

**REPORT TO
THE COMMITTEE ON POST OFFICE AND CIVIL SERVICE
HOUSE OF REPRESENTATIVES**

**REVIEW OF
AUTOMATIC DATA-PROCESSING INSTALLATION
GEOLOGICAL SURVEY
DEPARTMENT OF THE INTERIOR
OCTOBER 1959**



**BY
THE COMPTROLLER GENERAL OF THE UNITED STATES
DECEMBER 1959**



COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON 25

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Honorable Tom Murray, Chairman
Committee on Post Office and Civil Service
House of Representatives

Dear Mr. Chairman:

Herewith is our report on the review of the automatic data-processing installation of the Geological Survey, Department of the Interior. The review was made pursuant to your request of March 13, 1959, and was completed in October 1959.

In December 1956 the Geological Survey leased a medium-sized computer system, Datatron 205, at an annual rental of about \$123,300. The Datatron 205 system has increased the Survey's annual operating costs by about \$156,700. The Survey recently installed a larger computer system, the Datatron 220, which will probably go into operation in December 1959 and will further increase the annual operating costs by about \$127,500.

We found that the feasibility study preceding the Survey's decision to lease the Datatron 205 was adequate. We found also that the Survey has not received any direct dollar savings from the use of automatic data-processing equipment. The Survey derives benefit from the automatic data-processing equipment primarily because it computes scientific data which previously could not be done in a practicable manner because of the extended length of time required and it processes administrative and certain technical data more accurately and faster.

We shall be pleased to be of further service to your Committee.

Sincerely yours,

Comptroller General
of the United States

Enclosure

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REPORT ON REVIEW
OF
AUTOMATIC DATA-PROCESSING INSTALLATION
GEOLOGICAL SURVEY
DEPARTMENT OF THE INTERIOR
OCTOBER 1959

The General Accounting Office has completed a review of the automatic data-processing (ADP) installation of the Geological Survey, Department of the Interior. This review was made pursuant to a request in a letter dated March 13, 1959, from the Chairman of the Committee on Post Office and Civil Service, House of Representatives. The scope of our review appears on page 12.

GENERAL COMMENTS

The Geological Survey was created in the Department of the Interior by the act of March 3, 1879 (43 U.S.C. 31). The Survey is organized into five divisions: four technical operating divisions and one administrative division. The technical operating divisions are:

The Geologic Division which conducts research into the Nation's mineral resources.

The Topographic Division which prepares maps showing the surface features of the United States.

The Conservation Division which supervises private development of mineral leases on Federal and Indian lands.

The Water Resources Division which studies the Nation's water resources.

In December 1956, the Survey leased a Datatron 205, a medium-sized computer system, made by the ElectroData Division of

During our review we noted deficiencies relating to (1) inadequate controls over annual and sick leave earned and used, (2) inadequate controls over hourly pay rates, and (3) inadequate reporting of electrical accounting machine (EAM) equipment usage. We brought these matters to the attention of the Director, Geological Survey, for corrective action in a letter dated December 8, 1959.

Burroughs Corporation, at an annual rental of about \$123,300. The computer is used for scientific and technical applications and for processing administrative data. The computer is utilized about 75 percent of its actual operating time for scientific work and the remainder of its time for payroll, personnel, and leave accounting and certain cost distributions. The computer is operated more than two shifts a day.

Because of the heavy workload, the Survey is in the process of replacing the Datatron 205 system with the larger Datatron 220 system, for which the annual rental cost is approximately \$250,800. The Datatron 220 is faster and has greater storage capacity. It has been installed and is now being tested; the Survey estimates that it will be put into operation in December 1959.

In our opinion, the feasibility study conducted by Geological Survey for the Datatron 205 was adequate. For additional details see pages 4 to 7.

The Survey has not received any direct dollar savings from the use of ADP equipment. We found that for fiscal year 1959 the Survey's operating costs were about \$156,700 higher because of the Datatron 205 operation; the Datatron 220 will further increase the Survey's annual operating costs by about \$127,500. However, scientific projects not otherwise feasible are now being worked on regularly. Generally, the benefits the Survey gained from ADP consist of computing scientific data, which could not otherwise be done in a practicable manner because of the extended length of time required, and processing administrative and certain scientific data more accurately and faster. This matter is discussed in more detail on pages 10 and 11.

divisions. The members had varying backgrounds and authority, and most of them attended programing courses offered by equipment manufacturers. The ad hoc committee met 34 times during the period November 1954 to February 1956.

WORK PLANS CAREFULLY CONSIDERED

The operating divisions' workload plans which were believed to be practicable for performance on ADP equipment were outlined by the ad hoc committee. These plans included work which the committee believed would be impracticable to do manually or with conventional EAM equipment, either because of the voluminous data to be processed or because of the complex computations required. For example, the Water Resources Division desired a computer able to do high-speed processing in order to prepare voluminous stream flow data and the Geologic Division desired a computer with a capability to solve complex mathematical problems for the division's crystal structure program.

CONSIDERATION GIVEN TO COSTS, PERSONNEL, AND NECESSARY SYSTEMS ANALYSIS WORK

The ad hoc committee also considered the necessary staffing structure and anticipated cost of the proposed ADP system.

The committee's staffing plan shows that seven persons formerly needed to operate and program applications on conventional EAM equipment would not be needed for ADP. The new system would require 10 less machine unit operators but 3 more programers. This staffing change was expected to reduce annual personnel costs by about \$17,400; however, the committee did not anticipate an over-all dollar savings.

FEASIBILITY STUDY FOR THE DATATRON 205

The study and planning preceding the decision to install the Datatron 205 were adequate in that:

1. A committee which conducted the feasibility study was formed from technical and administrative employees representing all of the Survey's five divisions and accordingly was well qualified to consider the over-all needs of the Survey.
2. The work plans and problems of each division were carefully considered early in the study.
3. The committee considered the costs which would be incurred if ADP equipment were installed, the personnel training that would be necessary, and the length of time needed to complete necessary systems analyses, programing, and testing of proposed applications.
4. The Survey selected its equipment only after considering the technical specifications and nontechnical characteristics of 10 different computers.
5. The committee gave careful consideration to the place the computer was to occupy within the organizational structure of the Geological Survey.

At the conclusion of its study, the committee submitted a formal report to the Director, Geological Survey, who requested from the Department approval to rent the Datatron 205.

FORMATION OF COMMITTEE TO STUDY NEED FOR AND FEASIBILITY OF AUTOMATIC DATA-PROCESSING EQUIPMENT

Early in 1954, a geophysicist and a member of the Survey's General Staff Committee made a preliminary study of the Survey's need for ADP equipment. In May 1954 they concluded that a potential need existed and recommended to the Chairman of the General Staff Committee that a feasibility study be made.

Based on this recommendation, an ad hoc committee was established in November 1954 to make the feasibility study. The ad hoc committee was made up of individuals from each of the Survey's

instead of sending detailed specifications and proposed applications to the equipment manufacturers.

In December 1955, the committee recommended rental of the Datatron 205 because, in its opinion, this machine was more versatile, more efficient, and easier to operate than the IBM 650. Also, the Datatron 205 would accept punched paper tape as input data while the IBM 650 did not have this feature. The paper tape input device was particularly important because equipment at the water-gauging stations in the field produces punched paper tape containing stream flow data. Since the paper tape can be used as input media by the Datatron 205, the need for punching cards was eliminated. Other reasons for the committee's choice were that the delivery date of auxiliary equipment was about a year later for the IBM 650 than for the Datatron 205 and the rental charges were higher for the IBM 650 than for the Datatron 205.

POSITION OF AUTOMATIC DATA-PROCESSING BRANCH
WITHIN THE SURVEY

Formerly, the Survey's conventional tabulating equipment had been under the supervision of the Budget and Finance Branch in the Administrative Division because most of the tabulating was for administrative applications--usually accounting. For ADP, however, the committee pointed out that work would be coming from the technical operating divisions and recommended that the ADP and conventional tabulating equipment be separated from the Branch of Budget and Finance and be operated by a separate branch in the Administrative Division. The committee recommended also that the operating and programing functions be done by two separate groups within the branch. These recommendations were adopted by the Survey.

The following schedule shows the committee's estimate of the anticipated changes in personnel and equipment costs.

	<u>After ADP</u>	<u>Before ADP</u>	<u>Increase or decrease (-)</u>
Annual equipment rental	\$130,200	\$ 71,600	\$ 58,600
Annual personnel costs	<u>151,100</u>	<u>168,500</u>	<u>-17,400</u>
Total	<u>\$281,300</u>	<u>\$240,100</u>	<u>\$ 41,200</u>

Certain necessary systems analysis work, involving payroll and personnel accounting, was also done before the equipment was ordered.

EQUIPMENT SELECTION

During the feasibility study, the committee considered 10 computers made by 9 different manufacturers, as shown in appendix A.

The ad hoc committee adopted several basic computer characteristics considered necessary to meet the Survey's anticipated requirements. These characteristics had to do with matters such as drum capacity, previous customer experience, and prompt delivery.

Eight of the ten computers considered were eliminated because they did not meet one or more of the basic characteristics. Three of the eight were not available under acceptable lease agreements; three others lacked either storage capacity or speed, or both; the other two had no previous customer experience and no models were available for testing. This process left two computers for more detailed testing--the IBM 650 and the Datatron 205.

To determine which of the two computer systems was more suitable for the Survey, the committee picked certain applications for testing and actually programed and ran the applications on equipment furnished by the manufacturers. This technique was used

ECONOMIC IMPACT OF AUTOMATIC DATA-PROCESSING EQUIPMENT
AND BENEFITS GAINED

The Survey's equipment rental and personnel costs have increased substantially as a result of the use of ADP equipment, and equipment rental will further increase when the newly installed Datatron 220 goes into operation. The increases in equipment rental and personnel costs as at June 30, 1959, are summarized as follows:

	<u>After ADP</u> <u>(June 1959)</u>	<u>Before ADP</u> <u>(Dec. 1955)</u>	<u>Increase</u>
Annual equipment rental	\$189,324	\$ 68,016 ^a	\$121,308
Annual personnel costs	<u>296,430</u>	<u>260,955^b</u>	<u>35,475</u>
Total	<u>\$485,754</u>	<u>\$328,971</u>	<u>\$156,783</u>

^aPriced at rental rates effective on June 30, 1959.

^bSalaries adjusted to fiscal year 1959 salary rates.

The annual increase in personnel costs is made up of an increase in the personnel cost of the Branch of Computation less a decrease in the personnel cost of the Payroll Unit. These are the only two organizational units whose staffing was significantly affected. Details of changes in equipment rental costs are shown in appendix B. Details of changes in personnel costs are shown in appendix C.

The annual equipment rental will further increase about \$127,500 when the new Datatron 220 goes into operation. However, the Survey does not anticipate any significant changes in personnel cost due to the Datatron 220. The equipment has been installed but is still being tested. Rental of the new equipment

condition caused a backlog of work which should be on a production basis. The Survey also desired to extend the scope of certain existing scientific applications and to program some new applications. The lack of computer time, however, prevented the Survey from putting more work on the Datatron 205. The Water Resources Division, for example, found it necessary during fiscal year 1959 to contract for about 200 hours of time on the Datatron 205 of a private concern.

During the study of the Datatron 220, the Survey considered also the IBM 7070 but rejected it because (1) the equipment was not readily available for installation, (2) the rental was higher, and (3) the IBM 7070 does not accept punched paper tape. As mentioned previously in this report, the use of equipment permitting paper tape input data is particularly important because stream flow gauging equipment used by the Survey provides the requisite information on punched paper tape.

JUSTIFICATION FOR THE DATATRON 220

Before the Geological Survey requested permission from the Department of the Interior to acquire the Datatron 220, it made another study. Certain questions which faced the Survey before choosing the Datatron 205 system did not exist when the Datatron 220 system was considered. For example, the broad question of whether ADP was practicable for the Survey had already been answered, and accordingly did not require further study.

This second study was not as extensive, nor did the supporting documents give detailed descriptions of the work planned, as was done for the Datatron 205. Although the need for an extensive and formally documented study may not have been as great, we believe that the support for the new applications proposed for the Datatron 220 should have been more completely documented. Our review showed, for example, that the computer hours required and the related cost for new applications planned for the Datatron 220 were not documented. Also, in the comparison of unit costs incurred for existing applications on the Datatron 205 with estimated costs on the Datatron 220, the Survey used special reduced rental amounts for the Datatron 220 which were to be paid only for the first year's operation.

Primarily, the Survey desired a faster computer with a greater storage capacity. In a letter dated October 29, 1958, to the Administrative Assistant Secretary of the Interior, the Director, Geological Survey, justified the Datatron 220 system on the basis that the Survey's workload then exceeded the available capacity and speed of the Datatron 205. The Director said that this

will start as soon as the testing has been completed, which the Survey estimates will be sometime in December 1959.

The primary benefits gained from the Survey's use of ADP equipment are in the scientific and technical areas. One scientific application uses the computer to solve mathematical problems arising from the Survey's research on crystal structure analyses conducted experimentally to determine the arrangement of atoms in crystals. Prior to ADP, the Survey considered most of this work impracticable to do on EAM or by manual methods because of the extended length of time required. Officials in the Geologic Division told us that the crystal structure data produced has aided in prospecting for uranium. One of the Survey's geophysicists said that crystal structure analysis of boron is contributing to the research on fuels for military uses. Survey officials told us also that considerable research work is being done through the use of ADP in the interpretation of surface measurements from maps; this work aids in locating ores.

The Water Resources Division is utilizing the computer to perform statistical compilations on stream flow data which we were told are used in irrigation and flood control work and in power plant, bridge, and highway construction.

Because of its highly specialized nature, we did not independently evaluate the need for the scientific and technical data produced. However, we did determine that the scientific and technical areas in which the Survey uses ADP are those authorized by the Survey's organic act as outlined briefly on page 1 of this report.

APPENDIXES

SCOPE OF REVIEW

Pursuant to the request of the House Committee on Post Office and Civil Service, our examination of Geological Survey's automatic data-processing installation included a review of (1) the study and planning that preceded the Survey's adoption of the Datatron 205 and the Datatron 220, (2) the impact that ADP had on the Survey's operating cost, (3) the benefits the Survey derived from the ADP installation, and (4) the Survey's utilization of ADP and EAM equipment.

We did not independently evaluate the need for the technical and scientific data processed by the ADP equipment or the manner in which it is programed for ADP processing. Also, we did not make a detailed review of the payroll operations conducted on the ADP equipment; but we did review the controls established within the system to determine the adequacy and effectiveness of the payroll system and its internal checks.

COMPARISON OF EQUIPMENT RENTAL COSTS
BEFORE AND AFTER INSTALLATION
OF AUTOMATIC DATA-PROCESSING EQUIPMENT

Description of equipment	Type or model	On hand after ADP (June 30, 1959)		On hand before ADP (Decem- ber 31, 1955)	
		Units	Annual rental	Units	Annual rental (note a)
Automatic data processing:					
Datatron computer	205	1	\$ 46,800		
Typewriter control	446	1	1,644		
Flexowriter, modified	458	1	1,140		
Tape control unit	543	1	9,000		
Magnetic tape unit	544	4	18,000		
Tape perforator and verifier	122	1	1,596		
Cardatron	506	1	9,240		
Input station	507	1	6,720		
Output station	509	3	24,840		
Console	409	1	4,344		
Tabulator	407	1	9,780		
Collator	089	1	2,340		
Punch, summary	523	2	2,712		
Total, automatic data processing		<u>19</u>	<u>138,156</u>		
Electrical accounting machine:					
Punch	024	7	3,360	6	\$ 2,880
Verifier	056	3	1,800	4	2,400
Interpreter	552	1	1,140	1	1,140
Typewriter punch	826	-	-	2	2,760
Sorter	082	-	-	5	3,300
Reproducer	514	2	3,648	4	7,296
Collator	077	2	2,400	4	6,000
Tabulator	407	3	29,340	4	38,400
Calculator	602A	-	-	1	3,840
Sorter	083	3	4,128	-	-
Reproducer	528	1	3,012	-	-
Collator	089	1	2,340	-	-
Total, electrical accounting machine		<u>23</u>	<u>51,168</u>	<u>31</u>	<u>68,016</u>
Total		<u>42</u>	<u>\$189,324</u>	<u>31</u>	<u>\$68,016</u>

^a Priced at rental rates effective on June 30, 1959.

AUTOMATIC DATA-PROCESSING EQUIPMENT
CONSIDERED DURING FEASIBILITY STUDY

<u>Type of computer</u>	<u>Manufacturer</u>	<u>Principal reasons for rejecting equipment</u>
Datatron 205	ElectroData Division of Burroughs Corporation	Not rejected.
IBM 650	International Business Ma- chines Corporation	No provision for perforated tape.
ALWAC III	Logistics Research, Incor- porated	Magnetic tape not available and no provision for an on-line printer.
Elecom 125 and File Processor	Underwood Corporation	No performance experience and not available for program testing.
Monrobot VI	Monroe Calculating Machine Company, Incorporated	Leasing agreement and delivery date not acceptable.
National 102D and National 103	National Cash Register Company	Limited drum capacity of 1,024 words.
Burroughs E 101	Burroughs Corporation	Limited memory capacity of 100 words and no provision for punched cards as input media.
Circle	Hogan Laboratories, Incor- porated	Not available on a rent-lease basis.
Bendix G 15A	Bendix Computer Division of Bendix Aviation Cor- poration	Not available on a rent-lease basis.
Univac File	Remington Rand Division of Sperry Rand Corporation	Not assembled for testing and no previous customer experience.

CHANGES IN PERSONNEL DUE TO INSTALLATION
OF AUTOMATIC DATA-PROCESSING EQUIPMENT

		<u>After ADP</u> <u>(June 1959)</u>		<u>Before ADP</u> <u>(December 1955)</u>	
	<u>Grade</u>	<u>Number</u> <u>of em-</u> <u>ployees</u>	<u>Annual</u> <u>salary</u> <u>(note b)</u>	<u>Number</u> <u>of em-</u> <u>ployees</u>	<u>Annual</u> <u>salary</u> <u>(notes a</u> <u>and b)</u>
Computation Branch	GS-14	1	\$ 11,835	-	\$ -
	GS-13	2	20,740	-	-
	GS-12	2	17,620	1	8,810
	GS-11	4	30,040	-	-
	GS-9	4	25,740	3	19,305
	GS-7	4	21,720	2	10,860
	GS-5	9	40,410	10	44,900
	GS-4	12	48,480	7	28,280
	GS-3	1	3,780	14	52,920
	Wage board employees	<u>2</u>	<u>7,640</u>	<u>-</u>	<u>-</u>
Total, Computa- tion Branch		<u>41</u>	<u>228,005</u>	<u>37</u>	<u>165,075</u>
Payroll Unit	GS-9	1	6,435	-	-
	GS-7	-	-	1	5,430
	GS-6	2	9,880	-	-
	GS-5	8	35,920	4	17,960
	GS-4	<u>1</u>	<u>4,040</u>	<u>14</u>	<u>56,560</u>
Total, Payroll Unit		<u>12</u>	<u>56,275</u>	<u>19</u>	<u>79,950</u>
Total before adjustment			284,280		245,025
Less grade increases not due to instal- lation of ADP equipment			<u>5,940</u>		<u>-</u>
			278,340		245,025
Plus 6-1/2 percent retirement con- tributions			<u>18,090</u>		<u>15,930</u>
Total		<u>53</u>	<u>\$296,430</u>	<u>56</u>	<u>\$260,955</u>

^aSalaries adjusted to fiscal year 1959 salary rates.

^bIngrade step "c" was used for GS-11 through GS-14 salaries, and ingrade step "d" was used for GS-3 through GS-9 salaries.