

ELECTRONIC EQUIPMENT

- A. What significant indications affecting the possible uses of electronic equipment have developed within the last year?
- B. To what extent has the information necessary to evaluate the merits of electronic equipment become available within the last year?
- C. Are there any immediate prospects of joint use of large-scale installations by two or more companies?
- D. What actuarial activities have been accommodated by electronic data processing machinery to date?

MR. M. E. DAVIS recalled that it was not many years ago that the subject of electronic equipment first became of interest to the Society. It was only three years ago that the Committee on New Recording Means and Computing Devices made a report to the general membership of the Society to the effect: "There is something to this. This equipment offers great promise. It is something for us to be concerned about now."

Since that time, Mr. Davis continued, considerable progress has been made in further development of such equipment. A large number of companies today have sizable staffs of people devoting their full time to this particular subject. The use of this equipment is still very limited, but some actual experience is becoming available. At the Metropolitan, he reported, magnetic tape electronic equipment has been in use for ten months and the accuracy and dependability of such equipment is being established.

Mr. Davis then explained that the electronic equipment at the Metropolitan is comprised of several types of machines. There is the central computing unit which works only with tape and which actually does the work, and there is periphery equipment which transfers information from punch cards to tape, or from tape to punch cards, or from tape to printed record.

Speaking first about the equipment which converts punch cards to tape, Mr. Davis said that this operation runs at the rate of 240 cards per minute, including checking. Occasionally they have found a reel of tape that they cannot use because some error is made in recording onto the tape—a magnetic spot is placed where it should not be. The Central Computer, however, recognizes this and refuses to accept it. Fortunately, that occurs not very frequently and in itself is not a stumbling block. It has, however, indicated the advisability—almost necessity—of making use of a tape a short time after it has been prepared, so that when one is found that can-

not be used the original material is still available from which to make another tape.

As to the accuracy of the central unit after it gets the tape, Mr. Davis said that in the ten months that Metropolitan's computer has been running it has been working with the records, in one form or another, of about 20 million policies and they have yet to find one error that the computer has made, *traceable to the machine itself*. During this period, he said, they have been converting one job after another and they have found errors; but these errors have been due to the information given to the machine—the machine did its job perfectly.

Turning next to the operation of printing from tapes, Mr. Davis said that the printer they have will list 600 lines a minute, the lines being up to 120 characters long. They have listed for test about 50,000 lines and have done extensive checking to determine the reliability of the equipment. Out of those 50,000 lines they found one character in one line that was not printed correctly. From this, he said, the obvious conclusion is that the machine is accurate.

One of the problems that they were very much concerned with in the early days and which, to some extent, they are still concerned with today, is the matter of getting instructions into the machine—programming. At first, that looked like a tremendous job because it was necessary to spell everything out for the machine in the most minute detail. Things that can be expressed very simply in algebraic formulas would take hours and days to write in detail for the machine to understand and use. Here, too, considerable progress has been made.

Mr. Davis likened each little instruction to a building block, and said that there are hundreds of these to be assembled to get a final program for the machine. From experience, Metropolitan has found that many clusters of these building blocks are common to different jobs, even though the jobs may have entirely different names. It is possible to borrow whole clusters of the blocks from work already done so that it isn't necessary to repeat the minute detail.

As an example of this, Mr. Davis reported that recently the Life Insurance Association was faced with a problem of getting life expectancy values on a joint-and-survivorship basis for two lives for all combinations, where either life may be anywhere from age 6 to 110. This specific job had never been done before with such equipment, but by taking advantage of building blocks from previous jobs of an entirely different nature they were able to get the programming completed in seven hours. This, he indicated, was exceedingly fast; three years ago 10 weeks would not have seemed unreasonable. The seven hours to which he referred was the paper

programming time. It was still necessary to try the program on the machine to see if everything had been taken care of—and he said that it is very rare to find a program in which everything has been taken care of.

Trying it on the machine, correcting the little errors that had been made, and running it took another two hours. Next, the tape was taken to the printer and in 15 more minutes the job was done. All this was done in a matter of less than 12 hours, Mr. Davis continued—and this was a new job. If such a job had to be done again, it would not be necessary to repeat the programming. The same program can be used again and again. This, Mr. Davis said, is one of the big developments that has come along. It makes this equipment a much more practical instrument for flexible use on special jobs as they come up. Several years ago it was felt that such equipment might be suitable for doing routine jobs but that there might be a problem in handling a special job.

Mr. Davis said that one of the early problems to be faced by any company considering the possibilities of such equipment is the suitability of magnetic tape as a recordkeeping medium. He pointed out that there are several different types of tape and several types of equipment that go with them, and there are differences in how they may be used. He reported that the Committee plans to bring together available facts and current thoughts on this subject for a presentation at the Western Spring Meeting.

MR. M. R. CUETO said that one of the most significant developments during the past year among life insurance companies has been the trend toward mechanization of office procedures. This has been brought about by the continued rise in the costs of administration and by the effort on the part of each company to reduce costs and improve its own competitive picture.

By mechanization of office procedures is meant the adoption of systems utilizing punch cards or magnetic tapes, thus making available mediums susceptible of mechanical processing. It is possible to use mechanical or electronic equipment in connection with, for example, calculation of dividends, cash values, policy reserves and other insurance items and in premium billing and accounting.

The trend toward mechanization with its greater efficiency of operation, he continued, has made necessary a critical examination of office procedures and methods. It has brought about the conversion of manual records and files to punch cards (and currently, or later, the conversion of records to magnetic tape) and also the consolidation of many different files, where possible, to a single punch card file in the interest of reducing file maintenance work and keeping on one record as much information as

possible for purposes of answering inquiries. The effect of such analyses or surveys has been generally to get more out of a punch card system than heretofore and, at the same time, to prepare for the possible use of electronic equipment utilizing magnetic tape.

Mr. Cueto stated that another significant indication regarding possible use of electronic equipment is the increase in the number of life insurance companies within the last year which have sent or are sending actuaries and others to the various educational courses on electronic equipment given by the suppliers of such equipment. This fact may be an important indication of the possible widespread use of electronic systems of one kind or another in the industry in the near future.

Finally, he noted there appears to be among the life insurance companies a trend away from emphasis on the components of an electronic system as such, and more emphasis on the problems to be solved in each company, with the idea of selecting the most suitable equipment available for the office procedure involved.

Mr. Cueto said there are available today or may be obtained within a relatively short period of time (and the time to a great extent depends more upon the period of preparation required for acceptance by the insurance company than upon any lag in delivery) large, medium or small scale electronic systems which should meet most needs of life insurance offices.

In the interest of advancing their respective products, the suppliers of some of the equipment have done considerable work in devising and advancing new techniques for programming, such as automatic programming, speed coding, interpretive routines and new methods for sorting tape-recorded information in order to make sorting less of a problem. In addition, they have been tackling the file reference problem in order to come up with some kind of a realistic solution at a reasonable cost. The fact that information is serially arranged on tapes makes file reference on such tapes a very expensive operation. For the time being this has required in each company's concept the maintenance of supplementary punch card files for reference purposes.

Some of the significant developments in the equipment during the past year which Mr. Cueto noted are:

- a) High-speed printing from magnetic tape. Such printers are capable of printing up to 600 lines per minute of 120 characters each. One supplier expects to announce shortly a printer which will print 1,000 lines per minute of 60 characters each.
- b) The increase in tape density, that is, more characters packed into each linear inch of tape. This will result in reducing the number of reels of tape required for a specific file.

- c) The adoption of magnetic cores as satisfactory storage media as contrasted to electrostatic storage, acoustic delay lines and magnetic drums.
- d) An increase in the high-speed memory capacity of electronic equipment, permitting the use of more instructions and hence more operations per pass of the data through the machine.
- e) The use of tape buffers permitting simultaneous reading, writing and computing, thereby stepping up the speed of operation.
- f) An increase in the reliability of tapes and in the number of channels on a tape.

Among the developments taking place at present is the work going on in experimental models of transistorized machines. The transistors, which require very little power and throw off little heat, are being used in place of vacuum tubes. The elimination of vacuum tubes from computers is being universally favored by machine designers. The tubes consume considerable energy, are fragile, and their life is limited. Their generation of heat, their bulk and weight require that heavy metal framework be built to support the computer and that the components be sufficiently far apart so that the heat of operation can be carried away by a large capacity ventilating system.

Other developments which Mr. Cueto mentioned were the use of printed circuits which increase the reliability of the machine since they serve to reduce errors resulting from the instability of soldered joints. Work is going on in character sensing to make possible the reading of alpha-numeric characters printed by accounting and typewriting machines, dual recording, and provision for completely random field and record length.

These indications, to cite a few, represent improvements which will affect, and have served to greatly increase the interest in, the future uses of electronic equipment.

MR. J. W. RITCHIE stated that we have known for some time that the central computer unit of an electronic data processing system performs calculations with extreme accuracy and that with proper care and maintenance it will operate with a low percentage of unscheduled down time. While the central computer may be regarded as the heart of an electronic system, a number of pieces of auxiliary equipment are required for life insurance data processing operations. Some of the more important pieces of auxiliary equipment only became available to customers and for testing by prospective customers during the past year. He was referring to the card-to-tape converter, tape-to-card converter and high-speed printer produced by one of the manufacturers of electronic machines.

One large life insurance company has all three of these auxiliaries in operation in its office and has made available to other companies its ex-

perience with these machines. Mr. Ritchie's company, the Sun Life of Canada, as part of its testing of electronic procedures has, in recent months, been processing from month to month on the "Combined Operations Plan" the business of one of their Canadian branch offices. In this processing they have had the opportunity of using the auxiliaries. Their experience and that of the other company has been that, while the auxiliaries, being newer, have not yet reached the operating standard of perfection attained by the central computer, their operating standards are acceptable and give high promise of significant improvement in the near future. He mentioned that for their test branch office they have been producing on the high-speed printer premium notices at the rate of 100 a minute, the notices involving on the average between four and five lines of printing. The printing on these premium notices is of good quality.

Mr. Ritchie then turned to the question of obsolescence, saying that during the past year certain manufacturers have announced improvements in the electronic data processing systems which they have under development. Without going into detail, he said that these improvements in general increase the data processing speed and capacity of the machines but they also increase the cost of the machines. This appears to be the general trend, which means that in virtually every case of a machine improvement customers have to make an investigation to check whether they can make any use of the increased speed or capacity and, if they can, whether the savings are more than enough to cover the increased cost of the machine. This, he feels, has an important bearing on the question of obsolescence. Many machine improvements will be such that they will have no significance for an individual customer because that customer cannot make effective use of them. This tends to minimize the factor of obsolescence although it does not rule it out completely. In any event, for any company considering entry into the field of large-scale electronic computers the important point is whether there are machines in existence now which would effect economies for the company and, if so, which machine suits their purposes best.

He also pointed out that helpful information has been made available during the past year on life insurance company procedures in estimating costs relative to savings in combined operations or consolidated functions approaches to the use of electronic equipment. Moreover, one or two companies have been kind enough to release some of the figures obtained in their investigations. While such figures are not as valuable as figures taken from an actual operation over a period of years, in the absence of the latter they serve as useful points of comparison for other

companies on what is the most important single aspect of the investigation of the possible use of electronic equipment.

Mr. Ritchie said that his company has not yet finished its cost studies but in the course of these studies two points have impressed him. The first is that the critical volume of business in force for a company in the matter of showing savings from the use of a large-scale electronic computer is likely to be higher for a Canadian company than for a comparable United States company. One reason for this is that the electronic equipment may have to be imported into Canada with import duty payable. Another is that operating costs in Canada and the United States are, in general, on different levels.

The other point concerns the question of rental versus purchase of equipment. In a rental proposition the life insurance company has no control over the period of amortization. It is fixed by the manufacturer. In a purchase deal one can within reason adjust the amortization period to fit the use to which the computer is being put.

The speaker concluded by referring briefly to certain aspects of electronic data processing systems about which there are still doubts in some people's minds.

1. While the accumulation of experience seems to indicate that magnetic tape is more reliable than many had thought possible, doubts are still expressed in certain quarters regarding the desirability of carrying a company's main records in an invisible form. Judging from the tests which they have been conducting, any difficulties which do arise in practice in carrying records on tape are easily surmounted.
2. All experience with large-scale computers indicates the importance of surrounding the machine with highly competent engineering and technical help. The effective computing time varies considerably with the quality of the maintenance. The problem here is the supply of competent engineers and technicians.
3. There is the problem of maintenance of machines in time of war, which is tied in with the second item concerning the supply of engineers and technicians. Canadian companies might, perhaps, have a special problem in this connection.

MR. D. H. HARRIS said that the Equitable's program for the installation of electronic data processing equipment in connection with Ordinary insurance involves a transition phase in which medium-sized computers are to play an important role.

Their detailed planning efforts, he continued, so far have been directed at a magnetic drum data processing machine which—although it uses punch cards rather than magnetic tapes—has sufficient program and storage capacity, and sufficient flexibility, to fit rather well into at least the early stages of an approach to a consolidated functions operation.

He pointed out that it is important to realize that equipment of this kind is sharply distinguished from traditional punch card machinery by its large internal storage capacity and by its ability to follow, selectively, programs which may involve many hundreds of steps. In these respects, the medium-sized machines are essentially similar to the giant tape-using machines, differing from them importantly in speed and in many other ways, but yet differing primarily in matters of degree rather than in matters of basic operating principle. The Equitable studies have tended to fortify a view that the class of medium-sized computers has important possibilities and that such machines make possible a great deal in the way of consolidation of policy servicing functions.

Mr. Harris next discussed Equitable's reasons for choosing to explore this approach rather than moving directly toward the very large machines. He said that rather soon after they began to consider the question of how to go about using electronic machines, they concluded that the problems of conversion to a radically new method of operating would probably be more severe and would certainly be more time-consuming than the problems of developing that new method on paper. The transition would involve major changes in procedure, having a very wide impact in many areas of the company, and the job of preparing new, machinable records for each individual policy would alone represent a quite staggering proposition.

While they had no doubt that these steps would be very well worth taking, they were convinced that they would have to be taken gradually and that the new procedures would have to be installed to a considerable extent on a function-by-function basis. Studies indicated that the whole conversion would take considerably longer to pay for itself if a very large electronic data processing system were installed at the outset and were only partially occupied for some time, than it would if the acquisition of machine capacity could be kept more closely in balance with conversion progress.

They have therefore decided to make a series of conversions, each involving the mechanization and consolidation of a related group of functions and each requiring about the capacity of one medium-sized computer. These conversions are being planned in such a way as to fit into one another as parts of an eventual system in which larger equipment replaces the smaller units, and in such a way as to make the subsequent machine-to-machine conversion as simple as possible. Some doubling-up effort is involved, but they are inclined to believe that the greatest part of the work and a very substantial part of the benefits lie in the first step

--the step from present-day methods to methods which make use of stored program computer techniques.

Mr. Harris commented further that experience was showing that the conversion procedure, where one has to merge an old system into a new one, and where one has to get all the policy records from an old form into a new form, requires very careful planning. It will probably take longer to work out the details of these conversion operations than it will to plan the new systems themselves.

MR. H. F. ROOD said 1954 was the year that the revolution came to the office. Several new suppliers announced or began talking seriously of large-scale electronic data processing systems and several also announced smaller types of computers such as magnetic drum computers.

In the past year large tape computers have been installed at General Electric in Louisville, the Metropolitan Life, Franklin Life, Du Pont, U.S. Steel and Monsanto Chemical. In 1954 many orders were taken for the various types of equipment, some on a firm basis and others by letters of intent. Many companies formed committees to study the use of the big machines and considerable progress was made in developing programs for the use of the equipment.

Also during the past year, Mr. Rood pointed out, magnetic cores have come into use and high-speed printers have been developed. Another idea under development is the xerographic printer, a part of a process which might be described crudely as throwing the information required on a television tube in visual form, then photographing it to produce rapid transmission of information and then printing from the film using an electronic process. Among other developments is punched paper tape which may be used as an input medium. A more promising idea, however, is the use of photographic film or photographic discs for input and output. The ultimate may lie in character sensing, since almost all records start with a manually prepared form such as the application blank. Continued improvement in the transistor field appears to offer some hope that the price of machines will be reduced in the future. During the past year there has been no tendency toward a reduction in price.

Mr. Rood also said that the social implications must be considered. He mentioned the fact that, of late, automation in both the factory and the office has been receiving increased attention from labor leaders. They are concerned about the effect on the number of jobs as well as on the length of the work week.

Mr. Rood indicated, however, that a year or two ago many people had the idea that electronic machines would solve all of their problems; but as they have been working with these various types of electronic equip-

ment they have become a bit more realistic. They find there are many jobs that the machine will not do, and many jobs that it will do; they find that many jobs that can be done by the machine would not be done nearly as economically as by manual methods or by punch card methods or by other types of machines that are not as powerful.

Mr. Rood thinks that in life insurance the companies will also find that many of the savings which will be effected by a tape file arise from the fact that a lot of the present departmental files will be eliminated. A good many of the departmental files could probably be eliminated without going to tape. For example, a number of punched cards which might be filed together in one place—in a central tabulating department—would accomplish much of what could be done with tape, but it would be done by means of punched cards with much less expensive machines. He thinks many of the companies will find they cannot justify tape machines but will make substantial savings by adopting such a plan, using the smaller type of punch card computer.

Mr. Rood commented that one of the greatest problems yet to be solved is the random lookup question. Some companies feel that it will be necessary to run the complete file daily in order to obtain the status or other information necessary to perform current operations. Others plan to maintain a subsidiary manual file either in the branch offices or in the home office for this purpose. Both of these methods are expensive, although a branch office record card may be essential, in which case the branch may be depended upon for all random lookups. Still another proposal is to furnish the branch office with updated printed record cards on each policy anniversary. At least one manufacturer contemplates having all of the main tape titles permanently mounted on its equipment and proposes to furnish information regarding any individual policy by merely dialing the policy number. He indicated that his firsthand impressions are that this would be a terrifically expensive method on the basis now proposed.

Mr. Rood's company, the Lincoln National, found that the break-even point on a tape machine would be somewhere around 800,000 regular policies. Handling that many on a consolidated functions approach would probably pay for the tape machine. The savings, then, would have to come from handling group insurance or reinsurance or other lines of business on the machine and, of course, from the expansion which they hope to have in their direct line.

He thinks the approach that various companies have been taking in studying these machines is rather interesting. There seem to be a number of different approaches. The Metropolitan started out thinking in terms

of the actuarial function. Of course, the Metropolitan is large enough to have several machines ultimately, and perhaps to keep their departmentalization.

A company the size of Lincoln National will find they probably can afford to have but one machine. That means that they will do away with a good many of the departments that now exist, and they may end with a consolidated functions approach handled by a central recordkeeping and computer department. Some of the smaller companies will find that they cannot justify this type of equipment at all, but can do much the same thing on their smaller machines, such as the new magnetic drum machines which several suppliers have brought out.

One of these suppliers has provided for the optional use of tapes with the magnetic drum machine, and it is indicated that another supplier plans to do the same thing. Thus, these machines will be compatible with larger tape-using machines.

Referring to the previous remarks by Mr. Ritchie, Mr. Rood recalled that the Sun Life's approach was to take one branch office and follow through every item for that one branch office. Mr. Rood's company, however, has been looking at it from the reverse process of taking individual functions, such as dividends or commissions, and programming them first for a magnetic drum computer using punched cards. At the same time, they are developing their tape record and program. It appears that seven punched cards which may be filed in two separate departments—part of them in the accounting department and part of them in the actuarial department—will have exactly the same information which will ultimately appear in the tape record. After mechanizing the job on punched cards, it will be a fairly simple step to carry it from the punched cards to the large-scale tape computer.

Mr. Rood stressed the necessity for fully studying the use of electronic equipment. He warned against overenthusiasm for making a change and said that this could lead to false economy.

Chairman Jenkins then asked Mr. Rood if, from his reinsurance contacts, he had any information as to smaller companies that have studied this problem and have reached conclusions which would be of interest.

Mr. Rood answered that he had not had much chance to talk it over with smaller companies, but that unless a company has 400 or 500 employees it will be difficult to eliminate enough clerical operations to justify the large-scale equipment. He thought smaller companies would probably find themselves going to the magnetic drum type of computer, perhaps using some of the same procedures.

He added that, as a reinsurance company, his company has been thinking of certain problems—for example, those in connection with Yearly Renewable Term extensions. At the present time, it is common practice to compute reserves and amounts of reinsurance and Y.R.T. premiums for five years at a time. This procedure has been very convenient for both manual and punch card records. If Y.R.T. reinsurance records are put on tapes, however, the ideal arrangement would probably be to compute these figures annually; but he wasn't sure that such a plan would work well between companies. And, whereas the reinsurer might like an annual operation, his clients might not be equipped to handle their records on such a basis; consequently the reinsurer would provide the information required by its clients rather than adopt the program it found most economical.

MR. J. T. PHILLIPS noted that the preceding talks had stressed the use of large-scale magnetic tape electronic machines and the magnetic drum type of machine, but he thought that many companies could obtain substantial savings from the use of the small size electronic machines employing punch cards. The use of such equipment would involve, of course, a mechanization of office procedures, that is, the adoption of systems utilizing punch cards. He said it was true that in many cases this presented a conversion job from manuscript records to punch cards but the savings that could be obtained warranted such conversion. Also, an examination of present office procedures might point up other areas where streamlining and consolidating records would give additional savings in operations. Thus preparing for electronic equipment might generally be to get more out of a punch card system than heretofore.

He recalled that the New York Life started making use of punch cards back in 1909 in connection with certain mortality studies, and shortly afterward converted their valuation records to punch cards. They therefore have been able to use the small capacity punch card electronic computers to great advantage. Mr. Phillips then stated that some of the work that is being done with these machines is:

- (1) calculation of premium rates, dividend rates and dividend illustrations,
- (2) calculation of dividends for individual policies, including paid-up additional insurance and accumulated dividends left with the Company,
- (3) calculation of extended or paid-up insurance on foreclosure cases,
- (4) valuation of insurances and other items,
- (5) verification of valuation records on punch cards by means of a premium check,
- (6) preparation of various reserve factors for valuation purposes,
- (7) calculation of various items for annual statement purposes.

Small companies probably have many similar operations that could be handled with electronic equipment.

All the above jobs were done at a considerable saving in time and expense. To illustrate, the job involving the verification of valuation records on punch cards (20,000 cards a month) now takes 15 clerk-hours per month instead of 560. The calculation of extended insurance on 80% of the foreclosure cases (1,000 a week) now saves the company about 1,400 clerk-hours per month. The reason only 80% of these cases are done on the electronic computer is that the rest require special treatment making the calculation inefficient for the limited capacity of the machine they have at present. The saving in clerical time on these two jobs alone, although they take up only a small part of the machine's time, pays for the rental of two electronic computers (about \$53,400 per year).

Another procedure which he discussed was the asset share calculation which New York Life recently converted to electronic computation. Previously it took about 6½ hours of expert clerical time to compute and check an asset share calculation if there were no errors. The machine now computes, checks and prints the results of an asset share calculation for 20 years—about 35 columns of figures—in just 40 seconds.

He also mentioned that it was interesting to note that the tables for *Monetary Values for Ordinary Disability Benefits*, published by the Society in two volumes involving nearly 400 pages of tables, were all done in his company by electronic equipment in a matter of 4 weeks. This included printing the tables for reproduction by a photo-offset process. This job if done by prior methods would have taken so many months that the time could not have been spared to do it so completely.

Mr. Phillips next spoke of their billing procedures which have been mechanized by their comptroller's department so that premium notices are now prepared by means of punch cards giving the name and address and the amount of premium and any loan interest due. Recently they went one step further and incorporated the dividend in the billing notice. This is done by merging in the comptroller's department the premium billing punch cards with the dividend punch cards prepared by the actuarial department's electronic equipment.

He went on to say that the small capacity punch card electronic equipment which New York Life has been using not only effects great savings in time but gives the companies which use it for both computing and other data processing purposes a broad acquaintance with electronic techniques and electronic capabilities. Probably companies could make more effective use of small punch card electronic equipment than has been made to date. Companies should not lose sight of the fact that these

machines are highly efficient. It is easy to forget them because so much is being said about the installation of the medium size punch card computers which have recently become available or the still larger units employing magnetic tape.

Mr. Phillips' company with a quarter of a million Ordinary policies issued each year and about four and one-quarter million policies in force has, in their opinion, a large enough operation to justify at least one and probably more of the large magnetic tape electronic systems. Accordingly, they have recently decided to install in the actuarial department, as a company project, such a system.

He said that when the tape system is installed they will save about 110 clerks and they will also make a tremendous saving in space. This saving in space, he pointed out, is a far more important item in New York City than in some other cities. They believe that they will save about 13,000 square feet of space in the actuarial department merely from the consolidation of records and from using tapes instead of cards.

MR. J. S. HILL of the Minnesota Mutual reported that a significant development has taken place in Minneapolis and St. Paul in the past year. This was the formation of an organization known as Twin City Electronic Data Processing Associates—or less formidably known as TEDPAC. The organizer and chairman of this group is Mr. Charles Pestal, Associate Actuary of Northwestern National, and a member of the Society. The organization meets at the call of its chairman whenever a worth-while program can be assembled. This may be a visit of an expert from a computing machine vendor, a visit to a member company to hear and see a significant development which has taken place, or the discussion of problems and the exchange of ideas. Mr. Hill said that he has found the advantages of this organization to be very real and immediate.

Mr. Hill next mentioned the ever present need to review critically existing methods rather than to duplicate them blindly with new equipment. He suggested that the time may not be too far distant when electronic equipment will cause a critical review of certain basic actuarial concepts which have seemed so vital until now but which may appear rather artificial with the computing capacities becoming available. As examples of this, he mentioned the mean reserve concept, the deferred premium concept, the due and unpaid premium concept, approximate methods of obtaining expected mortality, required interest, loading, and other actuarial functions.

MR. R. D. ACKER spoke about the actuarial activities which have been carried out by the Metropolitan on a large-scale electronic data processing system.

He said that the major task assigned to the system was the taking over of work formerly done within the Actuarial Division by a highly mechanized punch card installation which included more than 100 separate punch card machines (excluding key-punch machines). This punch card installation was responsible on a schedule basis for the production of insurance statistics on the in-force status and policy changes for the following lines of the Company business: Ordinary, Monthly Debit (both Ordinary and Industrial), Weekly Debit, and Personal Accident and Sickness. These insurance statistics are required for determining many of the statement liabilities, particularly the reserve liability, and various policy exhibits, and are used in most of the analyses made on Company experience. In addition, the punch card equipment was used for any actuarial work requiring a large volume of calculations—as, for example, the calculation of premiums and policy values on new policies, and the calculation of various fund accumulations for use in the determination of dividend scales.

The adaptation of the electronic system to the work done formerly by the punch card equipment has been a progressive one, Mr. Acker continued. To date, the transition in the case of the Ordinary and Monthly Debit (both Ordinary and Industrial) lines of business has been 100 per cent completed for the scheduled production of insurance statistics. The flow of work through the electronic system in this production of insurance statistics is essentially the same as it had been with punch card equipment.

Punch card reports covering every policy transaction are still received from the operating divisions of the Company's Home Office and from the two Head Offices. These punch cards are converted to tape by a unit of the electronic system called a card-to-tape converter. Then the central computer processes these tapes to produce the desired insurance statistics on answer tapes, which are passed through a high-speed printer to produce the actual written reports desired.

Mr. Acker said that each individual policy transaction item must be classified into the cells which are used for valuation purposes. Also, a further type of classification must be made—namely, each policy transaction item must be summarized into the various classes of policy events used in insurance statistical work, such as new issue, death claims, matured endowments, surrenders for cash, changes to a new policy, changes to nonforfeiture, etc. In addition to statistics on policy transaction, there have to be produced in-force figures, classified by the cells used for valuation purposes. These in-force figures are produced on a monthly basis.

The results of these calculations and classifications by the central com-

puter of the electronic system enable many types of reports to be prepared, the most important of which are the following:

1. A verification of the accuracy of the premiums to be charged on each policy issued.
2. A record of in-force data by valuation cells, total Company and Canada separately.
3. Record of all required experience mortality statistics.
4. Individual State data for issue, payment, and in-force items.
5. Data required for policy exhibits; total Company and Canada separately.

Mr. Acker said that this classification work represents by far the bulk of the work that has been carried out to date by the electronic system in the Metropolitan. However, he added, the remaining actuarial work that has been carried out on this system has an interest all its own, because a good deal of it represents work which probably would not have been attempted on the punch card machines.

Soon after the central computer was installed in the Metropolitan last June, a program was prepared which enabled the central computer to prepare from a table of q_x 's a complete table of commutation functions, both traditional and continuous, in about two minutes per table. As a result, to date over 70 tables have been requested and produced on the central computer. The demand for such tables was very much peaked to the time when the program to produce them first became available. It would appear that one of the dreams of an actuary has been answered—all the commutation tables his heart could desire.

One result of the handling of instructions and data in the same type of storage units by an electronic computer is that it is possible to treat instructions as if they were data. This has prompted many people to study the possibility of using an electronic computer for the job of preparing its own instructions. The economic need for such study is obvious once one becomes acquainted with the vast amount of time that is necessary to prepare for a job to be done on an electronic computer. On large-scale jobs the time necessary to prepare a new program by hand without a library of former programs on tapes can vary anywhere from two man-weeks to six man-months, depending on the complexities involved.

The most commonly known method of using the computer itself as an aid in preparing programs involves a technique known as compiling. A skilled programmer must first recognize that certain combinations of instructions appear over and over again as parts of different programs which have been used on the work with which he is associated. These common combinations of instructions are called subroutines. When a sufficient library of subroutines has been accumulated, it is possible to use the elec-

tronic computer and the technique of compiling to bring together an entire program with less expenditure of time and cost than is possible by the hand preparation of a program.

In the Metropolitan the use of compiling techniques has already reduced the time necessary to prepare a program, in many instances, by over 50 percent. The art of preparing programs for large-scale electronic computers at all installations is only in its infancy and further improvements in this art are to be expected and looked for.

Mr. Acker said that he had discussed programming and compiling techniques primarily because there have been some actuarial jobs done by the Metropolitan electronic system which probably would not have been done at all except that there existed both (1) an electronic computer system, and (2) tried and developed compiling techniques of programming. Immediate and 10-year deferred annuity values, annual and monthly at all ages, were computed by a program prepared through the use of a compiling technique. Values on 32 different mortality tables were computed with a computer calculation time of approximately four and one-half minutes per table. This same compiling technique was used in connection with preparing programs for dividend studies. These programs were used to perform extensive calculations which involved over 200,000 multiplications as well as other arithmetic operations. As required by the compiling technique employed, the calculations in the central computer were performed logically as if there had been over 1,600 hand work-sheets of 17 columns and 20 lines each. The time necessary to do the calculations included in the logical bounds of one hypothetical work-sheet varied from 20 seconds to 45 seconds, depending on the complexity of the calculation. Also, numerous one-shot jobs of a relatively small number of calculations and of an actuarial nature have been put on the electronic computer since compiling techniques have been developed. A method must exist for preparing quickly the program to do the job before it is economical to use a large-scale electronic computer on small one-shot jobs which are too long to be done by desk calculators with ease.

Mr. Acker concluded by remarking that a great many of his facts were obtained from a paper prepared by Mr. Davis in October 1954. He said he had discussed only one of the many topics covered in that paper and he therefore recommended it to the attention of the group. It is entitled "Report of Some Early Indications of Univac Operations in the Actuarial Division of the Metropolitan Life Insurance Company." There is also a companion paper which was released at the same time entitled "Some Current Thoughts on the Possible Use of Magnetic Tape Policy Files in a Life Insurance Office."

MR. J. M. BOERMEESTER reported on John Hancock's three months' experience with the magnetic drum type computer which is now being used for actuarial work.

The John Hancock received its first computer in December 1954. Mr. Boermeester said that the Actuarial Department has been very much pleased with the operation of this machine during the 300 hours allocated for its use on actuarial problems. The second machine was delivered in March 1955 for direct use by the Actuarial Department. During this time the utilization of the second machine has been close to 100%. To their knowledge the machine is accurate and reliable.

Mr. Boermeester called to the attention of the group a 1952 report of the Society's Committee on New Recording Means and Computing Devices, which described the Consolidated Functions approach to servicing Ordinary insurance. Under a variation of this approach, he stated, a card would be prepared each year in order to show the amounts of the various policy equities. The card would contain, among other items, the cash value, current dividend, settlement dividend, dividend accumulation, monthly increase in cash value and one-twelfth of the net premium. The John Hancock experimentation to date has led them to believe that their magnetic drum computer can be used with advantage to produce such a card, a rather useful card from the viewpoint that clerks can use it to service a large part of policyholder requests without reference to various rate manuals and source documents.

The creation of this card, if one has such a magnetic drum computer, may be done by at least two different methods, Mr. Boermeester continued. One method may be used if the number of empirical values required in calculations is small. For example, the creation of such a card could be done by straightforward programming for the Monthly Debit line which has 19 plans. They discovered that if they stored relatively few functions, including the N_x 's and the M_x 's of the mortality table, and used about 1,200 program orders, they could then produce policy cash values, monthly increases in cash value and net premiums for policies filed in random order of policy number. Although they have tested this operation in part, they have not actually used it for production. That they were able to program this operation, he said, was due in no small part to the fact that the John Hancock dividend and cash value scales can be expressed in mathematical terms having relatively few variables. He also mentioned that they were able to program the calculation of values for the Family Income Plan and for juvenile plans having graded death benefit scales.

The second method may be used if the calculation formulas contain a

relatively large number of variables. Under this method, master cards would be used. Mr. Boormeester said that until they develop ideas further in connection with Method I, they will actually use the second method for production runs to service their regular Ordinary line. One pass through their computer produces for a particular policy the cash value, monthly increase in cash value, current dividend, settlement dividend, and one-twelfth of the net premium. In this same pass all necessary control totals are punched on trailer summary cards. The fact that the magnetic drum computer they are using has a 2,000 word memory and offers a choice of 35 program orders means that almost any problem may be approached from several points of attack. Mr. Boormeester said he is sure that anyone who is going to use such a machine will find it to be quite fascinating. It should also be a good machine on which one may "learn to crawl," so to speak, before being confronted with "learning to walk" with the larger-scale machinery now becoming available.

MR. SETH HASTINGS said that two years ago the Mutual of New York introduced certain forms of Group coverage designed primarily for small-sized groups of employees. It was considered essential under the circumstances to simplify the administration of these coverages to the greatest possible extent. Utilization of electronic data processing machinery therefore seemed desirable.

The only electronic machinery then immediately available in a size range between the small punch card machines and the very large tape systems was the Card Programmed Calculator, and the Mutual obtained this machine for use for the Group calculations in question.

The Card Programmed Calculator—or CPC—has some advantages which some later larger computers lack, Mr. Hastings said. The CPC is, in a sense, a system of machines rather than merely a computer. The CPC combines an electronic computer, a punch unit, a tabulator and memory units, all of which operate in a coordinated manner. The ability of the CPC, all under one program, to list and punch after calculation was extremely useful for their particular purpose.

On the other hand the CPC has very stringent limitations. With one memory unit it can handle only about 250 digits at any one time. It therefore required extreme ingenuity to accomplish the objectives and many expedients had to be introduced. The greatest difficulty was the fantastically complicated control panel wiring required. It took about three months of continuous work to prepare the program which he later outlined. Mr. Hastings stated that electronic computers with the stored program concept are far easier to program than the CPC.

Within this framework Mr. Hastings said the Mutual's objectives were as follows:

1. They wished to be able to make cost quotations quickly for coverage of any employee group of any size. Proposals for these coverages were to combine insurance, pension and accident and sickness benefits in various ways, and to base benefits on salary classes subject to various eligibility rules. The machine output was to include a list of employees which could be submitted directly to the employer without further processing. Another requirement was production of a punched card for each employee classified by age and insurance amounts, for subsequent use in summaries for underwriting consideration of the case as a whole.
2. When a case was placed in force they would be able to create permanent record cards for administrative use in subsequent accounting, valuation and other work. In addition, at each annual contract date each case would be adjusted for changes during the previous contract year, and for new benefits for the following year arising from salary increases or other reasons, and also an underwriting review might be required at each such annual review of the case.
3. The procedures should be so flexible as to allow for variations in benefits, salary class limits and other features which might be introduced from time to time.

Mr. Hastings then explained that with the limitations of the CPC, it was impossible to store tables of premium rates by age for the various types of coverages. A few premium rates which were constant by age could be stored in the memory unit. Mathematical formulas for calculation of other premiums were made part of the programming itself, or were generated through selectors and digit emitters.

Other aspects of machine use were utilized to the greatest possible extent to improve the efficiency of the operation. One instance of this is that exterior switches were used on control panels so that they could be preset for a series of a certain type of case, then easily switched over for another series of a different type of case. For example, Mr. Hastings said, the basic program involves monthly premium calculations, but any particular case could be processed on an annual, semiannual or quarterly premium basis by simply turning a switch. In addition, an over-all constant adjustment of premium rates could easily be accomplished by switching.

Mr. Hastings outlined the regular procedure for handling any particular proposal to one employer as follows:

1. A card program of 10 to 15 punched cards is made up for each case. This card program contains eligibility rules, benefit and pension specifications, rules about dates of retirement and other pertinent information, as well as

- identifying information for the particular case. This information is all read into the memory unit as the first step of the CPC procedure.
2. A punch card for each employee in the group has previously been key-punched. This contains date of birth, date of employment, sex, marital status, dependency status, salary, and employee name and number.
 3. Each individual employee card is read by the machine. Then for the particular employee the CPC runs through the generalized control panel program and applies the specifications of the card program for the particular case to calculate, successively, ages at employment, at contract issue date, and at retirement, period of service, whether or not eligible for each type of benefit, salary class, amounts of benefits, premiums, employee contribution, and credit amounts of insurance. This involves a series of calculations, with intermediate storage of the results of each calculation until these results are again needed for subsequent calculations in the series.
 4. As calculations are completed for each individual employee, a card is punched for subsequent record and underwriting use. Then the tabulator lists a line containing employee name and number, age, etc., benefits, employee contribution, and total premium for all benefits for which the employee is eligible.
 5. The third and fourth steps above are repeated for each employee until the entire group of employees has been listed. The entire procedure is completed for 7 or 8 employees in one minute. The original of the list goes to the employer. Carbon copies of the list are prepared simultaneously in the machine for use by the field underwriter, agency manager and Home Office.

Mr. Hastings said that no direct comparison with previous procedures is available in appraising the use of the CPC which he described, since the coverages in question were entirely new in the Mutual. He felt, however, that manual performance of the same work would have required a high clerical level because of the relatively complicated nature of the coverage. It seemed probable to him that the time required for the particular work described was cut at least in half.

With respect to variations of these group coverages as compared with the original design, Mr. Hastings said that the CPC has proved to be too limited to handle such variations very easily. Even here, however, processing through the CPC on the original basis, with subsequent manual adjustments for variations, has saved a good deal of clerical time.

Mutual has also considered adaptation of this CPC procedure to future larger computers of the magnetic drum type. Such a machine would not be able to produce a proposal listing, but could incorporate various additional calculations, such as the underwriting classification mentioned, as part of the basic procedure. The machine could then punch out a series of cards from the one program run. However, the CPC has proved to be peculiarly well fitted for the particular procedure described.

MR. A. L. WRIGHT of the Manufacturers Life reported that about 18 months ago an attempt was made by a Canadian manufacturer's representative to organize the installation of a large-scale computer for the use of insurance companies on a cooperative basis. The response was very discouraging and there has been no further effort along that line.

There is no very large Canadian company with a Home Office located in Toronto. There are three companies each with approximately two billion in force, three companies with approximately one billion in force, and several smaller companies. To one acquainted with the Canadian outlook, Mr. Wright said, it is therefore apparent that if companies located in Toronto were to contemplate extensive use of large-scale computers during the next few years, it would probably have to be on a cooperative basis.

Before a large-scale installation could be operated jointly on a satisfactory basis a number of problems would have to be solved, such as the allocation of expenses and the division of operating time, particularly at the year end when peak loads are unavoidable. Keeping in mind the inter-company cooperation for which the life insurance industry is famous, Mr. Wright said he feels sure that such obstacles could be overcome without too much difficulty. As a precedent for this type of joint undertaking he cited the Medical Impairment Bureau, which is most effective in operation. The step may eventually be forced on the smaller companies in order to keep pace with the larger companies.

Mr. Wright felt that a deterrent to such a scheme is the long period of planning and preparation which a company must undergo before it can adapt its operations to the large-scale data processing machine. The task will be less formidable once a library of routines has been set up.

As matters stand, in Toronto at any rate, the impetus necessary to set up the arrangement is still lacking. It probably will be lacking until the large companies which have assumed leadership in the field of high-speed data processing have clearly demonstrated that substantial economies are to be realized through the use of these machines.

Mr. Wright said that his company is taking the alternative approach of going to the magnetic drum computer. They expect to realize some of the economies which would result from a large-scale computer and they also feel that, if and when a move to a large-scale computer is indicated, the transition can be made with a minimum of delay.

Another point which Mr. Wright brought out was that in Toronto there is a large-scale computer available for use on a rental basis. The machine is, however, more suited to scientific calculations than to mass data processing. The Manufacturers Life has made use of this computer on several

occasions, however, for the purpose of calculating immediate annuity rates. The program includes the calculation of premiums for several types of annuities for single lives and for joint and survivor annuities. This work has been done partly with the idea of obtaining experience on the large machines. There are a number of other advantages. The annuity rates of the Manufacturers Life are closely tied to current interest rates and they transact annuity business in many territories, so they are making changes with relative frequency. The task of calculating survivorship annuities by desk calculator is long and laborious, even when using approximate methods. On the machine they can produce a new set of rates in less than a day. The costs of programming represent a substantial investment when compared to costs of producing the premiums by other means. However, the program can be used to calculate additional scales of premiums after only slight changes, so that the initial cost will be liquidated in the near future.

MISS FELICITAS REICH reported that the Equitable has recently had the opportunity of using a large-scale data processing machine, in connection with the adoption of a new group annuity rate scale. The necessary calculations, coming at a time of the maximum work load due to the year-end requirements, would have been a great additional burden to their home office staff. Therefore, it seemed desirable to have this extraordinary computation performed by an outside organization. Comparing cost estimates it became apparent that the cost under such an arrangement would not be substantially higher and might perhaps even be lower than the cost of performing the calculation in their own office. They therefore decided to make use of the supplier's computing service to perform the work according to their specifications.

Miss Reich said that a large amount of planning and programming time was required for such a rate calculation job, even though the actual machine run was comparatively short. In view of this it seemed obvious to them that, if it could be done without substantial additional programming, it would be economical to increase the output, despite the fact that they paid \$305 an hour for the use of the computer.

They therefore increased the scope of the job beyond the point where it would have been most efficient for their home office punch card machines. They obtained rates from the computer for a wider range of ages and computed the rates with greater accuracy because it was possible to carry more significant figures in the basic functions. They also had complete joint life functions computed instead of adopting some uniform seniority rule. They believe it would have been about as easy to compute rates with mortality forecast as it was for the static table they used.

Miss Reich also said they thought it best to use the electronic computer for only the basic rates per \$1.00 a year at retirement, correct to three decimals. The further manipulation of these rate factors to obtain the rates required for their rate book and for their administrative needs will be done on their own punch card machines because these further calculations involve such simple formulas that the punch card machines can produce results more efficiently and cheaply than the computer.

Miss Reich concluded with the comment that in retrospect she and her associates at the Equitable feel it would have been somewhat more efficient, if it had been feasible, to have all the work on and for the electronic computer done by their own personnel. The proximity of machine operator, programmer, and actuary would probably have been advantageous. However, they are satisfied that they made the correct decision under the circumstances.