing operation. Once weekly the paper tapes produced during the week were to be taken to the Treasury ADP Bureau and, with the use of a computer, the information was to be sorted, merged with all previous information (on magnetic tape), processed and printed. The one printing would give an up-to-date index together with any of the several lists of actions for hearing or combination of them, as required at the time. The system had been designed, programmed and tested when an amendment to District Court procedures removed the necessity for lists of cases set down for hearing. This was disappointing from a data processing viewpoint as the system contained the solution to some unusual programming and design problems. Nevertheless the indexing segment of the system is in operation and provides a weekly up to date index for both registries of the Metropolitan District Court. It is interesting to note that even producing only the index by computer shows an economic advantage over the previous manual system of index cards.

As for other advantages over a well thumbed, badly sorted card index, the sample page in the annexures will speak for itself.

The Licenses Reduction Board project.

Liquor licenses expire on the 30th day of June each year. The fee for renewal for a further twelve months is based on trading figures over the previous calendar year. With one or two insignificant exceptions the fee is a percentage, fixed by the Liquor Act of the price of liquor paid or payable by the licensee during the year. The Licenses Reduction Board is the body charged with the duty to assess renewal fees, and, during January each year each licensee or club secretary in the case of registered clubs, is required to submit to the Board, declarations as to his liquor purchases, and each supplier of a licensed premises or registered club is required to furnish a statement as to the value of liquor supplied.

After assessment of fees, the secretary of the Board, (the office of which is also the office of the Metropolitan Licensing Court), notifies the clerks of the Licensing Courts for the other 103 licensing districts, of the amount of assessed fee for the renewal of each liquor license or certificate of club registration in the district. At the same time each licensee or club secretary is notified of the amount of his renewal fee. The licensee makes application to the Court (for his district) for renewal, and if and when, the renewal is granted pays the assessed fee. A new license, permit or certificate, as the case may be, is then issued, to remain in force for 12 months from the 1st July next following.

Manual assessing procedures

In the past the individual items from each supplier's statement were extracted and placed with the file for the licensed premises supplied. After this had been done in respect of each licensed premises the figures on the extract and on the licensee's declaration were matched and compared with a view to noting omissions or discrepancies.

The elements of an automatic system

So far then, the process was an automatic procedure, so mechanical that the normally small staff of the Board's office was temporarily augmented for this nurpose with untrained junior officers newly recruited to the Public Service.

The process appeared suitable to a computer application but was the volume of data sufficiently large to justify it?

As there are about 5,000 licenses including club registration and over 400 suppliers, as most licensed premises have many suppliers (some over 100), as most suppliers supply very many licensees, and as each transaction between supplier and licensee is dissected into sub headings of wine, spirits, and beer, it is immediately apparent that the number of matching operations required, before any assessing was to be commenced, would be at least some hundreds of thousands.

Without going into an analysis of costs, it is sufficient to say that the computer system was found to be feasible and shows an annual saving of many thousands of dollars. No staff has been displaced, this monetary saving being effected by the elimination of overtime and the need for temporary staff.

Computer exercising discretion?

The above explanation of the method of assessment is over-simplified, other facts such as sales tax, discounts, a different procedure for assessing spirit merchants' fees, the fact that some licensees hold more than one license, are all added complications which nevertheless, are solved by fixed formulae, and there is no point in discussing them here.

However, section 23 of the Liquor Act makes provision in certain cases for the Board to fix the license renewal fee "at such amount as it thinks fair and reasonable". Such cases would include those licenses, the original grant of which, occurred after the 1st January of the current year. In such cases there has been no trading during the previous calendar year and no figures with which to determine a fee on a percentage basis. Here, the computer can be of no assistance, and the fee is fixed by the Board by the same method as applied before the computer system. But this section of the Act also applies to the licenses, the original grant of which, occurred after the 1st July of the previous year. The Board still fixed a fair and reasonable fee, but in these cases there are figures available which relate to trading, during part, at least, of the previous calendar year.

Would it be reasonable, if a new licensee had been trading only three months of the previous year, to assess a fee (on the normal percentage basis) on the figure supplied for that quarter's trading, and then multiply the figure by 4? This in fact is what is done. The computer assesses a fee on the figures supplied and multiplies it by the inverse of the fraction of the year (in days) for which the license had been in force. This however, is not the final step, such figures are printed out for the *guidance* of the Board, which may choose to accept or reject them and to substitute any other fee which it considers fair and reasonable.

Computer printing

When computer assessing, and the small amount of manual fixing of renewal fees is completed, fees lists for each licensing district are printed by the computer. At the same time the computer prints notices of assessment, and new licenses, permits and certificates. Each notice of assessment is placed in a window-faced envelope, no addressing being necessary, and posted to the licensee or club secretary together with a blank notice of application for renewal. The licenses, permits and certificates for each district, together with the list of fees, are posted to the clerk of the District Licensing Court. When the application for renewal is granted, the Clerk of the Court has only to receive the fee and sign, date, seal and issue the pre-printed license or certificate.

Other programs of the system supply indices and statistical reports which previously had been laboriously compiled by officers of the Board.

Fair Rents statistics

This system was designed to be used only on odd occasions and cannot be regarded as a regular system to process Court records. Furthermore, as it uses little more than the high speed sorting and printing facilities of the computer it barely qualifies for inclusion among automatic computer systems.

Computer systems being studied

Two computer applications for Court records at present being studied are in the Office of the Registrar of Probates and the Office of the Prothonotary.

The Probate Office

The preliminary study was made in that office as a result of difficulties being encountered with the index of probates. The index is being continually added to and contains information on every probate or administration ever granted in the State. To date these number about three-quarters of a million, and storage space for probate packets is becoming a further problem. A feasibility study of a system to maintain by computer these cards on magnetic tape, and to issue summonses to lodge accounts, has yet to be undertaken.

It is likely also, that a microfilm record of every will could be allied to such a system.

The Prothonotary's Office

This is an interesting example of a situation where the major activities of the area under study were lacking the elements of a computer system, but where an ancillary function, which might have been overlooked, did appear to be worth closer scrutiny. This was the matter of the registers of students under the rules of the Barristers and Solicitors Admission Boards, and the rolls of legal practitioners. A system postulated by the exploratory study indicated the computer storage and processing of all students' personal and examination records, from the time of enrolment up to and beyond admission to practice.

To date an exploratory study only has been undertaken in this office.

On-the-spot tickets and traffic summonses

These records are such potentially fruitful subjects for computer processing that work is well under way in the Police Department to this effect. Data from traffic infringement notices are to be fed into a computer, and payments, when made, matched against the original records. Any non-payment will result in the automatic printing of a summons for issue by the Court in the normal manner.

At this stage the proposed system does not go beyond the printing of summonses and thus does not come within the scope of this paper.

The Future

Other Court records might benefit in varying degrees by computer systems.

Payments into and out of Court of verdicts, fines, instalments, maintenance, alimony, compensation, suitor's money pendente lite, and in satisfaction of writs of summons and judgment.

In one Sydney petty sessions office alone there are over 30,000 current accounts. That is to say, over 30,000 people owe money payable under order, into Court, by way of maintenance, garnishee, fines by instalment, and the rest into that one court office. When it is considered that the average number of accounts in a suburban bank branch is only about 3,000 and that the head office of a bank itself may not have as many as 30,000 accounts, the amount of bookkeeping work in this one Court Office would indicate likely feasibility of a computer system. If further thought is directed to the financial loss to the State, resulting from the difficulty, occasioned by such a large volume of accounts, in instituting proceedings for recovery of unpaid fines, a computer system would appear desirable as well as feasible.

The social scientist might also care to ponder the effect of the delay by a Court in the enforcement of its own orders, on public respect for law and authority.

The same problems affecting the court office just mentioned apply to the offices of all Courts in some degree.

Could the one system assist them all?

A computer system is just as easy, or rather, no more difficult, to design, to keep the books of 300,000 accounts as it is for 30,000. The increase in volume of data to be processed requires little more than provision for extra card or paper tape punching, and program running time.

The New South Wales Treasury payroll system pays about 65,000 public servants including school teachers and police officers. It takes 17 hours computer time per fortnight and data is prepared on six punch machines. The system automatically every fortnight prints and sign 35,000 cheques, makes 15,000 deposits to as many bank accounts, prepares 15,000 cash payments and issues 65,000 advice slips. Unfortunately, no estimates are available of the full time staff which would now be needed to do the job manually, but let us assume that it would number say, 100 including typists and checking officers. A twofold increase in the number of people on the payroll would thus require a doubled salaried staff, or 100 extra officers. The same increase would affect the present computer system only by increasing computer time requirements to 34 hours per fortnight and punching staff to 12 operators.

Just as a computer system can accommodate future expansion in the bookkeeping business of a Court office, the similar work of other Courts can be brought into the one system. Thus a system to solve the problems of the Petty Sessions office mentioned earlier would be less than ideal if it confined its operations to that one office

What could such a system do or how might it be done?

It will be appreciated that no formal system study has been undertaken in regard to this or any other area of Court records discussed in this section of the paper. Particular examples are used by way of illustration only. Possible solutions are suggested to facilitate the explanation of principles which apply to Courts of law generally, and must not be taken as an authoritative forecast of future developments.

Possible systems

With this in mind, a computer system for the receipt and disposal of money in Court might be designed along the following lines.

Assuming the necessary conditions for computer application, sufficient volume of data, and the routine nature of processing, two broad situations may be considered. (a) where the offices of the Courts concerned are under the one roof, or at least in close physical proximity, (b) where the data to be processed must come from several localities or "remote stations". In each case a further distinction may be made between on-line and off-line computer facilities.

In situation (a) with an on-line computer available, all Court accounting records would be kept within the computer. Receipts could be entered directly into the computer by means of a keyboard, or perhaps automatically from cash registers. Payments out could be made automatically by a daily cheque printing run.

It may not be looking far into the future to suppose that the volume of payments may justify direct electronic access to another on-line computer at a bank clearing-house. Money could then be received, accounted for and paid out, an instant after receipt. In the same way regular payments into Court, which can now be made by bank cheque, may be made from such a clearing-house computer, and, after the Court's own records had been adjusted, paid out again.

Regular printouts of exception reports would indicate accounts in arrears and defaulting payers, and could automatically be followed by the issue of process for enforcement. The current state of any account could be instantly ascertained by means of a visual display screen or high speed typewriter.

The more likely situation is where no direct computing facilities are available, and time has to be regularly booked on a computer situated elsewhere.

Records of accounts would still be kept on some form of computer external memory, such as magnetic tape, and adjusted each run. The office would also need some visual record of the state of accounts, and this could be provided by regular printouts of the contents of the magnetic tapes. Operations on accounts would be transcribed to punch cards or paper tape and processed regularly, perhaps weekly. Cheques could still be automatically printed, as could warrants and summons in the case of defaulters.

The second situation where several scattered Courts are to share the same system, raises the problem of transmitting data from the remote office to the computer, and returning the output after processing. With on-line computing, an office having a sufficiently large volume of data to be processed would, most likely, have a data transmitting and receiving terminal linked by landline to the computer. Otherwise, and in the case of off-line computing, resort would need to be had to the mail and perhaps, on occasion, the telephone.

The most likely system

Let us now consider a hypothetical system for processing the receipt and payment of moneys in all Metropolitan Courts of Petty Sessions and Small Debts using the computing facilities of the New South Wales Treasury. It would first be necessary to establish a central data preparation centre where cards or paper tapes would be punched. This could possibly be housed in the office of the Court having the largest volume of data. Details of all accounts in all offices would be punched here, and at the computer centre read to magnetic tapes. The tapes would be kept at the computer centre. Each day copies of receipts issued by each Court Office would be posted to the data preparation centre and transcribed to cards or tapes.

Details of additions and amendments to the records on magnetic tape also would be entered on forms, and posted each day to the punch centre. Copies of the details of any cheques issued direct from the Courts would be treated similarly. Regularly, say, weekly, the punch cards or paper tapes would be run on the computer against the magnetic tape records, which would be updated accordingly. This would be followed by a printing run to issue cheques, summonses and warrants, as required, for each individual Court. A second printing run would issue a statement for each Court showing the current state of each of its accounts. These would all be returned to the data centre, from which the warrants and statements would be posted to the offices of the other Courts.

Once such a system is established it becomes a relatively simple matter to add additional functions for which, on their own, a computer system would not be warranted. Perhaps some Court lists could be printed as a by-product of the bookkeeping runs, and it is more than likely that the information on magnetic tape could provide some worthwhile statistical reports quite easily.

Alimony and maintenance moneys could also be dealt with in the above manner.

There is here, however, an added complication if payments out of a court are to be made only once per week. This is the inconvenience and financial embarrassment caused to payees who would have their weekly cheque day changed. The answer might be to manually issue cheques for those people likely to be affected, leaving the bookkeeping and arrears reporting functions to the computer. If not, closer study is certain to uncover some satisfactory solution.

Transcripts of evidence

The recording of evidence in Court cases is an area where great benefits might be obtained by a computer system. The present method of retrieving records of evidence in the superior courts, which perhaps the best that could be devised in the past, still leaves much to be desired. The shortcomings of this system are most evident in the cases of part-heard actions where a transcript of the day's proceedings is often not available to the presiding Judge and to counsel until late at night. Again, when an absent court reporter's shorthand requires transcribing, no other reporter can accurately read his notebook, and the transcript must wait until his return from leave or country duty. Court reporters are well aware of the shortcomings of the system and much thought has been given to newer techniques, such as sound recording.

The near future

In the joint Commonwealth-State Court Buildings to be erected in Queen's Square, it is proposed that all courtrooms be wired for the possible future use of a system for the sound recording of evidence.

In such a system, monitored microphones would transmit to a central transcribing room where evidence would be typed up as it is given. While this would solve some of the problems of the present systems, it would in so doing, create others. For example, if every word spoken in each of 44 courtrooms is typed, storage for the mass of typed paper coming out of the system would soon be inadequate. Again, the salary of the estimated 140 transcription typists required, for the State courtrooms alone, would exceed a quarter of a million dollars annually.

Is this the only way to remedy the failings of the present system?

The future of court reporting

Leaving aside the question of economic feasibility, how can a computer do the job?

Some sort of record must be made of evidence as it is given, either by writing in shorthand, sound recording or printing on a typewriter or steno machine (which is a form of shorthand typewriter). The steno machine types characters and symbols which can be read back by any shorthand writer. The facility exists for the keyboard to be electrically linked to a distant receiving station where the same symbols can be again automatically typed. It is obvious that instead of typing at the receiving station, the impulses from the keyboard of the machine in the courtroom, could be used to activate a paper tape punch or magnetic tape recorder. These impulses could also enter the appropriate symbols and characters directly into the internal memory of a computer.

How can this information be retrieved?

To print out the characters as they are, would result in printed shorthand in exactly the same form as originally typed. However, if the computer has an English vocabulary in memory, each word of which can be equated with a unique set or combination of steno characters, it becomes a simple matter for the computer to replace, in its own memory, the shorthand with plain English.

A further advantage could be that technical words or proper names, which would be unlikely to be already in the vocabulary, can, at the first occurrence of their use, be typed in such a way as to be spelt out in the steno machine, letter for letter.

Such correctly spelt words, followed by their shorthand equivalent, would be automatically added to the computer vocabulary.

At this stage we would have evidence typed in shorthand on to paper, and also stored in plain English in a computer.

What of retrieval? If no transcript is required, the evidence remains in shorthand and, if required in the future, can be read by any reporter. That part of computer memory, either internal or external housing this evidence is over-written and used in later reports.

But if a transcript is required immediately, or if it is known that it will be required, the computer can print it out, with carbon copies, at up to 1,000 lines per minute.

Just as many users of time-sharing computer facilities may, with apparent simultaneity, use the same computer, a system as described may use the one computer to serve many courts, evidence from each being read into memory, and retrieved if required, with no perceptible delay.

Such is the theory of how a computer may store shorthand, retrieve it and reproduce it in plain English. In practice much work has been done in the United States on systems which marry computer logic with techniques of micro miniaturized optical scanning and matching. The Stenographic Machine Company of Illinois has also been working for some years with several computer companies on a computer transcription system, and has recently announced that it will be in a position, by the end of this year, to offer such a service on an economic feasible commercial basis. What the nature of this system is and whether it has any similarity to the hypothetical system just expounded is not yet known.

The forthcoming Commonwealth State Court building, with over 40 courtrooms, is an obvious invitation for joint action to investigate the possibility of automatic preparation of transcripts.

The best present method of catering for transcripts in such circumstances involves an army of typistes.

The personal opinion of the writer is that an army of typists now is no different to an army of scriveners a century ago.

It seems clear that once the spoken word has been recorded, either as written or typed shorthand, or as sounds or symbols on magnetic tape, or magnetic or optical disks, the interpolation of further human activity to reproduce it, can never be anything but less than efficient.

Jury Rolls

It may be considered that to include the summoning of jurors in a discussion of Court records is to unnecessarily extend the definition of records. Still, jurors are members of the Court, and records of their names, occupations and residential addresses, are used by the Court.

Compiling Jury lists

Present methods, in compliance with the Jury Acts, require the police of each Police District to make out lists of persons in the district eligible for jury service. The lists are examined at a special Petty Sessions and certain classes of persons enumerated in the Act, are removed from them. Copies are then sent to the Sheriff who selects jurors from the lists in response to precepts directed to him from the Courts in the district.

The increasing use of computer systems in other Government Departments means that much information affecting the compilation and maintenance of jury rolls has already been collected, and is available on computer intelligible media, such as magnetic tape.

If we begin with the proposition that every person (or every male person), on the electoral roll in the district is eligible for jury service unless otherwise disqualified, we have only to eliminate disqualified persons, the process of compilation already having been disposed of. The electoral rolls can be copied by card or paper tape punching, onto magnetic tape, and if in the future as seems likely, electoral rolls are themselves produced by computer, a simple computer operation copying one tape from another, would eliminate the punching step.

This first jurors master tape, being an exact copy of the electoral roll, could then be periodically matched against the Registrar-General's tapes which record registrations of death and marriage. This would eliminate deceased jurors and change the names of newly married women jurors. Another run against the New South Wales Treasury payroll tapes would eliminate state public servants.

Similar use could perhaps be made of Commonwealth computer records.

The Police and/or Prisons Department will no doubt in due course have similar computer records available to eliminate criminals disqualified from serving on juries, and the Health Department will have computer records of the registrations of doctors and dentists who are also ineligible for service. The question of the rolls of legal practitioners being kept in this way, has, it will be remembered, already been discussed.

The provisions of the Jury Act relating to the special sittings to consider the list in each district need not be affected. A computer printed list could be supplied to the Police who, having been satisfied that it was prepared in accordance with the principles governing their own compilations, would with few amendments, adopt it as their own and present it to the Court. Computer processing, however, would not end there. Once the lists are forwarded to the Sheriff, the preparation of jury panels for the Courts is itself a major task which might well be taken over by computer. The requirement of the Act for the drawing of cards from a ballot box would be unnecessary– the computer itself making a random choice. At the same time the magnetic tape records of the jurors so chosen would be flagged to prevent their selection again before other jurors still unselected. The summonses to jurors would automatically be printed.

Conclusion

Firstly, it should again be emphasized that the foregoing systems do not purport to be the only way or the best way computers can aid Court reporting and Court records. At best they will each require lengthy and intensive investigation before an optimum system begins to emerge. At worst they will indicate likely areas where, modern trends of increase in population, and extension of service, make some degree of eventual computer involvement inevitable.

Secondly, there remains much to be said. Statute and case law, law libraries, criminal records and statistics, might all be regarded in some degree as Court records and as such warrant discussion in this paper. Also, it will be obvious that even in New South Wales there are other Courts such as Workers' Compensation, Industrial and the rest, which have not been mentioned. Still, the principles as previously expounded apply to all.

Finally, a word of explanation. It is easy for people who become deeply involved in one field of endeavour to forget that their audience, even if on the same technical plane, may find it difficult to follow them. This applies particularly to people in modern electronic and computer environments, where development of new concepts and techniques often outstrip the capacity of the profession to absorb them. As a result "buzz words", impressive but meaningless technical phrases, can be strung together at will, and humorous hoaxes using "buzz words" are not unknown among computer people.

This paper is deliberately intended to avoid confusing the reader. If, however, he feels that he has been talked down to, or even that he has been blasted with "buzz words", in either case it is the writer's fault, and he apologises.

Development of an ADP Project

The various stages of development of an ADP project might be classified as follows:

1. *Informal Discussions:* A Department might consider that there is a potential A.D.P. usage within the Department and Departmental Representatives might have informal discussions with either Officers from the Treasury ADP Service Bureau or the Public Service Board to assist in clarification of their opinions regarding A.D.P.

2. *Departmental Submission to Undertake Exploratory Study:* The first formal approach is a submission from the Department to the Public Service Board requesting approval to undertake an Exploratory Study in a particular area or an overall Exploratory Study of the Department to determine possible areas of A.D.P.
   Even at this stage the Department should be able to give some indication of the possible advantages of A.D.P.

3. *Exploratory Study:* The Public Service Board approves of an Exploratory Study being undertaken and the scope of the Study. The Treasury is advised of the approval and a Bureau Officer is assigned to the project to assist the Department. The amount of active participation by the Bureau Officer depends on the prior experience of the Department in A.D.P.
   At the conclusion of the Exploratory Study a Report is submitted by the Department to the Public Service Board either recommending a more detailed Feasibility Study or termination of the project.
   The Bureau Officer attached to the project should either actively assist with the preparation of the Report or at least be in agreement with its contents as the Report is virtually a Departmental submission prepared in consultation with the Bureau Officer. There may be occasions where there is not complete agreement and if such disagreements cannot be resolved prior to submission of the Report, there should be mention of this fact.
   Suggested contents of an Exploratory Study Report are included in these notes. An examination of the requirements of the Report should give an indication of the areas in which investigation is necessary.

METROPOLITAN DISTRICT COURT

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BULLMAN & ANOR	H.G. PALMER P/L.	42771	BUSHELL	DEPUTY COMMR. TAXATION	39867
BULLOCH	DEPUTY COMMR. TAXATION	41766	BUSTON & ANOR	H.G. PALMER P/L.	4500
BULMER	COLLIVER	5360	BUTCHER	DWYER & ORS	41068
BUNDY	BELL	37554	BUTCHER	GUILDFORD PLANT HIRE	42214
BUNDY	DEPUTY COMMR. TAXATION	38406	BUTLER	BUTLER	38684
BUNIS & ANOR	WHITFIELD	4124	**BUTLER	DOCKER & ORS	27036
BURCHAM	H.G. PALMER P/L.	36721	BUTLER	H.G. PALMER P/L.	37978
BURCHAM	HERMES LEATHERGOODS P/L.	4629	BUTLER	MIRANDA CO-OP TRADING CO.	38173
BURCHER	WALTONS STORES LTD.	37226	BUTLER	STAR FINANCE P/L.	37505
BURCHER & ANOR	FALKS AUSTRALIA P/L.	41307	BUTLER	WALTONS STORES LTD.	39528
BURCHER & ANOR	WALTONS STORES LTD.	39506	BUTLER	WALTONS STORES LTD.	42274
BURDOE	STANHOME P/L.	36769	BUTLER & ANOR	H.G. PALMER P/L.	39110
BURGE	MAURI BROTHERS & THOMSON	41565	BUTLER & ANOR	OKEL	3914
BURGESS	DONALD C. JEFFERIES P/L.	38318	BUTLER & ANOR	WALTONS STORES LTD.	37206
BURGESS & ANOR	AUSTIN FIBREGLASS P/L.	37708	BUTT	A. STILES P/L.	41852
BURKE	ALLIANCE ACCEPTANCE CO.	38578	BUTT	C'WEALTH OF AUSTRALIA	42479
BURKE	DAVIS	4471	BUTT	STACK & CO. LTD.	36775
BURKE	MARTIN & ANOR	4608	BUTT	VEHICLE & GENERAL INSUR.	41115
BURKE & ANOR	C.W. & A.D. SMITH P/L.	39570	BUTT & ANOR	WALTONS STORES LTD.	42314
BURKE & ANOR	H.G. PALMER P/L.	39173	BUTTERFIELD & ANOR	CAMERON	39675
BURLEIGH	WALTONS STORES LTD.	41496	BUTTERSHAW	WALTONS STORES LTD.	36663
BURMEISTER	ST. GEORGE COUNTY COUNCIL	4024	BUTTON	McLAUGHLIN & CO. P/L.	42668
BURN & ANOR	H.G. PALMER P/L.	42772	BUTTON	SOUTH AUSTN WINE DSTRBRS.	39460
BURNE & ANOR	H.G. PALMER P/L.	39174	BUTTON & ANOR	BP AUSTRALIA LTD.	39901
BURNE & ANOR	H.G. PALMER P/L.	40834	BUXTON	COMMR. MOTOR TRANSPORT	5207
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BURNS	CUSTOM CREDIT CORP	40397	BYNEN	WALTONS STORES LTD.	38780
BURNS	H.G. PALMER P/L.	40535	BYRNE	FELT & TEXTILES OF AUST.	5399
BURNS	HEALING P/L.	40131	BYRNE	H.G. PALMER P/L.	37980
**BURNS & ANOR	WALTONS STORES LTD.	32212	BYRNE	STOCK DISTILLERIES P/L.	37793
BURNSIDE	PUBLICITY PRESS LTD.	39705	BYRNE	WALTONS STORES LTD.	41497
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BURRENDONG DAM MARINE	MILLER & WHITWORTH P/L.	40091	BYRNES	STEAMSHIPS TRADING CO.	37609
BURROWS	W. & J. FARM EQUIPMENT	38222	BYRNES & ANOR	H.G. PALMER P/L.	40539

4. *Feasibility Study*: Provided the Exploratory Study Report indicates advantages to be gained by A.D.P., the Public Service Board approves of a Feasibility Study being undertaken. The Feasibility Study is much more detailed than the Exploratory Study which is fairly broad in its approach. A Report is submitted at the conclusion of the Feasibility Study to the Public Service Board and the Board either approves or refuses implementation of the project. The Feasibility Study Report is again a joint Departmental/Bureau Report.

   Suggested contents of a Feasibility Study Report are included in these notes and it should be particularly noted that the Report should indicate both how and whether the project should be implemented.

5. *Design Study:* Whilst the various stages of development up to this point have taken the project closer and closer to the computer, a more extensive Study of processing methods is now undertaken than has previously been the case.
   The object of this Study is to formulate a processing system that will ensure optimum efficiency so far as the department is concerned and also ensure optimum effective usage of the computers.
   The Department submits details of the various progams to be written; estimates of memory and magnetic tape usage of each program and a narrative description of each; the co-ordination of programs into jobs; files to be used; the layout of information on files; print layouts; processing cycles, etc., for Bureau approval.
   The design is analysed by a specialist team at the Bureau and approval given for program writing to commence.

6. *Program Writing and Testing:* This stage can be divided into the following steps:
   (a) Program writing and compilation.
   (b) Individual program testing – each program is tested as a self-contained unit.
   (c) System testing – all programs which make up a particular job are tested to ensure co-ordination between each program.

7. *Simulated Production:* All jobs making up a system tested under simulated production conditions. This is a most important step as it tests both the ability of the Department and the Bureau to meet processing requirements when in production – e.g. efficiency of operating instructions, Departmental ability to meet deadlines for preparation of data, the Bureau's ability to meet deadlines for processing, Departmental ability to satisfactorily prepare data and handle output, etc.

8. *Regular Production:* This speaks for itself and is the ultimate goal of all developmental work.

9. *Maintenance of Programs:* Despite all preliminary planning, program testing, etc., prior to production it is seldom that a project once in production, does not at some time require modification of some sort. This may be caused by changed circumstances which could not be anticipated during the developmental stage, a review of processing methods, etc.

It is, therefore, necessary to cater for the fact that some maintenance of programs will be necessary. The necessity for maintenance of programs emphasizes the importance of effective documentation of the programs and the system so that officers, who may not have been engaged in the development of the project can carry out any maintenance necessary.

10. *General:* As the Department, the Public Service Board and the Treasury are all concerned with the development of a project, an ADP Co-ordination Committee comprising representatives of the above offices, is established immediately a project is approved.
This Committee meets regularly throughout the development of a project to review progress, discuss problems arising from the project and generally ensure an interchange of information between the members of the Committee.

Exploratory Study

Approval for Exploratory Study:

The Public Service Board approves of an Exploratory Study following a submission from a Department. As the Public Service Board is responsible for the efficiency of the Service and determination of staffing and usage of staff, it must be the body to decide whether the investigation into a possible change of methods is desirable and whether the transfer of staff from their normal duties to such an investigation is warranted.

Purpose of the Study:

The purposes of the Study are to determine whether there appears to be sufficient advantages of conversion to A.D.P. to justify the expense of a Feasibility Study and implementation of a proposed project, and to determine the areas in which a Feasibility Study or Studies should be conducted.

Terms of Reference:

The Department's proposal to the Public Service Board should and the Board's approval will outline the areas of the Study and determine its scope. During the study of the areas stipulated it might be determined that the scope should be extended but unless such extension is only minor, Public Service Board approval should be obtained.

No precise formula can be laid down to say how long an Exploratory Study should take or the amount of detail that should be covered but as some guide it might be expected that the Study would be completed in 2 to 8 weeks depending upon the project and staff availability. Generally speaking, an Exploratory Study maintains a fairly broad approach but it must be long enough and detailed enough to determine whether A.D.P. appears to offer advantages sufficient to offset the costs associated with a Feasibility Study and implementation.

The Departmental submission to the Public Service Board will often give some idea of the potential advantages of A.D.P. and refer to the deficiencies of the existing system but these will be enlarged upon in the Exploratory Study Report.

Contents of the Exploratory Study Report:

The following points should be covered in the Report. The list is not necessarily exhaustive but is considered the minimum that should be covered.

A. *Index to Contents*

B. *Introduction and Recommendations.* This section would normally be fairly short and would contain the following:

(a) A Report on the scope of the Study with reference to the Public Service Board approval.

(b) The officers who have undertaken the Study.

(c) The duration and time of the Study

(d) A statement as to whether it is considered that the advantages of A.D.P. warrant further investigation and the particular areas which are considered worthwhile. A reference should be made to the section of the Report covering the advantages that are expected to be achieved.

(e) Any significant features regarding the plan for development of the project such as:

(i) timetable of development;
(ii) staffing requirements;
(iii) special accommodation;
(iv) special equipment;
(v) changes of departmental policy or objectives;
(vi) training within the department;
(vii) changes of legislation.

(f) A recommendation for proceeding into the Feasibility Study Stage or terminating the Study at this point.

C. *Existing System.* An explanation of the existing system, with diagrammatic presentation if necessary, to explain:

(a) the objectives and present methods generally;

(b) organizational structure; staff, equipment, etc., at present used;

(c) information flow:

(i) statistics of processing performed – including the processing cycle;
(ii) anticipated growth in processing;
(iii) repetitive tasks performed which would be suitable for a computer.

D. *Analysis of the Existing System*

(a) *Achievements*

Are the objectives met?

(b) *Deficiencies*

(i) Delays in meeting objectives.
(ii) Inaccuracies.
(iii) Unsatisfactory service to Management or the Public.
(iv) Legitimate complaints of inefficiencies.
(v) Excessive or consistent overtime.
(vi) Any *desirable* objectives not attempted because of lack of staff or any other reason.
(vii) Does existing system provide adequately for the growth factor?
(viii) Is the existing processing cycle satisfactory.
(ix) Is staff used to the best advantage, e.g. is staff engaged on work not suited to their qualification? Is staff engaged on purely routine work which could be better done on a machine?
(x) Is equipment at present in use efficient and sufficient?

E. *A.D.P. System.* A broad description of how processing would be performed by A.D.P., with diagrammatic presentation if necessary. This description would be necessarily broad in its approach and would only attempt to show runs that might be performed but not individual programs that would be included in the runs.

F. *Anticipated Advantages of A.D.P.*

(a) *Economies* – A cost comparison between the existing system and the proposed ADP system. The proposed ADP system should include costs of the Feasibility Study and implementation.
This comparison will probably be mainly concerned with staffing and cost of computer usage although if expensive equipment is involved (e.g. multiple bookkeeping machines used, etc.) this should be brought into consideration. At this stage it is necessary to make estimates of costs but not with the same degree of exactitude as will be the case in the Feasibility Study Report. In any cost comparison the salaries of Systems Officers, Programmers, Data Preparers and Controllers is a significant item both in the development of a system and in its maintenance after implementation.
In comparing the costs of the existing system with a proposed ADP system, consideration should be given to the degree in which the objectives of the system are met and what additional costs would be incurred under the existing system if all of the objectives were to be met.
If it is obvious that there will be no savings but an ADP system seems worthwhile on other grounds, there should be no hesitation in reporting in this vein.

(b) *Improved Efficiencies* – These might be much more significant than economies and could outweigh additional costs that will be incurred by ADP.

1. Can additional services be obtained? (*BUT* they must be desirable services – not simply additional services which nobody will use).
2. Will the existing service be improved?
3. Is the growth factor better catered for by ADP?
4. Can ADP achieve a better processing cycle – either more frequently or less frequently depending upon the desirability?
5. Can ADP eliminate unnecessary processing or reporting?
6. Can ADP ensure better employment of staff?
7. Will the improved accuracy and reliability of ADP be advantageous?

Feasibility Study

Approval for Feasibility Study:

The Public Service Board approves of a Feasibility Study following an Exploratory Study Report submitted by the Department. The Board exercises the authority for approving a Feasibility Study for the same reasons as it approves the Exploratory Study.

Purpose of the Study:

The purpose of the Study is to determine firstly whether there are advantages to be gained by transferring work to ADP and to determine methods of conversion. This Study might be better known as a justification study – anything that can be reasoned out by the human mind can be done by on a computer *but it is not necessarily worthwhile doing on a computer.*

Terms of Reference

The scope of the Study has been determined by the Exploratory Study Report and the terms of the Public Service Board's approval for a Feasibility Study.

Contents of a Feasibility Study Report

The following points should be covered in the Report. The list is not necessarily exhaustive but is considered the minimum that should be covered.

A. *Index to Contents*

B. *Introduction and Recommendation*

(a) A description of the scope of the Feasibility Study with reference back to the Public Service Board's approval.

(b) An indication of the officers who have undertaken the Study.

(c) The duration and time of the Study.

(d) A statement as to whether it is considered that the advantages of ADP warrant implementation with a reference to the section of the Report where the advantages are detailed.

(e) Any significant features regarding the plan of implementation. Some of these features will be covered in more detail in the body of the Report.

(i) Timetable of development.
(ii) Staffing requirements – systems officers, programmers, data preparers, data controllers, etc.
(iii) Special equipment required.
(iv) Changes of Department policy or methods.
(v) Training within the Department.
(vi) Accommodation requirements.
(vii) Changes of legislation.

(f) A recommendation for either proceeding into implementation or terminating the Study.

C. *Existing System*

The Exploratory Study Report would have contained some explanation of the existing system and its objectives, etc., but as the whole contents of the Exploratory Study Report are based on a fairly broad study, the more detailed work that has been carried out during the Feasibility Study will probably indicate that further comment is necessary in this area.

D. *Analysis of the Existing System*

The same comments apply to the analyses of the existing system as to previous section of the Report.
The Exploratory Study Report would probably be of a more general nature than comments made in the Feasibility Study Report but the same guidelines would apply.

E. *Proposed A.D.P. System*

(a) Objectives of the proposed ADP system – what is the ultimate goal of ADP? Particular emphasis should be placed on any objectives of ADP that differ from the existing objectives of the system. This would normally be a confirmation of the proposals contained in the Exploratory Study Report with possibly additional comments.

(b) Processing design of the proposed system. This will provide a narrative description and diagrammatic presentation of the proposed ADP procedures. This design will be in greater detail than was given in the Exploratory Study Report and will show proposed programs within jobs, usage of tapes, etc.

(c) An estimate of the computer time involved when in production.

(d) Proposed processing cycles with reasons for varying existing processing cycles if such is the case.

(e) Proposed printouts – including stationery layouts and the intended use of such printouts – use of exception reporting.

(f) Information to be contained on the various files.

(g) Choice of input media and reasons for such choice.

(h) Controls to be included in the system.

  (i) to ensure accuracy of input and output;
  (ii) audit controls if necessary.

(i) Facilities for handling inquiries within the computer system if this is a pertinent point.

(j) Security aspects – any special requirements for retention of magnetic tapes; any historical information to be held in storage on magnetic tape.

(k) An outline of the Departmental procedures so far as preparation of input and usage and control of output, highlighting any changed procedures involved.

F. *Advantages and Justification of an A.D.P. System*

(a) *Economies:* A comparison of the costs of the present system as compared with the proposed ADP system. This comparison should be more detailed than was shown in the Exploratory Study Report and should include the following factors:

Present System	*ADP System*
Staff engaged at various levels	Systems Officers and Programmers in the development of the system; Systems officers and Programmers in the maintenance of the system; Data Preparers and Data controllers in the maintenance of the system.

Present System	*ADP System*
Cost of equipment at present in use and costs that would be entailed in replacement or expansion if the present system is maintained.	Input equipment required and any special equipment for output (envelope inserters, etc.).
Stationery at present in use.	Stationery required for an ADP system.
	Computer tie involved in both development and production.
Additional costs that would be incurred if all objectives proposed for the ADP system were obtained under the present systems or any alternative system other than ADP.	
	Training of Departmental staff in new methods.

Costing might be done on the estimated life of the system. It would be reasonable to think of a maximum of 5-7 years as improvements in computers, changes in legislation, changes in Departmental administration and requirements could occur necessitating drastic changes in the A.D.P. system. An effective method of comparing costs is to present year-by-year statements of the costs of the existing methods and the proposed ADP methods. It might well be found that in the first or second years (because of developmental expenses etc.) that the costs of ADP are higher; a break-even point is reached and thereafter ADP shows advantages.

(b) *Improved Efficiencies:* The following advantages might be regarded as intangibles and it is difficult to place a money value on them but wherever possible a cost figure should be applied. A Feasibility Study might well find that purely on a cost basis ADP is more expensive than any existing system but because of one, some or all of the following advantages, the intangible benefits might outweigh any cost increase. There should be no hesitation in stressing the fact that purely on a money basis ADP does not seem to be advantageous but stress the fact that other advantages considerably outweigh the money considerations.

- (i) Increased accuracy and reliability.
- (ii) Possibility of coping with peak loads.
- (iii) Improved service to Public or Management.
- (iv) Improved goodwill.
- (v) Scope for expansion.
- (vi) Better processing cycle.
- (vii) More Management information obtained.
- (viii) Better usage of staff.
- (ix) Elimination of back logs of work or overtime.
- (x) Possibility of obtaining information that either could not previously be obtained or if obtained previously was too late to be of value.

G. *Disadvantages of A.D.P.* There are undoubtedly some disadvantages attaching to ADP and these disadvantage should be covered in the Report. Possibly the greatest disadvantages is that there will be a certain amount of disruption within the Department to convert to ADP. Staff will have to be trained in new methods, some staff might be required to be moved from their existing positions to other positions, etc.
ADP almost invariably means that the amount of visual records available to Departments is reduced but this factor should have been covered in the Feasibility Study and the Department should be in agreement with the amount of printed Reports that are going to be produced.

H. *Alternative to A.D.P.* The Report should include a section dealing with any methods other than ADP which were considered and should include discussion on the advantages and disadvantages of such alternatives.

I. *Summary of Advantages and Disadvantages of A.D.P.* A Section summarizing advantages and disadvantages should be included so that any officer who desires to gain an overall impression of the proposal can do so without reading the detailed explanation of advantages and disadvantages.

J. *Changes in Legislation.* This section should deal with any desirable changes in legislation, indicate the advantages to be obtained by such changes, whether action is proceeding for the changes and whether the ADP system is planned to cater for the changes envisaged.
If no changes are proposed but it is obvious that changed legislation would affect the ADP system, the Report should include comments as to what variations would be required to the ADP system.

K. *Planning for Implementation.*

(a) Staffing – the Report should include recommendations on the staff required for implementing the project and this recommendation should include Systems Officers, Programmers, Data Preparers and Data Controllers and a reference to the fact that a separate submission will be made regarding the appointment and training of such staff.

(b) Timetable of Implementation – this should include:

(i) Stages of development of the project. The project might be divided into stage 1, stage 2, etc. and it is proposed to implement the stages at different times.
(ii) Time for completion of the design study.
(iii) Time for completion of program writing and testing.
(iv) Estimated date of production.
(v) Essential deadlines for production.
(vi) Time for purchase of data preparation equipment.
(vii) Time for requisitioning of stationery.
(viii) Time for commencement of data collection.
(ix) Time for appointment of special staff.
(x) Departmental training programmes.

PENAL STATISTICS

*P. G. Ward**

Crime, as everybody knows, costs the community money. A recent estimate of the cost of crime in Australia stated that a conservative figure for the immediate cost was $350 million. At least one tenth of this cost is involved in maintaining the police, court and prison services. Added to the costs met from taxes, are the costs of insurance against theft and damage and the losses incurred by the uninsured. With operations of such a size, it seems proper to examine in what ways computers might be used to aid in more efficiently carrying out some of the functions of the various arms of the penal services.

The Police Force

The prime objective of the police is to develop efficient methods for apprehending people who break the law. Some of the main tools used in this work are the fingerprint files, the "modus operandi" files and the lists of stolen property.

The fully automatic pattern recognition by the computer of anything as complicated as a fingerprint appears to be a long way off. It might be possible to speed up the search process somewhat by recording the fingerprint type and spacing between ridges on a random access disc, but only rarely would this speed justify the cost.

Modus operandi reports are readily handled by computer and, in some United States' cities, this method is used, the computer being programmed to search its files for recurring patterns. Some success with this technique has apparently been achieved.

The major area for use of computers by the police at present is in providing quick feedback of information on stolen property, especially cars. With direct access devices operated by phone, it is possible to have the information available to answer an inquiry from an investigating officer within seconds. This may be crucial in allowing the officer to hold a suspected person. Of course, teething troubles may occur and we should learn from the American experience, where citizens have been arrested because the car they were driving was wanted because of an overdue parking fine.

A second function, which the police see as secondary to their work, is to provide statistical information on the numbers of complaints of crime coming to their notice and cleared up by them. This is at present a time-consuming procedure, involving policemen in work which they see as interfering with their more important functions. It should be possible with a computer and careful

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design of the methods of recording to introduce a system whereby more information should be obtainable, quicker, with less paper-work than is necessary at the moment.

The Courts

The use of computers to arrange court schedules will be discussed elsewhere. The computer, however, can also be adopted as an aid for sentencing.

Sentencing is a complex process, involving many factors in each individual case, but two general principles can be asserted to which the use of computers are relevant. The first principle is that, given two persons of essentially the same previous record and committing the same offence, the sentence they receive should be independent of the court in which they are sentenced. There exists, of course, the right of appeal by either the accused or the Crown, which will ensure that the final decision should meet this criterion adequately, but the extra cost of appeal means a different burden on some offenders. Large disparities in sentences for similar offences create more work for an already busy Court of Appeal. The effects, on both the person who receives the large sentence and becomes embittered and upon the person who receives the small sentence and feels he has outsmarted the system, are equally to be deplored.

The courts, at the moment, are having standard statistical sheets prepared for each case, and it would be possible to use this information to provide a set of background material in a computer memory which judges could interrogate to learn the general behaviour of courts in particular types of cases. More information on the seriousness of the crime would have to be provided, however.

The position of the judge, on receiving the computer information on average sentence in this case and general range of sentences imposed, would be very like that of a physician in a modern U.S. hospital. Here, when a physician prescribes a drug, the computer checks that the drug and rate of dosage are the ones generally prescribed for a patient of this age and illness; if a difference is found the computer queries the dosage and this physician has to deliberately state that the dosage was as intended. In the case of the judge, he could raise or lower the sentence as he felt fit but would realize that he would probably have to produce his reasons for the subsequent appeal.

The second principle in sentencing is that, although it must be admitted that the basis of sentencing is to find the correct quantum of retribution to impose for a given act, within this framework of retribution, which limits the greatest and least amount of punishment that can be imposed, the judge should be seeking the sentence which will provide the maximum probability of acting as a special deterrent. This requires that information of follow up studies should be obtained and it is here that a computer would be able to provide a means of checking through the records in its store in order to see just how certain penalties have worked when compared with the expected recidivism rate of the group to which it is applied.

Penal Agencies

Here again the main use of a computer would be in making readily available information about recidivism. Most prison authorities recognize as part of their function the need to try and ensure that, within the limits set by social attitudes, prisons should attempt to release people into society with the least change possible of offending again. For this reason educational programmes, discussion groups and work-release programmes, to name a few innovations, are set up.

One can evaluate such programmes in either of two ways. The first method is to prepare a "short list" of people eligible for a given programme and then to randomly select from this group those to be placed in the experimental group and those to be placed in the control group. The second method is to use information from all the prisoners to try to predict the expectations of groups given different treatments and to compare the results with expectations.

Methodologically, the first method is by far the superior but meets opposition because of a disinclination to determine people's fate by lot. The problem of crime, however, is at least as serious as the war in Vietnam and will certainly be with us for far longer. As there appears to be no ethical difference between selecting prisoners by lot to obtain reliable information about the efficiencies of treatment procedures and selecting conscripts by lot to satisfy the needs of defence, it may be hoped that public prejudice in this manner may be overcome when the matter is given mature thought.

Combined Penal Statistics

At present, much work is done in processing information about prior record for cases coming before the Court. It is possible, although a proper study of feasibility would have to be carried out, that the capital cost of a computer with a large random access memory store on which the prior records were kept could be justified. Land lines could connect the Courts, the Probation Service, the Parole and Classifications sections of the prisons, the Child Welfare Department, etc., directly to the central computer which would probably be controlled by the police. Special sections of memory could be also allotted to each user for their own purposes.

Such a scheme would allow quick access to records while releasing policemen from what is essentially office work to more productive tasks. It would also be possible to check background information from different sources for consistency. The main benefit from a research worker's point of view is that such a system would enable the crime careers of groups of criminals to be studied effectively. The present position is that it is impractical to try and do comprehensive follow-up studies except to check on the return to the same institution. Much information is usually available but so spread out that the work of assembling the whole is immense.

While this paper has concentrated on what computers might do in aiding collection of penal statistics, simply installing a computer is not the answer to all problems. Probably the most important lack in the various branches of the penal

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services is of anyone whose *primary* function is examining the methods of collecting of statistics within that service. It is hoped that when the proposed section for Research into Criminal Statistics is set up by the State Government that the problems of streamlining the collection of statistics and of dovetailing the information obtained from the different services will be placed high on the list of priorities.

Computers cannot solve all problems. It has been argued that for adequate research into problems of special deterrence, i.e. of the criminal himself, they will be of inestimable value. When general deterrence, i.e. crime rate in the community, is studied however, simply collecting crude rates of reported crimes, such as the computer would produce, is insufficient.

For example, if a particular magistrate raises penalties for traffic offences arguing that this will act as a general deterrent, an observed fall in charge for traffice offences may not mean less offences being committed but that some policemen are using their discretion more and only arresting the most flagrant violators. To study this problem one would need to pick matched sites in different districts with similar road conditions and traffic flows. One would then check the average speeds of vehicles at each site and the number of traffic code violations recording the vehicle number of the violator. The registration numbers could be checked to separate local from other district cars and any difference in traffic behaviour in the two areas compared. Only in this way can general deterrence be assessed.

Similarly, with sex crimes, changes in rates can only be assessed when estimates of the numbers of unreported offences are made. Completely confidential interviews are the only way in which any assessment of these occurrences can be obtained. These surveys are probably better carried out by university groups such as the Kinsey Group (well endowed by outside funds).

It is hoped that this brief survey of the field of penal statistics has given the reader some idea of the problems inherent in the effective study of this subject.

DIRECT ACCESS METHODS FOR COMPUTER USERS

*G. W. Grimsdale**

Introduction

Since the first electronic computers were introduced in the late 1940's we have been witnessing the development of an increasingly fruitful partnership between man and the computer. In such a short time, the information systems built around the computer are creating their quiet revolution in human society. As we have heard from previous speakers in this Conference, the computer is already taking on the mathematical drudgery of operating a large, industrialized economy. They are making business firms, governments, educational institutions, and national defence operations much more efficient. The computer is the intellectual tool that will allow each of us to deal more successfully with the growing complexities of daily living. Our challenge is to make this technique available to every business, government, school, and profession that can benefit from its use.

The Developing Partnership

The first electronic computers were developed primarily to assist the technical user, mainly the ballistician and the astronomer, to obtain numerical solutions to equations. Gradually techniques and machines were created to widen the technical areas of application and to allow us to bring new insights into natural phenomena. Scientists, engineers, and mathematicians accept as a matter of course their dependence on the computer.

The power of the computer to process data and provide information at fantastic speeds soon had them being used for the routine processing of the huge volumes of data that are required in the administration of the large complex organizations of our modern society. Gradually the computer's role is being developed further, as increasingly important use is made of these information systems in policy decision-making, both in government and business.

Because of the expense of the computer equipment, and its operation, it was feared that they would only be useful in the very big organizations. Events are proving otherwise. The ingenious use of small computers, and, even more important, the development of time-sharing information services, has meant that computer-power is within easy, economical reach of businesses of all sizes. It has recently been said that, through these innovations, the electronic information system may be the "great equalizer" – enabling the small organizations to match their larger competitors in productivity and technological development.

What I intend to cover in the remainder of this talk is a general review of computer "time-sharing", what developments we may expect in this area in the future, and why this area of computer utilization is regarded as the greatest development in the partnership between man and the computer.

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What is Time-Sharing?

Time-sharing means the simultaneous use of a central computing facility by many remote users. This is a reasonably new computer technique, which has been of practical use for only a very few years, and which is now receiving probably the greatest attention for developments of the utilization of computers in the future.

Time-sharing began as an economic necessity. The size and cost of powerful computers always have dictated the widely prevalent practice of sharing time and services at computer centres. These bureaus are normally run in what is called the "batch" mode of operation. In this mode a string of jobs is performed on the computer sequentially. This means that the user has to wait until his turn on the system arrives before he may have access to the computer facility.

The turn-around time normally associated with a computer bureau is of the order of a few days. The user, however, usually requires a much shorter time scale in his access to the computer. This is especially so in the case of the technical users who require answers as soon as possible to the small problems which make up the bulk of their applications. Also, the user who wishes to interrogate some body of information stored within the computer system usually requires the answers in real time; where this term refers to obtaining the information in time enough to use it.

It was through these two major reasons, the cost of the equipment, and the turn-around time on computer bureaus, that computer time-sharing systems, in their present context, were developed.

The technique of time-sharing divides the use of a large central computer among the subscribers, each operating from a remote terminal in their office or work-place. Each user apparently has immediate access to the central computer, thus giving the appearance of their having exclusive use of the central computer installation. In actual fact the computer in handling a large number of subscribers at the same time, still treats the users in its current work load in sequence, but "hops" back and forth among them in such a fashion that the response appears immediate to each user.

In using a time-sharing computer system the user communicates to the computer via some communication medium, normally the local telephone network. The responsive operation between the computer and the human being at a remote terminal frequently is referred to as the "conversational mode", which is a key feature of this type of system. The user conducts a conversation with the computer to describe the problem to be solved, or the data to be accessed. Both the computer and the human have unique contributions to make in the conversation to solve the particular problem; the computer with its tremendous computational power, its ability to store and retrieve vast amounts of data, and its speed and accuracy; the human in the area of being able to exercise judgement. The response time required by the system must be in seconds, at best within human reaction time, and certainly within normal human interest span.

The General Electric Time-sharing System

To give you some idea of the tremendous impact computer time-sharing is having throughout the world let us see what has happened in General Electric. The first GE Time–Sharing System was installed in the United States in 1965. Now there are such systems in every major city inside the U.S. with about 50,000 subscribers. Outside the U.S., we have systems installed in most of the major European cities, and the same G.E-265 System was officially opened on 18th March, 1968, in Sydney. General Electric now has developed, in the space of three years, an international time-sharing network.

The system installed in Sydney, has the central computer located at our offices at 103 York Street. The subscribers to this system have remote teletypewriter terminals installed in their offices, and which are able to be connected to the computer by the P.M.G. Telephone Network. When the user wants to use the computer he merely dials the telephone number of the computer then commences to conduct his conversation with the computer using the teletypewriter terminal. Up to 40 users may simultaneously be accessing the central computing installation without anyone of them being aware of other users sharing the system.

The terminal may be placed anywhere that a telephone may be installed, and can be used to communicate from there to the computer. General Electric has frequently conducted conversations from a terminal installed in Scotland to a computer in New Hamshire, U.S.A. In May, 1966, Australian General Electric conducted a conversation with a computer in Phoenix, Arizona, using a terminal installed in Canberra. Probably, as I am speaking, a terminal is being used in Melbourne to solve problems on our Sydney system.

You may well ask what is this GE-265 Time-Sharing System being used for, and who is using this system. Let us have a brief review of some of the applications of this time-sharing system.

Education

The first GE-265 System, similar to the one now installed in Sydney, was developed by General Electric in association with Dartmouth college in the United States. This system was primarily developed to teach students to use a computer as an essential part of their liberal education. The importance of this aspect of their education was recently stressed by a 1967 statement of the U.S. President's Scientific Advisory Committee, which said:

> "The handicap of a lack of understanding and skill in the use of computers is extremely severe in all areas in which data analysis is vital, in learning as well as in practice – in business, in the social sciences, in psychology, in geology, in the health sciences, for example. In a very real sense, students who have not learned to use computers are badly equipped for the postbaccalaureate world."

Professor Kemeny, of Dartmouth, goes even further when he recently said: "in the next generation, knowing how to use a computer will be as important as reading and writing."

The use of the system at Dartmouth has proved an outstanding success in teaching students how to use a computer and over 80 per cent of all students on the campus in June, 1968, have had a first-hand experience with the system. Through the technique of time-sharing, Kemeny has led the way in showing that "computer-power" can boost "learning-power", and now more than 100 colleges, universities and secondary schools use GE time-sharing systems in their instruction.

Australian General Electric recently conducted an experiment with the N.S.W. Department of Education at Randwick Boys High School using the time-sharing system. After about two hours instruction to a group of ten 5th and 6th form boys, everyone of them set to and wrote successful programs to solve problems from their mathematics curriculum. The experiment showed quite dramatically the power of time-sharing to assist in education as well as stimulate interest and the logical development of the students.

The Technical User

Once the power of time-sharing was discovered for the solution of technical problems it was the technical user – the mathematician, engineer, and the scientist – that is people who can think of their problems in terms of an equation, who immediately demanded this service. They are the main users of this system today. The impact of time-sharing on the technical user has been nothing if not dramatic.

In a world where we are continually lacking technical personnel to help increase our development, we require a tool that will allow the technician to do more creative work and to do less of the routine, tedious, and repetitive "hack" calculations that make up a large part of their tasks. This tool is the computer, and the time-sharing system makes this tool practical to use.

To give you some idea of the impact time-sharing can have on the technical users, in General Electric, where we employ over 20,000 engineers, time-sharing is applied wherever possible in the work that they do. Recent reports indicate that the use of this system has increased the productivity of the engineer from 50 per cent to up to 500 per cent in some areas. Along with this increase in productivity, experience to date has shown that the system can also help the engineer to create better designs, which may incorporate new features of safety, economy and efficiency; features which he strived for but could not obtain without a flash of brilliance or a superhuman calculating effort.

Business and Industry

The enthusiasm of the technical users has certainly been contagious, and more and more functions of business and industry are being developed on time-sharing terminals. The management scientist, the operations research worker, the industrial engineer all have applications immediately suitable for use on time-shared computer systems.

There can be no doubt that management generally is adopting more sophisticated approaches to their processes of converting information into action, i.e. decision-making. The application of mathematics to management means that somewhere or other calculations are involved; enter the computer. Once again time-sharing makes these calculations practical. In General Electric, as well as in many other organizations, the time-sharing system is being used to do such routine chores as forecasting, budget studies, scheduling plant and personnel, investment analysis, project control, simulation, and all the avenues leading to a decision of the communication of results. Management now has the opportunity to explore alternative decisions through this system, and more than one large organization in Sydney is using it, for what they call a "What-If" machine.

The more the time-sharing computer is used, the more that is demanded of it. The computer's prime ability is for computation, BUT, and this is a very big BUT, the computer has a tremendous capacity for storing information, for subsequent retrieval. Time-sharing presents plug-in computer power, and perhaps can be regarded as a step towards what may be called a "computer utility". To plug in, using a system like time-sharing, to a vast body of information extracted from the mass of data that floats around our society brings in the concept of what is called the "information utility". Can we, or will we be able to, time-share and cost-share such data banks?

Let us briefly look at some of the possibilities and developments of the "computer utility".

Hardware

Computers are getting faster, and the cost of using computers is definitely getting cheaper. Over the last 15 years computer speeds have increased by a factor of 1,000 to 1, whilst costs have gone way down by about 400 to 1. These trends will definitely continue.

During this period memory capacity of computers has increased by 1,000 to 1. That is in internal memory. It is in the area of backing storage, the mass storage devices where the banks of data are to be stored, that a major breakthrough is required if we are to set up the "information utility". The capacity of magnetic discs and drums has increased in the last few years. Large magnetic storage devices present manufacturing problems, however, and these are reflected in their prices. What is required is a relatively fast random access device, of extremely large capacity, and offering very much cheaper cost per unit storage than present devices if we are to set up the huge data banks necessary to make the ultimate concept of the information utility feasible. With the present equipment, however, much can be done as witnessed by the banking, airline reservation, market analysis, and credit reference systems already in existence.

The possibility of a few very large computers serving the entire community's processing needs would appear to be the aim of the computer utility, which would take its place beside utilities for power, light, and telephone services. Before such a concept may be realized a lot of pioneering work still must be done in the processing equipment, mass storage devices, and software necessary for its implementation. Communications charges must also be reduced.

Software

The question is often asked: "Is today's software keeping up with today's hardware?" The answer is usually given as a most emphatic NO! In looking for trends in applications, the problem is not usually so much the hardware. Are we taking full advantage of yesterday's innovation? The big challenge is to use available equipment more imaginatively.

In our GE-265 System we have the software to perform most adequately the time-sharing of the computer, at the same time permitting ease of conversation with the user. We could extract little more power from the system with any software improvements; but this has taken many, many man – years of programming to achieve.

The human programming effort required to establish anything approaching the idea of a computer utility, capable of handling all the processing applications of a community, and protecting the vast files of data required by that community, will be staggering to say the least. We are getting there slowly however. Every day a new advance is made in the software systems necessary to run the computer and maintain its data. Some fantastic developments have already occurred in the large defence and business organizations, with their vast communications and integrated computer networks, which make the idea of the utility a very much closer practical reality.

The Future of Time-sharing

The future of time-sharing computers is the future of the computing utility. Whether the information is set up in these systems is dedicated to isolated applications or can be integrated to the ultimate concept of the information utility remains to be seen. Let us have a brief look at some of the possible developments generally in these areas.

The present time-sharing systems throughout the world are not interconnected. There is no real reason why they should not be except the cost of communication. What we may expect in the future is a network of very large interconnected time-sharing systems each capable of communicating to each other, mainly for the purpose of sharing the work-loads, but also for transmitting data for maintenance purposes. On a world-wide basis this communication may be by satellite; already many experiments have been conducted successfully in having computers talk to one another by this rapid means of data transmission. One can imagine this network of computers having computing power, somewhat akin to all electrical power grid system.

Each of these systems will have a huge mass memory capable of storing vast amounts of data from groups of individuals, or even the local community. For example, banks may keep their records on the system, with the bank's clients able, through an appropriate key, to obtain current balances and maybe even to initiate transactions; this is the concept of the chequeless society.

The potential areas of application for the information bank are many and varied and fairly obvious. Credit references, legal libraries, in fact any library used by professional men, market research data, medical information, economic statistics, are but some of the possible data files that may be stored. The information will have to be protected from invalid access. Techniques for controlling access to information stored in a computer system exist today, and more fool-proof and tamper-proof techniques are being developed.

Time-sharing offers the best opportunity for personal use of computers. Gradually the use and application of this way of using computers will be integrated and developed to a point where it will be necessary not only to have a means of access to a time-shared system from each business office, but also from most homes. The potential of the computer to handle information, and the integration with the telephone or data transmission services may mean that even our daily newspapers may be delivered to the home by transmission to the terminal in the living room. The children's schoolwork may find a terminal necessary for homework. All banking transactions for payment of accounts could be performed on the terminal. There are limitless possibilities in such a system where, not only can one use a terminal to access computer power, but also all that information necessary for the efficient operation of our society either at the individual or the organizational level.

What can make this a reality now, and what factors are impeding the development towards such a concept? They would appear to be:

1 *Costs.* Lower costs of the computer and the terminal equipment. Perhaps more important at the moment, lower transmission costs of data, which are showing no significant downward trend.

2. *Standardization.* The requirement for standard hardware, software, and data designation among users sharing a common data base.

3. *Security.* The perfection of the hardware and software systems necessary to provide complete privacy and security for users is a problem, but it is demonstrably feasible. To convince users of this guaranteed security has and will continue to be a problem.

Conclusion

It would seem that time-sharing is leading the way in the continually developing partnership between man and the computer. Whether we like it or not, we are definitely heading for the establishment of computer utilities *and* information utilities.

We cannot, however, design hardward and software without taking into close consideration the operation of the community that is served by the computer system. It is this close coupling of the community and the operation of the computer system where the most dangerous traps and the greatest opportunities lie. The present computer time-sharing systems are serving only some of the needs of our society. To extend these systems to something approaching the ultimate concept of the computer utility will mean travelling over some very rough ground, but the worst part of the journey seems now to be behind us.

APPLICATION AND PROBLEMS IN INSURANCE

*L. Carroll**

Most articles dealing with the development of the digital computer for commercial use list the earlier applications as payroll, stock control and insurance. The references to insurance, however, relate to the use of computers for the processing of life assurance where alterations during the currency of a policy are not such a great problem and where there has been great concentration of repetitive tasks.

For quite some years now the major life offices both overseas and in Australia have used data processing methods and in many cases these systems have been developed in a highly sophisticated manner. It is now quite common for these offices to have systems which not only carry out all daily processing, accounting and statistical analysis but also extend into actuarial fields.

In the general insurance field the use of computers for file maintenance and billing is still comparatively new. In Australia the general offices have been very slow, if not even reluctant, to switch to computers. This is not altogether surprising and there have been a number of factors for this. Some of these are:

1. By tradition insurance has been a highly personalized service.
2. Some attempts to process general insurance by means of computer have failed e.g. the Commercial Union Group in England.
3. Insurance applications involve the problem of long records with low percentage activity.
4. The very nature of the business does not lend itself to batching and demands frequent updating.
5. The amount of printing involved in relation to other processing.
6. The high incidence of alterations.

It was not until 1962 that the first attempt at issuing renewal certificates and agents accounts by some form of data processing was made. Some years were to pass before further real progress was made and it was December, 1964, before a general insurance office in Australia actually began processing general insurances by means of an electronic computer using magnetic tape. It is pleasing to record that this distinction belongs to the Government Insurance Office of N.S.W.

In recent years there has, however, been a dramatic change in thinking with the result that the question of using computers for general insurance work has captured the imagination of the managements of the more progressive offices.

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Most large offices have already installed computers or are in the process of doing so while the smaller offices have transferred many of their processes to computer on a service bureau basis. This change in outlook has been brought about by a combination of factors. First of these is the continued expansion in business where the volume of processing to be carried out has called for a new approach rather than the continued employment of more and more staff. The transfer to decimal currency was a very strong factor motivating the large offices to instal computers rather than face up to the task of converting records manually. Let us not overlook too the pressure of the selling campaign conducted by the various machine houses in the last year or two – strange to think that there was a time when at least some of these had their salesmen under instructions not to quote for applications involving general insurance applications!

By now most readers having an interest in computers will have already read ad nauseam articles dealing with the factors to be considered in deciding the question of the purchase and installation of a computer such as the conduct of a feasibility survey etc. etc. and it is not proposed in this article to cover these general topics. In lieu I hope to be able to set out some of the common problems involved in general insurance and then outline in more detail some typical insurance applications.

Common Problems in General Insurance

Transfer of general insurances to computer is not an easy assignment. Systems and methods followed differ from office to office. This makes it difficult in many cases to take advantage of various "software" Packages available from the machine houses which may have been developed on general systems which differ substantially from that being followed in a particular organization. Again it is unfortunate but nevertheless true that most offices do not have standardization of methods even within their own organizations, and this is due in no small measure to the fact that these methods generally speaking have developed from day to day to meet special circumstances rather than having been planned using modern organization and methods techniques. Many exceptions have been made to meet the wishes of special clients and it is not always easy to fit these exceptions into a general system.

Mention has already been made of the highly personalized nature of insurance and this in turn demands prompt service to policyholders. At the same time the number of policies in action at any one time represent only a small percentage of the total number in force. These two factors tend to operate against each other. The first of these dictates that updating of records be done frequently. In terms of normal machine outlook the second, however, suggests that processing by computer should occur only at irregular intervals when sufficient processing has accumulated to warrant a "run" on the machine. Some offices try to wed these two conflicting requirements into an acceptable compromise but I doubt the wisdom of too much compromise where service is concerned and have long been an advocate of the daily update. This is very expensive – perhaps too much so for the small office – but there is a strict limit to the extent to which methods of doing business should be altered to fit some system which may be very sound from the point of view of the machine but fail to achieve the basic objective of providing policyholders with a prompt and efficient service. Developments overseas particularly in America are in the direction of keeping records as up to date as possible. One very large office is now thinking of a complete updating of its records twice daily and there has been considerable progress in the field of direct immediate retrieval by means of visual "interrogation" devices.

Bound up with the problem of the frequency of updating is the question of the extent to which visual records should be discarded. The answer to this question will depend almost entirely on that found to the first. Retention of some form of visual record becomes more necessary the less frequently updating is carried out and elimination of these records is really possible only where updating is a daily process. Retention of visual records involves some duplication of effort as alterations made manually must subsequently be processed by computer and in some cases results in a system where the computer is relegated to the role of a high speed printer – and a very expensive one too!

There is therefore no easy road to success. Each office has its own peculiar problems and must develop its own computer systems. Technical help is of course available from the various machine houses but these people generally lack knowledge of insurance. Transfer to computer invariably involves a complete rethinking of old methods of processing with consequent changes on an unprecedented scale. The decisions to be taken are top level and top management must directly involve itself. Too many installations have faltered or have not achieved the success possible because of lack of participation on the part of top management.

Some offices in Australia now have several years practical experience in the use of computers and other offices contemplating entering this field can learn much from them. Some of the lessons learned – and most of these the hard way of bitter experience – could be set out briefly as:

1. Top management should be directly involved or at the very least closely associated with the introduction of ADP.

2. Programmers and other ADP personnel as far as possible should be drawn from within the organisation.

3. These should be well versed in the subject matter. This is particularly so with insurance.

4. Systems should not become too complex. It should be realized that in all situations ADP is not the best solution for every problem. It is not necessary to use a steam roller to crack a peanut!

5. It is necessary not only to design in detail a suitable machine system but also to review all clerical processes both before and after.

6. The human relation problems associated with the introduction of ADP should not be underestimated. The main problem lies with people and not with the computer. A process of re-education is involved.

Some Typical Insurance Applications

The three main classes of insurance where processing in sufficient quantity exists to warrant transfer to computer are fire, comprehensive motor vehicle and workers' compensation.

Each class has its own peculiar problems but there are certain processes which basically are common to all. These are:

1. New business
2. File maintenance.
3. Billing and renewals.
4. Claims.

It is now proposed to set out how these processes could be carried out by computer. In doing so it has been assumed for the sake of simplicity that:

A. All records maintained on magnetic tape in sequential order of policy number.

B. These are in sufficient detail to enable all processing to be performed.

C. Updating of master tapes is carried out daily.

D. Other than an alphabetical index visual working records have been discarded.

E. Prime input is in the form of punch cards.

It should be appreciated too that limitations of space make it impossible to give other than a brief general outline of each process – the description of the motor vehicle system used by one office covers approximately 300 foolscap pages.

1. New Business

Data in respect of new business would be captured from the proposal following acceptance of the business by the underwriting officers.

After acceptance the proposal would be "coded" ready for punching. "Coding" is a method of representing much data merely by the use of one or two digits. This not only speeds up punching but saves considerable space on tape thereby speeding up machine processing.

Cards punched from proposals would then be processed each day by the computer and added to the master tapes in their proper order. Before "accepting" a new policy as many tests as possible would be carried out during the "edit" programmes to ensure the validity of the information to be recorded. Assuming the new policy is comprehensive on a motor vehicle the tests could be:

1. That the correct premium has been recorded and a receipt number has been quoted.
2. If a premium is shown for a second item that a code is also shown for the type of the second item.
3. If discounts are shown that a discount code has also been shown.
4. If no claim discount has been allowed that the correct NCD code has been shown.
5. If any premium loading has been charged that an extension coding has been supplied.
6. That the correct stamp duty has been charged or that the insured is exempt.
7. That all dates are valid and that due date is not less than commencement date.
8. That the vehicle statistical code is compatible with the body type code.
9. That the excess is not less than the minimum standard excess for the class of vehicle.
10. That district code does not clash with cover code.
11. That the group code agrees with the insured code.
12. That a sum insured is shown in all cases where the cover code requires it (assuming sums insured are in use).
13. That extension and discounts allowed are compatible with the type of cover granted.
14. That excess codes do not clash, e.g., there should not be a compulsory or penal excess if coding indicates a voluntary excess.
15. That the policy commencement date is not earlier than year of manufacture of vehicle.
16. That there is not already on tape a policy of the same number.

Failure by new proposal to pass any of these tests would result in the printout of a query by the computer for investigation and correction if necessary. In other cases the new policy would be added to the master tapes and a policy printed during subsequent print programmes.

Although relatively new printing of policies by computer has advantages. In this way all tests are carried out and any necessary corrections made before issue of the policy. In addition the "hard copy" produced by the computer produces the means of a visual check of what has been written to tape.

2. File Maintenance

By file maintenance I mean the keeping of up to date records of insurances on tape.

Very full details are required to enable all processing to be performed. In the case of a fire policy these details would include:

1. Policy number.
2. Name and address of insured.
3. Details of mortgagees (if any).
4. Description of property insured.
5. Situation of risk.
6. Sum insured.
7. Premium rating.
8. Due date and date current to.
9. Initial date of insurance.
10. Details of premium payments, i.e. date paid, receipt number etc.
11. Details of policy extensions and exclusions.
12. Details of reinsurance.
13. Details of agency.
14. Details of previous policy where applicable.
15. Various statistics.
16. Details of premiums received and claims paid under the policy.
17. Any special treatment required.

In planning a system for file maintenance it must be assumed that any or all of the details recorded could change and provisions made accordingly.

The method of making alterations is a process of removing old information and replacing it with new. When the old information has been removed there is no possibility of retrieval. For this reason it is absolutely vital that alterations be noted in proper chronological sequence so that the information retained on tape is correct and up-to-date. To my mind this necessitates there being a very rigid control by means of the computer over all alterations. The form of control I prefer is based upon two factors:

1. Acceptance of only one method of effecting alterations; and

2. The processing of only one endorsement for each policy at any one time.

Under this method officers desiring to alter a policy record must first obtain a "status" report from the computer. This is in the form of a certificate as to the current position of the policy and should be numbered. The use of such a form has the advantage of:

1. Giving the officer a clear picture of the present position – remember there are no visual records.
2. Serving as an added safeguard that the right policy is being altered.
3. Eliminating unnecessary alterations or duplicating alterations which may already have been made.
4. Serving as a "warning" signal to the computer that an alteration on the policy is to be processed.

I suggest that these "status" reports be printed in such a way that the top portion is in the form of the certificate by the computer with the remainder of the form available for completion of clerical processes. In issuing a report the computer would record the number of the report and this would indicate that an alteration was outstanding. This would "freeze" the policy until such time as the alteration was fed back and noted. Until then all other processing in respect of that particular policy such as the issue of renewal notices etc. would be suspended. A further "status" report would not be issued for a policy in respect of which one had previously been issued and was still uncleared.

After clerical processing has been completed the alterations desired would be noted on the report. Great care is necessary to ensure that alterations are accurate and complete. Many alterations give rise to other consequential alterations. A change of address for example could involve an adjustment of premium and an alteration to the district statistics. Or again where the interests of a hire purchase company are being deleted from a comprehensive motor vehicle policy changes are required to premium rating and statistics. As one means of ensuring that consequential changes are not overlooked it is possible to arrange certain defined groupings of transaction cards so that for example whenever transaction card say 30 is punched cards 31 and 32 must also be punched. Another safeguard is to have all alteration transaction cards preceded by a "lead" card which indicates to the computer how many cards are to be processed for each alteration. If any are missing the alteration would be rejected.

In processing an alteration the computer would first check that the number of the report being fed back agreed with that as being outstanding. This is a further test to ensure that the right policy is being updated.

Similarly as much testing as possible is carried out of the validity of the information being fed back. Some of these tests would be:

A. If the policy is being cancelled that the correct amount of return premium has been allowed.

B. If the sum insured is being increased that the correct extra premium has been charged.

C. If the sum insured is being decreased that the correct amount of return premium has been allowed.

D. If any statistics are being altered that the new coding is compatible with other statistics.

E. If the commencement date of a motor vehicle policy is being altered to make it later than that originally recorded that no claims have been recorded for the policy where the date of accident was earlier than the new date of commencement.

The success of all processing depends upon the reliability of the information recorded on tape. For this reason it cannot be emphasized too strongly that no effort should be spared to ensure the continued integrity of these records.

3. Billing and Renewals.

All billing processes would be carried out automatically by the computer according to a pre-determined timetable. This would cover issue of first notices, final notices and preparation of lists of policies due for lapsing.

To save machine time standard stationery should be used for all notices including:

1. First notice.
2. Final notice.
3. Amended notice.
4. Certificate of currency.
5. Media for charging broker's account or insured's account.

This is accomplished by slight variations of the headings printed by the computer on each notice. I know of one application where no less than 40 different notices are produced during the one print program without any change of stationery being involved. Opinions differ as to the amount of detail which should be printed on notices but in the interests of public relations I feel this should be as full as possible.

First notices would be produced by the computer the number of days ahead of due date desired. Those policies, for which first notices were due, would be selected by matching the due date against a date set up by the program, which is the desired number of days ahead of the date of the machine run. The selection would take place during the master update program and provides sufficient flexibility to enable the number of days notices produced to be varied according to the date used.

Policies selected in this manner would be written to an output tape with a transaction code indicating that a first notice was to be printed. This tape would then be sorted, according to transaction code, so that all first notices came together.

Policies due for printing of first notices are then rated and the necessary notices printed. The policy record on tape would be noted by insertion of a "flag" that a first notice had been issued.

At the desired interval after due date the computer would automatically produce final notices for those policies where first notices had previously been issued and renewal premium had not been paid.

The information produced on a final notice would be the same as for a first notice, but the heading would clearly indicate that it was a "final" notice. As in the case of first notices, selection of those policies due for issue of a final notice would be carried out during the Master update program. This is a process of matching due date against a date set up by the program and testing that the record of policy contains the "flag" indicating that a first notice had been issued. Those policies selected in this way are written to the output tape with a transaction code indicating that printing of a final notice is required. Unlike first notices, no rating would be involved as all rating details would be contained in the policy record, having been inserted as part of the process of issuing first notices.

Issue of a first or final notice would not take place if an alteration was pending on the policy. In such cases a listing would be produced as a reminder to the Underwriting Department to clear the alteration so that normal billing action could proceed.

When the alteration is cleared the computer as part of the process of noting the alteration would automatically produce the appropriate notice required. This would be a first notice where a first notice had not been issued. If, however, a "status" report had been obtained after the issue of a first notice, the notice prepared after feed back of the worksheet would be an amended notice. In both cases the information used would be up to date, i.e. it would incorporate any alteration flowing from the feed back of the worksheet.

For any number of reasons circumstances arise which demand that special actions be taken on renewal. To meet those cases where the action taken is other than normal, provision should be made to insert by means of coding details of the special action required in the policy records maintained on tape.

This coding could be as follows:

01 – Lapse on renewal – see proposal.

02 – Refer notice to Renewals Officer.

03 – Post Fire and other notices together.

04 – Send notice airmail.

05 – Do not issue renewal notice.

Any notices produced for policies in respect of which any of the above special instructions are recorded would be out sorted and referred to the Underwriting Department daily with a listing showing the action to be taken.

In addition to the automatic production of notices dealt with to date, provision would be made for notices of various types to be produced on request.

Most offices have facilities for payment of renewal premium to be made by a client in any of the following ways:

1. At Head Office or at any branch.

2. By postal remittance to Head Office or any branch.

3. To a representative or agent of the office.

4. By deposit at various banks.

Irrespective of which of the above methods of payment are used by the client money received would be dealt with in one of two ways. The first of these involves the issue of a combined receipt and renewal certificate in which case all that is required is to process the payment.

The second method would be followed where only a receipt acknowledging receipt of the payment had been issued. In these cases when processing the payment the computer would produce a renewal certificate for issue to the client.

Notation of payments would be carried out daily as part of the master update program. This would be accomplished by the punching of a payment card in respect of all receipt copies.

Information punched would be:

1. Policy number.

2. Transaction code.

3. Date paid.

4. Receipt number.

5. Amount.

Before accepting a payment the computer would check to see that the policy was in fact due for renewal – payment may already have been made – and the amount paid agrees with that payable. To avoid unnecessary work it is suggested that small under or overpayments within an acceptable tolerance be accepted and rating amended accordingly. Upon acceptance of a payment the computer would:

1. Record receipt number and date of payment.

2. Increment the due date by one year.

3. Remove the "flag indicating renewal is outstanding.

4. Calculate commission payable if agency is involved.

5. Update necessary accounting and statistical records.

As part of the billing and renewal processes the computer would also produce automatically all policies due for lapsing for non-payment.

4. Claims

I would expect that the following activities associated with claims would be computer processes:

1. Verification.
2. Claims experience per policy.
3. Keeping of claims statistics.

Depending upon the class of insurance involved verification would be accomplished by the punching of one or more cards from the claim form or report of accident. These cards would be processed during the daily machine run and verifications printed by the computer. To avoid waste of stationery common sense dictates that these verifications be in a form suitable for subsequent clerical processes. They should therefore be in such a form as to serve as the cover sheet for a claim file – the top portion containing the certificate produced by the computer and the bottom portion reserved for processing of the subsequent settlement and payment of the claim.

Before issuing a verification the computer would carry out as many tests as possible to establish validity. Assuming the claim was one lodged under a comprehensive motor vehicle policy some of these tests would be:

1. The registered number and make of vehicle involved in the accident agreed with that recorded on tape.
2. The date of accident was not after due date.
3. The date of accident was not before date of commencement.
4. The date of accident was not after cancellation of policy (if applicable).
5. That a previous claim for the accident has not already been verified.

In dealing with these types of claims it is necessary when verifying a claim to determine whether any no claim discounts have been allowed which should now be recovered because of the lodgment of the claim in question. Similarly it is necessary to provide a means of restoring the discount in certain circumstances where the insured was not at fault and recovery of the amount involved had been recovered. Some of these matters, however, involve complicated programming routines which it is not proposed to cover here. Suffice it to say that such routines have been successfully transferred to an automatic computer basis and the Government Insurance Office even has the computer automatically impose penal excess based upon the experience of each policy.

When verifying a claim lodged under a Workers' Compensation policy of insurance the normal tests as to whether the policy was current at the date of accident would be carried out but in addition a special test should be made to check the occupation of the injured worker against those for which premium had been collected. If there is no match a "flag" should be inserted in the policy to ensure that wages are ultimately declared and assessed for the particular occupation in question.

The speed and accuracy of the computer provides the facility to maintain individual experiences for each policy. This involves keeping records of the cost of claims. The methods used to obtain this information would depend upon the type of system in use. Where insurance and accounting processes have been largely integrated cost of claims would be "captured" as part of the process of paying claims. In other cases the total cost of a claim would be fed back after settlement.

This facility has been used by the Government Insurance Office in the development of a highly sophisticated machine system for the keeping of statistics in respect of Third Party. Under this system the history of each claim is maintained until finally disposed of so that the cost of claims in any year can be accurately determined.

What of the Future?

"Insurance companies should face the fact that their advent into data processing is inevitable. In the years to come it will not be possible for a company to survive unless it uses data processing methods."

These strong words were recently used by the writer of an article published in a local magazine. Those companies which have ventured into this field have proved that general insurance does after all constitute a worthwhile computer application and many of the sceptics have been silenced. To date, however, efforts seem to have been concentrated on day to day processing leaving the very important area of the use of a computer as a management tool largely untapped. It is in this area where I feel great advances will be made in the future as companies search for an answer to many of the problems facing the industry.

In the face of ever increasing costs with consequent drop in underwriting profits greater attention must be paid to the use of data processing to improve overall results. There is already a growing awareness that increased premium income does not in many circumstances result in increased profits and many companies now look more to selective underwriting for financial rewards. Proper selection however in turn depends upon the availability of up to date and accurate statistics to enable the right analysis to be made of results and on which to assess possible future trends. The insurance market is now subject to frequent change and statistics must be available at verv short notice.

The proper interpretation of statistics will of course remain a management function. The computer can never become a substitute for management. It does, however, represent the most powerful tool ever presented to management and the continued success of many companies will depend to an increasing extent upon the intelligent use to which it is put.

APPLICATIONS AND PROBLEMS IN BANKING

A. Craik and G. W. Watson†*

Introduction

The idea of using mechanical devices for computing purposes is not new. The abacus has been in use for something over 2,000 years and a digital computer was designed as early as 1840 but could not be built due to the inadequacy of engineering technology at the time. Office machinery, mostly manually operated, began to come into use early in this century.

The first computer actuated by electronics was built about 1942, and advances in design and efficiency since then have opened up avenues for the commercial application of this type of equipment.

During the last decade, automation has become an accepted and integral part of commercial life. Both business and government have been forced into the field by the sheer volume of information which has to be processed rapidly, accurately and economically, while maintaining a high standard of service.

The use of automated equipment will further expand and diversify in the years ahead. The development and sophistication of equipment, and of the systems using it, will continue.

Legal Consideration in Establishing an Automated Banking System

The legal rules governing rights and duties in the field of automation are as yet unclear. While an appreciable body of experience is no doubt being accumulated in this field, banks have had to feel their way, learning from experience, and exercising judgment and reasoning.

It will be generally agreed that the vast bulk of existing laws will be unaffected by the use of computers. Aspects will in the main involve banker and customer relationships and these are essentially unchanged.

On the other hand computer processing will no doubt require a deal of consideration in relation to the laws of evidence.

Considerations of the laws of probability and averages play a considerable part in the day-to-day activities of banking operations. Fortunately only an infinitesimal proportion of the huge volume of transactions handled by the banking system ever gives rise to litigation.

In developing the system a great deal of attention has necessarily been given to the procedural and operational controls which could reasonably be expected in a banking operation.

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Basic Means of Processing Documents in a Banking System and Some Aspects.

Banking systems in general are based on the M.I.C.R. encoding of cheques, which form the bulk of the paper which has to be handled. In some systems, deposit forms are similarly encoded.

The term "M.I.C.R." is an abbreviation of "Magnetic Ink Character Recognition". The system was developed, and is very extensively used, overseas. It is based on the electronic sorting and capture of information from documents bearing a code line printed in magnetizable ink. This is preprinted except for the amount which is later added during the machine accounting functions prior to entry to the computer.

The code line which is readable by the computer, serves to identify the cheque as to the branch on which it is drawn and the account to which it is to be charged. The equipment designed for an M.I.C.R. system cannot read the signature and account title which must be subsequently visually examined by checking officers along with other detail in the body of the cheque, including comparison of the encoded amount with the written amount. The code line is readily readable by the human eye.

The ability of the computer to process these vouchers at high speed is essential for an economic operation, but it carries with it a certain inflexibility. It will be obvious that a great deal of care has to be exercised when cheque forms are freely issued, as they must be, which carry a pre-encoded account number upon which a fully automated system will depend for account identification.

An example of what can happen may be taken from a court case that arose in England in 1965 (*Burnett* v. *The Westminster Bank Ltd*). It involved a customer of the bank who maintained accounts at two of its branches, holding an encoded cheque book for each of these accounts. The branch and account number code of each of these books would thus differ, and so would the domicile of the branch.

The branches could be referred to as being domiciles "A" and "B" respectively.

The customer drew and issued a cheque to another person using a cheque form bearing the branch and account number code of branch "A" but altered the printed domicile in the body of the cheque to that of branch "B". The code line was left intact.

Before the cheque was presented he instructed Branch "B" in writing to stop payment of the cheque, also advising that the Branch "A" domicile had been altered to that of Branch "B".

Nevertheless, because the original code line was still intact, the cheque entered the system, was processed by the computer and was charged to the account at branch "A".

A suit by the customer against the bank for recovery of the amount was decided in his favour. It was held that a notice appearing on the front of his cheque book did not constitute a valid notice binding him to restrict the use of the cheque to a particular account.

Had branch "B" with all the information at its disposal from which it could draw the correct conclusions, advised branch "A" of the stop payment, the payment at the latter branch could have been prevented. However this course could not have been expected had branch "A" been unaware of the change of domicile. An examination of the voucher at the paying branch, on the other hand, would have disclosed its correct destination

A similar situation could arise where one person borrows an encoded cheque form from another. In completing the cheque he may well be unaware of the significance of the printed characters at the foot of the cheque. Even if he were aware of this, he may not understand how to cancel the effect of the encoding. Such a cheque could be altered as to domicile or even as to the bank on which it is drawn.

While there can be other variations of the above theme none of them should cause concern if a careful examination of the voucher is made by the paying office.

It is a considerable safeguard to both customer and bank, that each cheque when preencoded with the account number, also has the name of the account pre-printed adjacent to the signature area. This materially assists in signature verification.

Not yet practice in Australia, but common in the United States of America, is the completion of the amount portion of the code line during the interbank movement of M.I.C.R. encoded cheques; that is, the amount is not necessarily encoded by the Bank on which the cheque is drawn. If the latter bank uses computer processing based on the code-line, and an undetected error in encoding the amount has been made along the way, the result could be an overpayment or underpayment by the paying bank.

All of these problems, present and potential, are well in mind and have been closely considered in the development of day-to-day procedures.

Computer Output

In considering the validity of computer output it is necessary to understand the nature of the equipment involved.

To many of those who have not been closely associated with this type of processing, the computer is understandably surrounded by something of an aura of mystery. The science-fiction computer capable of controlling its own destiny and that of those who service it, is not yet with us, nor is it likely to be.

The operation of the computer is made up essentially of two parts; it must be given information, normally referred to as data, and it must be given a series of instructions as to what to do with the information, and these instructions make up the program.

The digital computer in a commercial application is little more than a highly developed adding machine. It is incapable, within its own resources, of performing any work at all without human direction and instruction. The quality of the results will reflect the quality of instructions and information provided and that of the standards of control applying within the installation.

The Bank's Computer System

The first computer was installed in October, 1964, and in November of that year commenced some of the work of clearing cheques between branches.

Cheque account ledger processing for selected branches commenced in June, 1965, and at the present time some 125 branches are "on-system". This work, with other functions absorbed along the way, is being handled by three computers.

Means of input

The system is based essentially on processing by M.I.C.R. but where the code line is unreadable, or is not present, entry of data is made by punched paper tape, punched cards or similar means.

The initial input of data is referred to as an "entry run" and many of these are made during the course of the day as work is received.

Storage of data

Data once entered as input to the computer and having been properly read, validated and balanced to control totals, is stored on magnetic tape, passing through a series of processing cycles until the final reports are printed.

Magnetic tape is a compact, reliable and economic means of storage. Information can be read from, or written on, the tape which is wound on a reel and comprises a strip of polyester material coated on one side with an oxide.

Information is stored on the tapes in the form of magnetized spots, and in both reading and writing various automatic checks are made to ensure the accuracy of the data transfer between the computer and the tape.

Magnetic tape is also used for the storage of the master files such as the ledger information file. These files are subject to special security procedures described later.

Sequence of processing

As customers' deposits and other documents are received by the processing centre, the work is proved and balanced on proof machines which generate control totals to which the computer must balance. As a by-product of this accounting function the written amount of the voucher is simultaneously encoded, thus completing the M.I.C.R. code line.

Following the initial entry runs described above, the data which has been captured on magnetic tape in necessarily random order, is further processed and merged at the end of the day, so that all of the day's transactions are sorted in branch number order, in account number order within the branch, and if related to a cheque, in a serial number order.

The next operation is to check the incoming transactions against a master file of stop payment information. Any cheques which are to be stopped are detailed on a branch report and the relative transactions are not passed on to the following ledger posting run. In addition "Stop suspects" are listed for branch investigation. A "Suspect" condition is one where the cheque serial number tallies with that of a stop notice but the amount does not.

When all transactions have been checked against the Stop Payment file they are processed against the master ledger information file. This run, simultaneously with posting the ledger file, prints out details including balance, of every account whether it has operated or not. The program balances each account on the file, and the file overall, printing out control totals for each branch and similar overall totals for the entire group of branches.

In addition this run generates magnetic tape data which in turn provides information required for the printing out of customers' cycled statements and ledger sheets, and also the daily and periodical reports required.

Controls and validation

One of the prime functions of the initial entry runs is to establish to the maximum extent possible the validity of incoming data. They must check that the branch concerned is "On-System" and prove the account number by mathematical calculation. Each field of information is examined for completness and batches of work must be strictly homogeneous; for example a debit item in a batch of credit vouchers would not be accepted by the program which recognizes and tests the transaction code which all documents carry.

A printer listing of all transactions is produced at the time of initial entry and those which have failed the validation checks are given an error code which indicates the reasons for non-acceptance.

The entry run prints out totals for each of the various types of documents, balancing these to the control totals produced by the proof operation. It reports any apparent differences and the results must be reconciled by balancing staff.

When storing the captured valid data on magnetic tape the computer program records at the beginning of the tape, the date and run identification information. At the end of the tape it stores the various item counts and control totals.

When the captured information is later "sorted" into branch and account number order, transaction details are again listed on the printer in sorted order and with identification as to the initial entry run through which the transaction was entered. This provides a ready means of tracing the item through the system.

The process of storing tape identification and control totals on tape then becomes a function of each succeeding run in the cycle of processing. Each program must check and identify the magnetic tapes it is reading, typing this information out on the control typewriter for visual checking by the operator. As each program processes data, it progressively accumulates control totals and in due course balances to the totals stored at the end of the input tape.

Tape checking and balancing is carried out by each successive program until processing has been completed. Any errors which have occurred are detailed on both the control typewriter and the printed summary of totals produced by each cycle of processing.

At specified times the cycle of processing is temporarily suspended and the computer is subjected to certain diagnostic tests designed to demonstrate the correct functioning of output devices and the correctness of its calculations, printing the results so that visual examination can be made.

While the system incorporates all the above internal computer checking, it is essential also to externally balance work at various intervals during the processing cycle. Thus daily work is proved initially at proof machine level then at point of capture of information by the computer. These totals are clerically recorded and accumulated to be balanced prior to and immediately following the ledger posting operation, and finally through control balances in the branch general ledger accounts.

Records and reports

A total of thirty-five types of reports is available within the system. Of these twenty are produced daily, the other being required periodically. These reports provide each branch with such information as account balances, overdrawn accounts, changes made to customer information, unposted transactions, and a great deal of other detail to keep the branch fully informed, and to assist in the conduct of its daily affairs.

The basic report is the daily voucher cash sheet which in addition to listing transaction details for accounts which have operated, also lists the current balance and other detail of all accounts on file for each branch. This printout is very much like a progressive ledger record from which the account history can be followed or reconstructed from day to day and this is facilitated by the inclusion in the report of the date on which the account previously operated.

Customer's statements and ledger sheets are printed out on a cycled basis. This could be daily, weekly, monthly or quarterly accordingly to the customer's requirements. Until required to be printed the information remains stored on the ledger master tape file.

File security

The master files could be defined as those which carry customer information and account detail forward from day to day, as distinct from the transaction files which relate only to a particular day's work. The master file may be adjusted by incoming transactions and the amended information together with the unchanged data is transferred to tape which then becomes the current file. This may comprise several reels of magnetic tape.

The various files must be protected against error, misuse or damage. By storing sequential day's master files, together with the relative transaction tapes, files can be recreated to an up-to-date position in event of damage to the original.

It is current practice to store three sequential ledger master files in addition to the current file. These are kept in conditions of fire protection and air conditioning. Each working day the files are accessed by two officers and rotated as the old file is replaced by the new, and storage is maintained by two-key control.

Programme control

The programmes represent the instructions required by the computer to perform a task or series of tasks. It will carry out these functions strictly as directed. If the programme instructs incorrectly, the results produced will be incorrect.

It is therefore necessary, preferably by the use of test data, to establish that the programmes are functioning correctly or have not been amended without proper authorization.

In the installation being described it has been considered that the storage of certain production programmes on magnetic tape, rather than in the form of punched cards, adds to security and avoids invalidation of the programme due to damaged or misplaced cards during handling by the operator.

General

The system described above is applicable to this particular installation. Other installations will probably follow a pattern similar in many ways, but there will no doubt be variations in the methods and sequence of processing, reports produced and the type of controls carried out.

Future Trends in Automation

The processing and controls which have been briefly outlined here are those currently in practice. The system has been designed for use with a certain type of equipment to meet the needs of a particular period of time. As computer operations go, it could be described as a conservative approach.

Future systems in banking application may well be very different. Computer equipment is undergoing continual development in a very competitive field, and this also applies to the various input and output devices.

As has been shown, the present system is based entirely on magnetic tape as a medium for storing transaction and master file detail, with progressive cycles of processing culminating in posting the ledgers and producing reports.

While no doubt future installations will retain the use of magnetic tapes to a certain degree, the use of random access storage is likely to become more common because of the many advantages it offers in the way of interrogation facilities and the means to carry out file maintenance progressively instead of as the last of a series of processes.

The term random access (or direct access as it could also be described) means that particular account data or other information may be directly and rapidly referred to as it is required. This contrasts with the same information stored on a magnetic tape. If the particular account happened to be at the end of the tape, the entire reel would have to be processed from the beginning in order that the program could locate the required data.

A random access device could be in the form of a disc or drum rotating at high speed with a reading device enabling information stored anywhere on the surface of the disc or drum to be quickly located. There would be no need for accounts on such a file to be recorded in strictly sequential order as is essential on magnetic tape, although in practice the majority would be stored in this manner.

With this equipment, techniques of master file maintenance could differ from installation to installation. The files could be processed on the discs and subsequently stored on tape on completion of the day's work, or allowed to remain stored on the discs.

The direct linkage of remote terminals to the computer could open up considerable possibilities for automated banking. By this means data could be entered to the computer which could then print the answers to requested information at the terminal site. Reports and records could be produced in similar fashion. At least one American bank uses a remote terminal interrogation system which produces a verbal response to enquiries.

An extension of the remote terminal approach could be to link computer to computer by land line or other means into a network of computers, each having access to information stored in all the others. It would be quite feasible for ledger files to be processed in one city with the resulting records printed in another.

In considering changes to equipment and systems, a complex series of economic and other factors has to be taken into account. It will always be necessary to consider how best to offer a high standard of service at reasonable cost. The application of advances in design of equipment and techniques will inevitably produce unique problems which can only be met as they arise.

APPLICATIONS AND PROBLEMS IN ACCOUNTANCY

*J. M. Carroll**

Because of the state of the computer art in the accountancy profession, I am forced to devote the greatest proportion of my paper to applications. I will deal later with one or two problems but I can say now that perhaps the greatest problem is that accountants are not using the computer to its greatest advantage.

Most accounting applications one encounters are of the fairly simple type and generally restricted to two or three areas. There are, of course, other applications peculiar to certain types of businesses. I will give some examples of those shortly.

The areas I have in mind are Payroll, Debtors, Sales Statistics and Inventory. Payroll is by far the best known of them, being one of the earliest commercial applications. Nowadays one encounters many Debtors applications. I am referring here to trading debtors where Inventory control and Sales Statistics are important. The relative importance varies greatly. I recall one application where Sales Statistics is the main concern and Debtors are considered to be a by-product. Combined Debtors and Inventory Control systems on random access equipment have been fairly standard for some time.

Examples of special industry applications would be Hire Purchase (or Time Payment) Accounting and Wool Sales Accounting (between broker, buyers and growers). In both cases there is a large volume of data of a similar nature requiring standard processing and the results are required quickly. The conditions are ideally suited to computerization. Some detailed explanation of each will assist those who may not be familiar with the industries mentioned.

Hire Purchase Accounting

Consider the problem of processing and maintaining some hundreds of thousands of accounts which have to be up-dated regularly, a close and consistent arrears follow-up exercised, reminder letters issued and true income taken to account. Arrears actioning by means of a logical machine assures consistency and adherence to policy, although once an account falls into the "hard" actioning category experienced human-beings are better. Prior to computers accurate calculation of income was practically impossible. A popular method of determining the income yet to mature was to take a certain percentage of the total outstanding but, of course, this did not take account of arrears. When using a computer it is reasonable to carry out the required calculation (Rule of 78 or actuarial) and obtain the true information.

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Possibly one of the most beneficial uses of a computer in this industry is the projection of the anticipated cash flow based on actual performance. A further material benefit, provided that provision for the required data on the master file has been allowed for, is the ability to analyse arrears into the various categories of borrowers, e.g. home owners, non-home owners, self employed, location, etc. This is of invaluable assistance to management in determining policy.

For all its benefits this type of application has problems, the major one of which is the preparation of input. I shall deal with input separately under a later heading.

Wool Sales Accounting

What I have to say on this application is only a broad outline of the system. I shall tend to ignore or oversimplify certain of the operations but that will not matter.

As wool is received into store a punched card is raised for each bale (bale cards). When wool is due for sale and the catalogue is prepared "lot" cards are raised and the "bale" cards have their lot numbers punched into them. Price and buyer per lot is determined at auction and this information is also punched into cards. From the above details invoices for the buyers and account sales (credit notes) for the growers are prepared.

The governing regulations, which were laid down in precomputer days, state that invoices have to be available by noon of the day following the sale but 14 to 16 days is given to prepare account sales. In the past, brokers' staffs had to work overtime on sale nights to ensure completion of invoices and the 14–16 days allowance was necessary to allow for all the calculations that had to be done in he preparation of account sales.

Nowadays where the broker uses a computer everything is completed by the day following the sale.

I shall now deal with the more routine accounting areas.

Payroll

I have only one point to make on such applications.

For a payroll which remains fairly stable there are not a great number of problems but where there are a large number of variations from standard then in-put preparation can cause bottlenecks. One particular application that comes to mind is that of a hospital payroll. Because of shifts and varying allowances and rates of pay, the rate of variation is of the order of 90 per cent and because of the very restricted time available the preparation of in-put is a major problem.

Trading Debtors

There are a variety of approaches to normal trading debtors and a few are discussed below.

By-Product of Invoicing – Under this method data are captured in punched paper tape or punched card form as invoices are prepared. The tape or cards are then fed to the computer and debtors accounts are maintained on magnetic tape. Statements are raised by the computer as required. Normally, sales statistics information is also obtained and, where applicable, inventory records are up-dated. Normally the latter requires reprocessing of the transaction tape as opposed to the random access method mentioned earlier.

Invoicing – It is not uncommon to find the computer being used as an invoicing machine. This can be done in a variety of ways. One way is for product information and customer details to be maintained in the computer and only customer number and product numbers and quantities in-put to the machine by medium of punched cards. The computer raises the invoices and, naturally, maintains debtors accounts and the other information previously mentioned. Another way is to punch debtor and detail cards from, say, the order form. A still further way is for prepunched debtor and product cards to be maintained in tub files and on receipt of the order the prepared cards are drawn from the files for processing.

Inventory Control

Whether or not inventory records are maintained on a computer would depend on the nature of the business. For instance, the merchant handling a multitude of lines would probably not bother to maintain records by each individual line. Many of those lines may be in the range for only one season, there may be large varieties of small value items and, of course, there is the problem of someone having to identify each one when sold. For such a merchant, control by product groups may be sufficient and that could be obtained from the sales statistics.

It goes without saying that if inventory control is maintained on the computer then debtors would be maintained also. The information required for both comes from the one source and it would be unthinkable to maintain one and not the other.

I would like to stress one point. Inventory records on a computer do not of themselves afford inventory control. Generally, inventory records would only be printed out periodically, say, at the end of each month, or at the maximum at the end of each week, and the information then is only of historical (even though it be financial) interest. Even if a random access system were in use, having a quantity of a particular item recorded in the machine does not put the goods on the shelf. For those reasons we often find two different approaches to the type of out-put relating to inventory. Firstly, there is the purely financial approach which is concerned largely with establishing the value of inventory at any one time. It could be broken down into product groups but the prime concern is the total value. The other approach is the management accountant's

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approach. The management accountant is more interested in information which will assist management to better control the business. He does not ignore the financial requirements but treats these as being secondary to the management ones. A management accountant would be seeking a report that would provide such information as the rate of stock turnover, when certain products last moved, the average week's sales in stock and things of that nature. Information in this form will enable him to recommend to management courses of action that it can take to reduce investment in inventory.

Other

One other application that seems to be more popular nowadays is that of sundry creditors. The approach taken is usually one of "Well, we have all the outgoings on the computer, let us now put the incomings on." The principle is sound but in many cases sundry creditors applications are not necessarily economical. If the company is doing a large amount of business with small number of suppliers then, generally, it is worth processing by E.D.P. but if there is a large number of suppliers with only one or two purchases being made from each then it is almost as quick and economical to maintain on an accounting machine.

It would be appropriate to consider now the problem I mentioned in my opening remarks. That of accountants not using the computer to its greatest advantage.

In each of the foregoing examples the computer merely maintains the detailed records and the control accounts i.e. the financial information in total, is maintained on accounting machines or by manual methods. For example, the total debtors would appear in the general ledger maintained in that way, as would the total inventory, the total payroll and the total sundry creditors. In the latter the printout from the creditors would form the basis of a journal entry for a debit to the various expenses or inventory accounts. The computer is merely being used as a fast processor and printer and not as an information storehouse. What is required is what is commonly known as a management information system which provides all of the management accounting information and automatically provides the financial information to prepare profit and loss accounts and balance sheets. In, say, a large group, providing the coding is done correctly, management information can be provided on a total basis, a functional basis or by responsibility and at the same time financial information can be accumulated by legal entities. When business starts to use computers in this way it will really be achieving the benefits that are possible.

Secretarial Applications

The obvious applications under this heading are those of share and debenture registers. They also happen to be one of the problems. The problem is whether or not magnetic tape records constitute sufficient record under the Companies Act. Some firms who maintain their share register on a computer have a printout after each update of the master file so that there is a complete record of the register which can be made available to anyone wishing to inspect it. In fact, the only printout required is of those accounts which have changed as a result of the update but in that case it requires the destruction of the old record and the refiling of the new. Records can be lost this way. One tends to find that the share registry is duplicated. There is a manual or mechanized system and the records are also maintained on the computer which is used only for the calculation of dividend, preparation of cheques and the raising of labels for the issue of notices, etc. One debenture register with which I am familiar has been simplified to the extent that the original application forms are maintained in such a way as to constitute a register, the computer being used only for the purposes mentioned above.

If magnetic records were to be deemed sufficient record then it is probable that only those firms with large and expensive installations could meet the requirements. I am envisaging a system where the register is always available and can be accessed at any time.

Other Problems

Information Retrieval

I have already mentioned that the general, or private, ledger is not normally to be found maintained on a computer and one of the reasons put forward by accountants for this is the difficulty of retrieving from the machine certain information required at balance dates. The information normally relates to details required for the income tax return and it could be items of a capital nature which have to be included in a depreciation schedule, details of, say, subscriptions and donations, travelling expenses, etc. It is obviously not practicable to endeavour to establish a code of accounts which will provide for all possibilities so that some system must be devised whereby the information can be readily obtained.

Some people suggest that it is better to maintain this information outside the machine by manual methods and not keep any details, other than a total amount, on magnetic file but this is dependent too much on human beings. I suggest that it would be better to arrange by way of program for a dump of the references relating to the accounts from which information is required. This would provide the means of going back to the originating documents from which the necessary schedules could be raised.

Input Preparation

This problem has been mentioned under the headings of both Hire Purchase Accounting and Payroll. It could just as well have been mentioned for all applications as it is a common problem. In the field of Banking, for instance, the problem still exists even though it has been somewhat minimized by the use of M.I.C.R. However, encoding of the amount is still necessary. In the field of accounting, there has, until very recently, been only minor advances towards finding a solution.

Routine accounting for debtors and creditors is of such variety and complexity that no facts are available until after the events. It is not possible to say beforehand who will buy, or from whom purchases will be made, what products will be involved or at which location. Coding of the required data on, or from, the originating documents is still very common. As was indicated when discussing Debtors, in some cases, certain data can be prepunched but that is not always possible. The answer may lie in a machine which will be introduced into this country next year. It is capable of reading handwritten figures and printed letters.

Programming

You have already covered this subject in an earlier session and I am sure you have had impressed upon you the difficulties that can be encountered. Programming, apart from the fact that it is time-consuming, is also a problem in every application but I believe that it is more serious in accountancy applications simply because of the many possible ways in which an entry can be treated. When a systems analyst lays down his specifications he endeavours to provide for all possibilities and the programmer writes a program to meet those specifications. It is normal to run a test deck to prove the program and that deck endeavours to provide for all of the foreseen possibilities. Obviously, there must be some that are overlooked. We know there are, simply by what we read in the press of the errors that have been made by computers. We are also familiar with the various jokes about computers and some years ago there was a film on the subject. In the film the computer, as part of its payroll application, issued dismissal notices to all staff members; including the system analyst. I can recall a debenture register application in which the computer issued a large cheque to an investor who had redeemed her investments. An error had been made by a clerk, the program had never provided for such an occurrence and the machine did precisely what it was told to do.

Education.

My final point, which I have classified as a problem, is the need for education of business people as to how a computer works and what can be done with it. This is particularly necessary in the accounting profession. Accountants are conservative by nature and they have extreme difficulty in imagining the maintenance of records on magnetic devices when those records have previously been in handwritten or typewritten form. In the days of unit record equipment (punched cards) it was difficult enough to convert accountants to the maintenance of debtors ledgers on punched cards. They had a lot of bother accepting the fact those cards could replace the old ledger card. With some application they could at least interpret the holes in the cards but now we are asking them to accept information in magnetic form which they cannot even see. This may be one reason why we find very few management information systems as computer applications.

COMPUTERS AND THE LAW OF EVIDENCE

*A. R. N. Cross**

Computerized records and the existing law of evidence

In *Myers* v. *D. P. P.*[1] the House of Lords held that records based on information supplied by workmen, kept by motor manufacturers of the numbers of cylinder blocks in the engines of their cars, were inadmissible as evidence of the fact that blocks bearing those numbers were placed in the engines. This surprising decision was due to the rule against hearsay under which assertions by person other than the witness who is actually giving evidence to the court are inadmissible as evidence of the facts asserted. The records were only of evidential value if treated as the equivalent of assertions made by the workmen concerning the numbers on blocks placed by them in the engines of motor cars. There are many exceptions to the hearsay rule in England and New South Wales, including statements in public documents and bankers' books, but there is no general exception relating to business records, however compiled, such as there is by virtue of many American statutes. The House of Lords refused to sanction the creation of further exceptions although the need for legislative change was recognized in these speeches. It has been argued with much force that, thanks to the exception relating to business records, special legislation concerning computerized records is unnecessary in the United States;[2] such an argument is of course untenable in the case of England and New South Wales.

Myers v. *D. P. P.* was a criminal case. At the time of the decision there was, as there still is, an important statutory exception to the hearsay rule confined to civil proceedings in both England and New South Wales. Section 14B(1) of the Evidence Act 1898–1966 (N.S.W.) reads as follows:

"14B. (1) In any civil proceedings without a jury where direct oral evidence of a fact would be admissible, any statement made by a person in a document and tending to establish that fact shall, on production of the original document, be admissible as evidence of that fact if the following conditions are satisfied, that is to say –

(i) if the maker of the statement either –
- (a) had personal knowledge of the matters dealt with by the statement; or
- (b) where the document in question is or forms part of a record purporting to be a continuous record, made the statement (in so far as the matters dealt with thereby are not within his personal knowledge) in the performance of a duty to record information supplied to him by a person who had, or might reasonably be supposed to have, personal knowledge of those matters; and

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(ii) if the maker of the statement is called as a witness in the proceedings:

Provided that the condition that the maker of the statement shall be called as a witness need not be satisfied if he is dead, or unfit by reason of his bodily or mental condition to attend as a witness, or if he is beyond the seas and it is not reasonably practicable to secure his attendance, or if all reasonable efforts to find him have been made without success."

Although it renders certain types of record admissible, there are several reasons why the section is inapplicable to most computerized records. In the first place, there is, in the case of such records, no one corresponding to the maker of the statement referred to in the section, and the definition of "document" is narrow. Under section 14A "document" includes books, maps, plans, drawings and photographs, but it would hardly be held to include tapes, etc. Secondly, there is a narrow requirement of authentication of written statements admissible under the section. Section 14B(4) reads as follows:

"14B. (4) For the purposes of this section, a statement in a document shall not be deemed to have been made by a person unless the document or the material part thereof was written, made or produced by him with his own hand, or was signed or initialled by him or otherwise recognized by him in writing as one for the accuracy of which he is responsible."

Thirdly, the requirement that the maker of the statement or supplier of the information recorded should have had personal knowledge of the facts stated would be inapplicable in the case of most computerized records.

Shortly after the decision in *Myers* v *D.P.P.*, there was legislation confined to criminal cases in England; but it was only meant to be a palliative not a cure of the ills created by the hearsay rule. The reform of the law of evidence is under consideration by two committees in England. The Law Reform Committee has published several reports relating to evidence in civil cases. Most of its recommendations, including the virtual abolition of the rule against hearsay, are embodied in the Civil Evidence Bill at present before the English Parliament. The Criminal Law Revision Committee is working on evidence in criminal cases but it has not yet made its report.

The English palliative is substantially reproduced in Section 14CB of the Evidence Act of New South Wales. The provision reads as follows:

"14CB. (1) In any criminal proceedings, the hearing of which commences after the commencement of the Evidence (Amendment) Act, 1966, where direct oral evidence of a fact would be admissible, any statement contained in a document and tending to establish that fact shall, on production of the document, be admissible as evidence of that fact if:

(a) the document is, or forms part of, a record relating to any trade or business and compiled, in the course of that trade or business, from information supplied (whether directly or indirectly) by persons who had, or may reasonably be supposed to have had, personal knowledge of the matters dealt with in the information they supplied; and

(b) the person who supplied the information recorded in the statement in question is dead, or beyond the seas, or unfit by reason of his bodily or mental condition to attend as a witness, or cannot with reasonable diligence be identified or found, or cannot reasonably be expected (having regard to the time which has elapsed since he supplied the information and to all the circumstances) to have any recollection of the matters dealt with in the information he supplied."

The definition of "document" in section 14CA is broader than that contained in section 14B. "Document" includes any device by which information is recorded or stored. Some kinds of computerized records may be admissible under this provision, but it is confined to criminal cases, no allowance is made for the processing of information, and there is the restrictive requirement of personal knowledge on the part of the supplier of the information.

It follows from what has been said that, both in England and New South Wales, a large number of computerized records are inadmissible as evidence of the facts to which they relate. The situation can hardly be viewed with complacency and the proposed English legislation on the subject may be of interest in New South Wales.

English legislation

At the time of writing the latest draft of the Civil Evidence Bill available in Australia is that which emerged from the committee stage in the House of Commons. The Bill has passed through the House of Lords and, by the time of the conference, it will have become the Civil Evidence Act, 1968, although the relevant portions of it will not be in force until next year. Section 5, drafted after consultation with computer experts, reads as follows:

"5. —(1) In any civil proceedings a statement contained in a document produced by a computer shall, subject to rules of court, be admissible as evidence of any fact stated therein of which direct oral evidence would be admissible, if it is shown that the conditions mentioned in subsection (2) below are satisfied in relation to the statement and computer in question.

(2) The said conditions are:

(a) that the document containing the statement was produced by the computer during a period over which the computer was used regularly to store or process information for the purposes of any activities regularly carried on over that period, whether for profit or not, by any body, whether corporate or not, or by any individual;

(b) that over that period there was regularly supplied to the computer in the ordinary course of those activities information of the kind contained in the statement or of the kind from which the information so contained is derived;

(c) that throughout the material part of that period the computer was operating properly or, if not, that any respect in which it was not operating properly or was out of operation during that part of that period was not such as to affect the production of the document of the accuracy of its contents; and
(d) that the information contained in the statement reproduces or is derived from information supplied to the computer in the ordinary course of those activities.

(3) Where over a period the function of storing or processing information for the purposes of any activities regularly carried on over that period as mentioned in subsection (2) (a) above, was regularly performed by computers, whether –
(a) by a combination of computers operating over that period; or
(b) by different computers operating in succession over that period; or
(c) by different combinations of computers operating in succession over that period; or
(d) in any other manner involving the successive operation over that period, in whatever order, of one or more computers and one or more combinations of computers –

all the computers used for that purpose during that period shall be treated for the purposes of this part of this Act as constituting a single computer; and references in this part of this Act to a computer shall be construed accordingly.

(4) In any civil proceedings where it is desired to give a statement in evidence by virtue of this section, a certificate doing any of the following things, that is to say –
(a) identifying the document containing the statement and describing the manner in which it was produced;
(b) giving such particulars of any device involved in the production of that document as may be appropriate for the purpose of showing that the document was produced by a computer;
(c) dealing with any of the matters to which the conditions mentioned in subsection (2) above relate –

and purporting to be signed by a person occupying a responsible position in relation to the operation of the relevant device or the management of the relevant activities (whichever is appropriate) shall be evidence of any matter stated in the certificate; and for the purposes of this subsection it shall be sufficient for a matter to be stated to the best of the knowledge and belief of the person stating it.

(5) For the purposes of this Part of this Act –
(a) information shall be taken to be supplied to a computer if it is supplied thereto in any appropriate form and whether it is so supplied directly or (with or without human intervention) by means of any appropriate equipment;

(b) where, in the course of activities carried on by any individual or body, information is supplied with a view to its being stored or processed for the purposes of those activities by a computer operated otherwise than in the course of those activities, that information, if duly supplied to that computer, shall be taken to be supplied to it in the course of those activities;

(c) a document shall be taken to have been produced by a computer whether it was produced by it directly or (with or without human intervention) by means of any appropriate equipment.

Under section 6 a document may be proved by the production of that document or of a copy authenticated in such manner as the court may approve.

The following definitions in section 10 are also important:

"document" includes, in addition to a document in writing –

(a) any map, plan, graph or drawing;

(b) any photograph;

(c) any disc, tape, sound track or other device in which sounds or other data (not being visual images) are embodied so as to be capable (with or without the aid of some other equipment) of being reproduced therefrom; and

(d) any film, negative, tape or other device in which one or more visual images are embodied so as to be capable (as aforesaid) of being reproduced therefrom;

"film" includes a microfilm;

"statement" includes any representation of fact, whether made in words or otherwise.

(2) In this part of this Act any reference to a copy of a document includes:

(a) in the case of a document falling within paragraph (c) but not (d) of the definition of "document" in the foregoing subsection, a transcript of the sounds or other data embodied therein;

(b) in the case of a document falling within paragraph (d) but not (c) of that definition, a reproduction or still reproduction of the image or images embodied therein, whether enlarged or not;

(c) in the case of a document falling within such a transcript together with such a still reproduction; and

(d) in the case of a document not falling within the said paragraph (d) of which a visual image is embodied in a document falling within that paragraph, a reproduction of that image, whether enlarged or not,

and any reference to a copy of the material part of a document shall be construed accordingly.

Under section 6, in estimating the weight, if any, to be attached to a statement admissible by virtue of section 5, the court shall have regard to the question whether or not the information which the information contained in the statement reproduces or is derived from, was supplied to the relevant device or recorded for the purpose of being supplied thereto, contemporaneously with the occurrence or existence of the facts dealt with in that information, and to the question whether or not any person concerned with the supply of information to that computer or with the operation of that computer or any equipment by means of which the document containing the statement was produced by it, had any incentive to conceal or misrepresent the facts.

It is arguable that section 5 (1) should refer to statements of opinion as well as statements of fact for some computerized records, notably hospital records, comprise mixed statements of fact and opinion. This point was deliberately omitted from the English legislation because the whole matter of opinion evidence is under review by the two Committees which have already been mentioned.

It is understood that an amendment will be proposed at the report stage in the House of Commons, providing in effect that it shall be a criminal offence for a person knowingly to sign a certificate under section 5(4) containing false information.

Rules of court will provide that a litigant wishing to rely on a statement admissible under section 5 shall give notice of his intention to all other parties. Any other party will be allowed to serve a counter notice requiring that any person concerned with the supply of relevant information to or with the operation of the computer attend and give oral evidence which will, of course, be subject to cross-examination.

Section 5 is confined to civil proceedings, but a similar provision will probably be recommended for criminal cases in due course. The notice and counter notice provisions contemplated by the rules of court to be made under the Civil Evidence Act may not be considered appropriate in criminal cases, but there could be a provision under which the court may, for good cause shown, require oral evidence to be given of the matters dealt with in section 5(4).

The English legislation is undoubtedly elaborate, but it has the merit of ensuring the admissibility of computerized records while preserving the adversary's right to challenge the accuracy of such records if thought fit.

REFERENCES

1. (1965) A.C. 1001.

2. "Providing by statute for inspection of corporate computer and other records not legible visually", by Roy N. Freed, *Business Lawyer,* Vol. 23, 457 (1968).

COMPUTERS AND THE LAW OF EVIDENCE

*T. J. Martin**

If we take computers to be electronic machines for data processing we may consider problems raised by the law of evidence in respect of (1) machines, (2) data and (3) processing.

Machines

The problem here is not serious, for the law has so far been able to take machines as such in its stride. Though objections have often been raised in regard to the evidence, e.g. of a camera and a tape recorder in various jurisdictions they have, as far as I know, been unsuccessful (some recent instances are, as to tapes: *Reg.* v. *Travers,* 58 S.R. 85, *Reg.* v. *Maqsud Ali* (1966) 1 Q.B. 688, and as to photographs *Reg.* v. *Ames* (1964-5) N.S.W.R. 1489).

Indeed Simon P. has recently in "The Statue of Liberty" (1968) 1 W.L.R. 739 admitted in evidence a strip of film of echoes of two colliding ships recorded by radar and he spoke these brave words: "The law is now bound to take cognizance of the fact that mechanical means replace human effort". The radar was usually monitored by human agency, but in this case was not nor did it need to be, and it was strangely argued that because of the lack of human setting and control of the machine the hearsay rule was infringed and *Myers* v. *D.P.P.* (1965) A.C. 1001 was relied on. The Judge said the hearsay rule had nothing to do with it. He also said, "If evidence of weather conditions were relevant, the law would affront common sense if it were to say that those could be proved by a person who looked at a barometer from time to time, but not by producing a barograph record. So, too, with other types of dial recordings. Again, cards from clocking-in-and-out machines are frequently admitted in accident cases".

I assume that radar recording is connected with eletronic data processing and I suppose it could be at least said that the radar machine was processing certain data. The important thing in this case, I think, is that irrespective of whether the machine was monitored or not the data was being furnished by mechanical or mechanical combined with natural means and was being in no way supplied by human agency and certainly not by the agency of a number of humans. So it seems a little strange to have argued that there could be hearsay by machine. (Indeed, as I shall argue later, it is the intervention of humans that causes the hearsay rule to operate). I understand that there are computers which do record processes in factories without the intervention of human agency, and I think that in order to make the results of their recording admissible, it will only be necessary to explain briefly the mechanical operation, and the data supplying environment, and the results, insofar as they are relevant, of the machine's recording will be admissible.

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Data

However, contrary to counsel's argument in "The Statue of Liberty" I think that the last suggestion only applies where the data is supplied mechanically or by a combination of mechanical and natural means and that when the data is supplied by human agency, very serious problems will arise and the hearsay rule will be held to apply unless all the data is sworn to in Court by the relevant human suppliers.

Myers' case *(supra)* means that the Courts have taken the hearsay rule to the extreme logical limits. It also showed, as did the case of *Patel* v. *Comptroller of Customs* (1966) A.C. 356, that the law of evidence, although fitting perhaps the production and distribution methods of the 18th and early 19th century, has failed to keep pace with the methods of the first half of the 20th century. The hearsay rule is founded in the requirement that one man should testify as to what he did or saw done or heard transacted, and must refrain from testifying as to what he heard someone else assert that he had done or seen done or heard transacted. It strikes at oral or written assertions rather than transactions. Had the rule been kept within a reasonable limit of insisting on first hand narration of events or primary source reporting, so to speak, the law of evidence might have kept pace with modern production methods. But in Myers' case the House of Lords by majority of three to two held that motor cars could not be identified by comparing the numbers cast in their cylinder blocks with numbers of the castings recorded on factory cards by workmen who could not be identified and produced. It was held that the recording of the numbers in the records was an assertion and that because of the hearsay rule the records could not be proved by the evidence of the record keepers, but only by that of the record makers. Lord Pearce in the minority said that the evidence of the record keepers which was rejected by the majority was "the best evidence" (at p.1044). An opportunity was lost to treat such recording as a transaction rather than an assertion to treat the humans who supplied the data as though they were machines. Again in Patel's case the Privy Council held that the fact that goods imported into Fiji were in packages bearing the imprint "Produce of Morocco" was inadmissible as evidence that the goods were produced in Morocco because of the hearsay rule. Someone in Morocco had made a written statement out of Court. Lord Reid of the majority in Myers' case there said that reform of the hearsay rule was best left to Parliament, which could deal with the matter in a fashion other than piecemeal (at p. 1022). Parliament soon proved him wrong by passing in England the very limited Criminal Evidence Act, 1965, copied in New South Wales by the Evidence (Amendment) Act, 1966, which does not even seek to apply its remedy to civil cases. Indeed it is arguable that this Statute does not even meet the Myers' situation itself.

The hearsay rule did no great harm in a society where an individual craftsman made an individual artifact and delivered it himself to the buyer or handed it for delivery to a single carter who hired no staff or where an estate bailiff was individually employed and collected rent personally from the tenants and made out receipts and kept the rent rolls in person. But only those who have had to try to do it know the difficulty of proving delivery of large numbers of goods to buyers where there are many carriers of mass produced articles and the records of the business are not specially designed and operated with an eye on legal proof. I have myself failed to prove that a tenant was in arrears with rent although he and everybody else knew that he was, where the rent collection agent was a modern corporation collecting from the tenant over the counter through a numerous staff who were not identified on the receipts and there were no specially endorsed writs, interrogatories or discovery to aid me and even the fiction (see Myers' case per Lord Pearce at p.1036) of refreshing memory from records was of no avail. All the duplicate receipts and ledger cards in the world were useless. They were all hearsay. The duplicate receipt is the collector asserting a fact out of Court and the ledger card producer similarly asserted a fact in the card and moreover was told by all the collectors that these were the moneys received and no more, so that the card is hearsay upon hearsay.

What happens when the goods, say three magazines, are addressed by computer to be sent to 720,000 subscribers monthly (Desmonde – Computers and their Uses, pp 161–7) or hundreds of rent accounts are kept with debits for the passing weeks and credits for moneys received, by one big computer? How do you prove delivery of an individual magazine or non-payment of rent then? My view is that computers do not raise special new problems for the law of evidence, but merely underline the old. Because they can handle so much more data and because, if the data is supplied by human agency (speaking of data not mechanically or naturally supplied) the human agents are liable to be much more numerous and more likely to be unidentifiable, computers will accentuate the failure of the law of evidence to keep up with production methods of the first half of the 20th century and expose its complete inadequacy to serve the methods of the second half. But it is the same inadequacy that was with us before computers. So long as the data that is processed electronically is data from a human source as distinct from a mechanical or mechanical combined with natural source, the hearsay rule must be infringed, if it is sought to tender the record without the human data suppliers, and if the data comes not direct from a human being but from a document produced by another human to record information, it must be doubly infringed.

But the infringements are of precisely the same nature as the infringements where the data is processed non-electronically. The workman who recorded the number which was cast on the engine onto a card in Myers' case made a statement on the card and if tendered it is hearsay. Had he recorded it on the card by electronic means that would have made no difference – he was still recording a statement. Had some other person processed by computer either the handwritten card or a computer produced card, the result of the process, if tendered, would have been a double hearsay for the person processing would be recording a statement by means of the processing computer which was based on the statement recorded on the card. Had the card whether produced by hand or computer been electronically processed without further human intervention, then, in my view, there would only be the original single hearsay on the "Statue of Liberty" principle. But single or double, there must be some hearsay, except in the precise "Statue of Liberty" type of case. Further, I respectfully agree that the clocking-in-and-out cards, that Simon P. spoke of, though there is human intervention, would not be hearsay. Not because they are commonly admitted (for things that are hearsay are often admitted for want of objection) but because the person clocking-in-and-out is not himself making his own statement by medium of the machine. He is actually causing the machine to record its own version of the time, not his. If the machine had no clock and he had to tell the machine the time by looking at his own watch and punching that time, the card so produced would certainly be hearsay.

So if the debtor's accounts or stock records are required to be proved and they consist of electronically processed data, the data consisting of documents recording the delivery of goods and the payment of money and the production of goods, then the data in each case will be statements by someone that goods have been passed out of stock to the debtor or money has been received from him or goods have been produced in the factory and anything produced from such data must be inadmissible because of the hearsay rule, unless all the data makers are called, even though there has been no human intervention in the processing. If there has been human intervention there is a "double hearsay".

But if a computer should be so arranged as to photograph the goods as the debtor actually took them from the vendor's store and photograph the debtor's money as he handed it to the vendor and it were proved that no goods went out or money was received except before the camera and the computer then translated its pictures into an account, such an account would be admissible as the radar films in "The Statue of Liberty".

This concept may or may not be far-fetched at present, but Desmonde (op.cit.p.171) tells us that the Bank of America has a computer called ERMA which records customer's cheques made with magnetic ink in standard lettering and automatically enters them in the customer's accounts. The debit side of such an account could be tendered without infringing the hearsay rule in my view because the cheque is an order or transaction and not an assertion. But an electronically processed deposit slip would be in a more ambiguous position (unless it was the document of an opposing party) similar to that of a receipt (see *Carmathen etc. Railway Co.* v. *Manchester etc. Railway Co.* L.R. 8 C.P. 685).

Again American Airlines has a computer called SABRE (Desmonde op. cit. p.207) which enables agents all over the country to ascertain automatically the seats available on all plane journeys and also automatically to make reservations or cancellations by pushing buttons. Would it be possible to prove the state of seat availability at a particular time by tendering a certificate produced by SABRE? Insofar as the certificate was dependent for its production on the making of reservations through pushing buttons there would be no difficulty. Even if the reservations were made not by pressing buttons, but by inserting a written order, this would be a transaction not an assertion. It would be like a cheque and unlike the hypothetical clocking on where the workman read the time himself and recorded the time as read by him. If, however, SABRE were partly dependent on human intervention to feed into it a record of a plane leaving and so of a number of seats being withdrawn or of a plane and its seats becoming available, then such intervention would involve assertions, and records produced with their aid would be partly produced by hearsay means and inadmissible. (Evidence given which is not hearsay in form but represents knowledge gained by hearsay is itself hearsay. "I am 28 years of age and was born illegitimate at Stayley" is inadmissible. *Reg* v. *The Inhabitants of Rishworth,* 2 Q.B. 476.) If the planes leaving the airport and arriving there automatically gave impulses to SABRE so as to allow it to record its stock of seats, the resultant information would be admissible under the "Statue of Liberty" principle. I suppose what is more likely is that the timetable itself would be programmed into the machine. That would be borderline, but would I think be an assertion of future plans and therefore hearsay material.

In the latter case and in other cases the hearsay material (the timetable) might readily be proved by non-hearsay means, but in very many cases this will not be so. The data will tend more and more to be information from a number of unidentifiable people.

The Processing

This aspect is not a new difficulty for the law of evidence to cope with, but accentuates a difficulty already there. In the first place, if the processing has some form of human monitoring, then, as I have argued, the result of the processing will involve a recording of a statement by the monitor which will be hearsay material distinct from the possible hearsay material already involved in the data. In such cases it will not be possible to tender the result of the processing without calling the monitor or monitors. I imagine there will often come to be a number of monitors, perhaps not all identifiable and, if so, proof will be very difficult or impossible. But a further difficulty special to the processing arises from the rule against inference. Again it is the same sound basic principle that a witness must testify to what he himself did or saw done with his own eyes or heard transacted (as distinct from asserted) with his own ears. Inferences are for the jury or fact-finders. (Bushell's case 6 How.St.Tr. 999). The witness may not process his own sense data or, I believe, any other data. And this principle too is carried to its logical extremity. So in Petty Sessions in a too-many-cats-in-the house case when a witness said "I smell a catty smell" – "I object he must describe the smell precisely" or when he said "I heard a cry of pain" – I object he must describe the cry and let the Court decide whether it was caused by pain" and in all Courts – "The defendant said that he was quite happy with that arrangement" – "I object he must say what words the defendant used".

And so with business profits. It is not permissible to tender the profit and loss account of a business produced by its accountant. The books themselves must be produced and when that is done the accountant (as an expert and semble only because he is an expert) may summarize and give his expert opinion as to trading results disclosed by the books. (*Lakeman* v. *Finlay*, 59 S.R. 5).

(Incidentally, the Court did say that the books themselves were admissible despite the hearsay rule, relying on dicta in *Potts* v. *Miller*, 64 C.L.R. 282. But perusal of that case, though it undoubtedly justified the statement of the New South Wales Court, showed little basis in English or Australian law for such a view. The admissibility of the books themselves seems doubtful in view of Myers' case which was accepted by the Privy Council in Patel's case (at p.365). Can the books be tendered without proof of the cheques, the invoices, the sales dockets and all the other primary source material which is processed into books? And how are those primary source documents admissible themselves without calling all the staff who conducted the transactions recorded by them ?)

So although actuaries have commonly been allowed to give evidence of the calculated present value of £X per week for Y years, it has never been easy to get in lists of stolen goods or goods sold and delivered with values placed beside them and any necessary multiplication and addition carried out except without objection (the lack of or withdrawal of objection often induced by the pressures of expediency or other circumstances) – "The jury can multiply and add" – its an inference.

In the processing aspect as well as in the data aspect, computers add no new problems, but again accentuate the old. Machines cannot be allowed to process, whether it is seen as merely summarizing or tabulating or inferring any more than witnesses can, or anybody other than the judge or jury, – so long as the data in furnished by human agency. If the designers can be persuaded to concentrate on machines that supply their own data (such as the one I imagined which photographed goods going out and money coming in) than I think Courts will not prevent machines summarizing and tabulating or inferring from their own data on the "Statue of Liberty" principle.

What is to be done?

Since my task was to discuss computers and the law of evidence and my view is that computers do not bring new problems, I see no particular need to free computer evidence from the outdated rules, but a need to free all evidence from them. However, Professor Cross tells us that a special legislative provision has been drafted for computers in England and he is mentioning it to you.

I do not envy the New South Wales Law Reform Commission their task. I do not know what is to be done. I only know two things that ought not to be done. One is to allow things to go on as they are,to allow the hearsay rule and the inference rule or for that matter the primary evidence rule to continue in full force. If we do it might not matter much in assault or running down or divorce cases, but even in those the earnings and dealings of corporations have a tendency to crop up and a medical practitioner who was a hospital resident might be injured and counsel be set the impossible task of proving what he would have earned as a general practitioner. And more and more as our economic environment becomes complex and new kinds of litigation arise, we have to face up to proving the unprovable. (The writer was once, in a landlord and tenant hardship case brought by the Maritime Services Board to get space for a wharf, set the task of proving that shipping had doubled in the Port of Sydney in X years. It cannot be done unless you have identifiable and traceable individuals who count the ships and keep their own records.)

The second thing not to do is to codify, that is, if codify means codify the existing rules. (Somewhere I have seen "The law of evidence is ripe for codification".)

Unfortunately it appears that what will have to be done will have to be done by Parliament and that nothing more can be hoped for from judicial legislation with its greater ability to be flexible and develop. Unfortunately also Parliamentary reform comes in the environment of judicial interpretation by the letter and the history of the English legislation of 1938 (s. 14B of the New South Wales Evidence Act) with its confining language has not been inspiring. It is too much to hope that Parliament should say to the Judges "Take this as your guide and develop a system".

I don't suppose Parliament is likely to tear it all up and say to the Judges start again. Although it has done just that in Industrial Arbitration and Fair Rents legislation where complex technical data has been essential for the functioning of the tribunals, by providing that they are not to be bound by the rules of evidence. (Landlord and Tenant (Amendment) Act, 1948, as amended, s.43. Commonwealth Conciliation and Arbitration Act, 1904, as amended, s.40.) I imagine such a system must have worked reasonably well. So I suppose and hope that the next thing will be attempted and that Parliament will tell the Judges with some safeguards to admit anything probative whether or not it is forbidden by the hearsay rule. Something less than that seems to be what the 1966 report of the English Law Reform Committee recommended, and, as Professor Cross says, if its recommendation is adopted the hearsay rule will have been abolished without even having been authoritatively formulated. (Cross on Evidence, 3rd edition, p.396.) But I think we should go even further and say that anything probative should be admitted whether or not forbidden by the hearsay rule or the inference rule or the primary evidence rule or any of the other unnecessarily restrictive technical rules and I suppose that would be almost tearing it up and starting again.

No historian, archaeologist, logician, politician, journalist or anybody else in the whole world except an Anglo Saxon lawyer could possibly understand the objection to treating a wrapping branded "Produce of Morocco" as at least some slight evidence that the contents came from Morocco. I trust that the time must soon come when ordinary Anglo Saxon lawyers will be unable to understand it too, just as the present generation of them without historical study cannot understand the old rules about forms of actions.

PROBLEMS IN EVIDENCE

The computer in Court : are computer records legal evidence?

*F. Curtis Hacker**

Script

Resources Unlimited Ltd vs *Interplanetary Explorations, Inc.*

This takes place in the U.S.A. It is a fictitious private anti-trust suit for treble damages. A portion of the case-in-chief is being presented to exemplify some of the considerations that can be encountered when various new types of evidence related to computers are offered in court. The types of evidence treated here, which were selected arbitrarily to provide variety and do not represent, by any means, the entire range of possible items, are the following:

1. Accounting record print outs that were in the files of the proponent when taken by the witness to court and were complete. (page 4).

2. Print outs that are the same as in 1, except that they lack column headings. (Page 7).

3. Accounting record print outs that did not exist in the files of the proponent but were printed out while the witness waited and fairly promptly found their way to court. (Page 8).

4. Print outs that are the same as in 3, except that they were made at a branch installation at a substantial distance from he computer that searched the tape from which they came and sent the information by wire to the location of the printer. (Page 10).

5. Records in machine language, on punched cards and magnetic tape, rather than in readable text as a print out, were produced in response to a subpoena duces tecum because no print outs existed in the files. (Page 14).

6. Evidence of action taken by a computer that constitutes an extra-judicial admission. (Combined with 7) (Page 18).

7. Circumstantial proof of action taken by a computer where no records of the specific action were kept. (Combined with 6) (Page 18).

The trial occurs in a jurisdiction in which the Uniform Business Records as Evidence Act has been adopted.

* Applications Consultant, Honeywell Electronic Data Processing, Honeywell Pty Ltd.

Cast of Characters

Judge
Counsel for plaintiff (Resources Unlimited, Ltd) Darrow
Counsel for defendant (Interplanetary Explorations, Inc.) Crawford
Witnesses
James Beam, Chief Accountant, plaintiff's New York City office
John Jameson, Secretary, defendant
Hiram Walker, Supervisor, defendant's computer department
Jack Daniels, Head of sales administration, Aggressive Distributors, Inc.

THE COURT:

Gentlemen, we will resume the case of *Resources Unlimited, Ltd* v. *Interplanetary Explorations, Inc.* The plaintiff may proceed. I understand that today we will reach some items of evidence that are somewhat out of the ordinary. I look forward to their presentation. *(Pause.)* As I recall, all of today's witnesses already have been sworn and all exhibits to be offered have been marked in advance. *(nods head to Mr Darrow as a signal to proceed.)*

Testimony of James Beam

BY MR DARROW:

Q. Mr James Beam, would you please take the stand. What is your occupation?

A. I am chief accountant of the office of Resources Unlimited, Ltd located in New York City, which is the headquarters of the eastern region.

Q. How long have you served in that capacity?

A. Twelve years.

Q. Does Resources have offices outside New York City?

A. Yes, it has similar offices in Chicago, which also is the national or home office, and in San Francisco.

Q. Are you familiar with the accounting procedures by which records of Resources' sales are kept at the three offices you mentioned?

A. Yes. A standard procedure is used in all of them. I participated in the design of that procedure.

Q. Would you please describe that procedure as it relates to the recording of sales.

A. Incoming orders from customers go first to the sales department, where they are edited for the correct spelling of product names. Then, they are sent to the computer centre, where their information is put on punched cards. The cards then are used to feed data to the computer. That is the sole function of the cards. They are not records themselves. The computer automatically checks each such order fed to it to make certain that the desired merchandise is being offered, that the customer's credit standing is good, and that the quantities specified are consistent with the particular customer's buying patterns and are not so large that they are clearly in error. Orders that pass the tests are processed by the machine, which prints up shipping papers and invoices, makes entries on accounts for customers, and creates records of sales for statistical purposes. Where sales are not actually effected for any reason, like a cancellation or refusal to accept delivery, that information is picked up promptly and fed to the computer for it to make the appropriate correction in its records.

Q. Are there any precautions taken to insure that no errors are made in putting the order information on punched cards?

A. Oh, yes. Each card is verified to detect errors and any necessary corrections are made.

Q. Are there any other factors in the system that contribute to the accuracy of the information in its records?

A. We have built in a number of accuracy checks to verify arithmetical calculations and to make certain that the computer reads and writes correctly. But probably the most effective control over errors is the great care generally taken by the customers themselves. If any packing slips or invoices are wrong, the customer will catch the errors and call them to our attention. In addition, we have internal controls, too. For example, total recorded shipments are checked periodically against production figures and inventories to detect any errors.

Q. What happens if an error is detected?

A. All of the pertinent records are corrected promptly.

Q. I show you Plaintiff's Exhibit 30 for identification, purporting to be an accounting record, and ask you whether or not you have seen it before.

A. Yes, I have. I took it from the files of Resources myself.

Q. What is it?

A. It is a record of the sales of gubbers in the eastern region, monthly, for the years 1957 to 1959, inclusive, by states.

Q. Was that record made up by the procedure you described?

A. Yes, it was.

Q. I offer Plaintiff's Exhibit 30 for identification as Plaintiff's Exhibit 30.

BY MR CRAWFORD:

If the Court please, we would like to have your Honour reserve decision on the admissibility of this exhibit until we have had an opportunity to cross-examine with respect to it.

THE COURT:

It might be well to have that cross-examination right now. Would that be acceptable, Mr Darrow?

BY MR DARROW:

We are entirely agreeable to that procedure, your Honour.

THE COURT:

You may proceed, Mr Crawford.

BY MR CRAWFORD:

Q. When was Plaintiff's Exhibit 30 for identification printed up?

A. Undoubtedly, on one of the first business days in January 1960.

Q. Did you personally make any of the entries in the records from which that exhibit ultimately was made?

A. Oh, no. That was all done by clerks who punched the cards and then by the computer, which read the cards and carried out the accounting procedure.

Q. Does the computer work with records like Plaintiff's Exhibit 30?

A. It does not. Up to now, it can use only information in machine language. This includes punched cards and magnetic tape records.

Q. Is the information that results from the computer's operations put on punched cards?

A. No, our computer creates only magnetic tapes.

Q. At what intervals does the computer put sales information on magnetic tape?

A. At the end of each day, a transaction tape is made up. That transaction tape then is run through the computer in conjunction with the latest cumulative tape is updated to make a cumulative tape. We call the latest cumulative tape the "son tape" and the one preceding it, the "father tape", because they represent two generations.

Q. Do you save all the past magnetic tapes that have been updated?

A. It would be both a physical and economic impossibility to do so. We go back only to the grandfather tape. The older tapes are reused by writing over them in the same way that a sound recording tape is reused.

Q. Was Exhibit 30 printed up from one of the cumulative tapes you mentioned?

A. Yes, it was.

Q. And the entries contained on the tape from which Exhibit 30 was printed up probably were made at the end of December, 1959?

A. Yes, on the last business day of that December.

Q. Then those entries were made months, if not years, after the transactions they reflect occurred.

A. Yes, it would be almost three years after the sales made in January, 1957.

Q. That is all. (Turning to Mr Darrow). You may take the witness for redirect.

BY MR DARROW:

No questions.

BY MR CRAWFORD:

I object to plaintiff's Exhibit 30 because it is a bald, self-serving statement purporting to show plaintiff's sales. Its offer flies directly in the face of the hearsay rule because no witness having personal knowledge of the transactions purported to be reflected by the Exhibit is produced for cross-examination. By his own admission, Mr Beam has no personal knowledge of any of those transactions.

BY MR DARROW:

May it please the Court, Exhibit 30 is offered as a business record under our Uniform Business Records as Evidence Act. In that respect it stands on the same footing as a sales record made up by a business whose accounting system was run entirely by people.

BY MR CRAWFORD:

If that is the basis for offering the exhibit, it certainly is inadmissible. The act requires that the record being offered have been made "at or near the time of the act, condition or event" recorded. The witness stated positively that the entries on the magnetic tape from which the exhibit was printed were not made until long after the transactions ostensibly recorded actually took place, in some cases almost three years later.

THE COURT:

Gentlemen, I begin to see some of the interesting facets of this new type of evidence. I appreciate the thoroughness of your argument. I will admit Plaintiff's Exhibit 30 as a business record under the uniform statute. It seems to me to comply satisfactorily with the requirements of that exception to the hearsay rule. The suggestion that the entries on the magnetic tape, from which the exhibit was printed, were made unreasonably long after the transactions involved is highly technical and ignores the reality that the original entries were made with sufficient proximity to the events and were copied thereafter entirely by machine. In some cases, there were repeated copying of the entries but it was done automatically under circumstances that give the assurance of accuracy. The new type of records have been used by plaintiff in the conduct of its business and have the same assurance of trustworthiness that comparable records maintained by people using more traditional business machines have been recognized to have.

BY MR DARROW:

Q. I show you Plaintiff's Exhibit 31, for identification, purporting to be an accounting record, and ask you whether or not you have seen it before.

A. Yes, I have. I took it from the files of Resources myself.

Q. What is it?

A. It is a record of the sale of gubbers in the eastern region, monthly, for the years 1960 to 1963, inclusive, by states.

Q. Was that record made up by the procedure you described?

A. Yes, it was.

Q. There do not appear to be any headings for the columns of information on the exhibit. Do you know what information is contained in each column?

A. Yes, I do. They contain the same type of information as do the equivalent columns of Plaintiff's Exhibit 30.

Q. Can you state why the column headings were omitted from Exhibit 31?

A. Strictly as a matter of economy. We found that very few people had been referring to these printed records since we adopted our integrated computer management system, in which the machine itself compares actual experience with pre-established norms and reports deviations to management. This makes it unnecessary for our executives to look at the voluminous records. They concentrate on the apparent trouble spots identified by the computer. Since computers are extremely expensive to operate, we constantly try to eliminate unnecessary operations and records. Even column headings like the ones we're talking about involve program instructions and machine time. We eliminated them to save the cost of remembering and creating them by machine.

BY MR DARROW:

I offer Plaintiff's Exhibit 31 for identification as Plaintiff's Exhibit 31.

BY MR CRAWFORD:

Same objection.

THE COURT
Same ruling.

BY MR DARROW:
Q. I show you Plaintiff's Exhibit 32 for identification, purporting to be an accounting record, and ask you whether or not you have seen it before.
A. Yes, I have. I took it right from the printing machine in the computer room of Resources last Tuesday morning and handed it to our counsel, who was there with me.
Q. What is it?
A. It is a record of the sales of gubbers in the eastern region, weekly, for the years 1957 to 1963, inclusive, by groups of states, such as New England, Middle Atlantic, and the like.
Q. Was the record made up by the procedure you described in your testimony?
A. Yes, the underlying information represented by the entries on the magnetic tape was.

BY MR DARROW:
I offer Plaintiff's Exhibit 32 for identification as Plaintiff's Exhibit 32.

BY MR CRAWFORD:
Again, if the Court please, it is suggested that we have the opportunity to cross-examine the witness concerning the offered exhibit before your Honour rules on its admissiblity.

BY MR DARROW:
We have no objection to that procedure.

THE COURT – (ADDRESSING HIMSELF TO MR CRAWFORD):
You may proceed.

BY MR CRAWFORD:
Q. Apparently, Exhibit 32 never was in the files of plaintiff.
A. That is correct. That piece of paper went right from the printer into my hands and from my hands to the solicitor's.
Q. Why wasn't it possible merely to go to the company's files for a paper or group of papers containing the same information as that on the exhibit?
A. We have not kept or used information in that precise form. As a result, no such papers have existed until this exhibit was made up. In fact, it was necessary to prepare a special program to pick the desired information from the magnetic tape record and put it on another tape in the format in which it was printed out.
Q. Are you familiar with facts concerning any of the individual transactions from which Exhibit 32 was constructed?
A. No, I am not. Again, the sales data were produced by card punch operators.

BY MR CRAWFORD:
Mr Darrow, your witness.

BY MR DARROW:

Q. Mr Beam, have you had occasion previously to have print outs made up on special formats, of information contained in your company's computer records?

A. Yes, that happens very often. I referred to the great expense of operating a computer and the incentive to minimize operations put on it. For this reason, we have cut our routine reports to the bone. However, we recognize the need for special reports and are prepared to make them upon request. In practice we make up such reports frequently.

BY MR DARROW:

That is all.

BY MR CRAWFORD:

No questions. *(To the Court)* Plaintiff's Exhibit 32 is objected to on the ground that it is a self-serving statement made specially for this litigation and is objectionable hearsay because no witness with knowledge of the facts the exhibit purports to show is available for cross-examination. The exhibit is not admissible as a business record because it never was a business record used by plaintiff and never existed in its files. The witness stated that he took it right off the printer and handed it to plaintiff's counsel. It certainly was not made in the regular course of business, as required by the Business Records Act. It was conceived and made specially.

BY MR DARROW:

My worthy opponent misconceives the true nature of the exhibit and attributes to it improperly an existence separate and distinct from the business records that plaintiff made and used in the regular course of its business. The business records really involved are the records kept by Resources on magnetic tape. They were made and are used in the regular course of business. They satisfy the criteria of the statute. The print out represented by Exhibit 32 is merely a visually readable counterpart of the invisible entries on the magnetic tape. In the course of making the print out, the information was rearranged slightly. That is merely a matter of form. But its contents were not altered in any fashion. It may seem unusual that business records are invisible or at least not readable readily by the naked eye. However, that seems to be a fact of life we have to adjust to. To get information contained in those new types of records into evidence, it will be necessary to rely upon print outs, which might fortuitously exist in the files of the company or have to be created specifically for use in court, like exhibit 32.

THE COURT:

The Court is being called upon here to rule on very novel items of evidence. For the guidance of counsel, I will continue my practice, since we entered this portion of the case, of explaining the basis of each of my rulings more fully than ordinarily would be necessary.

I consider Plaintiff's Exhibit 32 admissible under our Uniform Business Records as Evidence Act, and it is received on that basis.

The business records actually involved are the magnetic tape records themselves. It is not essential that records be readable by the naked eye in order to be admissible. That is merely a matter of form, an entirely superficial consideration. The records here are converted into readable material by machine automatically, by techniques that apparently prevent the occurrence of errors in the transcription process. Other business records laws apply to records that are not readable visually. The Uniform Rules of Evidence are specific. In them, "writing" includes every "means of recording upon any tangible thing any form of communication of representation, including letters, words, pictures, sounds or symbols". It is sufficient that a visually readable counterpart of the record can be made available to the Court.

BY MR DARROW:

Q. (*To witness*) I show you Plaintiff's Exhibit 33 for identification, purporting to be an accounting record, and ask you whether or not you have seen it before.

A. I have. I took it off the printer when Exhibit 32 was finished, and as with Exhibit 32, turned it right over to our solicitor.

Q. What is that exhibit?

A. It is a record of sales of gubbers in the central region, monthly, for the years 1957 to 1960, inclusive, by states.

Q. How did the exhibit happen to be printed up?

A. I directed our computer department to send a message direct to the computer in the Chicago office, by telephone, asking for the information contained on the Exhibit. In response to that request, the Chicago computer sent the information to our installation and the print out resulted.

Q. Was the record represented by the Exhibit made up by the procedure you described?

A. Yes, as I stated, our company uses a standard procedure so that our computer systems will be compatible and the information they create will be consistent.

BY MR DARROW:

Plaintiff's Exhibit 33 for identification is offered in evidence.

BY MR CRAWFORD:

I object to Plaintiff's Exhibit 33, because it is hearsay pure and simple. Each item offered in evidence today has been progressively more removed from records that qualify as business records. Your Honour has found factors pertinent to the previous items that bring them within the exception. Any effort to stretch the rule to cover this latest exhibit goes beyond the breaking point. It simply is too remote to qualify. The witness is not the custodian of the records reflected by the Exhibit. Those records are located 800 miles from his office. He cannot testify directly and with personal knowledge concerning the mode of their preparation. He wasn't present when they were prepared. All he can state, in that connection is that the company has adopted a standard accounting procedure and a policy of achieving compatibility.

BY MR DARROW:

Although, in the course of his work, the witness is not present physically where the records reflected by the Exhibit are kept, he has a position of authority in the company whose records they are and direct access to those records, even though from a distance. For all practical purposes, he is a custodian of such records, within the scope and intendment of the Business Records Act. We are confronted, again, with a new phenomenon of business life. The witness has as ready access to the records in the Chicago office as does his counterpart who is located right there, or as he himself would have if the records were located in New York City. Where an integrated, company-wide computer system is used, all installations are elements of a single system. The practices and methods followed in all installations must be identical. Otherwise, the various machines that are interconnected by direct telecommunications by telephone wires or microwave systems, could not function in conjunction with each other. The witness is in a position to give assurance that the distant records whose contents he produces are genuine and accurate. The ostensible physical remoteness of the various installations from each other is entirely superficial and of no real significance.

THE COURT:

Plaintiff's Exhibit 32 is admitted. The exhibit qualifies as a business record of plaintiff. I am satisfied that the witness can testify about the manner in which the records reflected by the exhibit are made and kept and used. It appears that, where a computer system is used, uniformity is essential. Hence, the witness, who is an integral part of the system made up of machines and people, can describe the system with assurance that offices other than his comply with the procedures he describes. Furthermore, although the witness may not have physical power over the records making up the exhibit to exclude others from gaining access to them he has as much authorized access to those records as anyone else in the company, including the person who has them in his actual possession. He can produce copies of records by remote control with full assurance that they are official and accurate. We must be realistic and accept the new ways of doing business accounting with the help of computers. We must adapt existing evidentiary rules to cover the novel factual situations characterizing the new methods, especially where no genuine sacrifice of underlying principles is involved. We must not permit technicalities to induce us to impose unnecessary burdens on users of computer systems.

BY MR DARROW:

Q. (*To witness*) I show you Plaintiff's Exhibit 34 for identification, which purports to be a schedule, and ask you whether or not you have seen it before.

A. Yes, I have. I took it from the files of my company the other day and gave it to our company solicitor.

Q. What is that exhibit?

A. It is a schedule of average prices charged for products that can be used readily as alternatives to defendant's products. It covers the period 1957 to 1963, inclusive.

Q. From whose files in your company did the schedule come?

A. The section of the files assigned to the Sales Department.

BY MR DARROW:

I offer Plaintiff's Exhibit 34 for identification in evidence. *(To Mr Crawford.)* You may cross-examine.

BY MR CRAWFORD:

Q. Who prepared the schedule marked Plaintiff's Exhibit 34 for identification?

A. It was made up by our computer, the one located here in our New York City Office.

Q. You misunderstood my question. Let me rephrase it. Who compiled the information from which that schedule was made up?

A. Mr Resch Beer, our New York Sales Manager.

Q. What was the source of his information?

A. Our salesmen and some companies that bought the items involved.

Q. How was the information received by Mr Beer?

A. By telephone or in personal talks.

Q. What function did your computer play in the preparation of the schedule?

A. It computed the average prices from the mass of information collected and it created the magnetic tape from which the print out was made.

Q. When was the information that went into the schedule secured by Mr Beer?

A. I believe some time during early 1964.

Q. What use, if any, was made by plaintiff of the information reflected by the schedule?

A. To compile the schedule we are talking about.

BY MR CRAWFORD:

That is all. Your witness.

BY MR DARROW:

Q. In processing information to create the schedule, did your computer check the information for validity in any way?

A. Yes, it did. The program contained upper and lower limit figures. Those figures represented the highest and lowest prices that reasonably could be expected during the years involved. Prices beyond the range set by those two limits were rejected automatically and thus were excluded from the schedule.

BY MR CRAWFORD:

Plaintiff's Exhibit 34 for identification is objectionable on the grounds of hearsay. No witness is available for cross-examination on the information it comprises and no basis for dispensing with such a witness has been made out. That information was collected by someone other than the witness on the stand and, in most cases, at times long after the events involved. Furthermore, no showing is made that the records were used by plaintiff in the regular course of its business. Hence, the records themselves have not been subjected to the traditional test of trustworthiness. If no computer were involved with this exhibit, it would be characterized immediately as the clearest kind of objectionable hearsay. Despite my opponent's apparent hope, the presence of a computer in the picture cannot even begin to cure the fundamental defects in the exhibit.

BY MR DARROW:

Plaintiff's Exhibit 34 merits admission as a business record. The information in it was collected by employees of plaintiff in the course of their regular activities. The exhibit itself came from the files of plaintiff. It has a business purpose and was treated as a business record. My opponent's comments pertain more to the weight to be given the material than to its admissibility. The schedule should be admitted now. We can consider its probative value at the appropriate time.

BY THE COURT:

Plaintiff's exhibit 34 for identification is excluded. It is clearly hearsay and does not satisfy the very reasonable criteria to bring it within the business records exception. At the very least, the information does not appear to have been recorded sufficiently close to the events purported to be covered. The fact that a computer was used to process the information and create the proffered schedule is of absolutely no significance. Unless the underlying data have probative value, machine processing cannot work miracles for them.

BY MR DARROW:

You may step down, Mr Beam. *(Mr Beam leaves the stand. Mr Darrow takes his seat).*

Testimony of John Jameson

BY MR DARROW:

Mr Jameson, please take the stand if you will. *(Mr Jameson goes to stand with two cartons of punched cards under one arm and three reels of magnetic tape in containers under the other.)*

Q. What is your occupation?

A. I am Secretary of Interplanetary Explorations, Inc., the defendant.

Q. Did you receive a subpoena duces tecum directing you to produce in court this morning specified records of the defendants corporation?

A. Yes, I did.

Q. Do you have the record with you?

A. Yes, I do.

Q. Would you produce them at this time, please?

A. *(Handing the two cartons of cards.)* Here are the cards on punched cards of the sales of gubbers by Interplanetary for the years 1957 through 1961. *(Pointing to the three reels of tape).* And here are the records from 1962, when we mechanized further, to date.

Q. Don't you have in your company's files printed reports or other readable records reflecting the information requested by the subpoena?

A. I'm sorry to report that we do not. You asked for the information broken down in a way we never have needed it or kept it. However, the information you specified is contained in the card and tape records I brought. And don't overlook the fact that the information represented by the punched holes on each card appears in regular words and numbers across the top of the card. Let me show you. *(Withdraws a card and holds it up).*

Q. How many cards are there in the two boxes?

A. There are exactly 4,000 in all.

Q. How much information is contained on each card?

A. Since there are 80 columns across the card, there could be as much information as could be represented by 80 digits or characters.

Q. Those digits would be taken up for spaces between words and for punctuation, as well as for letters and numbers, wouldn't they?

A. Yes.

Q. And where more than one card is required for some information, aren't some of the digits used just to identify the cards themselves and designate their order in the series, like first, second, and so on?

A. That is so.

Q. Can the cards be used to print up the requested information?

A. Yes, they can, but it would be necessary to make up some punched cards in order to put in appropriate column headings on the print out.

Q. How long would it take to punch up the cards for the column headings?

A. No more than a half hour.

A. In all, no more than two hours.

Q. Why didn't your company take print outs to show the information specified in the subpoena and produce that instead of the decks of punched cards?

A. The subpoena didn't specify any particular form for the material to be produced, and these records here in court comply fully with the subpoena as we read it. All the requested information contained in them. In view of the tendency to use data processing equipment, it was entirely possible that the information actually would be preferred in this form in machine language. Then, it would be analysed by machine directly, without the need, if it were in normal writing to convert it into machine language by making punched cards. This delivery of information in machine language, on punched cards and tapes, is becoming increasingly common. The Federal Government is accepting reports in this form.

Q. What would be involved in printing out the requested information from the magnetic tapes?

A. We would have to make up a special program, which is a set of instructions to the computer how to sort out the information and organize it for the printer.

Q. How long would it take to prepare such a program?

A. Since we use COBOL, it would take no more than an hour to write out the program. Punching the cards necessary to feed the program to the computer would take less than an hour.

Q. What time would be involved in running the program and printing out the schedule?

A. Only a matter of minutes.

Q. How could your company continue to carry on its activities if the punched card and magnetic tapes you have here were to be put in evidence in this case?

A. Oh, that presents no problem for us at all. The cards and tapes here actually are identical copies of our records. We have the counterparts back in the office. We simply ran out sets of cards and the tapes through the appropriate machines and made these records.

BY MR DARROW:

(To the judge). May it please the Court, we request that the witness be directed to produce the information covered in the subpoena in the form of regular schedules that can be read by people conveniently. Although the decks of punched cards technically might be readable, because of the printed information along their upper margins, as a practical matter it is not feasible to use them in that way. Too little information is contained on each card, probably less than appears in a single line of typewriting across a page. And the sheer bulk of the thousands of cards would clutter up the record unnecessarily. The magnetic tapes are yet another story. As a practical matter, they cannot be read directly by people. Their information can be put into the record only by printing it out as a schedule. It would be possible for plaintiff to take the tapes and have print outs made. For this purpose, it would have to know the code by which the information is represented in magnetized charges on the tapes and also the format in which the items of information are set down. Then, when a print out was made, it would have to be submitted to defendant for authentication. Just describing this procedure reveals how cumbersome it is and how unreasonable it would be to impose it on plaintiff. The defendant could take care of the matter so much more easily and directly.

BY MR CRAWFORD:

Plaintiff's suggestion is entirely unwarranted in law. It is not entitled to have defendant do any special work in complying with a subpoena or production order. Defendant can be required to produce what it has in its possession in the form in which it then exists. It cannot be compelled to change the form of the material merely to satisfy the whims or even the special needs or desires of plaintiff. It cannot be required to undergo expense and inconvenience for that purpose.

BY MR DARROW:

The realities of the operation of computers, which already are in wide use and promise to become, before long, the normal method of keeping business records, make it entirely appropriate to expect users of the devices to make, at their own expense, whatever special arrangements are necessary to satisfy discovery requests of legal adversaries. Before the adoption of computers, litigants have been able to get desired records from their opponents without any problems of conversion and resulting expense. Why do companies adopt computers to do their accounting? Solely for their own personal advantage – to save money, to get information faster, to get more information about their own business than they could before. Where a company departs from traditional practices for its own private advantage, it must be prepared to pay for disadvantages it imposes on others. It cannot rightly expect to take all the benefits and shirk all of the burdens. A company turning to computers must stand ready to provide its legal adversaries, at its own expense, with the same type of information that always has been available through discovery procedures without charge.

THE COURT:

I am persuaded that plaintiff is entitled to receive a printed statement of the requested information that clearly exists in defendant's records in machine language. Furthermore, I feel that defendant should provide that statement at its own expense. It is unreasonable to expect that thousands of loose punched cards, each containing only fragmentary information, should be placed in the record. In some cases, 50 or more cards would have information that could be put on a single page. The sheer physical burdens and expense to the parties and to the Court, as well, are without justification. Similarly, it is impractical to admit in the record magnetic tapes whose information cannot be read with the naked eye, in any reasonable manner. That information has to be converted into normal words and numbers by someone using a printing machine. If plaintiff should do it, the print out still would have to be submitted to defendant for verification. That could be a tedious step. The same would be true for a print out of the punched cards. It probably would require defendant to make a print out itself and have the two documents compared by people. In light of these inescapable factors, defendant undoubtedly suffers no greater expense in preparing the requested schedule than it would have to undergo anyhow if plaintiff were forced to accept the proffered cards and tapes. There also seems to be much merit in the argument that defendant adopted its computer system for its own benefit and cannot, by that action, handicap plaintiff in the exercise of its normal discovery privileges. Defendant must be prepared to use part of its savings to provide information to plaintiff in the form in which it would have been available if a computer had not been adopted. Incidentally, the time probably has arrived when litigants should specify in the subpoena duces tecum and other discovery devices like production and interrogatories the form of the records desired, so that it will be known whether traditional written records or machine language records, or both, are wanted.

BY MR DARROW:

(To the witness.) You are excused for the present. Mr Jameson. You will be recalled when you have the schedules ready.

Testimony of Hiram Walker

BY MR DARROW:

(Looking around at the spectators.) Is Mr Hiram Walker in the courtroom? *(Mr Walker stands up).* Will you take the witness stand, please. *(Mr Walker takes the stand).*

Q. What is your occupation?

A. I am supervisor of the computer department at Interplanetary Explorations, Inc., the defendant.

Q. For how long have you had that position?

A. Since February, 1960.

Q. Please describe your duties in that position.

A. I am in full charge of the computer installation. This includes not only the actual operation of the machines but also the programming for them. All of the records involved in the activity, including the record tapes, programs, and documentation, are under my jurisdiction.

Q. As requested in the subpoena duces tecum served on you, did you bring with you the log of the activities of your computer department for the year 1961?

A. Yes, I have it here.

BY MR DARROW:

May I have it please? *(Taking log.)*

Your Honour, we will mark this log Plaintiff's Exhibit 35 for identification.

Q. Did you also bring with you the write up of the program used in 1961 to process incoming orders from customers?

A. I did. *(Witness hands booklet to Mr Darrow)*

BY MR DARROW:

Your Honour, we will mark this Plaintiff's Exhibit 36 for identification.

Q. Did Interplanetary's computer system have a direct wire connection with the computer of Aggressive Distributors, Inc., in 1961?

A. It did since early March of that year.

Q. What type of information was received by your computer from Aggressive computer on that direct wire in 1961?

A. Details on orders received by Aggressive from its customers.

Q. Was the information so received recorded by your company in any way?

A. No.

A. Our computer processed it, using the incoming order program.

Q. Is that the program the write-up of which you brought with you and was marked Plaintiff's Exhibit 36 for identification.

A. Yes.

Q. What did that program cause the computer to do with respect to order information received by it?

A. It caused the computer to compare the information on each incoming order with a set of standard criteria.

Q. What items were included in those criteria?

A. Price, quantities, types of merchandise, geographical areas, and other factors.

Q. What types of action resulted from the comparison you referred to?

A. If an order satisfied the criteria in all respects, a positive response was sent to the transmitting computer.

Q. And what if the incoming order did not satisfy the criteria in all respects?

A. Then, a negative response was sent back.

Q. Would you refer to the portion of Plaintiff's Exhibit 36 for identification *(handing it to witness)* relating to geographical areas applicable to order information received from Aggressive Distributors and tell us specifically what it contains.

A. *(Opening booklet)* It lists the state of Maine, New Hampshire, Vermont, Massachusetts, Connecticut and Rhode Island.

Q. How did the programme make a comparison of incoming order information with that list of states?

A. If the customer submitting the order was located in any one of these states, the geographical criteria were satisfied and a favourable response was sent back.

Q. And a negative response resulted if the customer was located elsewhere?

A. That is correct.

Q. Was any record made in your company of the incoming orders submitted to your computer for processing by the program, the write-up of which is marked Plaintiff's Exhibit 36 for identification, and of the response made with respect to each other?

A. No such records were made.

Q. Was the program described by Plaintiff's Exhibit 36 for identification run during the week of 15th April, 1961?

A. I don't recall specifically. It probably was.

Q. Would that fact be reflected in your log book for 1961, marked as Plaintiff's Exhibit 35 for identification?

A. It should be.

Q. Please refer to that exhibit and tell us what the fact was.

A. *(Opens exhibit and reads it).* That program was run in our computer every working day during the week of 15th April, 1961.

BY MR DARROW:

I offer Plaintiff's Exhibit 36 for identification as Plaintiff's Exhibit 36.

BY MR CRAWFORD:

No objection.

THE COURT:

Plaintiff's Exhibit 36 for identification is admitted as Plaintiff's Exhibit 36.

BY MR DARROW:

Q. Do you know whether an order of Rock Bottom Outlet bearing its number 75639, was processed by your computer on or about 16th April, 1961?

A. The entire order processing procedure is handled automatically and no records dealing with any specific orders are made or kept. As a result, neither I nor anyone else in my company would have such knowledge.

Q. When incoming order information is fed to your computer and the program described by Plaintiff's Exhibit 36 is being run in it, will the comparisons provided for be made in all cases?

A. Yes, they will.

Q. And will appropriate response resulting from such comparisons be sent back to the enquiring computer?

A. Definitely.

BY MR DARROW:

That is all. *(Turning to Mr Crawford.)* Your witness.

BY MR CRAWFORD:

No questions.

Testimony of Jack Daniels

BY MR DARROW:

Mr Jack Daniels, please take the stand. *(Mr Daniels seats himself in witness chair.)*

Q. What is your employment?

A. I am head of sales administration for Aggressive Distributors.

Q. Did you have that position in April, 1961?

A. Yes, I did.

Q. Do you have here in court the order placed with your company on 16th April, 1961, by Rock Bottom Outlet, bearing its order number 75639?

A. Yes, here it is. *(Produces order from his pocket.)*

Q. Was that order entered in your computer system for processing as an incoming order?

A. *(Examines order)* Let me see. Yes, it was. It bears the initial of the order editor who examined it before it went to the card punch operator and then into our computer system.

BY MR DARROW:

May I have it, please? Your Honour, this will be marked as Plaintiff's Exhibit 37 for identification.

Q. Is the customer placing that order located in New England?

A. No, it was in New York.

Q. In April, 1961, did your computer send information on all incoming orders to the computer system of Interplanetary Explorations?

A. Yes, it did.

Q. Did it do so during the week of 15th April, 1961, when Plaintiff's Exhibit 37 for identification was received by your company?

A. Definitely.

Q. Was information on Plaintiff's Exhibit 37 for identification entered into your computer system?

A. The fact that it was processed by the order editor indicates that it was so entered. We followed a rigid procedure of order processing at that time, and we still do. We have no other way of handling incoming orders since we installed our computer.

Q. Was the order, Plaintiff's Exhibit 37 for identification, accepted by your company?

A. No, it was not.

Q. Was the customer's credit satisfactory?

A. Oh, there would be no question about credit.

Q. Was your company able, at the time, to supply the items covered by the order?

A. They were regular, bread and butter items, and we were shipping right along.

Q. Do you know why the order was rejected?

A. I do not.

Q. Who made the decision to reject it?

A. The information on the order simply went into the computer and the print out said "reject". No people were involved at all.

BY MR DARROW:
I offer Plaintiff's Exhibit 37 for identification as Plaintiff's Exhibit 37.

BY MR CRAWFORD:
I object to that exhibit on the ground that it bears absolutely no relation to the defendant or to its alleged unlawful conduct and is completely lacking in probative value in this case. It merely is an order submitted to and rejected by a company other than defendant for reasons unknown. How that exhibit can advance plaintiff's case one iota eludes me completely.

BY MR DARROW:
Plaintiff's Exhibit 37 is admissible because the rejection of that order was accomplished in the effectuation of an illegal conspiracy between defendant and Aggressive Distributors. The conspiracy has been very cleverly concealed. Mr Daniels was probably entirely honest when he stated that he did not know why the order was rejected. The conspiracy was concealed from him too. The wonders of modern technology are utilized to carry it out with the notion and beliefs that no evidence would be created and no trace would be left of the act by which the defendant, not Aggressive Distributors, decided that Aggressive should not sell to Rock Bottom Outlet. And no direct record was created. The specific fact that defendant sent the rejection command for that order is nowhere reflected in the records of Aggressive or, in fact, in its own records. But we do know, by probative circumstantial proof, that such a command was actually sent and obeyed. Let us review the links that go to forge that chain of circumstantial proof. The information on the order that is Plaintiff's Exhibit 36 was entered in Agressive's Computer. That computer was linked by direct telephone wires to defendant's computer. Defendant's computer had a program that would cause it to send a "reject" command for any order received by Aggressive from a company not located in a New England state. The program was run on defendant's computer regularly when information on the particular order came to it for consideration. A command to reject the order was uttered by Aggressive's computer. No sound legal business reason for rejecting that order is apparent. The customer's credit was impeccable. The goods desired were available. A perfect circumstantial case has been made out.

BY MR CRAWFORD:
Even assuming that the alleged message was sent by defendant's computer, there is no sound legal basis for admitting that fact in evidence. It is not written direction or other communication that can be put in the record as an exhibit. It is not the act of a natural person in the course of his duties as the agent of or employee of the corporation. Hence, the exhibit has no probative role in this case. It just dangles in space, unconnected to defendant.

BY MR DARROW:
Your Honour, we are confronted here with a general phenomenon that may now seem unique but that soon will be commonplace – direct communication between computers. Using that new technique, the defendant's computer is sending silent, covert directions to Aggressive's computer. Secrecy

exceeding by far a telephone conversation between natural persons has been achieved. People have automatic memories and the penchant to make notes. But as a practical matter, a message has been sent by an inanimate representative of the defendant. That message, which lacks any physical representation that stimulates human senses, is, nevertheless, as much an extrajudicial admission of defendant as if it were contained in a letter or telegram sent by one of its duly authorized officers or employees. Defendant cannot disavow or escape the consequences of the acts of its machines any more than it can avoid responsibility for the acts of its human agents. Despite their silence and their swiftness, computers do not provide a licence to their users to break the laws, nor do they assume liability personally for the acts they perform for their masters.

THE COURT:

Plaintiff's Exhibit 37 is admitted. I am persuaded that the treatment of that order by Aggressive was linked to the interlocking computer system conducted by defendant and Aggressive. That order hardly exists in isolation from defendant. Considerable evidence has been adduced to show circumstantially that a message about that order went to defendant's computer and that a direction to reject it was sent back. In light of the great assurance that the machine system used will function as intended, I am satisfied that it could be found that the intended direction did go forth and was the sole basis for rejection of the order. Of course, such a finding must await the conclusion of the case. Many other situations entirely unrelated to computers are encountered where no direct evidence of a fact or event is available in the form of written records or the testimony of any eyewitness. In these situations, we have relied upon circumstantial proof for years, satisfying ourselves of the likelihood that an event did or did not occur. The presence of a computer system in a situation to be proved circumstantially seems to me to enhance the probative value of the proof, to the extent that the necessary elements of proof can be made out through documentation or otherwise. I would find such circumstantial proof of a computer's operations more convincing because of the high degree of organization that normally characterizes computer systems and the high levels of accuracy generally achieved in them. In most cases, there is greater likelihood that a machine took intended action than that a person did. In view of the testimony presented yesterday, furthermore, I understand that the operation attributed to a computer could be repeated simply by assembling the various elements, including the machine, the program, and the particular special information, and having them interact. With respect to computers, I believe that we must be prepared to receive increasingly this type of circumstantial proof relating to their operations. In the first place, the machines do not yet have automatic memories. They have to be directed to make a memory record and each such operation costs money. In many situations, there is no reason, apart from the possible unreasonableness of persons involved in the judicial process, to create such a specific record. The businessmen using the systems don't need them. Any records on paper, as distinguished from those on magnetic tape, also are costly because of the expense entailed in placing them in an orderly fashion in file drawers and in providing floor space for the files. One of the technical experts yesterday gave us as an example the case of an insurance company whose computer sends out policy expiration notes automatically, without keeping any file copies whatsoever. As I understand it, then, business users of computers are satisfied to rely on the same circumstantial factors as are pertinent in court in determining whether a computer took certain kinds of action that are of importance to them. It is an entirely realistic approach so long as the pertinent safeguards are present in each specific situation. Our primary responsibility, like the businessman's, is to make certain that the safeguards are present before we are moved by circumstantial proof.

The Court will recess until tomorrow morning at 10.00 a.m.

This material in its original form was prepared by Roy N. Freed, Esq., Division Counsel, Computer Control Division, Honeywell, Inc. and member of the Connecticut, Massachusetts and Pennsylvania Bars. It has been published in a somewhat different form in Volume 16 of American Jurisprudence *Proof of Facts Annotated*, pp. 273-350.

PROBLEMS IN EVIDENCE

*B. Porritt**

Magnetic Computer Tape

(1) What it is?
(2) How it is made?
(3) What it does?
(4) How it does it?
(5) Why it is used?
(6) Can records on tape be falsified?

(1) What is a magnetic computer tape

Let us first see what a Magnetic Tape is made up of. This can be broken into two areas, i.e. the backing and the magnetic coating. The backing is usually a plastic film similar to cellophane or polythene films as used for wrapping. This forms the base to hold the magnetic coating together so that it may be transported and handled easily. A thin layer of paint like material is coated onto this film to provide the active part of the tape. This coating contains a magnetizable oxide of iron mixed with a flexible binder which glues it to the backing in the same way as the colour pigments of a paint are adhered to a painted surface.

Backing materials and coating come in various forms. Backing material being either Cellulose Acetate, P.V.C., or Polyester films varying in thickness from a few ten-thousandths of an inch to about six-thousandths of an inch (the latter is actually the same base material used for movie film.) While the coating may vary in composition of both the oxide material used, the formulation of the binder and also the thickness, smoothness and eveness of the coating.

For Computer Magnetic Tape the backing material is today almost universally made from Oriented Polyester film such a Duponts "Tensalised Mylar"† which is a very strong and stable variation of polythene film. It is mostly one and a half thousandths of an inch thick. Sometimes on older systems one thousandth of an inch thick film is used, but this being more delicate, has lost favour to the strong type of film. With the development of higher density tape drives the advantage of the thinner tape, i.e. more tape hence more information on the same size reel, has become less important.

The coating on computer tape is generally thicker than for audiotape being 450 micro inches against the normal maximum for audio tape of 350 micro inches with some going as low as 120 micro inches. Computer tape coating also

* I.R.E.E., Works Manager. Olims Certron Pty Ltd.

† A registered trade mark of the Du Pont Chemical Co.

requires to be much more smooth than for Audio use since bumps cause the signal output from the tape to drop when the tape is being read back. For Audio Tape up to twenty dropouts in forty feet are acceptable where the signal from the tape drops to level less than 50 per cent. of normal for more than eight one-thousandths of an inch along the tape using a single narrow track, any loss of signal less than this being of no consequence and would not be noticed when listening to the tape played back. Where as for Computer Tape if any one or more half cycles, that is, bits (see section (3)) (i.e. where each bit may occupy from six ten thousandths of an inch to five one thousandths of an inch depending on the particular type of tape drive being used) drop below 50 per cent from one or more tracks (of usually seven or nine narrow tracks) in three or more places in any five hundred feet of tape would be considered in poor condition and in need of repair (re-certification).

The other difference with computer tape is in width. Audio tape is usually one-quarter of an inch wide. This will accommodate up to eight tracks but they are far too narrow to be reliable enough for computer use. Computer tape is usually half an inch wide with either seven or nine tracks with a few specials with such arrangements as ten channels (or tracks) on half inch tape, sixteen channels on three quarter inch tape and one which several government-operated computers use in Australia which uses ten channels on a three-quarter inch tape which gives about the same track width as is realized with seven channel half inch tape.

Computer tapes are often larger than many Audio tapes. For many years the standard reel for computer tape has been a ten and one half inch reel which will hold 2,400' of 1½ mil. (.0015") thick tape, or 3,600' of 1 mil (.001") tape. However, there is a trend now to use smaller reels with shorter lengths on them. This has come about since many jobs requiring computers to use magnetic tape do not require such long tapes, sometimes tapes as short as 50' are found to be very useful.

(2) How is magnetic computer tape made?

First of all the special oxide of iron is formed from a common oxide form which is used by the paint industry as a pigment. This is done by a baking process where the oxide is heated in a carefully controlled atmosphere for controlled lengths of time and temperatures. The result of this is to form needlelike particles of gamma ferric oxide. This form gives the most suitable operation for magnetic tape. These particles are very small being only a few millionths of an inch long and less than one-millionth of an inch across.

The oxide particles tend to cling together due to being magnetized and have to be dispersed and mixed with a solvent and binder so that each particle is separated from its neighbour and is coated with the bonding resins. This is done by grinding for many hours in a "Ball Mill". It must then be filtered to remove any large lumps still remaining. For computer use this filtering is most important since it is highly undesirable to have any particles larger than five microns although there will always be some present the lower the concentration the better the quality of the tape.

After the coating material has been prepared it must be applied to the backing film. The film is usually obtained from one of the large chemical companies such as I.C.I. or Du Pont etc., in rolls known as webs which may be from six inches to several feet wide. The coating is applied using a printing process. Today mostly reverse roll coating is used, here the ink is first applied to an accurately machined metal roller and spread in a thin even layer on its surface, then it is transferred to the film. As the film leaves the coating head it passes past an orientating magnet which lines up all the oxide particles with their long axis along the tape. This improves the recording qualities of the finished tape. It then passes through a drying oven to remove the solvent and is wound again into a roll. Most of the tape made now is then passed through a calender, i.e. a machine with a highly polished heated roll with another softer roll which presses the film hard up against it with many tons pressure. This process irons the oxide surface on the tape flat smooth and gives it a shiny burnished effect which improves both the electrical performance and the wearing properties of the tape also reduces wear caused by the tape to the computer tape drives. After calendering the coated web is slit into the width required, i.e. mostly half inch, cut to length (at this stage mostly 2,400') and reflective markers are fitted to the back surface near each end.

Even after being treated with the greastest care through the above processes, each being carried out under the most thoroughly clean and carefully controlled conditions, the tape is still not good enough to be used successfully on a computer since there will still be some irregularities on the surface of the tape which will make it impossible to read back exactly what was written on the tape. The last part of the tape manufacturing process, and perhaps the most important, is that of certifying. To certify a computer tape it is run on a specially modified tape drive which writes all along the tape and attempts to read back what was written having been set in such a way as to make it harder than normal to read the tape (this ensures that if the certifier can just read the tape the computer will read it easily). Where the certifier fails to correctly read what should have been on the tape it is stopped, inspected and if the cause of the error is repairable, it is corrected until all the tape is free of errors. If an error is unrepairable the tape is cut into shorter lengths discarding the section containing the error.

Computer tapes were originally supplied on 10½" diameter reels with either 2,400' of 1½ mil of 3,600' of 1 mil tape but shorter lengths are now becoming more popular the more common being 1,200' on an 8½" reel, 600', and 400' on a 6 15/16½ reel, 300' on a 6¾reel and 200' on a 5 15/16" reel.

(3) What does a computer tape do?

Computers are capable of handling large volumes of data very quickly. This data is stored in some type of binary coded form i.e. groups of "bits". A "bit" is the smallest element that goes to make up a code. There are two types of bits, namely, "zero" and "one". These can be represented by anything which can assume two discreet states, e.g. a lamp may be either on or off, a switch may be open or closed, a voltage may be + or – or it may be large or small etc.

If "data bits" are grouped into fixed patterns where each bit has its correct place this group may be called a code. A code may have from three bits up to eight or more although eight is usually the maximum used. The position in the code occupied by the bit is called its channel.

One way to form a binary (i.e. two state) code for numbers is to assign a numeric value to each channel and to sum the numeric values of those channels marked with a "one" to find the number which is represented by this code, e.g. if channels one, two and three have numeric values of one, two and four respectively, the numbers from zero to seven can be represented, i.e, the code 110, where the channels number from right to left, would be 0 + 2 + 4 = 6 therefore 110 represents the number 6.

From the above it can be seen that if groups of three bits are used in this way there are only eight numerals which can be seen that if groups represented instead of the usual ten commonly used by most people. However the computer not having ten fingers but having three channels will find it much easier to do its calculations in "Octal" arithmetic than in the decimal arithmetic we know or it may work in pure binary simply by running all octal codes in a number together and then just splitting the answer up into groups of three bits again.

If the computer were to have four channels per code instead of three it would be possible to represent sixteen numbers by the code groupings (i.e. Hexedecimal) or, by ignoring the last six combinations, it could have a "Binary Coded Decimal" (B.C.D.) form of coding. B.C.D. has one advantage over the other forms in that it can be directly read in and out and printed without having to be translated mathematically. However since it does not use all combinations possible it requires more complicated operations to perform each part of each calculation. Most computers can perform all required operations on all the data which can be stored in their internal memory in only a few seconds therefore if they are to be used at all efficiently it is necessary to have some large volume storage medium which is capable of very rapidly transferring this data into and receiving data from the computer. Magnetic tape fills this requirement very well. (One reel of tape can store almost one hundred million bits and can transfer them at up to a quarter of a million bits per second.)

(4) How does a magnetic tape store data?

The information is written on the tape in a series of tracks which run along the tape usually seven or nine tracks with the bits of each code set out across them one per track, and the codes succeeding each other along the tape. The codes are formed into blocks which may only contain a few codes or may contain many thousands of codes.

The actual process of recording consists of magnetizing the oxide coating in a controlled manner, the most common arrangements at the moment being to cause the direction of magnetization to change every time a one is required to be written (i.e. the "Non return to zero change on Ones" or "N.R.Z.I" system) if a zero is required the direction of magnetization remains the same. When reading back, a change in direction of magnetization produces a pulse, but no change in magnetization direction produces no output thus satisfying the requirements for representing a bit.

Data may be written at various densities commonly 200, 556, 800 and 1,600 bits per linear inch per track so that in one inch of nine track tape at 800 per bits per inch there would be 7,200 bits. As the density increases to the difficulty of reading back everything that was written on the tape increases so much so that at 1,600 B.P.I. the coding system is changed from simple to N.R.Z. to a phase encoding system which is not so sensitive to loss of signal amplitude from the tape.

Each block of data is separated from its neighbour by an inter record gap; this permits time and space for the tape to bė stopped and started again between blocks.

Most modern computer tape drives run the tape between 75 and 150 incher per second. They must be capable of starting and stopping the tape so that it goes from stopped to full speed or from full speed to stopped in less than a quarter of an inch, taking only a few thousandths of a second.

There is a check system used with magnetic computer tape to ensure that information is only accepted when it is correctly read. This system is called parity checking and consists of counting the "ones" in a code or any group of bits and only accepting the code if the number of "ones" is either even or odd, depending on the system used. With magnetic tape even parity is mostly favoured but odd parity is often used to distinguish between information written in pure binary and information written in B.C.D. etc.

Parity checking is carried out across the tape, i.e. horizontal parity (counting the "ones" in each character) and along the tape, i.e. vertical parity (counting the "one" bits in each channel of each code in each block of data). To ensure that the parity will come out correct one channel is set aside (called parity channel or track) so that when writing each code if the number of "ones" in the code being written is incorrect for the system being used a "one" is written in the parity track. If the number of "ones" is correct a "zero" goes in the parity track. Similarly if the number of "ones" in any track is incorrect a "one" is written in that track to form a special code at the end of each block (called parity code). Apart from checking that the read information is correct these bits and codes are ignored or read back.

It was mentioned earlier that seven and nine tracks were most popular and it can now be seen why. Firstly for those computers using Octal coding seven tracks allows two octal codes and a parity bit to be written at each point along the tape where as nine tracks suits B.C.D. systems which use eight channel codes allowing the ninth channel to be used for parity.

There are a few exceptions to the above. One which is of some importance in Australia is the system used with the "Honeywell" Computer Systems which are using three quarter inch tape. Here the information is written in groups of six bits, but these are split up. Some bits are in one line across the tape and some in the next etc. This system gives more utilization of the tape while still retaining a fairly strick check on the accuracy of reading while using eight bits across the tape to store information in octal coding.

(5) Why is magnetic tape used on computers?

As was said earlier, computers cannot store enough information in their own memories to function economically. While magnetic tapes can store vast amounts of data and can be written and read very rapidly, also it is possible to use the same piece of magnetic tape over and over since the process of writing on the tape automatically erases anything already written.

Because magnetic tape will hold large amounts of data in a small space and can be written and read rapidly it is also a very efficient means of transferring information from one computer to another.

The major disadvantage of magnetic tape is that to find a given piece of information it is necessary to search along the tape until it is found which at times may require running backwards and forward from one end of the tape to the other. This may take from about three minutes to half an hour. Also magnetic computer tape must be kept extremely clean at all times since a particle of dust on the tape no more than half a thousandth of an inch can cause the tape to misread and generate parity errors.

(6) Can records on tape be falsified?

The simple answer to this question is "yes", but that is where the simple part finishes. Records can be destroyed easily enough by simply bringing a strong magnet near the tape but to alter a record would require access to a suitable computer (not all computers are compatible with all tapes viz. a nine channel computer and a seven channel tape) plus a knowledge of programming plus a knowledge of the particular programme used with the tape to be altered.

It may be possible to tell sometimes that a tape has been tampered with by examining some characteristics such as the exact width and position of each track. Also a small error normally exists in the positioning of the bits in each channel (skew error) due to imperfectly compensated static skew in the particular write head used on the particular drives used to write the original and false information. However it cannot be said that just because no errors can be found in these characteristics that the information on the tape is all correct. However if such differences were found in a tape they would need explaining.

Basically if information on a magnetic computer tape is offered as evidence it could not be accepted directly but would require either proof that it could not have been in anyone's hands who could or would alter it or simply be used to supply information which can be verified by other means such as sworn testimony or separate records etc.

ANALYSIS OF THE U.S. SUPREME COURT DECISIONS

*A. R. Blackshield**

Statistical and mathematical methods of studying the judicial process began to receive serious attention about a decade ago. The first (and still the most substantial) studies were done by political scientists; but similar studies have now been undertaken by some academic lawyers, and even by a few hardy practitioners. These diverse investigators, mostly working independently, have produced a great variety of different procedures, and different objectives. But most of them have relied basically on variant forms of one or both of the two modes of analysis that I shall outline in this paper. And at the broadest level, the objective is the same for all investigators. Taking as their raw data the vast and ill-assorted materials comprised in the reported decisions of the Court selected for study, they seek by mathematical and statistical procedures to reduce these materials to a *pattern,* and then to attribute to this pattern a *significance.* The pattern is constructed by an objective and "scientific" method; and this (as we shall see) involves complex procedures of sorting, counting and computing for which electronic assistance is virtually indispensable. The significance ascribed to a pattern once found is (I believe) neither "scientific" nor computable. It depends rather on the judgement and insight of the human analyst, and his ability to formulate fruitful hypotheses which will "make sense" both of the statistical data, and of the decided cases themselves. In short, the role of the computer is a subsidiary one. Any notion that the computer itself can explain or predict judicial decisions – and hence, any notion of "machine-made justice" – should be set aside at the outset.

Even so, such work raises deep and serious problems of scholarly validity, and even of ethical justifiability. In presenting this paper orally, I hope to come to grips with some of these problems. I believe, however, that much of the discussion hitherto has been vitiated by the tendency of critics of quantitative analysis to make *ex cathedra* pronouncements, without having taken the trouble to understand the methods and objectives on which they pronounce; and that the exponents of quantitative analysis have often contributed to this tendency by inadequate or unintelligible explanations of what it is they are doing. Accordingly, rather than add to the existing mass of over-claims and over-criticisms, I propose to confine my written paper to a simplified outline of two typical methods of quantitative analysis of judicial behaviour; scalogram analysis, and multiple factor analysis.

Both these methods were originally developed by behavioural psychologists – the former by Louis Guttman, the latter by Louis Thurstone. For both, the first and most prominent application to *judicial* data was in the work of Glendon Schubert, and I shall here address myself only to Schubert's versions of them. But, with variations, the methods I shall describe are fundamental to the work of most other quantitative analysts as well.

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Like most of his colleagues, Schubert has thus far worked primarily on decisional patterns in the United State Supreme Court. Apart from the natural preoccupation of American scholars with their own highest Court, there are at least two excellent reasons for this. Substantively, the kind of information at which these methods are aimed – information as to relatively stable "values" and "attitudes" which predispose the judges to deal with litigated issues in a predictable way – is in any case highly plausible, and already widely acknowledged, with regard to the Supreme Court. Statistically, the practice whereby all nine members of the Court participate *en banc* in every decision means that statistical observations can be relatively complete, and hence much more reliable than where cases are regularly dealt with by only part of a Court's total membership. Schubert and others are currently attempting to extend their methods to other Courts, including the High Court of Australia; but I shall not here comment upon these still experimental extensions. For simplicity's sake I shall confine myself to data from the U.S. Supreme Court in its 1962 Term: that is, in the period from 1st October, 1962, to 17th June 1963. The members of the Court at that time were Chief Justice Warren and Justice Black, Douglas, Clark, Harlan, Brennan, Stewart, White and Goldberg; and in the tables and diagrams below I shall denote each judge by the first two letters of his surname. Many of these tables are adapted, and one or two simply copied, from Glendon Schubert's book *The Judicial Mind* (1965).

Scalogram analysis

The purpose of a Guttman scale is to arrange the subjects being studied (here, the judges) in order of the degree to which their responses to issues are governed by the prior "values" or "attitudes" which the scale represents. The word "scale" denotes simply the spectrum along which the subjects are located; the word "scalogram" denotes the diagram whence the order is discovered. In Guttman's own psychological work, the scalogram was based on the subjects' responses to items in a questionnaire: in transferring the method to the study of appellate courts, it has been assumed that appeals can be thought of as items in a continuing questionnaire which society puts to the Court. To each item (each case) the judges respond by voting either *for* or *against* the appellant; and the purpose of the scalogram is to discover whether these votes follow a predictable pattern based on attitudinal predispositions. The commonplace that some judges are "plaintiffs' men", others "defendants' men", is an apt example of the kind of hypothesis that a scalogram might test.

In most scaling of judicial decisions, it has been necessary for a hypothesis to be formulated in advance. The Supreme Court's 1962 Term, for instance, was notable for sweeping extensions of the constitutional rights of criminal defendants; and we might well hypothesize that the judges' voting behaviour in these cases was predetermined by how strongly the judges felt about guarantees of fairness in such cases. To test this hypothesis, we take *every* criminal appeal in which the Court divided in opinion over constitutional rights. A vote *for* the accused or convicted person is recorded by a plus sign; a vote *against* by a minus sign. If one of the judges did not sit, the space for his vote is left blank. (Other notations sometimes used are x for a plus vote, o for a minus one, and "np" for non-participation; or x for a plus vote, a blank space for a minus one, and * for non-participation.) On one side of this code we note an abbreviated citation to the law reports; on the other side a summary of, how the Court was divided. Thus, the famous *habeas corpus* decision of *Fay* v. *Noia* is recorded:

	Wa	Bl	Do	Br	Wh	Go	Cl	Ha	St	Total
372391	+	+	+	+	+	+	–	–	–	6 – 3

– indicating that the case is reported in volume 372 of the United States Reports, at page 391, and that by six votes to three the Court decided in favour of granting habeas corpus.

When all the relevant cases have been recorded in this way, they are listed in a sequence determined by the entries in the "Total" column. 1-8 divisions come first, then 2–7, 3–6, and so on down to 8–1. Within each type of division, the listing is in chronological order. Where the Court's full membership was not present, discretion may be used: a 2–5 vote might be treated as 2–7, 3–6, or 4–5.

The result is a matrix in which each *row* of symbols represents a case, and each *column* represents a judge. The *columns* are then shuffled and reshuffled so as to produce a pattern in which the maximum possible number of votes will be "consistent", in the sense presently to be explained. To some extent the *rows* may also be shuffled. (Analysts differ among themselves as to how far one may infringe the rules stated in the last paragraph; but there seems to be no good reason for a rigid adherence to them.) When maximum consistency has been attained, the *in*consistent votes are picked out by some distinctive mark (here, a ring). The result, for the 1962 Term cases on constitutional guarantees of criminal justice, is the following diagram (page 208).

The figures at the foot of the columns are the totals of each judge's plus and minus votes respectively; summing them at the foot of the "Total" column, we get 160 and 100, which are also the total of the individual entries in that column. The stepped diagonal line dividing plus and minus votes (the "breakline" is optional, but usefully stresses the configuration of the scalogram, and also helps to identify the inconsistent vote. For a case to scale consistently, all its plus votes must be to the left of the breaking, all its minus votes to the right. To put it another way, a consistent plus vote must have a plus vote to its left and also below it; a consistent minus vote must have minuses to the right and above.

The following scalogram distinguishes sharply between threee groups of judges: Bl-Do-Wa-Br-Go, Wh-St, and Ha-Cl. (But this divergence of these last two judges from the others may be exaggerated: most of the 7-2 items were mere applications of the first 6-3 case, *Douglas* v. *California*, with Stewart accepting the *Douglas* majority decision as binding, but Clark and Harlan reiterating their earlier dissent. Arguably, these cases should be treated as a single issue, and thus as a single entry.) As between Harlan and Clark the scale does not discriminate at all; and as amongst the first five judges, the discrimination is weak. In particular, as between Black and Douglas, the former's three inconsistent votes throw his placement on the scaologram into considerable doubt. But on the whole the scalogram entitles us to say that Black and Douglas are *more* predisposed to vote for constitutional guarantees in such cases than anyone else in the Court; and that their brethren will tend to join them in the order indicated, with Harland and Clark tied for last place.

Item	Bl	Do	Wa	Br	Go	Wh	St	Ha	Cl	Total
373420	–	–	–	–	(+)	–	(+)	–	–	2 – 7
373083	+	–	–	–	–	–	–	(+)	–	2 – 7
373179	+	+	–	–	–	–	–	–	–	2 – 7
371341	+	+	+	–	–	–	–	–	–	3 – 6
371392	(–)	+	+	+	–	–	–	–	–	3 – 6
373427	(–)	+	(–)	+	+	–	–	–	–	3 – 6
374023	(–)	+	+	+	+	–	–	–	–	4 – 5
371471	+	+	+	+	+	–	–	–	–	5 – 4
372293	+	+	+	+	+	–	–	–	–	5 – 4
372487	+	+	+	+	+	–	–	–	–	5 – 4
372734	+	+	+	+	+	–	–	–	–	5 – 4
373503	+	+	+	+	+	–	–	–	–	5 – 4
372353	+	+	+	+	+	+	–	–	–	6 – 3
372391	+	+	+	+	+	+	–	–	–	6 – 3
372710	+	+	+	+	+		+	–	–	6 – 2
372477	+	+	+	+	+	+	+	–	–	7 – 2
372708	+	+	+	+	+	+	+	–	–	7 – 2
372709	+	+	+	+	+	+	+	–	–	7 – 2
372711	+	+	+	+	+	+	+	–	–	7 – 2
372713	+	+	+	+	+	+	+	–	–	7 – 2
372771	+	+	+	+	+	+	+	–	–	7 – 2
373001	+	+	+	+	+	+	+	–	–	7 – 2
373242	+	+	+	+	+	+	+	–	–	7 – 2
373243	+	+	+	+	+	+	+	–	–	7 – 2
373723	+	+	+	+	+	+	+	–	–	7 – 2
374490	+	+	+	+	+	+	+	–	–	7 – 2
374498	+	+	+	+	+	+	+	–	–	7 – 2
374499	+	+	+	+	+	+	+	–	–	7 – 2
374509	+	+	+	+	+	+	+	–	–	7 – 2
Pro	25	27	25	25	25	16	16	01	00	160
Con	04	02	04	04	04	12	13	28	29	100

Such distinctions are usually recorded in the form of "scale positions' and "scale scores". Though these have been defined in various ways, probably the best procedure is to number the cases on the scalogram upwards from the bottom, and to take as each judge's "scale position" the number thus assigned to the case immediately before the breakline crosses his column. The "scale score" can then be worked out by the formula

$$\frac{2p - n}{n},$$

where p is the scale position and n is the total number of cases. For our present example, this would give the results:

	Bl	Do	Wa	Br	Go	Wh	St	Ha	Cl
Scale Position:	28	27	26	25	24	17	15	00	00
Scale Score:	+0.93	+0.86	+0.79	+0.72	+0.66	+0.17	+0.03	-1.00	-1.00

But these figures are significant only as another way of recording the *order* in which the judges appear on the scale. The relative scale scores for Goldberg and White (for example) can tell us that Goldberg responds to this sort of case *more* strongly than White, and that the psychological difference between them in this regard is substantially greater than that between, say, White and Stewart. But they cannot tell us – nor is there any sense in which it would be meaningful to say – that as between Goldberg and White, the former's response is ".49 stronger".

Now, in theory, the scalogram distinguishes not only amongst *judges,* but also amongst *cases.* In the first few cases (it is said), the claim to constitutional protection is so weak that only strong predisposition would produce a vote in its favour; in the last block of cases, the claim is so strong that a negative vote can only mean a predisposition *against* it. It is on this assumption that scalograms are sometimes used to base attempted predictions of the outcome of *future* appeals: if we can say that the appellant's claim is "stronger" than that in 373503, but "weaker" than that in 372353, then we should predict either a 5-4 or a 6-3 decision in his favour, with only White's vote doubtful. But in fact, though the quantitative analysts' predictions are in practice mostly correct, they have as yet produced no satisfying way of "weighting" cases so that such predictions can *reliably* be made. And the arbitrary nature of the rules by which the sequence of cases on the scalogram is settled makes the basis for such predictions dubious in any event.

As amongst judges, however, the scalograms are often extremely convincing. A scalogram riddled with inconsistent votes would, of course, be *not* convincing; but such a scalogram would be rejected by the analysts themselves. That group of cases would be judged "unscaleable", and the hypothesis we set out to test would be treated as disproved. (Both for the U.S. Supreme Court and elsewhere, the more obvious hypotheses about taxation cases have had to be rejected as "unscaleable".) But where, as in our example, the inconsistencies are few, we seem justified in treating the scalogram as at least persuasive.

How persuasive is it? In other words, how unlikely is it that the scalogram pattern could be due to random chance? To answer this question, it is usual to append to a scalogram certain statistical measures of significance. The simplest of these is Guttman's coefficient of reproducibility, written as CR (or simply R). As adapted for judicial scaling, this coefficient is defined as

$$CR = 1 - \frac{e}{n},$$

where e is the total number of inconsistent votes (7 in our example) and n is the total number of *all* votes (260 in our example). A scale is treated as statistically acceptable if and only if CR is greater than .90. Unfortunately, in judicial scaling CR will almost always exceed .90 (in our example it is .97). An acceptable CR thus means little; and more stringent statistical measures have had to be devised. The major one is Herbert Menzell's coefficient of scaleability (S); but I shall not discuss the rather complex formula for this. (An acceptable S is "somewhere between .60 and .65" or more; in our example S is .84).

Obviously, the more cases a scalogram contains, the more likely it is to be statistically significant. On the one hand, this has led to an arbitrary rule that if the chosen category turns out to include fewer than ten cases, it should be treated as unscaleable. On the other hand, it has led to attempts to frame broader and broader hypotheses, embracing more and more cases. The above scale, for example, can be made to fit a much larger category of "civil liberties" cases, embracing along with criminal cases appeals on censorship, racial segregation, government action against Communism and "Un-American activities", deportation of aliens, freedom of association and of assembly, the political use of union funds, and the separation of Church and State. The inclusion of all these issues *does* enable us to distinguish between Harlan and Clark; it still maintains a CR of .97, and an S of .83; and it obviously yields in substance a much more important and illuminating result. The ultimate thrust of this search for wider categories, exemplified in Schubert's most recent work, is to begin without *any* hypothesis; to record plus and minus votes for *all* divided opinions during the period chosen for study; and to construct a scalogram by finding that arrangement of rows and columns which will render the maximum possible number of cases "consistent". Only then are the issues in the consistent cases examined and an attempt made to formulate an *a posteriori* hypothesis which will explain what it is that makes all these cases fit a single massive scale. At this stage, Guttman scaling becomes a complement to multiple-factor analysis.

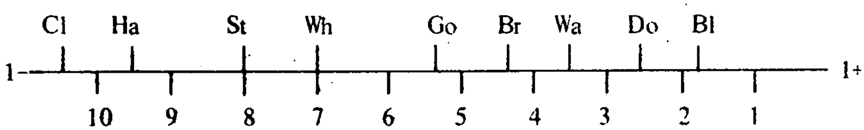
Factor Analysis

Objective: Location of Judges in "Space"

Factor analysis, like scaling work, proceeds on the behaviouralist assumption that human reactions (including those of judges) are determined by pre-existing "attitudes" of the individual. It adds the further assumption that, although these attitudes and the influences which shape them are empirically very diverse, scientific understanding of them need not flounder amidst endlessly different variables. Instead, the variables can be reduced to a few basic dimensions which alone suffice for *virtually* complete understanding of the behaviour studied. The identification of these few basic "factors" is the ultimate goal of analysis.

The computational methods of factor analysis cannot, of course, tell us *What are* the "factors" that are involved. All that these methods can give us is a set of mathematical properties which represent the role of the "factors" in the total mass of statistical data. These mathematical properties are most easily thought of as co-ordinates which allow us to plot positions in a geometrical "space". But the symbolism of this "space" must still be supplied by the human interpreter. The arithmetical figures which a factor analysis yields can tell us that the psychological "space" of Supreme Court judges is traversed by an ascertained number of basic axes (the factors), intersecting one another; they can tell us (roughly) where these axes lie, and in what directions they run; and they can tell us (roughly) how each judge, with his own unique combination of attitudes, is positioned in this "space", in relation both to the factorial axes and to his fellow judges. But what is the non-mathematical *meaning* (if any) of the fact that in 1962 Warren, Black, Douglas and Brennan were aligned in psychological "space" in what was (from one perspective) virtually a straight line, traversing Principal Axis I at a point far out along it in a positive direction, while Harlan was equally distant from centre in a negative direction? How would these positions affect response to cases – and to what sort of cases? These questions, if they can be answered at all, must still be answered by non-mathematical, non-computerized methods. Factor analysis may prod us to insights, it cannot give us any.

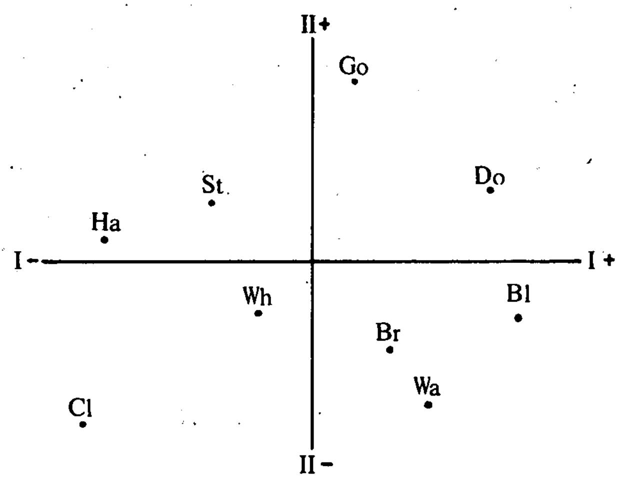
The kind of information aimed at may be more readily conveyed by a few hypothetical examples. Suppose that in the 1962 Term the criminal cases already considered had constituted the whole of the Supreme Court's decisional output. In that event, a single factor – degree of concern for accused persons' rights – would suffice to explain the whole Term's work. The Court and its work for the 1960 Term could be graphically represented by a single straight line:



The positions of the judges (here indicated above the line) would show, moving from left to right, increasingly strong concern for fairness of criminal proceedings. The positions attained on the same scale by particular cases (here indicated by numbers below the line) would be a key to the appellants' chances of success: for these positions (reading from right to left) would indicate increasingly strong cases. Case 1 would be so weak as to engage not even Black's concern, and Case 2 would engage *only* his. But in Case 3 he would be joined by Douglas, and in Case 4 by Warren; and in Case 6 and all later cases, a majority would vote for the accused. Case 7 would find White, and Case 8 Stewart, in the position of "swinging voters"; but in Case 9 they too would join the majority. And in Case 10, Clark would dissent alone.

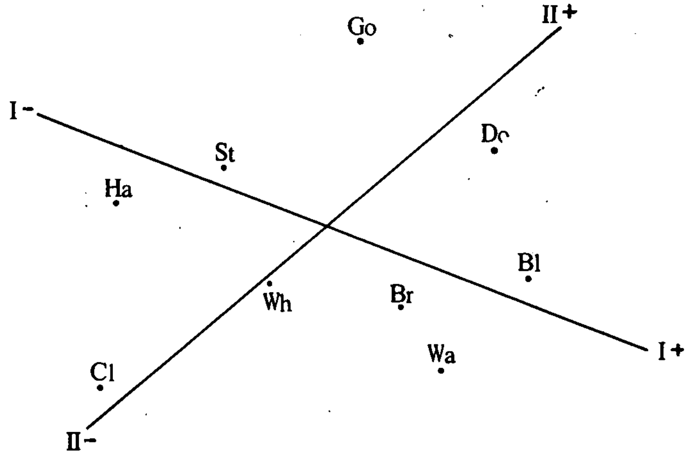
Now let us imagine that (in the same oversimple hypothetical Term) there was a second factor – but still only *one* more – in the Court's decisions. The positions of the judges in relation to our first principal axis (concern for accused's rights) would then have to be plotted against those in relation to a second axis (say, sympathy for labour as against big business). The result would no longer be a simple unilinear arrangement, but a scattering of the judges' positions over a two-dimensional graph. Cases too, would now have to be plotted by reference to both principal axes; and the measurement of cases, and of the psychological distance of each judge from each case, would involve very much more complex problems. In theory, however, the interpretation would be the same as before: "the individual responds positively if his own position equals or exceeds that of the stimulus, and otherwise he responds negatively."

Such a two-dimensional graph, in which the whole of the judges' behaviour was purportedly explained by a mere two factors, would still, of course, be far from the complexity of a real-life set of judges or cases. But already, we must confront one problem which is of crucial importance in a multiple-factor analysis. The two-dimensional graph we have postulated would have to look something like this:



That is to say, the ordinal and abscissal axes would have to be orthogonal (at right angles to one another); since it is only by means of orthogonal axes that points in a graph can conventionally be plotted at all. Statistically, however, orthogonal placement of axes implies that the variables thus depicted are completely independent of one another: in our example, the implication is that concern (or want of it) for the accused, and sympathy (or want of it) for labour, are wholly unrelated to and uninfluenced by one another. Yet empirically we know that there probably would be *some* correlation here: judges who regularly vote for safeguards of criminal procedure will tend also to support the claims of labour, and *vice versa*. Hence our axes should not be orthogonal, implying *No* correlation, any more than they should be flattened into a single line, implying complete identity. Rather, one (or each) of the axes should be partly skewed towards the other, so that both tend somewhat in the same direction, while yet following diverging paths. In factor analysis, the mathematically postulated axes by which the judges' positions are plotted always are orthogonal, so that *after* the judges' positions are fixed (and taking these as a guide), it is necessary to rotate the axes to produce a meaningful graph.

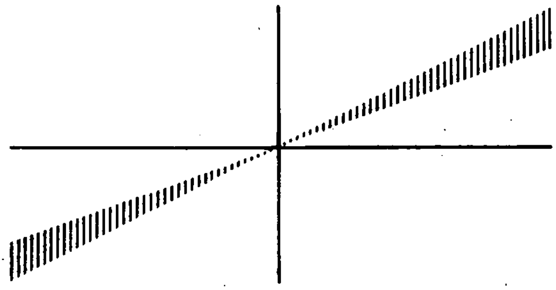
A crude solution to this problem would allow the clustering of the judges' positions itself to suggest a meaningful path for each of the principal axes. In the above graph, a simple visual inspection suggests that Principal Axis I could be rotated about 30°, so as to pass between Harlan and Stewart at one end and Black-Brennan-Warren at the other; while Principal Axis II might pass from Clark's position, to White's, to the flanking positions of Goldberg and Douglas. Since visual impressions (as we shall see) are largely accidental, this solution would be of little value; but for what it is worth, the revised graph thereby obtained is set out below. The point to be noted is that some such rotation, by some means or other, must always be effected.



Assuming that there really were only two factors involved, and assuming that our method of rotating the axes had been reliable, this last would be an exhaustive graphical representation of the entire Term's decisions. In fact, of course, even in a single Term, the Supreme Court like others must deal with a great diversity of issues, and its decisions must thus be affected by a very wide range of variables. But the quantitative analyst claims that in principle, the kind of analysis just described can be made to embrace virtually the whole range of variables. And this claim rests on two assumptions.

First, the process which we have thus far traced from one to two dimensions could theoretically be extended to any number of dimensions. If to our two factors we added a third, we would need to shift from a two-dimensional graph of the judges' psychological "space", to a three-dimensional model of it, with its basic dimensions marked not by lines passing through a plane, but by planes passing through a sphere. If we found it necessary to add a fourth dimension, it would no longer be possible to construct a single visual representation of the psychological "space" at all. But it would still be possible to calculate the mathematical properties of such a multidimensional space – and, indeed, to represent them by a *series* of graphs, taking two dimensions at a time. And this applies to any numbers of dimensions that we might find it necessary to add.

Second, the quantitative analyst claims that the number of additional dimensions needed will in fact turn out to be small. Obviously, cases in which management is pitted against labour will not raise *precisely* the same issues, nor engage precisely the same "attitudes", as those in which industry is pitted against government regulation, or corporate monopoly against the small competitor. And similarly with the different kinds of "civil liberties" issues which have already been referred to. As to each of these clusters of issues, however, it is said that the variables involved, while not wholly reducible to one, can be shown to cluster together within a very small area – the sort of area that, in two dimensions, would be represented thus:



If this is so, it seems reasonable to postulate that, somewhere within the shaded area, there is an axis which can be taken to represent a single factor; and that for practical purposes this single factor will suffice to account for all the variables involved. Indeed, factor analysis has produced mounting support for the claim that, in study of judicial decisions, the use of three factors suffices for a comprehensive analysis.

Such claims, of course, should still be viewed with a healthy scepticism. One reason for scepticism is that the mathematical theorems on which factor analysis depends set rather drastic limits in advance on the number of factors which it is *possible* for the method to discover. The factors are extracted, as we shall see, from a tabulation of the correlations between pairs of variables (in our case judges); and it can be shown mathematically that, if n variables are involved, the maximum possible number of factors will be

$$\frac{(2n + 1) - \sqrt{8n + 1}}{2}.$$

So that for the nine judges of the U.S. Supreme Court, the maximum possible number of factors will be half of (19 – 8.544), or a little over 5.

On the other hand, the striking simplification in our understanding of the Court that would be entailed if the relevant factors *could* be reduced to three (or even to five) ought not to be lightly dismissed. Schubert's defence of Guttman scaling is applicable here as well: "It seems to me that the question whether [this method] involves "vast" oversimplification" of the process of judicial decision-making is an empirical question, which best can be resolved on the basis of the usefulness and reliability of the knowledge to which it leads. When one compares the bulk and manifest complexity of the opinion and voting data in the typical Supreme Court decision, with the example I have suggested . . . it is evident that great simplification has taken place. If the results produced are not useful and reliable, then it has indeed been *over* simplification. If the contrary can be demonstrated, then this is the very kind of simplification for which social scientists ought to strive". In that event, he implies, we ought rather to say that the more traditional ways of studying the judicial process have been over-complicated.

The Fourfold Tables

Certainly, the procedures by which the simplified analysis in terms of factors is attained are sufficiently complicated for anyone: and it is here above all that the use of computers is indispensable to quantitative analysis of judgment. The complex observations and calculations which factor analysis entails demand resort to mechanical aids, both for simple counting of data, and for transformation of the results into their latent significant quantities, by successive computations. I shall here give a brief description of the successive steps involved.

The first step is to observe *all* the judges' votes in *all* the cases in which (in the period chosen for study) the Court was divided in opinion. For the 1962 Term this involved 107 cases, or about 60 per cent of the Court's caseload for the year. Each *majority* vote is now scored as +; each dissenting vote as –. The correlation table from which the factors are to be extracted is concerned with correlations of these + and – votes.

The variables whose behaviour we seek to explain are the judges; and the relevant correlations are between the judges' votes. How often did Black vote with Douglas in the majority, and how often in dissent? This *kind* of information has long been as vital to an understanding of Supreme Court processes: the general fact that Black and Douglas (for instance) very frequently do vote together (whether in the majority or not) is widely recognized as one of the more significant facts about the Court. But to this commonplace awareness the counting procedure adds two things. First, it tells us *precisely* how often this sort of concurrence occurred, and thus enables us to assess *precisely* how significant it is – especially when the results are to be entered in a table which also contains parallel observations for every other pair of judges. Second, it enables us to compare these figures with observation of how often the concurring pair did *not* agree – a perspective which general impressions tend to overlook, but without which the significance of their mutual agreements cannot really be assessed. For Black and Douglas in the 1962 Term, the following table shows four observations: that they voted together in the majority 68 times, and together in dissent 9 times; and that there were 12 cases in which Douglas joined the majority while Black dissented, and 14 in which these roles were reversed.

		Bl +	Bl –
Do	+	68	12
	–	14	09

If we now prepare a matrix having nine rows and nine columns, and write the names of the judges first at the top of each column and then at the beginning of each row, we will have a matrix of 81 cells in which the above information can be inserted for every pair of judges. Indeed, each pair will be included twice, since the cell in (say) the Goldberg column and the Warren row will contain the same information as that in the Goldberg row and the Warren column. In other words, the two halves of the table duplicate one another, and are divided by a diagonal composed of blank cells, in which in turn each judge's row intersects with his own column. For this reason it is usual to fill in only half of the table; but in the following example all the duplications are inserted.

		Do		Bl		Wa		Br		Go		Wh		St		Cl		Ha	
		+	–	+	–	+	–	+	–	+	–	+	–	+	–	+	–	+	–
Do	+			68	12	73	07	75	05	71	08	60	16	44	36	40	39	18	61
	–			14	09	19	03	20	03	19	04	22	01	20	03	18	03	19	02
Bl	+	68	14			78	03	78	04	71	10	63	16	44	38	46	35	19	62
	–	12	09			14	07	17	04	19	02	19	01	20	01	12	07	18	01
Wa	+	73	19	78	14			91	01	80	11	72	17	54	38	53	37	28	62
	–	07	03	03	07			03	07	09	01	09	00	10	00	04	05	09	00
Br	+	75	20	78	17	91	03			84	10	74	17	56	39	54	39	30	63
	–	05	03	04	04	01	07			06	02	08	00	08	00	04	03	07	00
Go	+	71	19	71	19	80	09	84	06			71	17	60	30	45	42	32	55
	–	08	04	10	02	11	01	10	02			10	00	03	09	12	00	05	07
Wh	+	60	22	63	19	72	09	74	08	71	10			59	23	52	27	34	45
	–	16	01	16	01	17	00	17	00	17	00			03	14	04	13	02	15
St	+	44	20	44	20	54	10	56	08	60	03	59	03			35	26	31	30
	–	36	03	38	01	38	00	39	00	30	09	23	14			23	16	06	33
Cl	+	40	18	46	12	53	04	54	04	45	12	52	04	35	23			26	32
	–	39	03	35	07	37	05	39	03	42	00	27	13	26	16			11	31
Ha	+	18	19	19	18	28	09	30	07	32	05	34	02	31	06	26	11		
	–	61	02	62	01	62	00	63	00	55	07	45	15	30	33	32	31		

The Phi Correlation Matrix

We now have, for every pair of judges, precise and easily examinable data on the exact significance which can be attached to our vague impressions of correlation or lack of it between particular pairs of judges. The next step is to compress these figures into a single one for each pair, which, while preserving the subtleties of our fourfold observations, will give us a single measure of the degree of correlation which each set of four observations cumulatively represents. Of the various statistical measures which might be utilized for this purpose, it is commonly agreed that the most appropriate is the phi correlation coefficient (ø). For, first, this measure is statistically sensitive to the kind of subtleties we want to preserve; and, second, it is distinctively adapted to the correlation of variables which have been grouped according to concurrence or divergence in two dichotomous directions – "Yes" or "No" answers to a questionnaire; male or female in social surveys; and, in the universe of judges, majority vote or dissent. Wherever four such observations have been tabulated in the form (as above).

	+	–
+	a	b
–	c	d

then the formula for calculating phi is

$$\frac{ad - bc}{\sqrt{(a + c)(b + d)(a + b)(c + d)}}$$

For our observations as to Black and Douglas, this gives:

$$\frac{(68 \times 9) - (12 \times 14)}{\sqrt{(68 + 14)(12 + 9)(68 + 12)(14 + 9)}} = \frac{612 - 168}{\sqrt{3168480}} = .249$$

And when all the entries in all the cells of our fourfold table are thus transformed into phi coefficients, the result is the following matrix:

	Do	Bl	Wa	Br	Go	Wh	St	Cl	Ha
Do		.249	.068	.106	.094	–.187	–.274	–.290	–.571
Bl	.249		.403	.213	–.035	–.162	–.345	–.051	–.579
Wa	.068	.403		.762	–.019	–.146	–.254	.084	–.409
Br	.106	.213	.762		.120	–.135	–.227	.005	–.358
Go	.094	–.035	–.019	.120		–.154	.276	–.319	–.033
Wh	–.187	–.162	–.146	–.135	–.154		.423	.327	.247
St	–.274	–.345	–.254	–.227	.276	.423		–.016	.358
Cl	–.290	–.051	.084	.005	–.319	.327	–.016		.191
Ha	–.571	–.579	–.409	–.358	–.033	.247	.358	.191	

Again, the matrix is symmetrical, and the diagonal cells are blank. But there are now at least two ways in which it will be meaningful to fill in these blanks. For some purposes, each blank cell may be given the value 1.00, this being simply an assertion that each judge is (as it were) totally and perfectly in correlation with himself. But our purpose is factor analysis; and for this purpose, the value that needs to be ascribed to each judge's blank cell is his communality.

Communalities

Factor analysis postulates that the total of the observations for each variable (1.00) is the sum of three components. One is the "common variance" – that is, the extent to which our observations for the variable are ascribable to the combined effect of the "common factors" we are seeking to elicit. A second component is the ... unique to each variable, and thus not caught by the factors. The third component – never to be forgotten – is "error variance", due simply to imperfections in our empirical observations, or to inevitable mistakes and distortions in our calculations, and likely to involve anything up to 10 per cent (.100) of any result we obtain.

The common variance, or communality, is mathematically defined for each judge as the sum of the squares of his factor loadings (later to be defined); and is usually written, h^2. Obviously the correct value of h^2 for any judge will be one main end product of the factor analysis; yet in order to discover the factors, it is necessary to have an estimate of h^2 in advance.

There are many ways of obtaining this estimated communality; and discussions of the competing methods, and attempts at devising new ones, occupy much of the literature on factor analysis. Most of the methods involved are mathematically quite complex, and depend on certain postulates which can be demonstrated in theory, but tend to be unreliable in practice. One relatively simple method consists of constructing a triad in the form.

$$\frac{ab}{c},$$

– where a and b are the two highest phi coefficients for the judge whose communality is desired, and c is the coefficient for the correlation *inter se* between the two other judges indicated by coefficients a and b. A more complex variant is to take the average of all possible such triads for the judge in question. A more complex method still involves the assumption that by eliminating an equal number of rows and columns, one can reduce the 81–cell matrix to a small matrix – a minor – contained within it. This might be a matrix of 64 cells, or 49, and so on down to 4-cell minor having two rows and two columns. If we take a minor such that it includes the blank diagonal cell for the judge whose communality we want, but no other blank cells, and also such that it includes at least one greater number of rows (and columns) than the number of factors we expect to extract – then a value for this minor can be computed by a well established formula. And if we postulate that the ultimate value of the whole matrix, and thus of any minor, must be equal to zero (since in theory extraction of factors extracts all value from every cell in the matrix), then we can construct an equation in which the only unknown is the required communality; and solving that equation will give us the estimate we want.

This last method, however, involves hundreds of individual computations, with many possibilities of error. If the minor is made too small, the resulting estimate will be grossly distorted; yet the bigger the minor, the more unmanageable the equation to be solved becomes. In the present instance, to have any hope of reliable estimates, we would have to work with minors of rank 5 (that is, of five rows and five columns). This would make it necessary to begin by calculating an estimated communality for Goldberg; then to insert that estimate in the matrix and calculate estimates for Brennan and White; and so on. Without a computer, this process of preliminary computation would occupy several days; and even then, we would have *only* preliminary and unreliable estimates.

If the factor analysis of judicial behaviour were to become fully computerized, it might be possible always to reach estimated communalities by whatever procedure was most satisfactory on mathematical grounds. It might even be possible to devise a way of producing *reliable* estimates. But, that possibility aside, it will still be questionable how much precious computer time should be spent on preliminary estimates. *A fortiori,* with the present limited access to computers, the problem of communality estimates seems better treated as one for a quick, pragmatic, and human solution. In practice, reasonably adequate estimates can be found simply by taking the highest coefficient in each column of the phi matrix. In the example on the previous page, the highest correlations for Douglas and Black are their *negative* correlations with Harlan; the highest for Warren and Brennan are their *positive* correlations with each other; and so on. Ignoring the plus and minus signs, these figures usually approximate communalities to within 10 per cent and since factor analysis usually involves about that amount of error in any event, the more theoretically satisfying communality estimates seem not worth bothering about.

Factor Loadings

Although it is common to speak of extraction of *factors,* what are really to be extracted from the correlation matrix are a set of loadings – one for each judge – representing the extent to which each postulated factor affects *his* voting behaviour. If the factor be thought of as a line passing through space, the factor loadings are the figures which allow us to measure off each judge's position along the line.

It must be emphasized that there is no one single "correct" set of factor loadings for any given correlation matrix; nor any single best method of extracting them. The loadings are not expected to indicate a precisely "true" location of the judges in the postulated psychological space; they are expected only to indicate an approximate area of that space, within which a postulated location can be expected to lend itself to meaningful interpretation. Mathematically, the "best" method of factoring would be one which would make it rigidly certain that each successive set of factor loadings was of maximum possible value, and thus accounted for the maximum possible amount of variance. On this basis, there is currently a tendency to prefer Harold Hotelling's "principal axes" method of analysis. But this method precisely because of its mathematical sophistication, makes full computerization essential. Where computer access is limited, most analysts have had to rely on alternative methods, involving varying degrees of compromise between mathematical purity and pragmatic manageability. The most widely-used method, which I shall here discuss, is the "complete centroid" method developed by Louis Thurstone.

The theory underlying this method is simple. Take each judge's column in the correlation matrix and add up all its entries, including his estimated communality. (In practice the communalities are added only *after* the adjustments I shall presently describe). Then each judge's loading for the first (and assumedly most important) factor will be the total thus obtained *divided by the square root of the sum of the absolute values of all the totals thus obtained.* If the nine totals were respectively .100, .200, .300 . . . to .900, then their combined total would be 4.500. The square root of this total is 2.121, and when the nine totals are divided by this, we get the successive factor loadings .047, .094, .141 . . . to .424.

If all the totals of all the columns turned out to be positive, this simple process of division would in fact be all that is involved in factor extraction. In fact, however, almost invariably, some totals will be positive and some negative. This indicates that our observed correlations for some judges – those with negative totals – are not yet ready for comparison with the rest: if all the factor loadings be thought of as measuring off segments of diverse length along a single line, then our figures for some judges are (as it were) pointing in the wrong direction, and need to be "turned around" before comparisons can be made. If, for instance (as in our example), the figures for Harlan are thus askew (since the sum of his entries in the correlation matrix is –1.154), we need to bring him into line by adjusting the observed correlations between him and all eight of his brethren. To this end, in all eight other totals, the observed correlations with Harlan need to be deducted *twice* – once to bring Harland back to starting point, and once to bring him forward in the same direction as the other judges, to an extent equal to that of his previous divergence in the opposite direction.

Until these adjustments have been made, the communalities are left out of account, and the totals involved based only on each judge's eight observed correlations with his brethren. Only at the end of the process should the communalities be added in, each one taking the same sign (+ or –) as the adjusted total now bears. Only then can the factoring proceed.

The following example takes as its first row the totals of the nine columns in the phi correlation matrix already set out. (In practice one would need to total each row in a tenth column on the right-hand side, for checking purposes.) Thereafter the example follows the above theoretical description, but simplifies the computations involved by two preliminary (and temporary) steps. First, before the process of adjustment begins, plus and minus signs are reversed throughout, so that the adjustments can be made by addition instead of subtraction. Second, the quantities involved are halved, so that each adjustment can be effected by adding *once* instead of *twice*. Both these changes are effected in row A, by multiplying the figures in the first row by –½. The entries for Douglas, Black, Goldberg, Stewart, Clark and Harlan – all *negative* in the first row – are now all *positive,* and hence in need of adjustment. Harlan's is the largest. Accordingly, his entry is placed in brackets (and all subsequent entries for Harlan will also be bracketed, to indicate that *his* adjustment has already been made.) His column is column (9); so +(9) is placed at the beginning of the next row, and the entries from row (9) of the phi matrix are added into the totals. The largest unbracketed positive entry among the new totals is for Stewart (column (7)); so his entry is bracketed, and the entries from row (7) of the matrix are added in.

At this stage the adjustments already made for Harlan and Stewart have had the incidental effect of bringing Douglas and Black into line as well; on the other hand, White now has a positive total, and is thus in need of adjustment. This is done by adding entries from row (6) of the matrix, and a final adjustment for Clark adds entries from row (8). At this stage (row B) all the entries are either negative (and hence not in need of adjustment) or bracketed (and hence already adjusted). Accordingly, row C multiplies the totals by −2, thereby reversing the temporary conversion effected in row A; row D gives the estimated communalities, with plus or minus signs corresponding to those in row C; and row E adds rows C and D together.

	Do	Bl	Wa	Br	Go	Wh	St	Cl	Ha
s	-.805	-.307	.489	.486	-.070	.213	-.059	-.069	-1.154
−½s=A	.4025	.1535	-.2445	-.2430	.0350	-.1065	.0295	.0345	(.5770)
+(9)	-.5710	-.5790	-.4090	-.3580	-.0330	.2470	.3580	.1910	—
	-.1685	-.4225	-.6535	-.6010	.0020	.1405	(.3875)	.2255	(.5770)
+(7)	-.2740	-.3450	-.2540	-.2270	.2760	.4230	—	-.0160	(.3580)
	-.4425	-.7705	-.9075	-.8280	.2780	(.5635)	(.3875)	.2095	(.9350)
+(6)	-.1870	-.1620	-.1460	-.1350	-.1540	—	(.4230)	.3270	(.2470)
	-.6295	-.9325	-1.0535	-.9630	.1240	(.5635)	(.8105)	(.5365)	(1.1820)
+(8)	-.2900	-.0510	.0840	.0050	-.3190	(.3270)	(-.0160)	—	(.1910)
B	-.9195	-.9835	-.9695	-.9580	-.1950	(.8905)	(.7945)	(.5365)	(1.3730)
-2B=C	1.839	1.967	1.939	1.916	.390	-1.781	-1.589	-1.073	-2.746
D	.571	.579	.762	.762	.319	-.423	-.423	-.327	-.579
C+D=E	2.410	2.546	2.701	2.678	.709	-2.204	-2.012	-1.400	-3.325

The sum of the entries is row E (ignoring plus and minus signs) is 19.985; and the square root of this is 4.47. Accordingly, the entries in row E are divided by 4.47; or (what is the same thing) multiplied by .2237. The results are the first-factor loadings for the nine individual judges.

If the first-factor loadings for any two judges are multiplied together, the result will be a measure of the extent to which their correlations are attributable to their respective positions *vis-a-vis* the first factor. For Warren and Brennan, the first-factor loadings are .604 and .599 respectively; and the product of these loadings is .362. Accordingly, of the phi coefficient of .762 which was given for these two judges in the original correlation matrix, .362 can be accounted for if we can ascribe a meaning to the first factor, and .400 will remain unaccounted for. Using this sort of calculation, we produce a new correlation matrix, containing the residues left after the first factor has been extracted – a tedious process, involving 36 separate multiplications and subtractions, with additional ones for checking purposes. This residual matrix is then factored to produce a set of second-factor loadings; and the cross-products of these in turn are subtracted from the entries in the first residual matrix, to produce a second residual matrix from which third-factor loadings can be obtained.

In theory (subject to what has already been said as to the maximum possible number of factors) this process might continue indefinitely until a residual matrix was reached in which all the entries in all the cells had been reduced to zero. Empirically, this tidy result will never be attained; and it is necessary to make a judgment in each case as to when to stop factoring. In this case, after three factors have been extracted, the third residual matrix will look like this:

	Do	Bl	Wa	Br	Go	Wh	St	Cl	Ha
Do		–.065	–.036	–.005	.012	.164	.038	–.008	–.125
Bl	–.065		.014	–.104	.082	.084	.075	–.019	–.069
Wa	–.036	.014		.004	–.019	–.027	–.035	–.017	–.006
Br	–.005	–.104	.004		.001	.010	–.096	.000	–.001
Go	.012	.082	–.019	.001		–.011	.074	–.010	–.058
Wh	.164	.084	–.027	.010	–.011		.203	.042	–.126
St	.038	.075	–.035	–.096	.074	.203		–.023	–.113
Cl	–.008	–.019	–.017	.000	–.010	.042	–.023		.018
Ha	–.125	–.069	–.006	–.001	–.058	–.126	–.113	.018	

There seems to be a significant correlation unaccounted for between White and Stewart; but there are only five other correlations greater than .100, and it would be reasonable at this stage to assume that the only factors of general significance have already been extracted. Assuming that one did go on to extract loadings for a fourth factor, the fourth residual matrix would be:

	Do	Bl	Wa	Br	Go	Wh	St	Cl	Ha
Do		–.121	–.021	.032	–.028	.073	–.067	.000	–.048
Bl	–.121		.028	–.069	.045	–.001	–.024	–.012	.003
Wa	–.021	.028		–.005	–.009	–.005	–.009	–.019	–.025
Br	.032	–.069	–.005		.026	.066	–.031	–.005	–.049
Go	–.028	.045	–.009	.026		–.072	.004	–.005	–.007
Wh	.073	–.001	–.005	.066	–.072		.042	.054	–.009
St	–.067	–.024	–.009	–.031	.004	.042		–.010	.023
Cl	.000	–.012	–.019	–.005	–.005	.054	–.010		.008
Ha	–.048	.003	–.025	–.049	–.007	–.009	.023	.008	

And at this stage (unless one were making a special study of the relations between Black and Douglas) it would obviously be futile to look for further significant factors.

We have, then, a set of factor loadings which will enable us to plot the judges' positions in relation to axes representing four principal factors. For each judge, the sum of the squares of his factor loadings represents his "true" communality; and the following table, after listing four sets of factor loadings compares the "true" communalities with the estimates with which we began.

	FACTOR LOADINGS				COMMUNALITIES		
	I	II	III	IV	Derived (d)	Estimated (e)	Difference (d – e)
Do	.539	–.216	–.266	.244	.469	.571	–.102
Bl	.570	.257	–.237	.229	.499	.579	–.080
Wa	.604	.541	.395	–.060	.818	.762	.056
Br	.599	.367	.499	–.151	.766	.762	.004
Go	.159	–.456	.383	.163	.407	.319	.088
Wh	–.493	.244	.120	.373	.456	.423	.033
St	–.450	–.227	.445	.431	.639	.423	.216
Cl	–.313	.550	–.021	–.031	.402	.327	.075
Ha	–.744	–.100	.253	–.315	.727	.579	.148

It will be seen that with exceptions for Stewart and Harlan (and a wholly trivial exception for Douglas) the differences between derived communalities and pragmatic estimates are well within the postulated range of ± .100. In theory, since the derived communalities are the more accurate, we should now return to row D of the first-factor calculations set out two pages back, substitute for that row our derived communalities, and repeat the entire factoring process from that point on. In the present example, such a refactoring would yield (approximately) the following results:

	FACTOR LOADINGS				COMMUNALITIES		
	I	II	III	IV	New Derivates (d)	Old Derivates (e)	Difference (d – e)
Do	.511	–.312	–.096	.221	.416	.469	–.053
Bl	.545	–.117	.294	.206	.439	.499	–.060
Wa	.610	.536	.401	–.033	.821	.818	.003
Br	.593	.612	.267	–.056	.801	.766	.035
Go	.176	.198	–.512	.136	.350	.407	–.057
Wh	–.495	.185	.200	.357	.446	.456	–.010
St	–.493	.367	–.405	.461	.755	.639	.116
Cl	–.326	.166	.453	–.033	.340	.402	–.062
Ha	–.769	.206	–.176	–.361	.794	.727	.067

On our first factoring, the derived communalities differed from our original estimates by an average of ±.089; on the second factoring, the average difference has been reduced to ±.051. A third factoring, using the new derived communalities as original estimates, could be expected to reduce the difference still further; and ultimately a stage would be reached at which estimated and derived communalities were virtually coinciding. At that stage, the factoring process would cease.

If strict mathematical satisfaction were the goal of factor analysis, this iteration of the factoring process would always be necessary. In fact, however, given the postulates that there may be a number of equally "correct" solutions to any factoring problem, and that no solution obtained in practice will ever be "correct" in any event, the results of a second or even a first factoring tend to be taken as sufficient. The consequences of such a decision will be seen in the next section.

Graphs and Interpretations

The following graphs illustrate how the factor loadings are used to plot two-dimensional graphs of the judges' positions in "space". Figure 1 plots against one another each judge's loadings for Factors I and II, using the figures obtained from our initial factoring – that is, from the *first* set of loadings tabulated on the last page. As in Schubert's treatment of the same data, I have "reversed the polarities" of the loadings for Factor II: that is, Douglas' position on the graph in relation to Axis II is plotted as +.216 instead of –.216; Black's as –.258 instead of +.257; and so on for all nine judges. Schubert's reason for doing this is to facilitate comparison with his results for other Terms; my reason is to illustrate the readiness with which the direction of any axis may be reversed without affecting either its mathematical loadings, or its substantive significance. In Thurstone's often-quoted example, "plus grouchiness" is equal to "minus cheerfulness".

In Figure 2, the loadings for Factors I and II are again plotted against one another, but this time using the different set of loadings obtained by our repetition of the factoring process – that is, those set out in the *second* tabulation on the last page. Figures 3 and 4 make a similar comparison of the initial and revised sets of loadings, this time using the respective figures for Factors III and IV.

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Figure 1

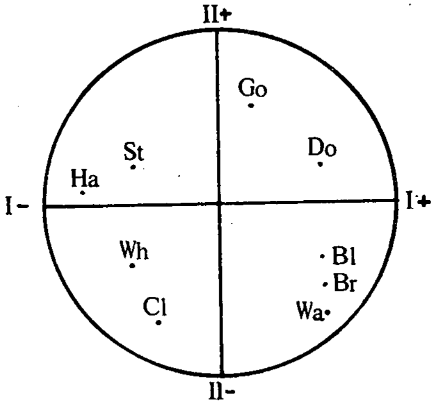


Figure 2

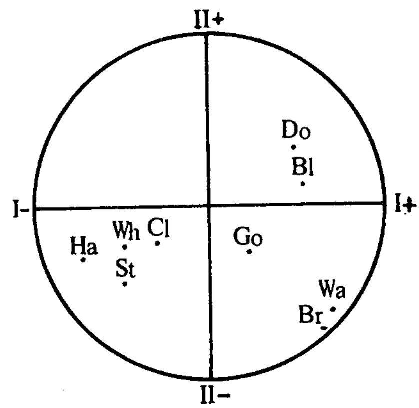


Figure 3

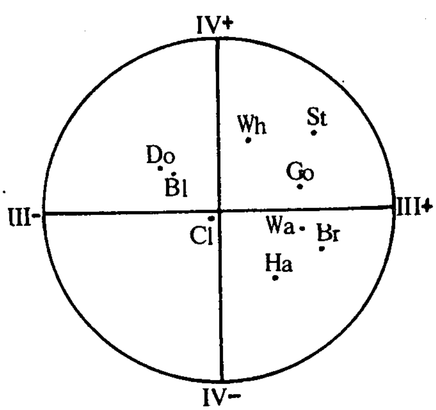
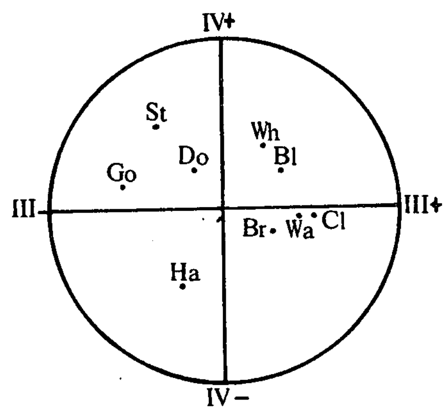


Figure 4



What has happened is not that the positions of the judges have changed, but that our perspective on them has changed. Imagine that nine different-coloured balls were suspended, on strings of varying length, from random spots on the ceiling of a room, and that the arrangement was then photographed from many different heights and angles. In some photographs the red ball would appear to the left of the blue and green ones, in others to the right of them, in others in between. Sometimes it would appear higher in the photograph, sometimes lower. Yet the actual positions of the balls would remain unchanged throughout. So it is here. The positions indicated by the loadings obtained in our second factoring are the same positions as those indicated by the earlier set of loadings – the same distances from one another, and from the geometrical centre of the "space". But the use of slightly different estimates for the communalities has had the effect (in three-dimensional terms) of first rotating Axes I and II about 170°, and then rotating Axes II and III about 80°.

Accordingly, the *apparent* changes observed above do not in themselves entitle us to dismiss as misconveived or unfeasible the enterprise of using the judges' positions as a guide to the location of meaningful factorial axes. The judges' respective positions *are* uniquely fixed in space; and the same positions will be ascertained by *any* properly extracted set of factor loadings, no matter how much the loadings themselves, and the orthogonal axes to which they relate, may shift from one set to another. But these shifts *do* mean that the method of finding meaningful axes by simple inspection of the two-dimensional graphs, outlined on page 211 of this paper, will produce satisfactory results only by the sheerest accident – especially when it is realized that shifts of perspective are taking place in more than three dimensions. At the same time, the fact that the orthogonal axes rotate as the perspective changes, reinforce the point that *these* cannot be regarded as meaningful. A method must be found of rotating the axes with the consequences indicated earlier in this paper, but without the dependence on deceptive appearances that was there involved.

A variety of methods have in fact been devised for effecting the rotation of axes by reference to purely mathematical criteria; but I shall not here discuss these methods. Even assuming that an acceptable location for the rotated axes can be statistically found, the problem still remains of interpreting the axes as thus rotated – of saying *what are* the factors which the rotated axes represent, and by which judges' positions in "space" have actually been determined. And this is a problem which neither statistics nor the theories of behaviouralist psychology can solve. In the pioneering application of factor analysis to the Supreme Court, Thurstone himself, in 1951, produced a set of rotated axes (mathematically determined) for the 1943 and 1944 Terms; but neither he nor anyone else was able to supply any interpretation of the factors thus represented.

In recent years Schubert claims to have found a way out of this impasse, by a hypothesis which is now fundamental to his studies in this field. This hypothesis may still yield a number of equally acceptable solutions, and mathematical criteria can still be used to narrow the range of these. But his basic assumption is that the problems of factor analysis can be solved by scalogram analysis.

Assuming that the judges' positions in space (which I shall here take to be three-dimensional space) mean anything at all, it should certainly be possible to plot through that space *somewhere* an axis representing any group of cases in which the judges' votes have been found to follow a scaleable pattern. This would not require that all the judges' positions be located on the scale axis; it would require only that when lines were projected from their respective positions so as to meet the scale axis at right angles, these projections should hit the axis in the order, and at the approximate intervals, indicated by the scalogram. In the extended form of scalogram analysis whereby *all* divided cases are scaled with a view to finding that scale which "fits" the maximum number of cases, the scaling technique is being used to identify the most important single component in the attitudinal structure deemed to underlie the Court's decisions; then the second most important component, and so on. Hence, if three such scales are found to inhere in a given body of cases, these ought to stand for the *same* underlying attitudes as are represented by Factors I, II and III respectively. It follows that if we plot an axis which will be met by projections from the judges' positions in the order indicated by the largest possible scalogram, this ought to give us the "correct" location to which Axis I is to be rotated – and, at the same time, a reading of the cases on the scalogram should enable us to determine the *content* of the factor thus represented. Similarly, an axis for the second largest scalogram will be the "correct" rotation of Axis II; and so on. Once the rotated axes have thus been found, it becomes a simple trigonometrical matter to calculate a revised set of factor loadings, showing how each judge's position relates to each rotated axis. In this say (it is said) the scalograms can provide a factor analysis with the substantive interpretive meanings which that analysis lacks; and at the same time factor analysis can furnish the (more or less) precise mathematical loadings which a scalogram cannot give.

Much more work needs to be done before the usefulness of this hypothesis can be regarded as established; and Schubert's current version of it entails additional assumptions which are (to say the least) dubious – – notably, that the orthogonal axes as well as the scale or "rotated" axes have an ascertainable meaning. But the basic hypothesis is a plausible one; and our judgment on its usefulness (and hence for the time being on the usefulness of factor analysis) ought properly to be reserved until all the evidence is in.

Quantitative Analysis of Cases

Assuming that this combination of methods can give us results whereby (1) points representing the judges's attitudinal positions can be accurately plotted in "space", (2) axes representing sets of cases evoking the same attitudinal responses can be plotted through the same "space", and (3) points and axes can be related to one another so as to permit meaningful interpretations – – we would still have only a *partial* mathematical model of the Supreme Court's workings. To complete the model, we would need also to have a means of plotting (in the same "space") a precise position for any individual case, as distinct from a series of cases. Only then, for example, could the model be reliably used for the predictive purposes which tend to be the ultimate goal – or at least the ultimate means of verification – – of any "scientific" method. At this stage, therefore, attention must shift from the work of Schubert and others on the quantitative study of *judges,* to the work of some of their colleagues on the quantitative study of *cases.*

Here again, the field has been characterized by experimentation with a great diversity of methods, the most promising of which so far appear to be those of Fred Kort. The much more detailed nature of the work undertaken by Kort tends to limit it to results which are in the short run more piecemeal, and less spectacular, than the overall visions claimed by Schubert; but it is conceivable that the accumulation of such results might in the long run prove to be of more practical significance.

Choosing selected areas of decision ("right to counsel" cases, "involuntary confession" cases, and so on), Kort and his colleagues concentrate on what in the past have appeared to be the material facts in such cases: that is, recurring elements in the fact-situations giving rise to appeals, which may or may not have influenced the outcome of such appeals. For "right to counsel" cases, Kort offers a list of 23 such facts: youth and immaturity of the accused; illiteracy, subnormal education, ignorance of English, and the like; no previous experience in court; and so on through 20 other categories of "material facts". For other kinds of issue, lists of 40 or more such facts have been put forward. (The preparation of such lists is probably itself best treated as a problem for the computer, working by semantic content analysis of the judgments delivered.)

The material facts thus listed are then treated as the variables in a mathematical problem. The objective is to find which combinations of variables have in the past evoked favourable decisions, and which have not; and, by analysis of these results, to attach to each variable a "weight" which will enable us to predict the results of combinations of variables which have not yet occurred. In Kort's work, this problem has been solved in two alternative ways. One is factor analysis along the lines already discussed (though of course these lines become much more tangled when 20 or 40 variables instead of nine are involved). The other method makes use of simultaneous equations, using at least as many equations as there are variables, with the weights to be attached to the variables treated as unknowns.

The principle which underlies the construction of these equations is a very simple one. Let f_1, f_2, $f_3 \ldots f_{23}$ represent the 23 variables; x_1, x_2, $x_3 \ldots x_{23}$ represent the weights to be attached thereto and the number of judges who voted favourably. Then, for any particular case, the value of v is given, and values for f_1, f_2, $f_3 \ldots f_{23}$ can for each decided case easily be assigned. Each such term is given a value of 1 if the fact was present in the case; O if it was not present; and 2 or more in the rare cases where facts classified as the same one were present in more than one manifestation.

Thus, for an 8–1 decision in which facts f_1 and f_2 were each present once, and f_2 was present twice, we would write the equation

$$1(x_1) + 1(x_2) + 2(x_3) = 8$$

Similarly, the following equations represent respectively a 4-5 decision involving facts f_1 and f_2, and a 3-6 decision involving facts f_1 and f_3 :

$$1(x_1) + 1\ (x_2) = 4$$

$$1(x_1) + 1(x_3) = 3$$

Solving these three equations together, we would get the weight $x_1 = 1$, $x_2 = 3$, $x_3 = 2$; and these weights could be used to predict the outcomes of combinations not yet given. Thus, a case which turned on two manifestations of fact f_2, and one of fact f_3, would be given the value:

$$2(x_2) + 1(x_3) = (2 \times 3) + (1 \times 2) = 8$$

– indicating that a claim based on this combination of facts would attract 8 favourable votes.

We have seen that Kort's work applies this procedure not (as above) to three variables, but to 20 or 40. For some observers, the greater complexity thus involved may seem to make the results more persuasive than in the above crude example; for other observers, less so. My own doubts are more fundamental, and concern the *jurisprudential* assumptions of any analysis based on the concept of "material facts". It is for this reason that I have chosen to focus this paper on applications of quantitative analysis not to *cases*, but to *judges*; for I find the jurisprudential *assumptions here in substance acceptable. Whether* the mathematical and psychological assumptions are equally acceptable is rather more doubtful; but these are questions which most lawyers can judge only by their fruits.

By this test, the value of scalogram analysis seems (within limits) well proven. As to factor analysis, we should be prepared to wait and see.

COMPUTERS AND LEGAL LOGIC

I. Tammelo and R. Klingert†*

1. Introduction

This paper aims at examining the reasons why it is desirable that computers carry out certain functions of modern legal logic or are to be used in conjunction with such logic. Before commencing this examination, two preliminary questions are to be answered:

(1) What is modern legal logic?

(2) What is the scope of modern legal logic and what functions can be carried out by its use?

In the history of ideas the word "logic" has been employed in a great variety of senses giving rise and certain justification to its multifarious use even today. So we find expressions as "formal logic", "material logic", "traditional logic", "modern logic", "transcendental logic", "meta-logic", "logic of emotional life", etc. Karl Jaspers has called one of his major books presenting his existential-philosophy as "Philosophical Logic" and Chaim Perelman has referred to his theory of argumentation or "new rhetorics" by the phrase "*logique passionnelle*". To sort out what all the different uses of the word "logic" import is a task which cannot be performed here. All that needs to be said for the present purposes is that for the scholars who call themselves "logicians" and who are so called by their academic colleagues, "logic" means today a discipline of thought concerned with principles and methods of self-consistent reasoning in abstraction of the material content of the thought involved in reasoning. This feature of logic is indicated by the word "formal" – logic is thus a formal discipline.

Logic thus understood may be divided into traditional logic and symbolic logic. The former deals essentially with the Aristotelian patterns of reasoning, including immediate inferences and syllogistic inferences; its subsequent developments include hypothetic and disjunctive inferences. Symbolic logic, developed during the last century, is different from traditional logic not so much in kind but rather in degree. Nevertheless, the difference in degree is enormous (such as the difference between draughts and chess as games requiring mental agility, or between the chariot and jet as means of transportation). With its special, highly advanced technical language, symbolic logic is a far superior instrument both for analysis and for deduction. The term "modern logic" is often used to refer solely to symbolic logic, and the qualifying adjective "legal"

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in "modern legal logic" indicates only that symbolic logic is applied to a particular sector of reality, namely law. Modern legal logic, then, is modern logic in its application to legal thought. It is to be noted that "legal logic", will be hereafter used throughout this paper to mean modern legal logic in this sense, and this meaning should be constantly borne in mind.

So conceived, legal logic contains two main areas: juristic logic and juridic logic. Juristic logic is the logic of thoughts about law or legal phenomena; juridic logic is the logic of the thought of law itself. The functions which can be performed with the aid of legal logic fall into two main categories: analysis and deduction.

Analysis is concerned with the examination of language used in:

(a) legislation;

(b) judgments;

(c) legal drafting, such as contracts, wills, etc.

(d) other legal materials.

The aim of such analysis is the clarification of the language used and the detection and elimination of ambiguity, especially syntactic ambiguity. This aspect will be examined further below.

Deduction is concerned with the reasoning employed in legal context, whether by judges, by counsel, or by others. It seeks to ascertain whether the conclusion claimed or tried to be established does in fact follow from the premises stated or assumed. Within this area falls the examination of fallacious reasoning and also the modes of proving that a certain argument is in fact valid.

If one were to ask what were the aims of a course in legal logic in a Faculty of Law, the answer would be that such a course should produce:

(a) proficiency in *correct* reasoning;

(b) avoidance of fallacious reasoning;

(c) aptitude in detecting fallacious reasoning;

(d) proficiency in the techniques for testing the correctness of any reasoning;

(e) increased clarity of thought, expression, and communication;

(f) heightened awareness of the syntactic structure of language, and particularly the special problems of legal language;

(g) understanding of the relationships which hold between basic legal concepts.

2. The Value of Modern Legal Logic and Some Problems of its Application

Since by far the greater part of legal argument is concerned with non-deductive arguments and logic limits itself to methods of testing the validity of deductive arguments, it is relevant to ask, how important is logic for the members of the legal profession. Although use of logic in general by lawyers has been decried by distinguished legal scholars ("in the field of law, logic has no use" – Julius Binder; "the life of the law has not been logic, it has been experience", "a page of history is worth a volume of logic" – Oliver Wendell Holmes), it must be remembered that these were not speaking of modern logic but of traditional logic, which, all must agree, is too unsophisticated to cope with complex legal situations. The bases on which courts make decisions are rarely as elementary as a one-sentence major premiss, a one-sentence minor premiss, and a one-sentence conclusion. The reasoning in judicial proceedings is far more complex and consequently a far more advanced and intricate logic is required for its rational treatment and intellectual mastery.

Furthermore, even though legal argument may not be primarily deductive, logic still has techniques for the investigation of such arguments; it can show that the conclusions from given bases of decision are not logically compelled conclusions. Thereby logic can assist in indicating areas of judicial choice and also in assessing the weight to be accorded to non-deductive arguments. Whereas deductive arguments are valid or invalid (and their validity or invalidity can be demonstrated), non-deductive arguments can be regarded as "sound" or "unsound", that is, whether they are highly or poorly convincing in the audience of reasonable and competent men. These modes of legal reasoning, though included by some scholars within the denotation of the term "legal logic", are better assigned to different disciplines of thought, for instance, to zetetics or the theory of non-stringent argumentation (zetetics here covering all those modes of reasoning which do not lead to results whose tenability is beyond any doubt, but beyond reasonable doubt, viz., inductive reasoning, deductive reasoning (or analogy reasoning), and paraductive reasoning (or rhetorical reasoning)).

It is not proposed here to advance lengthy arguments for establishing the relevance and value of logic within legal universe of discourse. For the purposes of this paper suffice it to say that it is beyond reasonable doubt and that such value and relevance has not been effectively challenged by contemporary legal scholars. A detailed justification of the standpoint can be examined elsewhere [1] and the existence since 1959 of a quarterly periodical devoted to the application of logic to law is a weighty testimony. [2] To judge the worth and potential role of logic for lawyers, it is not sufficient to be merely a competent lawyer but also a competent logician.

It is important to remember that symbolic logic deals primarily with *propositions*, that is, with thought-formations which can be either true or false. Hence distinction between juristic logic and juridic logic becomes significant when it is considered that thoughts about law or legal phenomena are normally expressible in the form of propositions, whereas this cannot be done with essential parts of the thoughts of law itself. The latter typically occur in the guise of legal *norms*, norms being thought-formations about which it cannot be safely said that they are either true or false. It hardly makes sense to ask: "Is this law true?, Is this provision false?", etc. The logical values here relevant are not simply propositional logical values but rather deontic or normative values which could be expressed perhaps as either "tenable" or "untenable".

Since symbolic logic, as ordinarily conceived, is centred around propositions and their elements, the propositional values "true" and "false" are of constructive significance for it. However, it seems that this is not a necessary but an accidental feature of logic; for logicians have so far been mainly concerned with propositional thought-formations. Insofar as self-consistency plays a role in an area of thought, logic is applicable in any such area of thought, whether or not the propositional values can meaningfully be assigned to those thought-formations which require logical treatment. It is obvious that self-consistency plays a role also in the thoughts of law itself. Therefore systems of juridic logic can be constructed parallel to the logic applied to propositional thought-formations. It is to be mentioned that there are other areas of modern logic in which the propositional values cannot be applied. The most important of them is the logic of classes, classes being among those thought-formations to which it is not meaningful to assign the values either "true" or "false" but perhaps "filled" and "empty" (depending on whether a class has or has not members).

The existence of thought-formations which are amenable to logical treatment but do not constitute propositions has been one reason for the construction of a system of logic consisting of uninterpreted signs, a system which can be called "protological calculus". In special areas of reasoning special requisite interpretations are given to these signs, for example, the sign "C" is interpreted in the logic of propositions as the operator of conditional (usually called "implication") whereas in the logic of classes it is interpreted as the operator of extensional inclusion: the signs "+" and "–" are interpreted as "true" and "false" and as "filled" and "empty" respectively. Similarly the interpretation of other symbols vary according to the particular area of logical reasoning involved.

3. Computers and Decision Procedures of Legal Logic.

Formal logic finds application in legal reasoning, because this reasoning is characteristically concerned with legal consequences stringently drawn from legal premisses, which is a logical operation. The drawing of these consequences may often not follow the standard patterns of logical inferences. However, this does not mean that logic is not here in operation. The deviation from these patterns is due to the fact that legal reasoning is usually expressed in ordinary natural language, which always seeks available shortcuts of the expression and imposes an enthymematic form on the logical inferences employed. Whether or not the operations of legal logic are so simple that the services of the computers are here not required is moot. It may be pointed out that so far legal reasoning has been carried out without the aid of the computers from the dawn of our civilization; nevertheless, this does not establish that legal reasoning has been carried out so far in a satisfactory manner: it may be argued that its results have often been poor because its logical aspects have been treated in a superficial and haphazard manner due to the lack of requisite knowledge, skills, and instruments; it may also be argued that its process, even where it has led to logically impeccable results, has been needlessly laborious, time-consuming, and fuzzy because appropriate and adequate tools of thought have not been employed.

Symbolic logic has developed various decision procedures establishing the validity or invalidity of arguments, for instance,

(a) the tabular method;

(b) the normal forms method;

(c) direct, indirect, and conditional proofs methods.

Of these, the first two are algorithmic decision procedures, that is, they yield a result by a mechnical procedure; the first is the simpler. On the other hand the third often requires a considerable amount of insight, imagination, and ingenuity, which are still considered as faculties peculiar to the *human* mind.

A simple example of the application of the tabular method in propositional calculus (the truth-table method, so called because the relevant values are "true" ("T") and "false" ("F") here) would be as follows:

p	q	C	K	C	p	q	p	q
T	T	T	T	T	T	T	T	T
T	F	T	F	F	T	F	T	F
F	T	T	F	T	F	T	F	T
F	F	T	F	T	F	F	F	F
		1	*2*	*3*	*4*	*5*	*6*	*7*

Apart from the guide-matrix (the two left-hand columns), the table consists of 7 columns and 4 rows, i.e., of 28 entries, and establishes the validity of an argument (viz. *Modus Ponens*) in the form *If* p *then* q; p. *Therefore* "q", where p and q are any two propositions. This presents no difficulty, but it is when arguments become more complex that the tabular method becomes awkward. For instance, the following argument (with just three premisses):

1. **KCpKqrKqb**

2. **CKCoNpze**

3. **CCzeKoa / . . Arb**

would require a table of 256 rows and 32 columns, i.e. of 8192 entries. By human means this would take a considerable time to complete and the risk of error in such human computation (one error could yield a wholly incorrect deduction) is obviously very real.

Yet the same argument by direct proof methods would not require more than a 14 line proof and most adults of average intelligence having studied logic would be able to provide the necessary proof in a fairly short period. However, it may happen that such an adult, despite training in logic, would struggle in vain for a very long time in search of the proof, perhaps because the requisite insight escapes him. This, naturally enough, would be alarming when, as it frequently is the case, the solution is urgently required.

Clearly, when the problem is even more complex, as it would be in many legal contexts, merely human methods are inadequate to cope with the task. Thus in a legal argument with numerous variables and numerous premisses a table would be required whose entries may run even into millions on some occasions. Formal proof methods would be equally laborious because of the complexity and uncertainty of yielding a result.

Here, then, is where computers can be of invaluable service in the application of legal logic, for the tedious and troublesome determination of validity or invalidity, which may take human operators weeks to complete, could be carried out by a computer in a matter of minutes. To programme a computer to construct a table of logical values would be simplicity itself (since the formulae in symbolic logic are readily reducible to two symbols of logical operators (even one such symbol) apart from the variable symbols), and it would then be merely a matter of formulating the argument in symbols; the necessary computation would then be done by the computer, speedily and without the fear of error.

The effect of this would be that direct, indirect, and conditional proof methods and normal form methods (which were developed to combat the tediousness of the tabular method) would no longer be necessary, at least for such calculi which lend themselves readily to the tabular method. The position is somewhat more difficult for areas where the tabular method does not apply, such as predicational calculus; but it should require only a different programming so that the computer is fed all the principles and methods of this calculus. On receiving a particular set of premisses, it could produce all the conclusions which would validly follow, and could then scan all these conclusions to ascertain whether a particular conclusion does in fact follow from the given premisses.

Programmed in this way, computers could answer the following questions:

(1) Given certain premisses (that is, certain statements of facts and certain legal rules), does a particular conclusion (decision) validly follow from those premisses?

(2) Given certain statements of facts and a certain desired decision and given a certain legal rule would that decision (that is, what extra premisses are necessary to "cook" the conclusion)?

(3) Given certain legal rules and a certain desired decision, what statements of facts must be established to reach that decision (again, what extra premisses are necessary to "cook" the conclusion)?

(4) Given certain premisses (legal rules and statements of facts) what possible conclusions (decisions) follow; or is there only one possible decision, and if so, what is it?

(5) Given certain premisses (legal rules and statements of facts) and a certain conclusion (decision) which does follow from those premisses, what are the steps of the proof which establish that the conclusion does follow?

4. Other Aspects of Computers and Modern Logic in the Service of Law

In recent years, notable work has been done in formulating systems of deontic logic, that is, structures exhibiting formal relationships between concepts such as "obligation", "prohibition", and "permission", which have a particular relevance in legal systems. The systems of deontic logic can be appropriately formulated only by recourse to principles and methods of modern logic; traditional logic would not furnish the requisite tools of thought here. Deontic logic provides a fundamental frame of reference for juridic logic and thus a basis for rational organization of all thought of law.

Modern logic has a special utility in helping to detect and avoid the so-called syntactic ambiguities in legal expression. These ambiguities arise from the fact that legal provisions, drafted as they are from *merely* "hard thinking", leave it open to which of the several possible expressions a given expression relates. The syntax of legal prose is generally more cumbersome and loose when necessary and anyone familiar with symbolic logic would agree that much legal prose could be greatly simplified if the principles of this logic were strictly observed. Much litigation could have been avoided and can be avoided if, as a result of training in logic, ambiguities in the syntactic structure of the expression of legal provisions are eliminated or exhaustively identified.

Legal norms could be rendered or construed as conditionals: "*if* certain conditions are fulfilled *then* certain legal consequences ensue." By formulating them in this manner and by making conjunctions (*p* and q) alternations (*or* q), and other logical relationships obtaining within or between legal norms easily identifiable, a certain standardization of legal expression could be achieved enhancing the rationality of law and its application. Already much work has been done in this field illustrating the potentialities of symbolic logic in the achievement of clarified legal language[3], but much more is required to be done. It may be noted that application of the best available logic in the legal universe of discourse by no means narrows the area of choice for the legal decision-maker; on the contrary, it helps him to ascertain the available choices (which may be greater than imagined) and thus to serve justice and expediency while retaining fidelity to law. The rigour of modern logic in no way imposes rigidity on the application of law, unless the applied law itself is rigid, in which case it may have to be reformed.

Whereas in previous sections it was suggested that computers could be of great assistance to the application of legal logic, it now appears that logic can be of considerable value for deriving the greatest possible benefits from computers in the service of law. For the programmer, it is clearly advantageous that legal language to be fed into the computer is a logically clarified language. If all antinomies are to be detected or avoided within the law, this can be done through combined services of modern logic and modern electronics. It is virtually impossible for the human mind to delve through all legislation, all regulation, and all case-law to seek out antinomies and other defects of law. However, if law is expressed in logically clarified language, programming a computer for legal purposes would be quite simple. By feeding all legal materials, logically preformed, into a computer, it would be feasible to discover ambiguities, antinomies, and gaps in law and to eliminate them if desired. Ultimately, this would procure a completely rational structure of a legal system.

There is a popular misconception as if the use of computers in the service of law would make the application of law a merely mechanical procedure and would therefore remove the "human" and humane element from legal reasoning. This idea is wrong for multiple reasons. First of all, the computers are among the finest products of human genius and their excellence does not lie only in the fact that they are ingeniously constructed but also, and mainly, that they can perform ingenious work. They are still subservient to the controlling human mind, which programmes them and which evaluates and utilizes the data supplied by them. There is no question of machines starting to rule man, unless man decides that he be ruled by them. The blessing which results from the use of electronic devices in the service of legal and other reasoning is that they take over those parts of reasoning which are mechanical by their nature and which machines can handle better than brains. In this way lawyers would have more time and energy for displaying their *esprit de finesse* (as distinguished from *l'esprit de geometrie)* in legal reasoning.

The great saving in time and energy and the assuring of the accuracy in formal legal reasoning which computers offer may create the desire to make law such that it would be completely amenable to mechanical operations. Following this desire may lead sometimes to regrettable results, but this is not necessarily so. There are certain parts of law in which rules are so settled and in which situations which give rise to the application of the rules are so uniform that computers could be entrusted with legal decision-making. For example, regulations of rail-traffic and of traffic of airplanes are of that kind; it has also been maintained that computers can sucessfully be used for decision-making in the areas of the law of taxation, the law of social services, and the law of minor traffic offences. In some computerizable areas of law, questions of justice or equity may not arise at all, in others they may arise, and if they do, a special procedure of adjustment may be provided for, in which the decisions made by the computers may be over-ruled by decision-makers.

The lawyers' judgements on the potential services of computers to legal reasoning may sometimes be unsound because they usually do not know what the potentialities and limitations of computers are. Thus they tend to overrate the capacities of the human mind and underrate the capacities of mechanical "minds". It is sometimes believed that the computers are incapable of evaluation. This is wrong if evaluation is supposed to be a rational activity, an activity governed by settled rules. Evaluation so conceived is computerizable; thus if we know, for example, what the applicable precepts of justice are in a given case, a computer can supply us with a just solution of the given problem. It is sometimes also believed that computers cannot act "creatively" in the area of legal reasoning in the sense that they cannot discover applicable principles. This, too, is wrong, for computers can efficiently scan the possibilities of applicable principles and select the most suitable one, provided that they are instructed what these possibilities are and what are the criteria of the selection among these principles. There are speculations about the possibility of building computers which have the same rational capacities as human minds, but do not have the shortcomings of the human mind which account for bad decisions. So the quandary arising in connection with the use of computers for legal reasoning is not whether or not to use them but how complicated, and how expensive, they would be.

It is sometimes thought that computers can be used in legal reasoning only where the meaning of legal expressions is clear and unambiguous; if this is not the case, there is no point in drawing any legal conclusion at all, let alone to apply computers for this purpose. This opinion, too, does not hold. In case of vagueness or ambiguity of law there is scarcely any point in proceeding to a legal decision until it is ascertained what the relevant meaning precisely is. However, for this ascertainment it is necessary to see what the implications of each conceivable version of a defective legal expression are. To test all the possibilities may be a task too laborious and tedious for the mind of man. Here again the electronic "minds" can take over the toil by scanning all the logical possibilities and by helping to select the reasonable ones by reference to available criteria, thus preparing the ground for a rational decision.

It is sometimes argued that various defects of legal regulation manifesting themselves as ambiguities, vaguenesses, antinomies, or lacunae may be desirable on certain occasions, because they give leeways to those who apply the law to adjust it to the given social circumstances and requirements, which are ever-changing. However, normally these defects are something to be shunned and normally legal draftsmen are anxious to supply legal texts which do not give rise to them. To make law adequate to cope with contingencies of social change, legal draftsmanship, whilst avoiding anything which is logically "untidy" or opens ways for logical "licence", can make wider use of broader legal concepts and provide for desirable discretion in the application of certain rules. In order to perform their tasks efficiently and impeccably, legal draftsmen would find the services of computers indispensable. By their aid, and by the aid of modern logic, it is possible to determine quickly and reliably what needs to be done to assure formal excellence of the law. Where the contemplated new law affects large areas of previous law, mechanical "minds" are particularly required to assist the minds of legal draftsmen.

It is sometimes considered that computers may supply the decision-maker with such a mass of relevant legal materials that he would not be able to cope with it. If this is so there must be something awfully wrong with the existing state of law and the prevailing elephantiasis of law can only be treated by a radical law-reform having recourse to computers and legal logic. In the meantime, computers may help to deliver the lawyers from complacency about their law and to dispel the illusion that the legal process has so far been rationally determined and yielded *legally* predictable results.

5. Computers, Legal Logic, and Legal Education

Computer technology is a part of contemporary civilization. However idyllic the past less civilized ages may have been, we seem to be no longer free to regress to them nor retain their vestiges in our time. Computers will irresistibly come to wider use, and they will come to wide use also for legal purposes. We must therefore prepare ourselves to make the best possible use of them. Knowledge of legal logic and skill in its application which lawyers may acquire would avoid that computers would serve them merely for trivial purposes or serve them so as to increase their load of problems by supplying defective answers to questions defectively asked.

While curricula of our law schools are now under revision, it is the time to consider thoroughly whether courses in legal logic should be established in them, if not otherwise than on an optional basis. This would give an opportunity for students who have a sound judgment in choosing to equip themselves with contemporary tools of rational thought to make this choice. Just now, perhaps the moment of extensive application of computers in the service of law has not yet arrived. However, the aim of education is not only to deal with instant problems but also to plan for the future; it is essentially a pro-ceiving and pro-acting – a promethean enterprise.

So far regular courses in legal logic could not have been established in the Anglo-American world largely because of the lack of text-books of legal logic. These will soon be available[4] : several authors are working on their preparation. Establishing courses in legal logic in our law schools would, alas, mean addition to their already crowded curricula. But expenditure of time here involved is a time spent on a "productional detour", during which the worker will acquire equipment and skills to perform more efficiently and expeditiously his tasks and thus ultimately be able to save time in the total process of his efforts. It is therefore to be hoped that those who frame new curricula for law schools will have the intelligence and insight to provide for such studies and thereby enhance the intelligence and insight of lawyers-to-be.

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3. See, for example, L. E. Allen, "Symbolic Logic: A Razor Edged Tool for Drafting and Interpreting Legal Documents" (1957) 66 Yale Law Journal 833 *et seq.*; L. E. Allen and Mary E. Caldwell, "Modern Logic and Judicial Decision Making . . ." (1963) 28 Law and Contemporary Problems 213 *et seq.* See generally throughout issues of M.U.L.L.

4. A compendium of logic in the service of law entitled Outlines of Modern Legal Logic has just been completed by Ilmar Tammelo and was published by Franz Steiner Verlag GmbH, Wiesbaden, Western Germany, at the beginning of 1969.

DATA BANKS AND THE FUTURE

*P. N. Rose**

I believe it was Socrates who said "Define your terms, and then I shall argue with you". In the field of data processing a corresponding statement is most appropriate – "Define your problem, and then there is a chance of someone's solving it."

This paper reviews the nature and status of data banks in very general terms. Details may be obtained from the references given in the bibliography.

What is a Databank?

A databank is basically an organized collection of related information[1-5]. This definition includes just about every library, book-keeping system and record keeping system ever devised. The term "bank" has been applied because it is possible to make deposits and withdrawals of data, in a way analogous to monetary deposits and withdrawals at conventional banking institutions.

Two forms of the databank are presently under discussion – these may loosely be termed "special" and "general". The adjectives "private" and "public" or "partial" and "total" might also be applied.

A special databank is set up by the records of a single organization or for a single special purpose. The records of credit ratings maintained by a credit bureau are an example.

A general databank is set up by the consolidation of the records of a number of organizations, and is used for multiple purposes. This may be illustrated by the Nevada Statewide Information System (NASIS), where a single information filing facility, with one set of records, serves the purposes of virtually all State instrumentalities.[9]

Obviously, there has always been the potential for the establishment of organized databanks. There appears to be no *theoretical* reason why, for example, the Taxation Department and Department of Social Services should have maintained separate record systems with duplicate information on many members of the population. Neither does there appear to be any real *theoretical* bar to the use of such a system by the Bureau of Census and Statistics.

In practice, there has been a real practical problem involving the storage of such records, since a huge volume of space would be required. Retrieval of the information has also been a problem: suppose all three departments require a given file simultaneously. Even if they did not, retrieval of a given record will take several minutes at least, and extraction and update of the desired information probably even longer. During this time, the entire record is unavailable to any other user.

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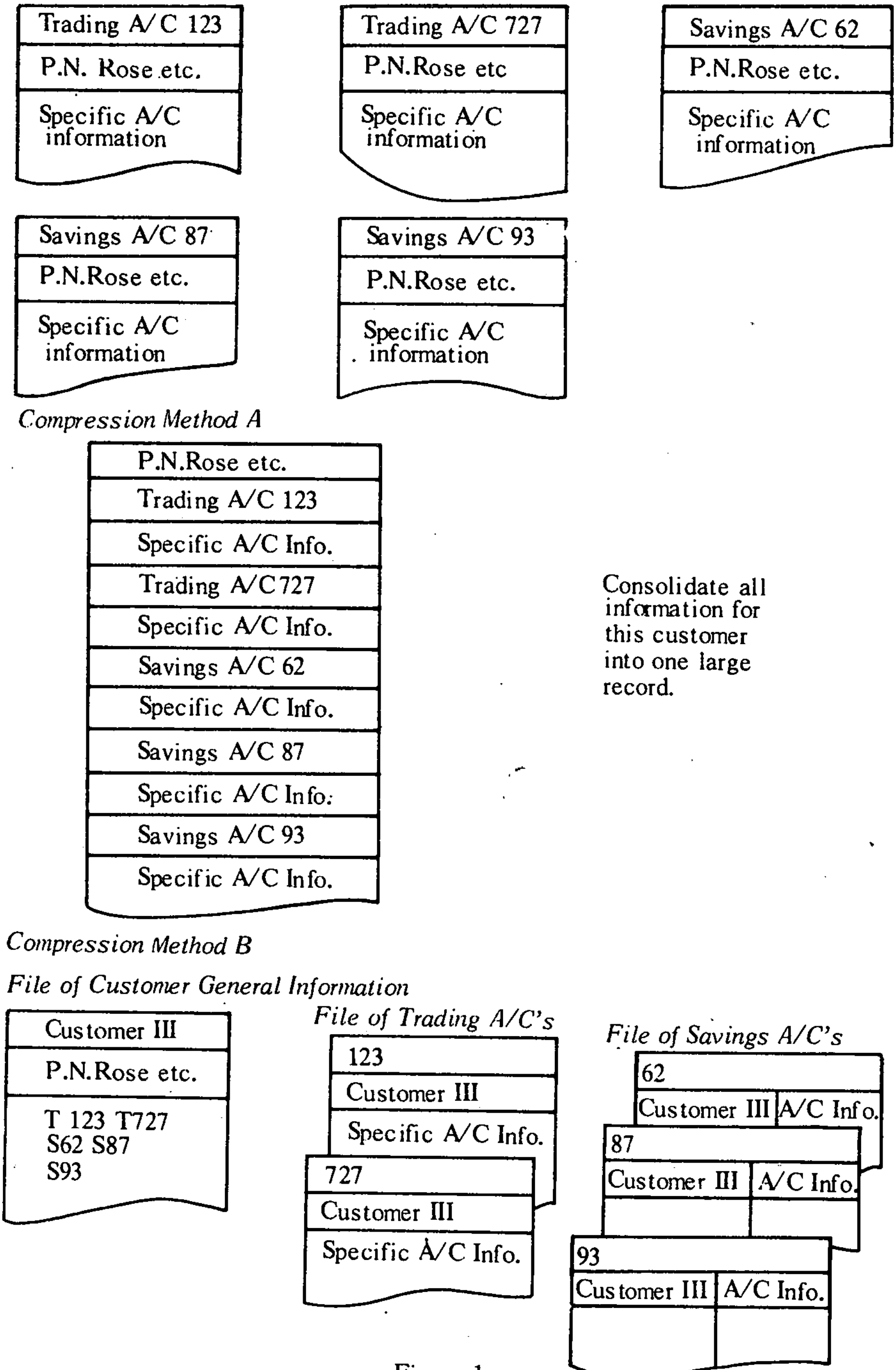
Trading A/C 123
P.N. Rose etc.
Specific A/C information
Trading A/C 727
P.N.Rose etc
Specific A/C information
Savings A/C 62
P.N.Rose etc.
Specific A/C information
Savings A/C 87
P.N.Rose etc.
Specific A/C information
Savings A/C 93
P.N.Rose etc.
Specific A/C information
Compression Method A
P.N.Rose etc.
Trading A/C 123
Specific A/C Info.
Trading A/C727
Specific A/C Info.
Savings A/C 62
Specific A/C Info.
Savings A/C 87
Specific A/C Info.
Savings A/C 93
Specific A/C Info.
Consolidate all information for this customer into one large record.
Compression Method B
File of Customer General Information
Customer III
P.N.Rose etc.
T 123 T727 S62 S87 S93
File of Trading A/C's
123
Customer III
Specific A/C Info.
727
Customer III
Specific A/C Info.
File of Savings A/C's
62
Customer III
A/C Info.
87
Customer III
A/C Info.
93
Customer III
A/C Info.

Figure 1

Another point about traditional record-keeping systems is that they contain a large amount of redundant information. For example, I personally maintain five separate accounts at one branch of an Australian bank. My name and address, occupation and business address, plus some other general information, are recorded five times.

Reduction of redundancy

Figure 1 illustrates two methods of reducing the amount of redundant information held in the above example.

Both methods imply organization of the information in some way. Method B also requires cross-referencing of the files, so that each customer's accounts are identified, and for each account the customer record may also be found.

Many other methods of organization are possible. A rule of thumb that might be applied in that organizations resembling Method B allow information to be retrieved quickly when all the types of retrieval request are known in advance. Organization along the lines of Method A usually gives better results when retrieval requests are unpredictable. [22]

Enter the computer

There is no theoretical reason why such approaches could not have been widely implemented a century or more ago. However, it is obvious that the amount of clerical effort involved in doing so would be enormous, even for a single firm.

By the mid-1960's, many organizations came to realize that most of their records were now being kept in machine-readable-form usually punched cards or magnetic storage. This meant that the huge clerical burden could be shouldered by machines.

By the same time, direct access storage devices for computers had evolved to the stage where there were no practical limits to the volume of data that could be stored on-line, and the per-character cost of this storage had dropped significantly below the per-character cost of sequential storage media such as magnetic tape.

Inquiry termials, located anywhere in the world, had alos been proven in operation by the mid-'60's, and so there existed a situation in which –

(a) existing files could be consolidated by machine effort;

(b) huge volumes of data could be accessed directly in milliseconds, at low cost;

(c) multiple inquiries to a single record could be processed simultaneously, from terminals located anywhere.

Given this climate, the development of computer-based data banks was feasible and economically attractive. A number have been implemented, and references are given in the bibliography. A few examples follow.

Oregon State – Project Otis[8]

This is an embryonic special-purpose databank, encompassing information from all school districts in Orégon. A noteworthy feature is the provision of special controls to ensure individuality and "complete security" of records.

Nevada – Project NASIS[9]

The Nevada Statewide Information System is a shared information resource for all state agencies and the University. Common items such as name, date of birth, address, weight, etc., are stored only once. Up to 53 per cent of the information in an individual agency's file, proved to be duplicated elsewhere.

Pennsylavania General Assembly – Legislative Information System.

This is a retrieval and update system, used only for bill drafting, bill status and history and statutory retrieval of existing laws. Full English text is available, and a very wide range of inquiry types is processed.

Alexandria Databank.[12]

This is designed to serve all departments of the Alexandria municipal government. An outline of it has already been given by Mr Maino in his discussion of land registration.

Alameda County – People Information System[7]

This is a centralized system serving the San Francisco Bay area. Records are maintained for both public employees and county residents. Law enforcement agencies have full access to this information.

Brisbane City Council

Tenders have closed for the provision of systems to the B.C.C., Australia's largest local authority. This will be used amongst other things for implementation of this country's first governmental databank.

The above are very brief comments on a few databank systems presently operative or planned. More details will be found in the publications referenced in the bibliography.

General organization of a databank[1]

One of many possibilities is illustrated in figure 2. The most important thing to realize is that it is not possible to set up the databank in such a way as to be able to answer conveniently all possible types of inquiry. For some types of request, at least, there will be no alternative to a complete scan of the stored data. (There is at least one major computer-based information retrieval facility now operating, which services all requests in this way.[10])

It should also be noted that the actual physical organization of the data-bank does not necessarily concern the user, who need only be aware of its apparent structure. (This principle was first enunciated by Blaauuw, and has been widely implemented in computer hardware and programming systems.)

For efficient searching and scanning techniques, the reader is referred to the text "Automatic Data Processing" by Brooks and Iverson, listed in the bibliography.[21]

The Future – Problems and opportunities

It is safe to say that general databanks are already with us, and that their use will expand. Most discussions concerning this fact immediately focus on the potential erosion of individual freedom resulting from the general availability of personal "private" information.[3-15]

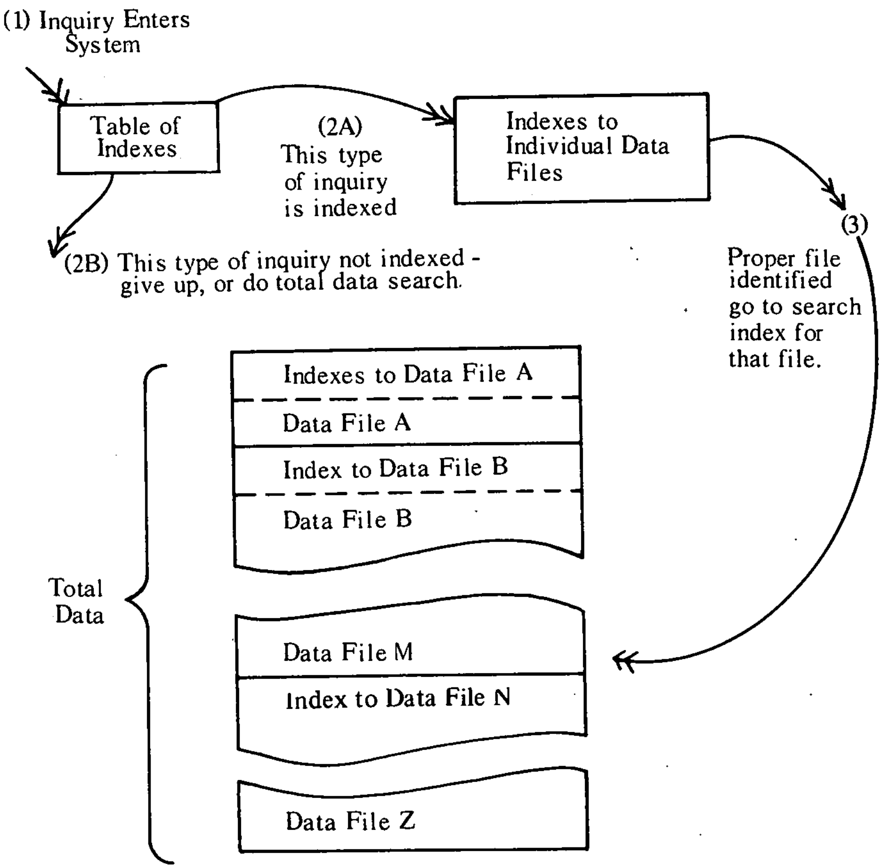

Figure 2

I must point out that, in this regard if no other, the advent of the computer has not created a problem. It has merely drawn attention to one which has existed, relatively unnoted, for a long time.

Personal "private" information is already publicly available. Does anyone of you doubt your ability to obtain quickly, very complete information on the life, habits, prejudices and thoughts of an individual whose name happens to appear on the jury list? The storage of such information in a computerized data-bank merely makes it available (a) from one single source instead of many and (b) very much more quickly.

That is, computerization *facilitates but does not create,* availability of the information.

What is needed is a definition of what information about individuals should be considered public, and what private. Indeed, "public" and "private" will themselves require a rigorous definition in this context.

THIS DEFINITION IS NOT THE RESPONSIBILITY OF COMPUTER PROFESSIONALS AS SUCH. It obviously requires legislative action, and so falls into the political and legal spheres, rather than the technical.

Once the individual's rights as to privacy of information are adequately defined, the computerized databank and the computer professional, as a team, will actually be able to provide greater protection of privacy than presently exists. For example, supposing I, without being an authorized person at a properly-located terminal, attempt to determine my manager's salary level. The system would be programmed to reject my request as improper, and could also notify my manager, automatically, of (a) the nature of the attempted violation, and (b) the apparent identity of the violator. The information would then be released to me only if my manager entered a specific authorization.

Summary

Several of the papers at this seminar have referred to data banks and information retrieval. These have indicated the very real effects that will be noticed by the legal profession, and indeed by us all, during the next five or ten years. It is apparent that uncontrolled growth and use of general databanks could lead to significant impairment of personal privacy, and that this is avoidable, provided action is taken prior to implementation of the systems. Remedial action against an operative system would be prohibitively expensive and disruptive.

It is also evident that timely action could ensure that the safeguards to be built into such systems, would, in fact, enhance the individual's protection.

Conclusion

The Australian Computer Society, New South Wales Branch, has established a Data Banks Committee, to draw attention to the problems and opportunities involved, to foster professional discussions within the data processing industry, and to give advice, upon request, to interested individuals and groups outside the industry.

Inquiries may be directed through the Hon. Secretary of the N.S.W. Branch of the Society.

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USE OF COMPUTERS FOR LAW ENFORCEMENT

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SYNOPSIS

Due to the increasing complexities of law enforcement, a premium has been placed on efficiency, accuracy, and speed of all activities. The (U.S.A.) President's Crime Commission concluded: "The most important improvement to be made in law enforcement is to improve the capability of supplying supporting information for the patrol's initial investigation".

NCR had developed a Law Enforcement System designed to improve the capability of law enforcement agencies. The NCR Law Enforcement System is programmed to accept punched tape, punched cards of direct input from Vehicle Accidents, Traffic Citations, Court Dispositions of Citations, Offences, Arrests, Prosecutions, Missing Persons, Stolen Vehicles, Stolen Guns, Stolen License Plates, as well as many other source documents.

Master files of data are kept on magnetic disc and are available for data retrieval and statistics reporting as the need arises. The sort of data kept on these magnetic files includes Accidents, Driver History, Offenses, Crime Index, Unsolved Offenses, Crime Totals by location and area, Crime Statistics, Wanted Persons, Missing Persons, Stolen Items, and many other items of pertinent data.

The most commonly produced reports from this system are:

- Driver History for each driver with details of offences, parking offences, current and previous charges and the disposition of the charges, with the date, time and location of incidents and their disposition.
- Summary of Motor Vehicle Traffic Accidents provides uniform statistics for Local and National traffic analysis and pinpoints classes of accidents for immediate remedial action.
- Daily Bulletin of Police Incidents provides detail information of daily events by beat and watch with full details of each incident.
- V Crime Incidence Analysis provides details of actual criminal activity in each specified area with comparisons by crime classification being made with a moving average to pinpoint trends and charges in criminal activity.
- Other reports analysis offences by type, age of offender, sex and race of offender, disposition of charges and various classifications.

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In addition to existing computer systems such as this one, research is being conducted in various areas of Criminology, including the use of computers for matching fingerprints and for classification and analysis by modus operandi. In addition, new computer components, such as remort terminals and CRT units may make it possible, eventually, for every policeman to have direct immediate access to much of the data that is kept on the magnetic files of the central computer.

Publications available from the Institute of Criminology :

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