ORIGIN, HISTORY AND DEVELOPMENT OF CALCULATING MACHINES

AND

THE ART OF PUNCHED HOLE ACCOUNTING

Calcuating machines are mechanical contrivances designed to facilitate computations to relieve the calculator from the mental strain of his work and to insure much greater accuracy in results. Calculating machines exist in various forms and are now made in such perfection that all important business houses regard them as a necessity and many scientific computations would not be made if it were not for the aid of these machines.

The earliest known instrument of any importance is the Abacus. The Abacus is a simple device for indicating numbers in addition and subtraction. It was in common use among the ancient Greeks and Romans and is still to be seen in general use in the Far East.

The Chinese lay claim to the invention of the abacus. Its use by the Egyptians as earlly as 460 B. C. is definitely asserted by Herodotus. It was probably used by the Babylonians and certainly by the Greeks and Romans from whom it spread to all Europe. It has existed in various forms—the knotted strings, the sand board, the pebble tray, the counters and the frame of beads. The last form, which is still in use, is known as the Chinese Swan Pan, the Russian Stchoty, or the Japanese Soroban. The ordinary Swan Pan consists of a frame divided into two sections, holding several parallel rods, each containing several movable beads. In the Chinese Swan Pan, each bead on the bottom row in the right division represents one unit, and each on the bottom row of the left division represents five units. In the next higher row, the value of each bead is ten times as great and so on.

Charles Babbage of London, England, was probably the first individual to forecast the computation of arithmetical calculations by machinery. His first calculating machine, which he called a "difference" or "analytical engine" was built between the years 1820 and 1822. It operated, after the manner of the "Jacquard" loom, from holes punched in a card. The card used by Babbage contained as many holes punched in a vertical column as the number desired to record. For example, if it was desired to record a "6," six holes in one vertical column would be punched.

The original model of one of the three Babbage calculating machines was purchased from the inventor in 1858 by an American citizen for $100,000.00 and donated to the Dudley Observatory at Albany, N. Y.

Several improved and distinctive types of automatic, mechanical and electrical punching, counting, sorting, tabulating and printing machine have been developed by resourceful inventors since the days of Babbage, notable among whom was Dr. Herman Hollerith, the founder of the Tabulating Machine Company.

The Tabulating Machine Company, subsidiary of the International Business Machines Corporation, is the pioneer in the manufacture and application of Tabulating machines. At about the completion of the tenth United States Census (1880), Doctor Herman Hollerith, an engineer who had won early recognition as an exceptionally able and accomplished statistician, realized the need of mechanical addition for census tabulation. For this purpose, Doctor Hollerith developed a system which recorded descriptive data for each individual or each unit of inquiry, by punching holes in strips of paper and later, in cards, both of which controlled electrical mechanisms, in the form of accounting or adding devices, either singly or in desired combinations. The first practical utilization of this machine and the mechanisms devised for its application, was in the tabulation of mortality statistics in the City of Baltimore; and the machines were also used by the Bureau of Vital Statistics of New Jersey and by the Board of Health of New York City.

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At the beginning of the organization for the Eleventh United States Census (1890), the Superintendent of Census appointed a commission of three of the most experienced statisticians in the United States to make a practical test of all systems of tabulation that might be offered for use in connection with that census. The report of this Commission (November 30, 1889) showed that three methods were offered in competition and thoroughly tested, the Commission reporting that the punching could be done more rapidly than by writing on slips, and that tabulating by machine was approximately eight times as rapid as by sorting slips, as well as being decidedly more accurate. As a result of this report, Dr. Hollerith was awarded a contract for furnishing the equipment for tabulating the returns for the Eleventh Census.

ORIGINAL KEY PUNCH

This machine had a perforated board, bearing letter or figure characters beside each hole, which corresponded with the same information appearing on the Tabulating Card. Over this key board swung an index finger whose movement, after the manner of a pantograph, was repeated in the rear. In the open space underneath the arm in which a card was inserted, was a split holder or receptacle resting over the bed of the Punch. When the index finger was pressed down in any of the holes in the front of the Punch, the corresponding hole was punched in the card.

FIRST POPULATION TABULATOR

After the cards were punched, they were tallied or counted on a Tabulator which was the forerunner of our present varied line of Accounting Machines. The cards fed into this machine by hand were placed on a hard rubber bed plate which was provided with suitable stops or guides in order to assure the cards taking their proper positions. The bed plates were formed with a series of holes or cups corresponding in size and number to all the holes which could be punched in a card. The need of providing a bed plate with the same number of holes as the number that could be punched in a card is naturally apparent as the location of the holes in a card would vary for each subject punched; therefore, in placing a punched card on the bed plate, there would always be corresponding holes underneath the card.

Each hole in the bed plate was, in reality, in the nature of a cup partially filled with mercury which, as is generally known, is a good electrical conductor. These mercury cups were all connected by individual wires with the adding mechanism of the Tabulator. Above the bed plate was a frame provided with a number of projecting spring-actuated contact points, each contact point conforming in position with the center of the corresponding mercury cup. When a card was placed face up on the bed plate, the handle was brought down by hand and these contact points or pins went through the punched holes into the mercury filled cups and formed circuits corresponding to the digit or location of the hole punched in each column on a card. Where no holes were punched, the pins were merely pressed upward and upon the release of the handle, due to the spring actuation, they went back to their normal position.

The circuits, which were formed wherever the cards were punched, as previously described, actuated electro-magnets which operated counters. To tabulate any of the facts recorded on cards, it was only necessary to connect binding posts for specific counters with the corresponding mercury cup connections, place the cards singly on the plate underneath the pin box, pull down the handle on the right hand side of the machine and the results for each card were added to the preceding ones, the accumulated total for all the cards showing directly on the counter connected. The number of facts thus recorded at any one operation was only limited by the number of counters used.

The original Tabulating Machine used by the Census Bureau, was supplied with a series of dial counters adding "one" for each card passing through the machine. Each counter on this machine was connected with an individual mercury cup for a specific class of information, in accordance with the location of the hole in the card.

Each Census Card was complete in itself. Amounts or sums were not added on this machine but a great number of individual classes of information was automatically separated into groups, dependent upon the location of the holes in the card, and accumulated on the various counters.

The speed of this machine was entirely dependent upon the operator and the rapidity with which cards were placed on the bed plate and the handle pulled down. An average speed of approximately 50 or 60 cards per minute was considered good.

FIRST COMMERCIAL TABULATOR

The use of Tabulating Machines on population statistics presented the need of other mechanical devices for compiling agricultural, manufacturing and similar classes of data which required the adding of quantities or amounts. To accomplish this, a so-called "Integrating Machine" was developed which would accumulate or add digits ranging from 1 to 9 in each column, the accumulating being determined by the location of the hole in the card. This machine in so far as the placing of the cards on the bed plate, the pulling down of the handle, the removing of the Tabulating Card and the placing thereon of a new card were concerned, followed the same method outlined for the Population Tabulator. Its operation was, likewise, electrical but it was considerably different in appearance.

As a result of the latter type of Tabulator, Punched Hole Accounting was adopted in railroad, insurance and commercial circles and has since developed into virtually all lines of commercial and industrial activity including Federal, State and Municipal Governments. Manufacturing and distributing concerns of national and international prominence use the art of Punched Hole Accounting for compiling the cost of goods manufactured, for distributing their sales and for determining profits by territories, classes of goods, salesmen, agencies, etc.

In general, the principle of Punched Hole Accounting is represented in practically every industry and Tabulating Machines are used wherever figure-facts are called upon to assist in directing the operations of a business.

The foregoing is a brief but accurate resume of the early development of Punched Hole Accounting.

SPECIMENS OF BASIC TABULATING CARDS

The mechanisms presented were those originally devised for use in the practice of Punched Hole Accounting, but the unit which has made the operation of these machines both practical and successful is the commercial Tabulating Card which was originally designed for 27 columns on the short cards and 37 columns on the long cards, and later, in order to increase the capacity of the card, the short card was increased to 34 columns and the long card to 45 columns. These latter cards are still used, the one containing 45 columns being of greater value on account of its almost unlimited capacity to meet all requirements. While the number of columns on the cards was changed to increase the recording capacity, the size of the cards, however, remained the same.

Please notice that these cards, are still used in the same sizes as originally adopted, indicating how well and on what a solid foundation of reason Doctor Hollerith's work was based, as after years of practical experience, we are still using the same size cards that were used in the early days with the hand machines when there were no precedents to follow and practice was built step by step, in establishing the principle of Punched Hole Accounting.