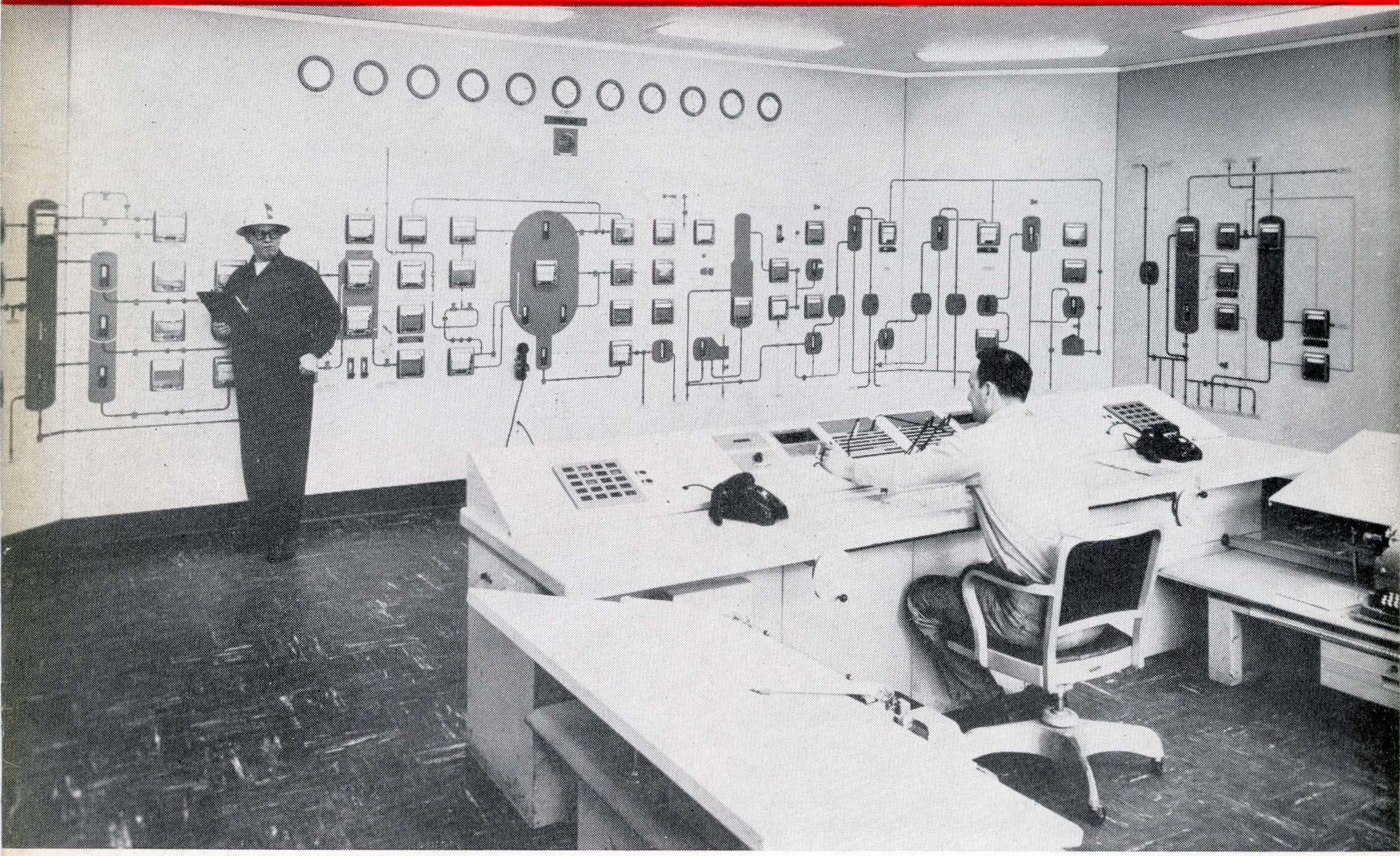
COMPUTERS
and AUTOMATION

DATA PROCESSING • CYBERNETICS • ROBOTS



NOVEMBER
1957
Vol. 6 - No. 11

Satellites and Computers - and Psychology

OIL AND NATURAL GAS INDUSTRY: Market for Computers; Magnitude of the Industry, Some Uses of Computers.

Readers' and Editors' Forum

MASTER CONTROL ROOM AT A NEW OIL REFINERY

In the picture on the front cover of this issue, one man sitting at a "twenty-first century" desk controls the entire operation of the new Delaware Refinery of Tidewater Oil Company, the largest plant for distilling crude oil in the world. On the wall in front of him, another man can read exactly what is happening in any part of the equipment of the plant.

More information about this new giant refinery is reported beginning on page 21, "The Refinery of the Year". But this picture is a good introduction for this issue of "Computers and Automation", which concentrates on the oil and natural gas industry, and the applications of computers to that field.

THE OIL AND NATURAL GAS INDUSTRY

When we began preparing this issue, with its focus on computers in the oil and natural gas industry, we did not quite realize how much we would find to report. The table of contents shows what we could put into this issue, but there is an overflow. What is left over we hope to put into the December issue, particularly, "Oil Industry Comments on Computers".

THE SATELLITE SPUTNIK

During the final stages of assembling the November issue, the Earth acquired a new satellite, courtesy of some Russian scientists, productive capacity, and computing mechanisms. Your editor found a good deal to be said on the subject—so much in fact that the comments entirely outgrew an editor's note, and became an article (see page 6).

But please consider the subject and everything said in the article as much open for discussion, argument, and controversy as if published as a part of Readers' and Editors' Forum.

CORRECTION

In the June issue (The Computer Directory), on page 15, in the entry for Burroughs Corp., in the phrase "now owns . . . and Adalia Ltd." replace "Adalia Ltd." by "Data Processing Associates Ltd." Both Adalia companies (see page 10) are independently owned. We regret this unfortunate error.

CONTROVERSY

In connection with controversy, we would like to quote from "The Editor's Notes" published in "Computers and Automation", April, 1954:

"We believe in the value of controversy, in the field of computers and automation as well as in all other fields. A controversial subject is an interesting subject, an important one to argue about and seek the truth about, through discussion, investigation, and the clash of different views. . . . .

"In the pages of this magazine we shall do our best to promote controversy, honorable controversy which truthfully and honestly explores ideas, and which tries to make sure that each side of a question is expressed fairly — without calling names, attacking reputations, or hugging orthodoxy."

COMMENTS ON "COMPUTERS AND AUTOMATION"

Raymond Toledo
Santiago, Chile

1—Please receive from these distant latitudes my sincere congratulations for the "new look", in nice letterpress, of COMPUTERS AND AUTOMATION. This improved presentation will match favourably with the interesting variety of the articles and reference information appearing in each issue.

2—Your decision to continue using the name COMPUTERS AND AUTOMATION seems to me correct, for the reason indicated in your editorial note of July, 1957. Besides, this name has the advantage of being shorter than COMPUTERS AND DATA PROCESSING. The idea of data processing appears in your subtitle "Data Processing, Cybernetics, Robots."

3—I find your section "New Patents", prepared by Mr. Raymond R. Skolnick, most useful for keeping duly informed about research and development in this rapidly growing new field of technology. Now, in order to ease the search of the patents, of this section, regarding a determined subject matter, I take the liberty to suggest that the title of each patent could be made more visible (and hence easier to locate with a glance) by printing it in bold type or in capital letters for instance.

4—It seems that the location of determined articles would be rendered easier if, on the front page, the article titles were accompanied by the corresponding page numbers. Perhaps readers would also be helped in their search by indicating too, on the front page, the reference information titles and corresponding page numbers, similarly to what happens in many other interesting technical publications. This would speed the finding of the "address" (i.e. page number) of useful material in back issues of COMPUTER AND AUTOMATION.

COMPUTERS
and AUTOMATION

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SATELLITES *and* COMPUTERS—*and* PSYCHOLOGY

Edmund C. Berkeley

Sputnik

On FRIDAY, October 4, scientists of the Union of Soviet Socialist Republics opened a new era in the history of the world. Close to midnight, from a rocket launcher north of the Caspian Sea, they fired a three-stage rocket which ejected an instrumented globe named Sputnik into space above the earth's atmosphere. It weighed 184 pounds, was 23 inches in diameter, and had four extendible radio transmitting antennas, through which signals have been coming continually.

Together with the nose cone, possibly, and the last stage of the rocket, certainly, Sputnik has been cruising around the earth at five miles a second in an orbit ranging from about 180 miles to about 580 miles above the earth's surface. It circumnavigates the globe in about 96.1 to 96.3 minutes at present writing. In the first week, it traveled farther than a dozen times the distance to the earth's first and regular Moon. The name Sputnik comes from Russian "put" meaning "a road", "putnik" meaning "a traveler", and "sputnik", one who tags along with him, "a fellow-traveler". The Soviet radio announcer has been calling Sputnik's arrival over global points as if he were a conductor announcing a local train, "Vancouver, Canada, 9:50 a.m.; Frederickshaap, Greenland, 10:00 a.m.; Casablanca, Morocco, 10:11 a.m. . . ." At 3000 miles per 10 minutes, this schedule is reasonable.

One can estimate, perhaps even compute, the effect of this data-processing output on the psychology of people everywhere.

This of course is a magnificent, epoch-making achievement. The Soviet people and all human beings everywhere can take great pride in it. Certainly it is on a par with the Italian sailor Columbus' discovery of America.

When the Russian leader Krushchev was asked why there had been no announcement beforehand, he engagingly said that they preferred to do it first and talk about it afterwards, so that people would not think they were bragging. (Item 2 under the head of psychology.)

Many important conclusions can be drawn from this event, just as they can be drawn from similar events marking turning points in history.

Rocket Energy

The rocket energy at the command of the Russians when they launched the satellite must have been enormous. Not only was the satellite launched into an orbit around the earth, but also the nose cone and the third stage rocket. Sputnik is too small to be seen with the naked eye (at least most naked eyes). It is an object two feet across which at its closest is some 180 miles away; but it gives plenty of radio signals as it travels around the earth. But the rocket body appears in the sky before dawn or in the evening twilight like something in between a high flying airplane and a shooting star.

I watched it myself October 16 from about 5:58 a.m. to about 6:01 a.m. (near Boston), seeing it appear in the northwest, pass a little west of the zenith, and go off into the south. The light of the predawn sunlight reflected from the rocket body varied strangely from very bright to dim and bright again, as presumably the amount of surface of the rocket facing towards me varied. The figures—200 miles high, 120 degrees of sky, 300 miles a minute, slightly less than three minutes' sighting—are roughly compatible.

Had Needed Resources

The scientists who launched the rocket had enough resources to make very certain that it would be launched in exactly the way they desired. They oriented the whole third stage rocket to the position, direction, and velocity that they desired, and then separated the parts of it. There was evidently no stinting in the supply of all that was needed—and this time for a basically scientific achievement and not a military one. I am reminded of something I was told on a short visit in Russia in 1934, about planning in a socialist society: a man might need a great ship to accomplish something worth while, but he would never need 50 pairs of shoes or a house with 50 rooms.

It seems apparent from various accounts that the rocket energy, productive capacity, and skills at the command of the Russians are almost certainly greater than what is at the command of Americans. In the first place, the space satellite planned to be launched by the United States is only about 10 inches in diameter and is to weigh about 30 pounds. Compare this with the 23-inch diameter Sputnik weighing 184 pounds.

In addition, the Russians have stated that they have successfully tested an intercontinental ballistic missile. At least some American authorities say they believe this statement. The Russians have added that they can place such a missile on any spot on the earth. Almost all of us in the United States have no access to information which enables us to judge whether this statement is likely to be true or not. In comparison, however, the Americans have only partially tested an intermediate range ballistic missile, and there have been a number of tests that failed.

These facts imply however that the Russians have essentially escaped from the confinement of the ring of American bases surrounding the Soviet Union. They imply as well a substantial change in the psychological weight of the Soviet Union in world affairs. As B. M. Jones said in the New York Times on October 13, "In its swift passages the satellite is advertising Russian technical powers in a manner to be envied by Madison Avenue motivationists."

Computing and Data Processing

But the energy, design, and manufacture of objects and vehicles for space travel are not all of the story. Some more of the story is causing them to go where you want them to go, and after you have got them there, keeping track of them and getting information from them. Here is where automatic control, automatic computation, telemetering, and automatic data processing enter the story.

The Boston Globe on October 11 announced, "M.I.T. Scores Notable First in Tracking Soviet Rocket, Fixing its Orbit." The story went on to say "Course Pinpointed for the First Time by Mammoth Electronic Brain—Giant electronic brain in Cambridge fixed for the first time today the orbit of the Soviet satellite's rocket. Using data fed to it in the form of punched tape, the complex machine determined the orbit in just 21 seconds."

It is hard to believe that an American orbit calculation should precede a Russian calculation determining the orbit—when the formulas for computing an orbit are common astronomical knowledge, and the Russians had the advantage of knowing the exact time, place, and direction of launching, and thus knew where to look for the satellite's rocket on its first few trips around the earth—which would clearly establish its orbit. The launching of the Sputnik and the reporting of the locations of the Sputnik by the Russian radio show mastery also of the data processing aspects by the Russians.

Exploration of the Moon

One of the most interesting next stages in this great scientific advance, the conquest of space, is the sending of an unmanned rocket around the moon. Part of it hinges on the putting of a television transmitter in the rocket, with improved solar mirrors to give the necessary power, and improved telemetering, so that what the rocket observes of the moon will be transmitted to human beings on the earth. As I. M. Levitt says, "Now the Space Age Opens", in The New York Times Magazine: "But the principles of these devices are known now; only technical development work remains to make them applicable" to a space vehicle.

To leave the earth's gravity, the speed imparted by the rocket needs to be only seven miles per second, as compared with the five miles per second of the Sputnik. If we judge from the success so far achieved, the stage of sending a space vehicle away from the earth should not be too difficult—but doing it usefully is something else again. For the whole reward from this first undertaking is the information to be gained, the satisfaction of curiosity, the acquisition of knowledge.

The field of information-handling mechanisms for unmanned space vehicles without doubt will become one of the important and fascinating subdivisions of automatic computers and data automation.

The Surprise

Probably the most prominent feeling of nearly everybody including Russians over the second moon of Earth was surprise—surprise over the fact that it was a Russian moon and not an American moon. Especially in the United States we have the psychology of taking it for granted that the technical progress of the United States in all fields excels that of any other country. "Pride goeth before a fall"—this is no longer unqualifiedly true and probably, even, was never previously true.

Why has a Russian moon happened?

There are several reasons of great importance, which do not require the elaborate reasoning of automatic computers and data processing to demonstrate them.

First, the Soviet Union has been putting forth a massive effort in good, sound education, especially education in science and technical fields. It is currently graduating something like twice as many scientists and technicians as the United States. And there is good evidence that they are educated much better.

Computers and Automation printed in its July 1956 issue, and its January 1957 issue, and will now print again, a comparison:

	Soviet Union	United States
Average number of students in class per teacher	19 or 20 and decreasing	34 or 35 and increasing

Second, the Soviet Union has about 50 percent more people than the United States; and if you have more people, and they are better educated, it stands to reason that the quantity of mental power to be devoted to solving problems and advancing science is greater and is likely to accomplish more.

Third, the standard of living of the great majority of people in the Soviet Union is considerably lower than the standard of living in the United States. Consequently more of the national income, the product of the work of the whole society, is available for what the government considers important—and the Soviet government does consider the advancement of science extremely important.

Fourth, professors, scientists, and intellectually able people are highly regarded in the Soviet Union as they are in most of Europe. In the Soviet Union they are well rewarded for good work, with a very high standard of living. They are not ridiculed in a stereotyped way as highbrows, eggheads, queers, and eccentrics. It is not considered that their careers should be secondary to those of good mixers, star football players, and organization men.

It is no doubt true that they may be looked on with suspicion and investigated as likely to be subversive, in the Soviet Union as well as in the United States. Exceedingly few Soviet scientists are permitted to travel outside of the Soviet Union into the Western world; we are sure that they have less freedom than Western scientists. But this fact does not seem to affect very much the quality and quantity of scientific work being done.

In addition, there is undoubtedly a tremendous moral fiber in the peoples of the Soviet Union. They suffered over 6 million deaths in World War II. They liquidated over 70 percent of the divisions of the Nazi armies under Hitler. Theirs were the armies that captured Berlin. And certainly the peoples of the Soviet Union believe that they are in danger from the United States. This moral fiber is certainly being tapped by the Russian government to develop "a position of strength," to "overtake and surpass the most advanced capitalist countries."

And finally, the secrets of nature are never secrets that can be betrayed. They are necessarily open to any imaginative, well-trained, hard-working scientific investigators who are well organized and well financed. Thinking people know this; but people suffering from mass fears and delusions of grandeur refuse to believe this—and always argue that so-and-so "stole" the knowledge from them.

The achievements of the Soviet scientists "cannot be the result of some kind of lucky guess in inventing a gadget" said columnist Walter Lippmann on October 11. "It must be that there is a large body of Soviet scientists, engineers, and production men, plus many highly developed subsidiary industries, all successfully directed and coordinated, and bountifully financed."

The Remedy

The readers of **Computers and Automation** all over the world are computer people, scientists in the field of computing and data processing, **information engineers.** We are responsible for looking at all the sciences and branches of knowledge that deal preeminently with information and technique. We need to have the widest possible vision and readiness to recognize and absorb information and ideas, and prepare to handle such data reasonably, with human minds or with machines. Some of the time it seems as if we concentrate on machines; but certainly what can be mechanized is only a part of the responsibility of an **information engineer.**

Those readers who, like your editor, live in the United States need to consider what are the reasonable things we can do to help the United States catch up and surpass the Russians, in this eminently exciting field, the exploration of space, and the information science aspects of it.

The first part of the remedy is not pride but humility. We need to go back to school; we need to learn things about other countries that we did not know—or that we did not want to think—or, if we knew, did not let ourselves believe. What are the important features of life and education and science and information-handling in Switzerland, and Western Germany, and Scandinavia, and the Soviet Union, and India, and other countries? What are the practices they have in these countries which might be of interest and of use to us? Can we try to see ourselves in the perspective of the space age?

The second part of the remedy is determined application of known and obvious knowledge in a modern, coordinated way in this country. Vannevar Bush, head of the United States' huge research program including 30,000 scientists in World War II, said on October 15 that the only way to "catch up with the Russians" in missiles is to "unify our military planning." "Without it", he said, "all else is futile, and without it you cannot have unified research."

In my opinion Dr. Bush is only partly right—because we need even more badly "unified national planning." This is required in order to double the output of scientists and engineers in this country, to train them a great deal better than we do, to accustom the people of the United States to have fewer delusions of grandeur and less a feeling of automatic superiority over other countries of the world, and to become people of a virtue more qualified to live in a space age.

How Much Time?

How much time do we have?

Those of our readers who have read the fine novel "On the Beach" by Nevil Shute, a novel of the aftermath of a war in which some 4000 hydrogen and cobalt bombs were dropped, may wonder how much time we have—time to remake people and psychology in a human world so that it will become safe for the expansion of the computer art, the exploration by human beings of outer space, and all the other exciting prospects of a world from which war has been eliminated.

The novel opens with all people in the Northern hemisphere dead from radiation sickness. The winds are gradually spreading it to the last people in Australia, who have an estimated six months more of life. The plot centers on the reactions of half a dozen convincing and likable characters to this problem, which is expressed by one of them, a scientist: "You've got six months more. Plus or minus something. You've always known that you were going to die sometime. Well, now you know when. That's all. Just make the most of what you've got left."

Another cogent remark from the book: "Some kinds of silliness you just can't stop. I mean if a couple of hundred million people all decide that their national honor requires them to drop cobalt bombs upon their neighbors, well, there's not much that you or I can do about it. The only possible hope would have been to educate them out of their silliness. . . . You could have done something with newspapers. We didn't do it. No nation did, because we were all too silly. We liked our newspapers with pictures of beach girls . . . and no government was wise enough to stop us having them that way. But something might have been done with newspapers, if we'd been wise enough."

There is hardly any doubt that peaceful coexistence on our shrunken planet, with its new moon going around it in 96 minutes, is the only real alternative to any existence whatever for human beings. How much time do we have to achieve it?

The most encouraging of recent events, it seems to me, was the handling by the United Nations of the attack by Britain, France, and Israel on Egypt in connection with the Suez Canal problem. I think this has gone a long way to show a fairly good probability that we have time enough to be able to settle some of the important problems of social psychology—the real psychology of real peoples—so that human beings can obtain peaceful coexistence. Just as the feudal ages came to an end with the use of gunpowder, which destroyed the impregnability of the great feudal castle,

(Please turn to page 14)

THE MARKET FOR COMPUTERS IN THE OIL AND NATURAL GAS INDUSTRY (REPORT NO. 3)

Ed Burnett
New York, N. Y.

THIS report, "The Market for Computers in the Oil and Natural Gas Industry", is the third one in a continuing series of reports being published by "Computers and Automation" dealing with the market for automatic computers, data processing equipment, and other computer field products. In the May issue we published "The Computer Market Survey—Report No. 1", in which the entire U. S. A. market for computers and computer products over the next five years was estimated to total between $4 and $7½ billion dollars. In the September issue, we published "The Market for Computers in Banking: Report No. 2", showing an estimated market over the next five years in banking alone of one third of a billion dollars.

The oil and natural gas industry is an immense one. It is so large in fact that we have split out and put elsewhere in this issue the description and summary of the industry: see the report "Oil and Natural Gas: the Magnitude of the Industry".

SIZE OF OIL INDUSTRY MARKET

Putting together information from the answers to the computer market survey questionnaires we received in April and information from other sources, we can construct a "Tentative Estimate of the Market" for computers and other computer products in the oil and natural gas industry. This estimate is somewhat over half a billion dollars; the details appear in Table 1.

The survey indicates that the oil industry will rent (in most cases probably *not* buy) digital computers and data processors over the next five years valued (at sale price) at about $525 million. In the largest 40 companies there is some evidence that computer products worth $500,000 will be rented for each 1000 persons employed. The evidence for expenditures per 1000 employees in smaller companies is mixed—but is likely to be less. No sales are projected to over 80 percent of the companies in this field which employ less than 50 employees.

At the present time (see Table 2), the value of large and medium digital computer installations now in use is approximately $75,000,000, with some $45,000,000 worth of computers definitely on order. IBM alone in the last 12 months has seen approximatly $50,000,000 of its product go into operation in oil companies—or about one-sixth of its present annual value of production in computers.

The information in Table 1 and 2 indicates that the average annual value of equipment installed is about $110,000,000—of which some $80,000,000 per year will probably be in Large and Medium Computers. This is approximately double the average annual rate of the last two years. While this is a considerable increase, it should be noted it is not as rapid an increase as predicted by "Computers and Automation" in its first market report (May, 1957) for the market as a whole. The overall market prediction anticipated that the total value of computer product in 1960 will be about three times as great as it was in 1956. At $525,000,000 the oil field will represent something less than 10 percent of a total market which may reach $7½ billion.

The top 40 oil companies, which dominate the industry, account for virtually every rental to date (no sales of medium or large digital computers are known to Computers and Automation in this field). They are expected to utilize some 90 percent of comparable systems in the next five years, and will likely account for some 70 percent of all computers and data processing equipment used by the industry.

The top 20 companies, which dwarf the next 20 by about a 10 to 1 ratio, represent some 60 percent of the market visualized. Each of the top 20 companies is a likely market for from $10,000,000 to $25,000,000 of

TABLE 1: TENTATIVE ESTIMATE OF MARKET FOR COMPUTERS AND DATA PROCESSING EQUIPMENT IN VALUE OF EQUIPMENT INSTALLED—OIL AND NATURAL GAS INDUSTRY

Number of Companies	Average No. of Employees	Total No. of Employees	Estimated Average Value of Equipment Installed Per Employee Over Next 5 Years	Average Value of Installatoin Over Next 5 Years	Total Value For Group
(1)	(2)	(3) = (1) x (2)	(4)	(5) = (2) x (4)	(6) = (1) x (5)
Top 20	35,000	700,000	$500	$17,500,000	$350,000,000
Next 20	3,000	60,000	500	1,500,000	30,000,000
Next 150	500	75,000	400	200,000	30,000,000
Next 750	250	187,000	300	75,000	55,000,000
Next 1500	100	150,000	250	25,000	40,000,000
Next 3000	50	150,000	200	10,000	30,000,000
5440	250	1,322,000	—	$ 100,000	$525,000,000

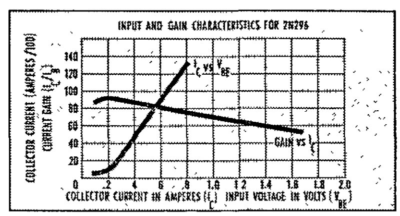
Note: No sales or rentals are projected to the some 37,000 other firms in the field, in the main having less than 50 employees.

Sixty Volt Power Transistor Type 2N296

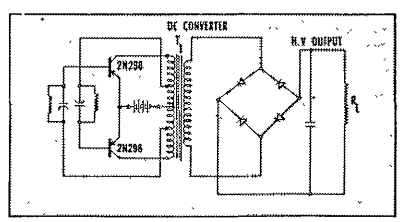
Sylvania develops a high voltage power transistor with optimum performance factors for a wide range of circuit applications.

Now Sylvania offers type 2N296, a PNP germanium alloy transistor designed for high voltage power amplifier or switching applications where supply voltages are 25-30 volts. The new unit is already finding growing use in computer, telephone and aircraft circuits.

The new 2N296 is physically identical with Sylvania type 2N242 and can be used as its high voltage companion.



Input and Gain Characteristics for Type 2N296



Transistorized DC Converter with Type 2N296

Here are the general features of the new 2N296

- 25 Watts. Max. Dissipation (Mounting base maintained at 25° C)
- 2 Amps Collector Current
- 60 Volts Max. Collector Voltage
- 0.8 Saturation Voltage (Typical)
- 20 Minimum Current Gain
- 85° C Storage Temperature
- 100° C Junction Temperature (Operating)
- Temperature Gradient (from junction to mounting base) 3° C/Watt
- New Welded Hermetic Seal Construction

Call or write your Sylvania representative for complete particulars on the new 2N296 60-volt power transistor.

SYLVANIA

SYLVANIA ELECTRIC PRODUCTS INC.
1740 Broadway, New York 19, N.Y.
In Canada: Sylvania Electric (Canada) Ltd.
Shell Tower Bldg., Montreal

LIGHTING • RADIO • ELECTRONICS • TELEVISION • METALS & CHEMICALS product. One or two companies approach this today. For example, Shell Oil and its affiliates has 20 powerful computers on line or on order now—plus, undoubtedly, dozens of smaller card-controlled units.

The actual size of the oil market for computers is complicated by two conflicting trends. The market is necessarily slowed down today by the need to digest the rapid influx of recent new systems. Virtually all large computers, and most medium computers have been delivered within the last year. Over the next 6 to 18 months the sizable group of machines now on order will have to be integrated. A number of major prospects for multiple installations will face shortages of trained people—and accordingly may be reluctant to schedule new system requirements.

On the other hand, and in the long run, a trend expected to prove overpowering is the growing utilization of computers for scientific, technical, and operations research applications. While business and accounting uses now are dominant (for most computers used jointly for accounting and scientific uses are programmed heavily on the accounting side) the next beckoning field is scientific—and the great increases in large computers for one-field use in the next five years will undoubtedly be for specialized scientific use.

In general, data developed on business uses is reasonably consistent among the majors. The great variations show up in differing company guesses on scientific needs. It is likely that the engineering acceptance and demand anticipated for computers will prove that the above predictions err rather in being too small than in being too large. Beyond the large computers, valued at $700,000 and up, there would seem to be a market of 1000 units in oil alone for a low cost computer in the $100,000 class.

Indications are that at least 90 percent of the value of computers in the oil industry in the next five years will be digital, and something less than 10 percent analog. The primary reasons for this conclusion, as brought out by respondents, are (1) the industry is concentrated in a relatively few hands; (2) there has been a great penetration to date for general business utilization—which is almost exclusively a digital function; (3) smaller firms will desire their first, or their first and second units for joint accounting and scientific applications; (4) the complex scientific data inherent in the oil industry lends itself better to digital exploitation.

WHY COMPUTERS ARE IMPORTANT IN THE OIL INDUSTRY

Computers are important in the oil industry basically because of the fact that the oil industry, like any business, has all of the usual business and accounting needs for computers, *plus* a large number of specialized requirements in technical and scientific applications and operations research. Unlike insurance companies, where the prime problem is maintenance of and action upon policy records, or retailing, where inventory control is the prime problem, the oil field has a multitude of problems where computers can and are earning their keep.

Underlining this multiple need for computers is the vast complexity of the industry . . . with many large problems, such as exploration, imports, foreign operations, multitudinous products, variable processes, locations, forms of transport, competitive marketing conditions, and flexible pricing.

Vast as the industry is, it must become vaster. The

TABLE 2: A CENSUS OF COMPUTERS IN THE OIL INDUSTRY

(Based on an article in Petroleum Week, September 27, 1957, and quoted by permission)

I. THE UNITED STATES, BY TYPE	
INSTALLED	
A. Large Computers	
IBM 705	7
IBM 704	1
B. Medium Computers	
IBM 650	57
Burroughs Datatron	9
Bendix G 15	5
National Cash Register 102A	2
Elecom 120	1
Oil-Company own make	
Subtotal, Installed	84
ON ORDER	
A. Large Computers	
IBM 709	2
IBM 705	5
IBM 704	4
Univac File Computer, Model 1	3
B. Medium Computers	
IBM 650	24
Other manufacturers (have orders but have not announced them for competitive reasons)	xxx
Subtotal, On Order	38
Total, Installed and On Order	122
II. BY GEOGRAPHIC AREA	
Texas	22
Oklahoma	15
California	10
Elsewhere	75
Total U.S.	122
III. BY USE	
Both accounting and scientific	62
Scientific only	34
Accounting only	18
Applications undecided	8
Total U.S.	122
IV. DISTRIBUTION	
No. of different oil companies among which the 122 computers are divided	37
V. OUTSIDE THE UNITED STATES	
At least 12 are in use and on order	

Note: These figures should be increased by five Royal McBee Librascope LGP-30's installed and four on order.

50 per cent increase in petroleum production predicted 10 years hence, the need for a company to add 5 percent to volume each year just to stay even with the rest of the industry, is another great impetus to the use of electronic data processing.

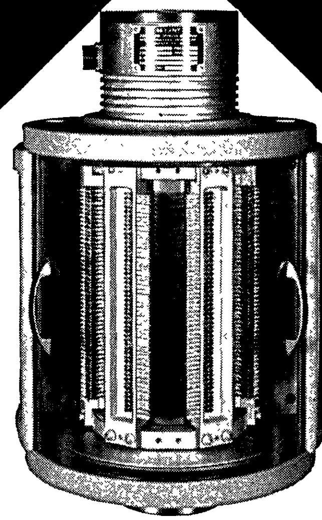
From an accounting standpoint, there would seem to be a sizeable need for better accounting control. Controllers find ample reason to install computers to replace inadequate and out-of-date reporting . . . from clerical staffs unable to cope with increased data processing. Loss of clerks is likely to increase this demand.

Several Reasons

From the engineering point of view, several reasons can be advanced. The primary reason is the very large number of variables entering into most petroleum engineering problems, such as those found in geological prospecting, refinery utilization, manufacturing processing. In oil companies, engineering problems and the engineering approach are respected. Beyond this, instrumentation is rapidly increasing; there is a great need for precise controls for best operation; widespread activities call for "common language" communication; and companies need to increase the favorableness of the odds affecting them.

There is one other sizeable motive that cannot be ignored in this brief listing—and that is the vigorous competition found, particularly among the major companies. Computers mean more facts, better judgments, faster reports, better tie-in control; in other words, better "odds"; higher profit over the long run. While a costly tool, no computer leased by an oil company has been tossed out. Rather each large system ordered is eagerly anticipated, and producers are pushed to improve delivery promises. Each new successful application of computers at one of a dozen big companies will tend to result in that application spreading to other oil companies as well . . . and as applications increase so will the number and value of systems.

In this regard note that a large portion of major oil companies have established company-wide electronic advisory committees, to make best use of the speeds and capacities of computers. A year from today it will



be surprising if virtually all have not taken this basic preliminary step.

One particularly large and new area for computer application in the oil industry is cooperative sharing of data for better use of computers. It seems from talks with industry representatives and with systems analysts for computer producers that this may happen eventually. Every company with access to a computer is calculating plate-to-plate patterns; every company is eager to refine geological probability; every company is studying drilling patterns. Neither engineers nor analysts can see any insurmountable handicaps. A carefully programmed computer in a central place could for example compute solutions based on the findings of a number of companies, without any one company having access to the actual data supplied by another. At Remington Rand in particular, such applications of computers are seen as an important contribution in mapping the entire earth . . . for the good of all companies, and other people besides.

Satellites

(Continued from page 9)

so does the invention of nuclear warheads and the intercontinental ballistic missile destroy the immunity of any country from huge destruction. It places a most powerful deterrent on certain kinds of psychology. War is obsolete—at least big hot war, if not little hot wars, and cold wars.

The Application of Computer Techniques to Psychology

Problems of changing people's minds, problems of psychology, problems of getting rid of delusions of grandeur, problems of learning science, technology, and psychology—all these and many more are part of the field of computers and data processing. In 1949 in the book "Giant Brains" I wrote "It is conceivable that machines that think can eventually be applied in the actual treatment of mental illness and maladjustment . . . as an aid to the physician. We might call this kind of machine a **psychological trainer** . . ." The suggested machine would use sound movies, putting situations in front of the patient; it would accept responses from the patient; it would be guided by a program of instructions from the physician; it would present alternatives according to indications calculated by the machine as it operated; it could provide repetitions of information if needed or desired; it would make a record for the physician to study and comment on; and it would save an enormous amount of time from a highly trained and educated physician.

Under "unified national planning", or better still "unified international planning", the computer and data processing industry could make a very large contribution in machines for teaching, training, dealing with psychological problems, and making men more civilized. Such machines would help develop an era of peaceful coexistence and space travel WITHOUT intercontinental ballistic missiles which hold no joy for anyone. And we might never need to say as does one of Nevil Shute's characters, "Maybe we have been too silly to deserve a world like this."

SOME USES OF COMPUTERS IN THE OIL AND GAS INDUSTRY

A. SCIENTIFIC, TECHNICAL, AND OPERATIONS RESEARCH

1. Geophysical Exploration and Research

Reduction and analysis of data collected in gravity, magnetic, electrical and seismic surveys, such as:
- —Harmonic analysis of data obtained from seismic exploration
- —Computer "fitting" of wide band recordings of seismic shots . . . to eliminate necessity of frequency adjustment by trial and error filter settings in field
- —Construction of maps, such as residual gravity maps
- —Interpretations in making velocity profiles
- —Solving multilayer refraction problems
- —True depths and displacements of seismic reflection points for steeply dipping areas
- —Application of regression analysis to the correlation of geological data obtained from drill holes

2. Production and Field Development

Minimization of oil field development costs for a variety of well patterns, separator plant locations, flow rates, bottom hole pressures, and trap pressures

Mechanical, physical, and chemical design of oil field components, such as:
- —Study of water wave forces in design of off-shore facilities
- —Studies for pump and compressor horsepower

Solution of partial differential equations representing fluid flow of homogeneous and heterogeneous liquids for the prediction of oil reservoir performance, such as:
- —Prediction of radial flow of fluids through porous rocks
- —Calculations of secondary recovery problems utilizing fracturing, steam injection, water flooding, acidizing

Operating characteristics of natural gas storage reservoirs—to determine volume stored at given average pressure and viscosity, and production under given sets of conditions.

Maintenance of production and injection history of reservoirs, with corrections such as:
- —Computation of crude oil gravity and volume correctness
- —Well logs corrected for salinity, extent of invalid zone
- —Perforation history
- —Effect of prorating on marginal wells or fields

Mathematical determinations, such as:
- —K values and enthalpy data
- —Preparation of engineering tables

3. Transportation

Application of linear programming to distribution of

(Please turn to page 23)

OIL AND NATURAL GAS:

THE MAGNITUDE OF THE INDUSTRY

Ed Burnett
New York, N.Y.

WHEN considering the present and future applications of electronic data processing and automatic computers in the oil and natural gas industry, it is worth taking a look at the nature and magnitude of the industry.

Petroleum now provides over 40 percent of the total energy used in the United States. Natural gas accounts for 25 percent. Between them they provide over two-thirds of the total energy consumed in this country. (Coal contributes 30 percent; water power, 4 percent.) In 1920 oil and gas together accounted for less than 20 percent. In the intervening period, while total energy consumption in the United States has doubled, energy from petroleum has increased eightfold, while that from natural gas has increased elevenfold. By 1966, energy specialists at the Chase Manhattan Bank believe that oil and natural gas will account for over three quarters of all energy used. *All* of the growth of energy in this country since 1920 has been by oil and gas.

America is both the world's greatest producer and the world's greatest consumer of oil and gas products, accounting for about 45 percent (until recently over 50 percent) of total free world production, and for about 60 percent of free world consumption. Per capita, consumption of oil products in this country is estimated by the American Petroleum Association to be approximately 20 times that of the rest of the free world. Over 40 percent of U.S. consumption of oil is in the form of motor fuel. Total motor fuel used is now double that required in this country in 1941.

BASIC STATISTICS for the oil and gas industry (which influence the use of computers).

The Oil and Gas Industry:

Employs one of every 38 American workers—or nearly 2 million in all.

Leases 600,000 square miles, or 20 percent of the land area of the country, for oil and gas exploration.

Delivers over 350,000,000 gallons of product, daily, to American consumers.

Has drilled over 1,600,000 wells in the U.S. alone—and embraces over 540,000 producing oil wells in 29 states, under 29 sets of regulations covering, at the least, spacing, drilling, casing, completion, operation, proration, conservation.

Drills approximately 250,000,000 feet of hole, or more, per year—or over four times the diameter of the earth.

Utilizes close to 200,000 miles of pipeline.

Imports now about 500,000,000 barrels of oil annually.

Accounts for over 40 percent of foreign and domestic waterborne tonnage, as well as sizeable portions of rail, pipeline, and truck capacity.

Runs over 300 refineries, over 550 gas processing plants, and over 300 petrochemical plants in the U.S. —plus 425 outside the U.S.

Consists of over 42,000 individual businesses, in 10 classes, through the wholesale level, plus over 180,000 service stations, plus over 150,000 other retail dealers in oil products, including garages, repair shops, and country stores.

Expends a quarter of a billion dollars a year, at least, in geophysical exploration.

Expends now over 4 billions annually in all other production investment.

Expends now over $1 billion annually in all other capital expenditures—the largest part in manufacture (refinery operation).

Over the past few decades, demand for oil and oil products has shown a consistent increase. Since 1941, the increased demand has been quite spectacular, due to a great increase in oil consuming equipment:

a. Motor vehicles, farm tractors, other agricultural machinery
b. Industrial and home-heating oil burners and space heaters
c. Commercial aircraft
d. Diesel locomotives

Additional contributing factors have been the expanding industrial activity since the war, and the greatly accelerated use of petroleum and natural gas as raw materials for the new industrial giant known as petrochemicals.

MAJOR DIVISIONS OF THE OIL AND GAS INDUSTRY

The oil and natural gas industry is usually divided, for reference, into the following four major segments: Production, 400,000 employees; Refining, 300,000 employees; Transportation, 125,000 employees; Marketing, 850,000 employees; total, 1,675,000 employees.

PRODUCTION INCLUDES geophysical exploration, drilling, rig-building, and operation and maintaining of producing wells.

The search for oil utilizes the combined experience of a number of highly specialized scientific disciplines. In time, it will probably start with the computer specialist. As of now, it usually starts with the geologist—whose main function is to help determine where oil may be found. He uses geological maps, aerial surveys, results of drilling, his own world-wide experience.

After the lease department acquires a lease or concession on a likely plot, the geophysicist enters to study the subsurface characteristics, using principally gravometers, seismographs, and magnetometers; some of his research may be done aerially; mostly it is on the ground and on the site. Drillings from holes bored are then examined by a paleontologist, or fossil expert.

In good part, all of the basic findings of geologist, geophysicist, aerial magnetometrist, and paleontologist can become raw material for the computer specialist to integrate, analyze, and interpret . . . to determine the economic advisability of drilling in a given location.

This search for oil may extend over a period of years, entail substantial expenditures for exploration, lease rentals, investment in producing wells, and related facilities . . . plus large outlays for non-productive wells. Following successful exploration work, a great expense of development drilling and field exploration is required to bring a new field into efficient production. Three out of four wells drilled in a producing field, under modern drilling location procedures, are productive.

But drilling of just one well is a tremendous undertaking. A typical 10,000 foot well utilizes a rig weighing 200 tons, which costs about $300,000, involves 25 full time men for weeks or months plus upwards of 125 men part-time. The average wildcat well drilled runs about $125,000. And since success today in unproven fields is no better than 1 in 9 or 10, a successful wildcat well reflects an investment of $1,000,000 or more. Despite the odds, independent operators, according to the American Petroleum Institute, drill more than three-fourths of the wells that open new fields.

During its lifetime, a producing oil well may go through several phases:

a. **Flush** well is one that flows by itself due to natural-gas or water pressure
b. **Settled** well is one that will produce adequately, if pumped
c. **Stripper** well is one that will produce little, even if pumped (Some 340,000 of the 540,000 producing oil wells in the country are of this "stripper" or marginal variety.)
d. **Secondary Recovery** well is one that produces adequately under artificial extraction processes—such as re-pressurizing with gas, air, or water.

Proved Reserves of a well or a field are the amounts of crude oil, natural gas liquids, or natural gas estimated to be recoverable by production methods available at the time. Each new well, each change in an old well, each increase in the art of recovery, such as the recently introduced gas-recycling to maintain or control pressure, affects proved reserves—and the economics of recovery of such reserves.

REFINING is the name given the various manufacturing processes used to convert mixtures of thousands of different hydrocarbon compounds, called crude oils, into the 2400 products made by oil companies.

There are three major refining processes—each of them with different proportionate yields, costs, times, efficiencies:

Separation—by distillation (boil off and condense fractions at different temperatures).
by solvent extraction (dissolve with a solvent one part of a mixture, and not others).
by refrigeration (solidify and separate out certain parts of a mixture).

Conversion—by thermal cracking (chemical molecular rearrangement by breaking or "cracking" under controlled high temperature and high pressure conditions).
by catalytic cracking (breakdown of larger, heavier hydrocarbon molecules under high temperature but moderate pressure in the presence of a catalyst).
by polymerization (chemical molecular rearrangement by combining, or polymerizing, under controlled high temperatures and high pressures).

Treating—the overall name for refining out or conversion of minor impurities in petroleum products. Typical processes include "acid treatment" to remove certain materials in the form of a sludge; "desulferizing", a treatment to remove corrosive elements; and "sweetening" to make a product harmless and odorless.

The major products of oil refineries are gasoline, kerosene, light and heavy fuel oils, lubricating oils, wax, asphalt, and coke. In addition petroleum yields carbon black, liquefied petroleum gas, and petro-chemicals. Thirty years ago, processing methods yielded 25 percent gasoline from the average 42 gallon barrel. Today gasoline represents 44 percent or more of finished product . . . and is a better grade of gasoline.

Refiners point out that two gallons of today's gasoline do work that previously would have required three gallons. Gasolines are produced in several grades; so are light fuel oils and diesels, heating and residual oils. Lubricating oils on the other hand are made in several hundred different types . . . a large number featuring chemical additives for special characteristics.

Among the many factors which must be taken into account in the operation of a refinery are types of crudes processed, refinery design, method of processing, proportionate yields, by-product processing, re-cycling of constituents and partly processed products, market demand by product and grade and price, competitive action, inbound and outbound freight, stockpiling, seasonal characteristics . . . plus many more. An indication of the complexity of modern refinery operation is given in the review of the newest semi-automatic Tidewater refinery elsewhere in this issue.

TRANSPORTATION . . . involves the physical movement of oil and gas from the producing field to the refinery and the physical movement of finished product from the refinery to wholesale storage at or near the market.

The means used to handle the volatile liquids involved, include barges, oil tankers, pipelines, railroad tank cars, and tank trucks.

Transportation of Petroleum Products by Type of Carrier

	Inbound to Refineries (1955)	Outbound from Refineries (1954)
Pipeline	76%	42%
Water	23%	31%
Tank Truck		22%
Tank Car		5%*
	100%	100%

* As late as 1938 railroads accounted for 16 percent of outbound movement.

Pipelines carry more oil than water, rail, or highway carriers. The nationwide network of pipeline systems carries some 16 percent of all ton-miles of intercity public and private freight, the greatest part of which consists of petroleum and its products. Some 190,000 miles of pipe line carry crude oil and refined products exclusively . . . with at times 10 or 15 different products following one another in close succession thru the line.

The growth of this vast network, ranging from crude oil gathering lines in oil fields to refined product trunk lines has resulted in the construction and installation of a vast secondary network involving control and communication. This communication network, involving trunklines, feeders, terminals, storage tanks, switch systems, dispatchers, telegraph, telephone, radio, ultra high frequency microwave, and telemetering, is necessary to control a flow which in 1955 reached over 750,000,000 barrels of refined products alone. Twenty-four pipeline companies have invested close to $20 million in microwave systems alone.

Water transportation is second in oil tonnage. The major movement is domestic (coastwise) because the large East Coast refineries depend primarily on tankers for their crude oil supplies. Tankers offer low cost, flexibility to meet demand, large bulk volume. The U.S. tanker fleet numbers over 500 vessels, accounts for about 20 percent of the deadweight tonnage of all tankers in the world. When American owned tankers registered under friendly foreign flags are included, the U.S. owns or controls over a third of the world's carrying capacity. A large volume of oil is moved over inland waterways by barge; oil in fact accounts for over 25 percent of total inland waterways traffic. Most large producing fields and refining centers are served by waterway traffic.

A substantial fleet of tank cars is utilized to transport oil. Of 150,000 tank cars of all types, over 80 percent are petroleum tank cars carrying an average of from 8000 to 10,000 gallons of product. However tank car utilization has not kept pace with oil growth. The development of the pipeline network and diversion to tankers, barges, and tank trucks have all cut substantially into rail volume.

The final link in the oil transportation chain, in most cases, is the tank truck. Over 85,000 tank trucks are now in use carrying products to local bulk stations, delivering gasoline and diesel fuel to service stations and farms, and transporting heating oils and bottled gas to millions of users.

MARKETING—covers the entire gamut of distribution and marketing of petroleum products. It includes physical transportation, storage, handling, delivery and sale; the development and utilization of equipment for such handling; sales planning and budgeting, based on analyses of market demands; sales effort, including promotion and advertising; and the billing, credits and collections inherent in sales of thousands of items through several hundreds of thousands of outlets.

Marketing is complicated by the fact that most major oil companies are "integrated", that is their operations include more than one of the four main divisions of production, refining, transportation, marketing. Each oil company thus has its own specific individuality overlaying a broad basic industry marketing pattern.

The pattern places wholesale distribution, based on storage tanks and handling and transportation equipment (primarily bulk plant operations) at or near the market. The main job of such wholesalers, however owned or controlled, is to receive large bulk shipments from refineries near or far and deliver them to the resale market, and to users such as commercial customers, public utilities, transportation companies, factories, farms. Maintenance of adequate inventories of each of the multitude of products required by a market is one chief problem. Delivery scheduling is a second. Billing, collection, credit is a third.

There are three major classes of resale or retail dealers. The first, and by far the largest from a dollar volume standpoint, is the drive-in service station operator. There are now over 180,000 such stations in the country. Their retail volume of oil and gasoline alone is over $7 billion per year. In addition there are over 150,000 other retail outlets for gasoline, lubricants and other petroleum products, chiefly garages, repair shops, and general stores. The third class of resale dealer is the local fuel oil dealer who delivers directly to the home or plant. Some fuel oil dealers operate out of the bulk plant of the supplier; others maintain their own bulk plant installations.

A separate but parallel distribution is followed in marketing of liquefied petroleum gas. In general the producer of LPG, also known as LP-gas, butane, propane, bottled, or tank gas, ships in bulk to a specialized wholesale bulk tank operator who in turn delivers directly to the consumer, or markets through distributor-dealers. Either the distributor or the dealer maintains cylinder filling stations to test, service, fill, exchange, and control the cylinders. Appliance, hardware and implement businesses are often the ultimate dealer in this chain.

APPENDIX 1

POSITION OF TOP COMPANIES IN FIELD

In the oil and gas industry there are some 42,000 businesses engaged in production, refining, transportation, and wholesale distribution. The breakdown carefully made by the American Petroleum Institute to remove duplications found in census figures is as follows:

crude petroleum and natural gas production	12,010
petroleum refining	270
lubricating oils and greases (not made in refineries)	243
pipe line companies	54
tankship companies	42
tank car companies	43
barge line companies	174
for-hire carriers, tank trucks	1,063
petroleum bulk stations, terminals	14,047
fuel oil dealers	11,127
LPG companies (one or more bulk plants)	3,000
Total	42,075

But just 20 companies,* employing 10,000 or more persons each, dominate the industry all the way from geological exploration, to leasing and servicing of the great majority of the 180,000 retail service stations. These top 20 companies employ

* In Fortune's list of the 500 largest U.S. industrial corporations, 7 of the 1st 20, 17 of the 1st 100 are oil companies. With their 1956 rank, they are Standard of New Jersey (2); Socony Mobil (6); Gulf Oil (10); Texas Co. (12); Standard of Indiana (14); Shell (16); Standard of California (18); Sinclair (24); Phillips Petroleum (30); Cities Service (33); Sun (49); Continental (67); Atlantic Refining (72); Tidewater (75); Pure (80); Union (90); Standard of Ohio (92).

an average of 35,000 persons each—over one-third of the total manpower employed in the industry. They employ more than all the other 5420 companies employing an average of 50 employees or more combined. They also employ more than all the other 37,000 firms in the field put together. The top 20 employ about 10 times as many persons as the next 20. A Chase Manhattan Bank report covering 34 oil companies, and including virtually all the leaders, finds this group:

1. Produced 58 percent of the oil produced by the free world
2. Processed 65 percent of the oil processed by the free world
3. Accounted for 61 percent of net crude production in the U.S.
4. Accounted for 86 percent of United States refining
5. Derived 64 percent of their total earnings from domestic operations, 36 percent from foreign investments.
6. Expended $2.5 billion finding and developing new reserves—the equivalent of $1.83 per barrel of net crude produced in 1955
7. Made 20 percent of gross investment in fixed assets employed by the industry in the free world.

These same 34 companies accounted for approximately 60 percent of some $5.6 billion invested in 1955 in property, plant and equipment in the United States. It is interesting to note that their investment alone, at today's accelerated rate, is equal to that of the entire U. S. industry in the decade 1946 to 1955. The $5.6 billions of capital expenditure were allocated as follows: Production—73 percent; Refining—15 percent; Transportation—4 percent; Marketing and other—8 percent. Gross sales for the group were split as follows: Refined products —72 percent; Crude oil sales—20 percent; Natural gas—2 percent; Chemical products—3 percent; all other—3 percent. It is pretty obvious that for large digital computer systems, the market is concentrated in relatively a large handful of major integrated producers.

APPENDIX 2

WHAT OIL MEN EXPECT

Anticipating further great growth in motor car registrations (some 60 million on the road by 1960; some 65 to 70 million by 1965) oil industry leaders expect demand for gasoline, and for petroleum in general to increase over 20 percent in the next five years, and upwards of 50 percent in the next 10.

In the marketing area this increase will be highlighted by extensive service station renovations and replacement of many present retail units by modern super-service stations.

New cars mean new demands on technology—as close to half of all gasoline for the year 1965 is expected to be 100 octane premium. This continuing octane race will require more complicated, more expensive, and more automated refinery units. This is underlined by a survey made by the McGraw Hill Department of Economics which found that all industry will add 15 percent to their engineering staffs in the years 1957–1960. The largest increase in scientific and engineering employment for the period, some 33 percent, is expected in petroleum refining.

LPG is expected to increase faster than overall oil—by 50 percent in the next five years, over 100 percent in the next 10.

With much more oil needed, with oil harder and more expensive to find, with great increases in equipment needed to transport and refine and market it, these projections indicate a sizeable future increase in the present high rate of capital formation in the industry. The experts at Chase Manhattan bank estimate the new investment in the next 10 years will be $75 billion domestically, plus another $40 billion by U.S. companies in their foreign production and facilities. Even today Petroleum is a huge industry, the third largest in the U.S. in net assets, next only to Agriculture and Public Utilities. It is destined, obviously, to get much larger.

A far stronger marriage with the chemical industry is in prospect . . . and mergers of oil companies and chemical companies to integrate sources of raw materials, manufacturing facilities and marketing channels is certainly in the cards. With more and more additives, more and more synthetic lubricants, and the vast development of the petro-chemical field, such a marriage makes good sense to far sighted oil industrialists.

Some 99 percent of crude oil is used to make the better known petroleum products—leaving only 1 percent today for chemicals. But that 1 percent reputedly accounts for 25 percent of the total organic chemical production in the United States. Within a decade fully half of such production will be from petroleum. And the volume of petro-chemicals is growing apace. In 1925, when most organic chemicals were made from coal tar, wood, and fermentation, the volume of chemicals from petrochemicals came to 16 million pounds. By 1950 this figure had increased to 16 **billion** pounds. Today it has more than doubled to between 35 and 40 billion pounds. Some 75 oil companies are now engaged in the manufacture of petrochemicals. Present investment of $4 billion is expected to double by 1960.

Key petrochemical derivatives are detergents, synthetic rubber, synthetic fibers, and plastics. Included are cleaning fluids, packagings, polishes, disinfectants, cosmetics, antiseptics. The trend now seems to be away from natural gas to by-products of refining operations such as ethylene, butylene, cyclohexane, phenol . . . and many more.

* * *

It is reasonable to expect then that oil men are thoroughly conditioned to a great increase in automation, automatic control, the first glimpse of a truly automatic refinery, and great increase in the utilization of computers to help solve many of the pressing detail, engineering, and operations research problems posed by such great growth by an already huge structure.

THE MARKET FOR ANALOG COMPUTERS

AT THE present time there are about 15 general purpose analog computer installations in the oil industry. Among those are Esso at Baton Rouge, Esso Research at Linden, N. J., Humble Oil, Phillips Petroleum, Ohio Oil, Royal Dutch Shell, Shell Development, Standard Oil of Ohio, Standard Oil of Indiana, Texas Company, and Sun Oil. Many of these installations are Electronic Associates' analog computers.

The value of analog computers in use is on the order of $2,000,000–since most installations in the oil industry run from $50,000 to $150,000. Including units on order, the committed analog market is no more than $2,500,000–or about 2 per cent of digital.

The use of analog computers is almost certain to increase absolutely, as well as proportionately when measured against digital. It is probable that analog computer makers will be able to match each IBM 650 or equivalent with $50,000 of analog equipment, and each IBM 700 series or equivalent with $100,000 of analog equipment over the next five years. Since there are now 122 digital systems on hand or on order, and some 300 to 400 more due, the probable general purpose analog computer system market would seem to range from $25,000,000 to $30,000,000–or about 5 percent of the combined analog and digital computer market estimated for the next five years.

If this figure is reached, analog sales to oil companies in this period will total 12 to 15 times the amount of sales to date. In fact, the oil industry alone on the basis of this estimate will purchase in five years more than the total annual production of all analog computer makers in 1957.

Applications: Unlike digital, the analog computer is almost exclusively an engineering tool. It is used primarily on two kinds of problems in this industry—design of components and design of actual process control systems. To the surprise of many in the field, design use has predominated over actual control.

Most analog applications have been in the following classes of problems:

Study of Reactions for Reactor Design
- Problems in catalyst regeneration
- Yield of high octanes from various crude sources
- Removal of certain gases and other impurities from various crudes
- Fluid cracker catalytic bed

Simulation of Physical Systems
- Study of pulsations, to determine compatible system of lines, pressures, speed of compressors, valves . . . within given pressure maximums
- Calculation of horsepower requirements for pipeline company, utilizing long line electrical theory

Study of Reservoir Recovery

Control of Processing Equipment

In addition there have been some analog applications in mass spectrometer work, in distillation studies, and in linear programming for optimization.

Why Analog Will Increase: While actual sale of analog computers has been modest in the oil industry to date, the record of petroleum company utilization of time at the Electronic Associates Computation Center has been extremely high. In 1956, some 24 percent of time charges were to the oil industry; in 1957 oil has accounted for 42 percent, higher by far than any other industry including aircraft, the bellwether in analog applications.

The basic reasons for this record lie in the advantages of analog—price, time, ease of programming, the "understandability" of the simulation by analog means, the fact that analog provides answers simultaneously to many variables, and the fact that the company engineer himself can easily and quickly learn to operate and "feel" the equipment. On one distillation steady state problem, a digital service bid $75,000 and stipulated six months. The job was solved analogwise, programmed in three weeks, run in one week, and cost just $12,000. The client, who rents several digital units, has since purchased $200,000 worth of analog equipment of his own.

What Lies Ahead for Analog Equipment: Just around the corner is a punched tape program input for analog computers which will enable an analog computer to handle successive problems. For example, if a given analog system can handle 60 variables out of say 300, that system with a programmed tape will be able to transfer after dealing with the first 60, automatically to the next 60. A reservoir grid consisting of 6500 points will then be within the ken of an analog system costing $500,000. A digital system set up to run this same problem has a probable value of $2,000,000 or more. The analog system can be stopped, checked, rather easily programmed again. The digital system is easy to stop and check, but not so easy to reprogram.

Other new developments in analog computers are reliable electronic analog-to-digital converters, the use of magnetic tape for both input signals and stored results, and somewhat greater accuracy. In fact, in design and process control problems, present analog machines are more accurate than the instruments the processes must ultimately work with.

As more computers are purchased exclusively for scientific and engineering work, the number of analog computers, particularly for simulation problems, will increase in the oil industry. Engineers familiar with analog note that many technical applications, except those involving masses of data, can be studied by analog means.

Analog manufacturers suffer to some extent because the word computer has become almost generic for the digital computer, and because all accounting and business applications that top management directly know about are digital. They also suffer, and perhaps more, from the fact that the advantages of analog in many cases are not very well known, as yet, even among technical people. The problem for analog computer makers would seem to be not as much producing the product, as lack of knowledge among the men normally expected to use the product, of what the product will do.

COMPUTER APPLICATIONS IN THE OIL INDUSTRY

Selected Typical Examples . . .

Development of a Field

FOR A large foreign oil complex, the Remington-Rand Univac Service Center has produced some 800 possible ways to drill, pipe, and exploit a particular oil field. Given spacing, pattern, production, bottom hole pressure, trap pressure, the computer determines production in barrels, how many gas-oil separation plants to utilize, where to position them, which wells to pipe to them, what size casing to use, optimum flowline length and diameter, plus cost for each alternative.

Before the computer, such studies were too complicated; development of fields was governed by decisions, necessarily arbitrary, which often proved costly as the ultimate pattern evolved. With this type of study, the cost of capitalization can be measured against return, and provision made, pipe and equipment-wise, at the start for future development.

Interaction of Fields

A Canadian exploration company is utilizing a Royal McBee LGP-30 to study two oil fields located in the same aquifer (water bearing layer) as several other oil fields. The computer is probing the interaction of various rates of production in the six different fields to determine their effect, and to help develop the best policy of withdrawal for the controlled fields and, necessarily, for the other fields as well.

Interpretation of Seismic Data

SeisMAC, made by Texas Instruments, is designed to perform many of the computational tasks involved in getting seismic vibration records in shape for interpretation. At Gulf Oil, a new computer bypasses the usual sensitive recording pens; it transforms the returning sound wave from seismic probing directly into cross-section pictures of the underground area.

Gas Analysis

Magnolia Petroleum is programming a Royal McBee LPG-30 to perform gas analyses. The operation formerly took trained personnel familiar with punch card operation 30 minutes, to produce the results of one mass-spectrometer synthesis. The computer handles two such spectrometers, and provides a printed report directly on the analysis inside of five minutes.

Improvement of Gasoline Blending

At Esso Standard's Baton Rouge refinery, one of the largest in the world, production is at the rate of more than 5,000,000 gallons per day. Even relatively minor improvements mean substantial savings. The problem is most complex; more than 60 gasoline streams are produced continuously by a variety of refining processes, and grouped into about 15 blending mixtures. The application of linear programming, utilizing a Royal McBee LPG-30 has had several important results. Among them—a finding of over $1,000,000 of profit between the best and worst feasible operating programs; obtaining an unexpectedly large dividend in reduction of give-away of product; better inventory control from monthly operating plan calculations; easily obtaining a new operating plan when something unforeseen happens; easily studying interrelations of separate but related operations for best solution based on a multitude of variables.

Refinery Simulation

At Esso Standard Oil, data are fed to an IBM 705 computer describing the crudes to be processed, estimates of processing conditions, product specifications, raw material costs. From this information, the computer automatically finds a feasible manner for operating the simulated refinery within stipulated physical limitations and quality requirements. By using such techniques, Esso reports it expects to save $1,000,000 in the design and construction of a complex refinery. The use of the computer also cut both the basic engineering time and the manpower needed for the project at least in half.

Variability of Product

The computer can predict the variability to be expected when a product mixture is based on one or more changing components within the mixture. Regression techniques are utilized in a problem of this kind.

Refinery Scheduling of Operations

The Texas Co. is using a computer to study the many alternatives to select schedules of unit processes (distillation, cracking, refining, alkylation, polymerization) to produce gasoline, diesel fuel and other products conforming to given specifications.

This is one of the classes of problems in which the time required to obtain answers, prior to the use of computers, has been prohibitive. One important advantage of such a study is that it puts the refinery in a much better position to meet unexpected situations such as equipment breakdown.

Multicomponent Distillation Problems

Using a stored program computer, Humble Oil has developed a completely integrated, flexible and rigorous program for problems of multicomponent distillation. All initial assumptions, data conversions, preliminary and set-up calculations, adjustments, and terminal calculations are accomplished in a single computer run. The technique involves definitive and rigorous calculations, includes such refinements as complete heat balances around each stage, evaluation of equilibrium data at true tray temperatures, and automatic feed-plate matching.

Detailed Analyses of Crude Oil

Socony Vacuum, using a Datamatic linked with a mass spectrometer, finds that the computer makes possible more rapid and more detailed analyses of crude oil, lubricating oil stocks, and waxes than ever before possible. The studies are designed to help improve the quality and characteristics of lubricating oils and waxes.

Catalytic Reformer Gas Plant And Equilibrium Calculation

At Standard Oil of Ohio, 61 hours of IBM 650 time served to replace an estimated 6000 man hours (roughly 100 to 1) utilizing desk calculators. Basic computing revolves around performance calculations varied by design conditions and operating conditions. Increased value of product was obtained by decreasing the low pressure flash-drum temperature, increasing depropanizer pressure, and decreasing the propane recycle rate.

Pipe Stresses

The determination of proper provisions for safe distribution of thermal stresses in process plant and power plant piping, is a very complex and time consuming problem. It is now done by Univac . . . for Blaw Knox Company's Power Piping Division. Blaw Knox found it paid to spend considerable time, about 18 months in this case, to solve the generalized theory, basic mathematics, and computer programming—which was done in conjunction with Arthur D. Little, Inc. Now, with the program and know-how stored at the service center in New York, virtually any piping stress and flexibility problem can now be solved by Blaw Knox in one day on the computer . . . instead of 30 times as long, utilizing an engineer and a desk calculator.

Purchasing and Purchase Accounting

Ethyl Corporation uses a File Computer for sales, operations planning, manpower, and materials handling. Included in this latter is purchasing which includes production and control by computer of quotation requests, checks, cost distribution, control records, accounts payable, perpetual inventory, recalculation of reorder point, economic reorder quantities, spotting of significant changes, control of freight bills, and trial balance.

Inventory of Tanks

At Gulf Oil, a part time use of an IBM 650 is to provide a complete dailv inventory by grade of approximately 700 oil tanks. The report includes gross barrels, unavailable oil, available oil, room left in tank, and net barrels on a corrected basis.

Cost Control

One large oil company has found that cost control, utilizing an IBM 705, is running about one fourth of one percent of the costs it is trying to control. Any other way known would run several percent—or 8 to 12 times as much.

Job Order Costing

At its Whiting Refinery, Standard Oil of Indiana is utilizing an IBM 705 for accounting problems, starting with maintenance of the job order cost system. The computer accumulates and summarizes costs of all maintenance, repair and construction jobs.

Marketing Data Processing Center

Esso Standard is equipping its new center for processing of Marketing Data with an IBM 705. Data to be processed initially, from data received over leased telephone lines from 10 sales divisions in 18 states, will include records concerning sales invoices, payroll, stock accounting and sales reports. The center is designed to improve system accounting, reporting, and custom service by furnishing information faster to management.

A likely market where computers have as yet made no inroad—Retail Credit Accounting for Petroleum Companies

So far this operation, with a great volume of accounts, with concomitant accumulating, sorting, posting, controlling, billing, and analyzing, has resisted the onslaught of computers. The main hitch is the need to return a carbon copy record of each purchase at any service station to each credit card holder to support and verify the billing. So far, this requirement has present equipment buffaloed. The time will probably come, however, when either the system gives way to new and unique computers, for the need is there, or computers able to "read" hentracks are evolved. At present, most such systems are on a punched card basis. Analysis is now being done, via punched cards, in some cases, on small computers.

THE REFINERY OF THE YEAR

FROM a nearby car or boat or plane, a refinery appears to be an odd collection of complicated large towers and tubes, connected by a maze of piping to a multitude of tanks of various sizes, shapes, and colors.

The site seems particularly inactive. No conveyers, or visible pumps or even men turning valves can be seen. But this inactivity is a distinct illusion—for this is a factory which works continuously, hour after hour, day after day, month after month, year after year. The petroleum refinery is a classic example of a continuous flow process operation—in which even the products in the process are rarely seen. Formerly, samples for laboratory analysis were collected periodically; now even these are being automatically analyzed and controlled by harnessing electrons.

It is likely that the powerful advertising campaign used by Tidewater Oil for its Eastern marketing area has made its new Delaware refinery, instrumented mainly by Panellit, one of the best known refineries in the world.

Hailed at its recent opening as the "Refinery of the Future", the "first in a new generation of petroleum refineries", the new $180,000,000 plant producing 130,000 barrels per day is possibly the nearest approach yet made by the oil industry to an automatic refinery.

From an engineering standpoint, the keynote of this plant, as it must be for any major refinery in the modern world, is *flexibility*. It has been designed to handle a variety of crude oils or blends, and produce a variety of fuels. No lubricating oils or asphalt are produced at this installation. Feed stocks are split into the customary fractions—light ends, light straight run gasoline, intermediate naphtha, heavy naphtha, virgin distillate, light gas oil, heavy gas oil, and vacuum distillates. Straight run gasoline and heavy naphtha are treated immediately. The other fractions are re-routed through semi-automatic controllers, for reprocessing.

AUTOMATIC FEATURES

The automatic features of this carefully designed unit are many. They may be grouped into a number of basic classes.

CONTINUOUS BLENDING

Perhaps the chief use made of automatic control is in the continuous blending process. All distillate fuel products are blended automatically in "continuous stream blenders." None of the older batch blending methods are employed. Continuous blending is faster, reduces inventory requirements, allows better control over final products, minimizes manpower needs. But it places a much higher premium on control than does batch processing, for like a chain, it only works as long as all parts are functioning.

Continuous automatic blending adds all of the finished base stocks and additives * that make up a product in proper proportion and simultaneously so that at any given moment finished specification product is available directly from the line. In the older process, batch blending, the individual base stocks and additives are added one by one or in partial combination in a mixing tank—and the specified product is not available until the last component has been added and the total blend thoroughly mixed.

During continuous automatic blending, the actual flow of each component is continuously compared by machine against the amount specified by settings on the control board. Any deviation beyond pre-set limits automatically stops the entire blending operation. Calibration of any of the flowmeters utilized can be checked at any time—even while the system is in operation.

AUTOMATIC DATA LOGGER

Each of the major processing units is equipped with an automatic data logger. This device not only reads pertinent operating data regularly, but also monitors the unit continuously, and sounds an alarm when any control point reading goes beyond predetermined limits.

AUTOMATIC REPORTING OF YIELDS

The equipment is set up so that selected data can be programmed through an IBM 650 computer to come out with overall refinery operating figures and yields—within minutes of collection of the last readings.

The computer output provides technical personnel with basic information for study and optimizing of operations and flows. It also will provide information to management about crudes, markets, and other areas requiring management decisions.

AUTOMATIC INVENTORY CONTROL

The computer also now handles part of the function of "stores control." For a refinery the size and complexity of the Delaware unit, stores control is an impressive job ranging over hundreds of thousands of items. The IBM 650 is now being used to type a preliminary purchase order for any item stocked below a predetermined level. The machine scans the order, accepts it if the stock is within levels established and if the size of the order is consistent with ordinary practice. This preliminary order goes to the purchasing department which in turn writes a final purchase order to the outside vendor. In time, the hope is that the form printed by the computer can be sent directly to the vendor without the need for other processing operations.

AUTOMATIC REMOTE REPORTING

All crude and product tankage is automatically gaged remotely. The readings are then digitized by a computer to give the liquid content of any tank in barrels—corrected automatically for temperature, gravity, and tank irregularities.

The reports from the remote gaging of each of 86 tanks can be read to the nearest hundredth of a foot on a console in the control room. Each tank is equipped with a Shand and Jurs level transducer which produces a voltage on a potentiometer proportional to the height of liquid in the tank. Analog-to-digital convertors change the potentiometer reading to a digital value.

Average temperature of each tank also shows on the control console. Four resistance bulbs mounted to a boom inside the tank are positioned at four different heights. Their resistance readings are averaged and converted to a single average temperature—which is also digitized.

A highly specialized computer has also been installed which takes the data on height, temperature, gravity, and type of liquid in storage, and computes the volume corrected to 60 degrees F.—even taking into account any oddities in individual tank configuration.

CONTROL CENTERS

The central nervous system of this vast refinery is one of the most extensive information-system installations in the country. It is believed that this system provides the eight central control rooms at Tidewater with more data than is received by any other plant in the country. The capacity of this nervous system, which consists of 13 separate systems, is 4700 individual points of reference . . . and information from most of these is being continuously received and continuously and automatically logged. The cost of this system is over $1,000,000.

The system provides five basic forms of information:

1. Graphic Panel Control Monitor Board

Individual pneumatic instruments instantly record any change at hundreds of individual check points. The operator is no further than 15 feet away from any recorder—close enough to see deviations from pre-set control points, even though absolute values cannot be read at this distance.

2. A Bank of Trend Recorders (Standard uncalibrated roll-sheet recorders)

Virtually any process variable can be plugged in from the operator's console. Each recorder can handle four different items simultaneously. Where deviations of a given flow, or pressure, or temperature appear, a trend line can be plotted and studied. Then by changing settings the process variable can be brought back within the predetermined limits.

3. TelAutograph for Remote Stations

This is used primarily at present to transmit information instantly on tests from the laboratory—so there is no delay in changing settings, flows, temperatures.

* Up to 7 base stocks in one product plus tetra ethyl lead, choice of 3 dies, metal deactivator, antioxidant, and corrosion inhibitor.

4. Data Logger-Scanner

This data processing device reads all control points, at a rate of about one per second, and records them. Once an hour the output data from the logger are typed on log sheets. Each point has pre-set limits, which can be adjusted to desired high and low values for the process. Whenever a point records outside these preset limits, the output is typed in red. When it falls again within the limits set, it again logs in black. In addition to logging off-normal points during read-out hourly and on-demand, the machine scans for off-normal values at the rate of five points per second. Off-normal values so scanned are typed separately for immediate attention. **In addition, any point can be connected to an instantaneous digital read-out by plugging in the appropriate connection.**

5. Computer Runs from Punched Tape

All output data are also automatically punched on tape—giving a daily summary of unit performance. This summary is also logged on the accounting section of the log sheet. Tapes from the several information systems are sent to a central data processing facility—where a summary for the preceding 24 hours takes the computer only a few minutes. The summary shows averages for important temperatures and pressures, feedstocks, and utilities used by each unit, and the volume of each product made.

All instrumentation equipment is serviced under a single contract for instrument maintenance by Panellit Service Corporation. This organization was founded expressly by Panellit, Inc., when their contract to maintain the Panellit-built information systems was extended to all instrumentation in the refinery. This is believed to be the first such overall refinery instrumentation maintenance contract in existence.

Virtually all of the signaling devices to be maintained are pneumatic. While electric and electronic devices were considered, pneumatic was chosen for several reasons:

1. At the time the refinery was on the drafting boards, the designers felt there was a lack of standard electric signal devices—and, rather than be tied to one supplier, Tidewater chose pneumatic.
2. Many of the control personnel came from the old Bayonne refinery, and were familiar with pneumatic instrumentation.
3. By keeping the control rooms centrally located, transmission distances were kept to an average of 250 feet so that speed of response was not critical.
4. In a few instances, electronic instrumentation was selected.

A brief list of instruments in this system is impressive:

900 Flowmeter points
300 Pressure points (not including gages)
350 Level Controllers (not including gages)
120 Temperature Controllers
1400 Thermocouples
400 Dial Thermometers
1000 Control Valves
23 Oxygen Analyzers

and a number of other instruments unique to fluid processing.

There is no doubt that this refinery and its automatic information-handling system is a high-water mark on the incoming flood of data automation.

Some Uses of Computers

(Continued from page 14)

refinery products to minimize shipping costs, maximize profit.
Pipeline design
Preventive maintenance

4. Refinery Design and Operation

Design and operation of refinery and gas plant components

Chemical and physical, such as: Plate-to-plate distillation; heat exchanger; condensation; stripping; flash vaporization; gas vapor cycle; liquid-vapor equilibrium; Propane-Propylene; reflux rate; storage separation; hydrocarbon processing

Mechanical, such as: Pipe stress analysis; vessel calculations, fractionator design, machine breakdown, engine performance, power plant and network design.

Application of linear programming (simplex techniques) to the blending of fuel oils and gasoline and crude allocation, such as:
- —Operating plans
- —Refinery simulation
- —Potential value of virgin and intermediate refinery streams
- —Calculation of manufacturing costs, overall profit, and material balance
- —Analysis of costs to indicate which equipment to modify or replace
- —Signaling trouble spots where costs and scheduling vary from standards
- —Optimum crude allocation to several refineries
- —Optimum inventory and production rates for variable seasonal requirements
- —Octane blending correlations

Control of Quality, Flow, Inventory, such as:
- —Mass spectrometer analysis; pilot and unit run data; daily inventory; test analyses; absorption integrals

Economic Analysis, such as:
- —Evaluation of crude oils; incremental costs; corrosion analysis; fuel disposal; replacement; costing of a project

Mathematical Determinations, such as:
- —Multiple regression and correlation; matrix inversion; evaluation of definite integrals; multisource planar diffusion problems; thermodynamic functions; heat transfer equations; finite difference equations.

5. Marketing

Application of operations research techniques to marketing problems, such as:
- —Location and capacity of warehouses
- —Location of new marketing areas
- —Location of new service stations

(Please turn to page 34)

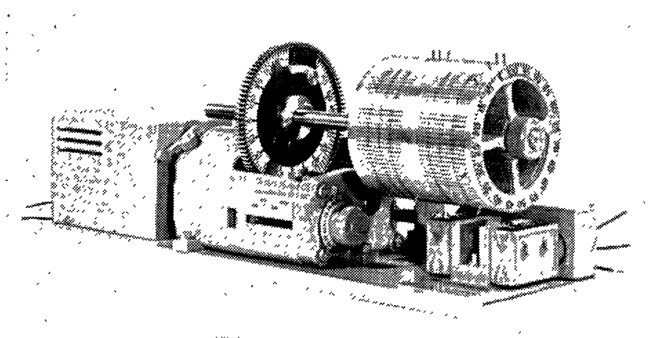
INDUSTRY NEWS NOTES

Ed Burnett

New York, N. Y.

LITHOGRAPHER UNION ADVOCATES AUTOMATION

A $2 MILLION union-management fund to promote automation in the graphic arts industry was proposed recently by Edward Swayduck, president of Local 1, New York, of the Amalgamated Lithographers of America. As chairman of the union's New Machines and Manning Committee, he made this proposal before the annual convention of this national union of 35,000 members. This proposal reversed labor's usual position on automation, advocating equal contributions by union and management to finance the harnessing of the "new technological developments for the mutual benefit of the industry and the consuming public." Training lithographers now for future handling of new automation equipment, said Mr. Swayduck, should lead to an orderly transition to the revolutionary changes on the horizon of lithography and printing.



ADJUSTABLE PROGRAM TIMER

COUNTER AND CONTROL CORP., Milwaukee, Wisconsin, has added a synchronous motor drive to its adjustable multiple circuit program timer. Thus the machine provides a continuous or repeat-cycling timer with great range and flexibility and fine degrees of adjustment.

The unit has dial controlled choice of the overall time range in one-second increments from zero to one-half the maximum range, and in two-second increments for the second half of the range. The timer can be arranged for any time cycle, up to a maximum of 4000 seconds (66 2/3 minutes) in 100 second increments. The timer, designed to control a signal circuit, provides as many intermediate switching events in one second increments as desired, limited only by the total cycle time.

Changing the intermediate switching events is effected through pluggable switch pins inserted into a series of holes arranged in a helical pattern. To aid in correct selection of pin holes, the timer includes a reference grid system employing numbered dials at each end of the cam cylinder and tracer lines at 500 second intervals along the length of the cylinders.

TAPE CONTROLLED WELDER

GENERAL ELECTRIC CO., Specialty Control Dept., Waynesboro, N.C., has developed a welding machine controlled by a punched tape that automatically makes 1600 precisely controlled spot welds on a jet engine part in 1½ hours—or one-quarter the time required when welding by hand. All the machine attendant needs to do is turn the machine on and off.

NEW NPN TRANSISTORS

GENERAL TRANSISTOR CORP., Jamaica, N.Y., has announced four new NPN germanium alloyed junction transistors, especially useful for applications amplifying small signals and switching at high speed. The four units offer alpha cutoff frequencies ranging from 0.5 to 9.0 megacycles and ranges of small signal current gain from 15 to 125.

SARNOFF SEES "DIAGNOSTIC ROBOTS"

COMPUTERS STORING the latest medical knowledge and the complete previous record of a patient was a recent forecast by David Sarnoff, chairman of the board of Radio Corporation of America. They will be important factors in future medical examination and diagnosis, he said. Such "diagnostic robots" will give an almost instantaneous picture of changes in the patient, and applicable therapies and treatments for the physician to choose between, giving him in a machine the equivalent of a whole brigade of consulting physicians and laboratory technicians.

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Max S. Weinstein, 25 Highland Drive, Albany 3, N. Y.

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EDMUND C. BERKELEY, Editor.

SWORN TO and subscribed before me, a notary public in the Commonwealth of Massachusetts, on October 2, 1957.

George W. Odell, Notary Public

My commission expires March 17, 1962.

Bulk Subscriptions

These rates apply to prepaid subscriptions to "Computers and Automation" coming in together direct to the publisher. For example, if 7 subscriptions come in together, the saving on each one-year subscription will be 24 percent, and on each two-year subscription will be 31 percent. The bulk subscription rates, and savings to subscribers depending on the number of simultaneous subscriptions received, follow:

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3	5.00, 9	8.80, 16
2	5.25, 5	9.55, 9

For Canada, add 50 cents for each year; outside of the United States and Canada, add $1.00 for each year.

Special Issues

The June issue of COMPUTERS AND AUTOMATION in each year commencing with 1955 is a special issue, "The Computer Directory and Buyers' Guide" containing a cumulative "Roster of Organizations" and a cumulative "Roster of Products and Services in the Computer Field", and other reference information.

From time to time we publish a cumulative "Who's Who in the Computer Field", as an extra number of COMPUTERS AND AUTOMATION. The last one published, "Who's Who in the Computer Field, 1956-57", was issued in March 1957, and contained over 12,000 entries.

EASTERN JOINT COMPUTER CONFERENCE

WASHINGTON, D. C., DECEMBER 9-13, 1957

PROGRAM, TITLES, AND ABSTRACTS

THE Eastern Joint Computer Conference and Exhibition for 1957 will take place at the Sheraton Park Hotel, Washington, D. C., Monday, December 9, to Friday, December 14, 1957. It is sponsored jointly by the Institute of Radio Engineers, the Association for Computing Machinery, and the American Institute of Electrical Engineers, through the National Joint Computer Committee formed from the three societies. Non-members as well as members are cordially invited. It is expected that the proceedings of the conference will be published, and will be available from any one of the sponsoring societies, as for example, the Association for Computing Machinery, 2 East 63 St., New York 21, N. Y. Following is the program, the titles of papers, and abstracts.

For more information about the conference, and for advance registration ($4 before November 25, $5 thereafter) write to Mr. Richard T. Burroughs, Registration Chairman, 1957 EJCC, IBM Corp., 1220 Nineteenth St., N.W., Washington, D. C., giving your full address.

Conference Theme

COMPUTERS WITH DEADLINES TO MEET

"Computers with deadlines to meet" is the idea that modern automatic control and simulation systems are assuming a structure like that of an elementary organism, with its feelers, its action members, and its central nervous system. Often, in our automatic systems, we can identify a trio of sub-systems that function in a similar way—the "receptor," the "effector," and, for the central nervous system, a computer. Whenever the pace of receptor and effector set the tempo of the machine system, there is a permissible time for data to get through the computer. Computers that can meet such "deadline" requirements, usually called "real-time" or "on-line" computers, are growing very rapidly in importance.

For this reason, the theme "Computers with Deadlines To Meet" is the common denominator which runs through the wide range of computer problems and applications to be discussed in the nine sessions and fifty presentations of the 1957 Conference. Whether our interest is in the analog or digital approach to design, or in applications in the field of simulation, automatic machinery, traffic control, or data processing, we face the common and ever-pressing demand to shorten and centralize the action-reaction cycle of our computer nervous systems. The Program Committee believes that by sharing the experiences and ideas on this common problem in varied technical and subject matter fields, all conference participants will be better equipped to meet their own computer deadlines.

S. N. Alexander, 1957 Conference Chairman
U. S. Bureau of Standards, Washington 25, D. C.

CONFERENCE CALENDAR

Sunday, Dec. 8
12:00 Noon–6:00 P.M., Registration.

Monday, Dec. 9
9:00 A.M., Registration opens.
10:00 A.M.-12:30 P.M., INDUSTRIAL CONTROL COMPUTERS AND INSTRUMENTATION (PART ONE). Chairman: Cal Johnson, Bendix Aviation Corporation.
2:00 P.M.-5:00 P.M., INDUSTRIAL CONTROL COMPUTERS AND INSTRUMENTATION (PART TWO). Chairman: Frank Reintjes, Massachusetts Institute of Technology.
6:00 P.M.-8:00 P.M., Cocktail Party.
10:00 A.M.-9:00 P.M., Exhibits.

Tuesday, Dec. 10
9:00 A.M.-12:00 Noon, TRAFFIC CONTROL, NAVIGATION AND SURVEILLANCE (PART ONE). Chairman. Morris Rubinoff, University of Pennsylvania.
12:15 P.M.-1:45 P.M., Luncheon. Speaker: To be announced.
2:00 P.M.-5:30 P.M., SIMULATION IN REAL-TIME. Chairman: Robert M. Howe, University of Michigan.
10:00 A.M.-9:00 P.M., Exhibits.

Wednesday, Dec. 11
9:00 A.M.-12:30 P.M., SYNTHESIS OF REAL-TIME SYSTEMS. Chairman: John W. Carr III, University of Michigan, President ACM.
2:00 P.M.-5:00 P.M., TRAFFIC CONTROL, NAVIGATION AND SURVEILLANCE (PART TWO). Chairman: Arnold A. Cohen, Sperry-Rand Corporation.
6:00 P.M.-7:00 P.M., Hospitality Tour.
7:00 P.M.-9:30 P.M., Banquet. Speaker: E. R. Quesada, Special Assistant to the President for Airways Modernization.
10:00 A.M.-6:00 P.M., Exhibits.

Thursday, Dec. 12
9:00 A.M.-12:00 Noon, ON-LINE BUSINESS SYSTEMS. Chairman: Richard E. Sprague, Teleregister Corporation.
12:15 P.M.-1:45 P.M., Luncheon. Speaker: Max Woodbury, New York University. Topic: "The Voters Won't Wait!"
2:00 P.M.-5:30 P.M., DIGITAL COMMUNICATIONS TECHNIQUES. Chairman: Isaac L. Auerbach, Auerbach Electronic Corporation.
10:00 A.M.-9:00 P.M., Exhibits.

Friday, Dec. 13
9:00 A.M.-1:00 P.M., DOCUMENT READING, PATTERN RECOGNITION AND OUTPUT DEVICES. Chairman: Howard Engstrom, Deputy Director, National Security Agency.
1:00 P.M., Conference Adjourns.

TECHNICAL SESSION PROGRAM, TITLES, AND ABSTRACTS

Monday, December 9, 10:00 A.M.

Session I: Industrial Control Computers and Instrumentation (Part One). Session Chairman: J. F. Reintjes, Massachusetts Institute of Technology.

1. THE ELECTRONIC PHASE SHIFT DECODER

G. T. Moore
Concord Controls, Inc., Boston, Mass.

Digital-to-analog conversion is a necessary step in continuous position control systems which employ digital signals. One form of digital signal is a train of "command" pulses where the controlled position must change by a fixed increment in response to each "command" pulse. This paper describes a decoder in which two chains of flip-flops operated as counters derive the signals transmitted to a receiving synchro serving as the position feedback device.

2. SYSTEMS DESIGN OF A NUMERICALLY CONTROLLED MACHINE TOOL

E. C. Johnson and Y. C. Ho
Bendix Aviation Corporation, Detroit, Mich.

The primary objective of a numerically controlled machine-tool system is direct production from engineering data of finished machine parts with high accuracy and little human effort. A system concept comprising a small general-purpose digital computer with a flexible automatic programming system and, linked by means of a punched tape, the machine tool and control unit combination is presented.

3. LOGICAL ORGANIZATION OF THE DIGIMATIC COMPUTER

J. Rosenberg
Electronic Control Systems, Inc., Los Angeles, Calif.

Initially, specifications for input data to the DIGIMATIC computer were formulated and output requirements determined. The black box to bridge between input and output with adequate speed, complexity, cost, and built-in programming characteristics is described in block diagram form. A short film demonstrating input and output operation will be shown, as well as machine pieces produced.

4. THE MASTER TERRAIN MODEL SYSTEM

J. A. Stieber
U. S. Naval Training Device Center, Port Washington, N. Y.

An automatic data reduction system which will extract three-dimensional contour information from maps of various projections, serial stereo photographs, or existing master models, and store these data in a universal format is described. Now in prototype production, it consists of a map scanning unit, a recording and playback unit, and a contour cutting mechanism, all controlled by digital computers.

Monday, December 9, 2:00 P.M.

Session II: Industrial Control Computers and Instrumentation (Part Two). Session Chairman: E. C. Johnson, Bendix Aviation Corporation, Detroit, Mich.

1. A COORDINATED DATA PROCESSING SYSTEM AND ANALOG COMPUTER TO DETERMINE REFINERY PROCESS OPERATING GUIDES

C. H. Taylor
Fisher and Porter Co., Hatboro, Pa.

The design features and operation of a special-purpose analog computer for Esso Research and Engineering Co. are described. The computer has been automatically programmed to sequentially determine a series of Process Operating Guides. Although it is not dynamically varying process set points, the calculated data should lead to a better understanding of refinery performance.

2. SYSTEM CHARACTERISTICS OF A COMPUTER-CONTROLLER FOR USE IN THE PROCESS INDUSTRIES

W. E. Frady and M. Phister, Jr.
Ramo-Wooldridge Corporation, Los Angeles, Calif.

Studies have been carried out with the objective of developing digital control systems for specific operations in the process industries. The requirements common to all these control systems are discussed and a set of computer-controller characteristics which satisfy these requirements described. The RW-300 computer-controller, especially designed for process control applications, is also described.

3. REAL-TIME HYBRID COMPUTERS FOR ELECTRONIC CONTROL SYSTEMS

C. T. Leondes
University of California, Los Angeles, Calif.

The more unified point of view of considering both analog and digital elements has been recently evolving as a concept in the design of electronic control systems A critical study of the field of hybrid computers with a statement of some of the outstanding problems and their solutions is presented as well as a description of a new mechanization for control systems.

4. REAL-TIME PRESENTATION OF REDUCED WIND TUNNEL DATA

M. Bain and W. Hoover
Calif. Inst. of Technology, Jet Propulsion Lab., Pasadena, Calif.

The Jet Propulsion Laboratory has two supersonic wind tunnels in operation and one hypersonic wind tunnel under construction. The ability to save wind tunnel operating time by monitoring reduced coefficients has stimulated the plans for a data processing system to supply reduced data in real time. This paper presents the data handling and computer system proposed by the Jet Propulsion Laboratory for real time presentation of wind tunnel data.

5. MECHANIZATION OF LETTER MAIL SORTING

I. Rotkin
National Bureau of Standards, Washington, D. C.

Mail processing in the U. S. post offices today is almost entirely manual. This paper describes a study of the sorting of letter mail with the objective of mechanizing this operation and discusses the system features of sorting equipment in development. The operation of the four basic units — code printer, code reader, translator and distributor — is presented as well as the systems and engineering problems encountered.

Cocktail Party — 6:00 p.m. — 8:00 p.m. — Shoreham Hotel

Tuesday, December 10, 9:00 A.M.

Session III: Traffic Control, Navigation and Surveillance (Part One). Session Chairman: Morris Rubinoff, Philco Corporation, Philadelphia, Pa.

1. PREPARATIONS FOR TRACKING AN ARTIFICIAL EARTH SATELLITE AT THE VANGUARD COMPUTER CENTER

D. A. Quarles, Jr.
International Business Machines Corp., New York, N. Y.

An IBM 704 is in use at the Vanguard Computing Center to perform calculations for tracking artificial earth satellites launched during the International Geophysical Year. Deadlines pertain to processing the observational data and to distributing predicted position information. Principal aspects of the structure and operational characteristics of the programming system are described.

2. USE OF A DIGITAL COMPUTER FOR AIRBORNE GUIDANCE AND NAVIGATION

S. Zadoff and J. Rattner
Sperry Gyroscope Company, Great Neck, N. Y.

Following a general statement on the use of digital computers in control loops and a brief statement as to the range of requirements of such computers, particular emphasis is placed on the application to CYTAC, an airborne long-range all-weather tactical bombing system. The computer in CYTAC is used as a guidance computer, as a system component, and as a source of automatic bombing information.

3. EXPERIMENTATION ON THE HUMAN OPERATOR TIE-IN TO AN AIRBORNE NAVIGATION COMPUTER CONTROL SYSTEM

C. A. Bennett
International Business Machines Corp., Oswego, N. Y.

In an airborne navigation system, the human operator recognizes and essentially tells the computer to correct for location errors indicated on the topographical display. Such tracking has typically involved continuous display from analog computers in the system. A series of experiments to determine the optimum solution rate by digital computers for periodic display will be described.

4. MULTI-WEAPON AUTOMATIC TARGET AND BATTERY EVALUATOR

A. E. Miller
Burroughs Corp., Paoli, Pa.

This paper will present the operational organization of the MATABE with respect to the real-time air defense system for which it was designed. The types and methods of computation of this large-scale digital computer, probably the first whose design was tailored to effect a control function, will be discussed, together with related topics.

5. CONTROL OF AUTOMOBILE TRAFFIC—A PROBLEM IN REAL-TIME COMPUTATION

D. L. Gerlough
University of California, Los Angeles, Calif.

The principal deterrent to the great and increasing need for urban traffic control on an area basis by means of a computer has been lack of knowledge of traffic flow behavior. Simulation has been considered as a computational technique for real-time control and as a laboratory tool. The research to date, both theoretical and by simulation, is reviewed and areas requiring further research are indicated.

12:15 p.m. to 1:45 p.m.—LUNCHEON—Sheraton Park Hotel.
Speaker: R. J. Slutz, National Bureau of Standards, Boulder, Colo.
Topic: IGY and Automatic Data Handling.

Tuesday, December 10, 2:00 P.M.

Session IV: Simulation in Real Time. Session Chairman: R. M. Howe, University of Michigan.

1. PHYSICAL SIMULATION OF NUCLEAR REACTOR POWER PLANT SYSTEMS

J. J. Stone, B. B. Gordon and R. S. Boyd
Battelle Memorial Institute, Columbus, Ohio

The operating characteristics of a hydraulically controlled nuclear reactor power plant were analyzed by simulation methods. This study which involved complete electronic simulation followed by a physical mock-up of the hydraulic control system coupled with an electronic simulation of the remaining parts of the system is discussed.

2. APPLICATIONS OF COMPUTERS TO AUTOMOBILE STABILITY AND CONTROL PROBLEMS

R. H. Kohr
General Motors Corporation, Detroit, Mich.

Research has resulted in a verified mathematical model which describes the lateral rigid-body motions produced in an automobile by steering control inputs. The system of equations representing the "handling motions" of an automobile on a flat road is presented together with a description of methods used to verify them by means of full-scale response tests made with an instrumented vehicle.

3. COMBINED ANALOG-DIGITAL SIMULATION OF SAMPLED DATA SYSTEMS

H. K. Skramstad, A. A. Ernst, and J. P. Nigro
National Bureau of Standards, Washington, D. C.

Many complex control systems have the common characteristic that they are closed-loop sampled-data systems involving human beings in control loops. While ordinary analytical means have proved inadequate, simulation is proving an effective tool in their study. A simulation facility which interconnects the digital computer SEAC, an analog computer, and human-operated display and control equipment is described.

4. FACILITIES AND INSTRUMENTATION REQUIRED FOR REAL-TIME SIMULATION INVOLVING SYSTEM HARDWARE

A. J. Thiberville
Convair, Ft. Worth, Texas

This paper describes real-time simulation as used in closed-loop testing involving system hardware. Primary emphasis is placed on the hardware and associated instrumentation required. The discussion is general in nature, but evolved primarily from experience with testing B-58 systems.

5. EXTENDING FLIGHT SIMULATOR TIME SCALE

E. J. McGlinn
Bendix Aviation Corporation, Detroit, Mich.

The Bendix Three-Dimensional Flight System Simulator is a device developed specifically for simulating high-performance air-to-air missile systems. Although the dynamic range of its three-axis flight table exceeds 1,000:1, some applications require performance on the low side of the range. Two techniques for extending the range into the lower dynamic performance region are presented.

6. ANALOG, DIGITAL, AND COMBINED ANALOG-DIGITAL COMPUTERS FOR REAL-TIME SIMULATION

W. W. Seifert
Massachusetts Institute of Technology, Cambridge, Mass.

For simulation of dynamic systems, analog and digital computers have disadvantages as well as advantages. For complex dynamic problems, analog techniques have the advantages of speed and direct analogy, with principal drawbacks of limited accuracy and the difficulties arising in problem changeover. Digital machines have high accuracy and quick changeover but require long solution time. The several developments of computers especially designed to meet the needs of real-time simulation are described.

Wednesday, December 11, 9:00 A.M.

Session V: Synthesis of Real-Time Systems. Session Chairman: John W. Carr, III, University of Michigan, Ann Arbor, Mich.

1. THE PLACE OF SELF-REPAIRING FACILITIES IN COMPUTERS WITH DEADLINES TO MEET

L. Fein, Consultant
Palo Alto, Calif.

When the time available to do a job equals the time required for computer solution, the equipment is required to operate in real-time. For problems like this, which essentially require 100% equipment reliability, down-time must be zero. Automatic error detection, automatic failure diagnosis, and automatic failure repairing (self healing) philosophies and techniques that may effectively reduce computer down-time to zero will be discussed.

2. ORGANIZING A NETWORK OF COMPUTERS TO MEET DEADLINES

A. L. Leiner, W. A. Notz, J. L. Smith
and A. Weinberger
National Bureau of Standards, Washington, D. C.

This paper discusses some system requirements that are imposed on computers by the need to meet deadlines. It describes logical techniques for hooking together two or more digital systems into a network of computers, so that all of the machines in the network can be made to work collaboratively on a job that is beyond the capability of any single machine.

3. A PROGRAM-CONTROLLED PROGRAM INTERRUPT SYSTEM

F. P. Brooks, Jr.
International Business Machines Corp., Poughkeepsie, N. Y.

To facilitate real-time operation of a new large-scale computer system, an instruction control system has been designed which permits automatic interruption of the computer program upon occurrence of any of a large number of conditions. Special provisions are also described that permit interruptions of interruptions to occur without causing program confusion.

4. A TRANSISTOR CIRCUIT CHASSIS FOR HIGH RELIABILITY IN MISSILE GUIDANCE SYSTEMS

G. A. Raymond
Remington Rand UNIVAC, St. Paul, Minn.

The ground guidance computer for an intercontinental ballistic missile requires an entirely new order of magnitude of freedom-from-error. Significant features of its circuit design are explained, and the engineering and manufacturing operations that result in such circuit reliability are described.

5. A METHOD OF COUPLING A SMALL COMPUTER TO INPUT-OUTPUT DEVICES WITHOUT EXTENSIVE BUFFERS

J. H. Randall
National Cash Register Company, Dayton, Ohio

A system is described in which a small magnetic core memory was synchronized to the communication devices, thus eliminating expensive buffering. The input and output involved magnetic ledger cards, an accounting machine and punched cards. Techniques used to transfer data between these sources and the computer are described.

6.THE OPTIMUM SYNTHESIS OF COMPUTER LIMITED SAMPLED DATA SYSTEMS

A. S. Robinson
Bendix Aviation Corp., Teterboro, N. J.

This paper discusses the synthesis of systems in which a single digital computer is used in conjunction with an array of outputs either to simulate the dynamic transfer characteristics of a number of linear continuous systems or to filter random messages from a number of continous inputs. Although the computer operates on and supplies sampled data, the synthesis techniques assist the system designer in determining optimum match between the actual continous system outputs and the ideal outputs.

Wednesday, December 11, 2:00 P.M.

Session VI: Traffic Control, Navigation and Surveillance (Part Two). Session Chairman: Arnold A. Cohen, Remington Rand UNIVAC, St. Paul, Minn.

1. SAGE — A DATA PROCESSING SYSTEM FOR AIR DEFENSE

R. R. Everett, C. A. Zraket and H. D. Bennington
MIT Lincoln Laboratory, Lexington, Mass.

SAGE is the data processing portion of our continental air defense system. Each of the 30 Direction Centers has its own computer in communication with a variety of terminal devices to maintain a current record of the sector situation for selective display. Major requirements, salient features and the capability of SAGE data processing are described.

2. AN/FST-2 RADAR PROCESSING EQUIPMENT FOR SAGE

H. W. Taylor, E. W. Veitch and J. Wylen
Burroughs Corporation, Paoli, Pa.

The AN/FST-2, designed to operate as part of the SAGE system, is a computer that receives radar data, processes it, and transfers the processed data to the Direction Center. In order to handle data that varies unpredictably in amount and structure, a special-purpose machine was designed. The paper discusses its design and operation.

3. OPERATION OF THE SAGE DUPLEX COMPUTERS

P. R. Vance, MIT Lincoln Lab., Lexington, Mass.
L. G. Dooley, Rand Corp., Lexington, Mass.
C. E. Diss, IBM Corp., Kingston, N. Y.

Large-scale digital computers perform the routine control and data processing functions of the SAGE Direction Centers. Duplexed computers are provided to assure system reliability around the clock. This paper describes the functions of the standby computer and the process of transfer of the air defense function from the active computer to the standby computer.

4. A DIGITAL SYSTEM FOR POSITION DETERMINATION

D. C. Ross
IBM Corporation, Kingston, N. Y.

A prime requirement in improving the nation's air traffic control system is the provision of frequent, accurate, and identified position information on all aircraft in the system. This paper describes a system which satisfies these requirements for all aircraft aloft on a single pair of radio frequency channels without infra-system interference. Flight tests of the radio communication portions of the system have been successfully completed.

5. REAL-TIME DATA PROCESSING FOR CAA AIR TRAFFIC CONTROL OPERATIONS

G. E. Fenimore
CAA Tech. Dev. Evaluation Center, Indianapolis, Ind.

As a result of experimentation with a special-purpose message storage and processing system, requirements for an air traffic control system were developed and became the basis of a three-phase program for evolutionary improvements in air traffic control operations. The first phase, now in the development and evaluation stages, is described and the objectives of the second phase reviewed.

6:00 p.m. to 7:00 p.m. Hospitality Hour
7:00 p.m. to 9:30 p.m. BANQUET. Speaker: E. R. Quesada, Chairman, Airways Modernization Board.

Thursday, December 12, 9:00 A.M.

Session VII: On-Line Business Systems. Session Chairman: R. E. Sprague, Teleregister Corporation, Stamford, Conn.

1. DESIGN TECHNIQUES FOR MULTIPLE INTERCONNECTED ON-LINE DATA PROCESSORS

F. J. Gaffney and S. Levine
Teleregister Corporation, Stamford, Conn.

Three important characteristics of multiple interconnected on-line data processors are reliable performance, use of specialized input-output devices, and unusual communication design methods. The application of these techniques to several special-purpose data handling systems is discussed and their importance to overall system performance analyzed.

2. RESERVATIONS COMMUNICATIONS UTILIZING A GENERAL-PURPOSE DIGITAL COMPUTER

R. A. McAvoy
Eastern Airlines, Miami, Fla.

This is a review of the reasoning leading to the design of Eastern Airlines' new reservation system. The installation represents one of the first applications of an intermediate speed general-purpose, digital computer to a real-time data processing application. The unique Ticket Agent Set (input-output device) and the communications facilities will also be described.

3. STOCK TRANSACTION RECORDS

A. H. Payne
Melpar, Inc., Boston, Mass.

The output of the New York Stock Exchange Ticker (6-channel punched paper tape) is run through a converter to produce a paper tape input to the Datatron Computer. Hourly indices of the highs, lows, and last prices for 500 selected stocks are computed for Standard and Poor's Corporation and transmitted to their New York office via teletype.

4. ON-LINE SALES RECORDING SYSTEM

J. S. Baer, A. S. Rettig and I. Cohen
Radio Corporation of America, Camden, N. J.

This paper presents an equipment description of a pilot on-line sales recording system consisting of point-of-sale units connected to a central computer by means of an input-output buffer unit. Its operating characteristics are such that they may be extended to include, for example, inventory and production control, and the handling of transportation reservations.

5. THE G. E. INTEGRATED BANK DATA PROCESSING SYSTEM MODEL 2B100

J. Levinthal, J. Weizenbaum and H. Herold
General Electric Co., Palo Alto, Calif.

This paper describes a new system evolved in converting the ERMA prototype into production systems capable of meeting the stringent deadlines imposed by banking applications. Characteristics of the data processor and the automatic electronic reading device are presented, and programming techniques for gaining operating speed are discussed.

12:15 p.m. to 1:45 p.m. LUNCHEON — Shoreham Hotel. Speaker: Max Woodbury, N. Y. U. Topic: "The Voters Won't Wait!"

Thursday, December 12, 2:00 P.M.

Session VIII: Digital Communications Techniques. Session Chairman: I. L. Auerbach, Auerbach Electronic Corporation, Narberth, Pa.

1. DERIVATION OF BUSINESS MACHINES DATA CHANNELS FROM STANDARD TELEPHONE LINES FOR SIMULTANEOUS TRANSMISSION WITH SPEECH

E. Hopner
International Business Machines Corp., San Jose, Calif.

This paper describes the basic principle of how to derive data channels from regular telephone channels, allowing for simul-

(Please turn to page 33)

NEW PATENTS

RAYMOND R. SKOLNICK, Reg. Patent Agent

Ford Inst. Co., Div. of Sperry Rand Corp.

Long Island City 1, New York

THE following is a compilation of patents pertaining to computers and associated equipment from the "Official Gazette of the United States Patent Office," dates of issue as indicated. Each entry consists of: patent number / inventor(s) / assignee / invention. Printed copies of patents may be obtained from the U.S. Commissioner of Patents, Washington 25, D. C., at a cost of 25 cents each.

August 13, 1957 (Continued):

2,803,407 / Jacques Berger, Chicago, Ill. / Welding Research, Inc., Chicago, Ill. / A counting system including step-by-step devices providing predetermined operation.

2,803,415 / Edward F. Mac Nichol, Jr., Hamilton, Mass. / U.S.A. / An automatic hyperbolic navigation system for guiding a mobile object along a predetermined course.

2,803,704 / Joachim Grambow, Eutingen Baden, and Ewald Rieger, Villingen, Black Forest, Germany / Saba August Schwer Sohne G. m. b. H., Villingen, Black Forest, Germany / An electrical repeating method and apparatus

2,803,815 / Karl N. Wulfsberg, Bedford, Mass. / U.S.A. / A digital-to-analog converter.

2,803,818 / Robert M. Byrne, Hartsdale, N. Y. / Goodyear Aircraft Corp., Akron, Ohio / A pulse time data reducer.

2,803,820 / Everhard H. B. Bartelink, Cambridge, and Willoughby M. Cady, Belmont, Mass. / U.S.A. / A computer for use with aircraft and radio object locating equipment.

August 27, 1957: 2,804,264 / Robert G. Stern, West Caldwell, N. J. / Curtiss-Wright Corp., Del. / A mock flight computing and indicating system for vertical system.

2,804,570 / Graham I. Thomas and Brian W. Pollard, Hollinwood, Eng. / National Research Development Corp., London, Eng. / A method of electrostatic storage of digital information.

2,804,605 / John E. DeTurk, Ann Arbor, Mich. / Raytheon Manufacturing Co., Waltham, Mass. / A magnetic recording playback circuit.

2,804,612 / Job R. Rogers, Cambridge, Mass. / U.S.A. / An automatic range tracking circuit.

2,804,613 / Leland J. Haworth, Champaign, Ill. / U.S.A. / A ship centered present position indicator.

Sept. 3, 1957: 2,805,020 / Walter C. Lanning, Plainview, N. Y. / Sperry Rand Corp., Del. / A digital computer circuit for selectively performing the arithmetic operations of addition and subtraction in the series mode upon a first binary digital number by a second binary digital number.

2,805,021 / Erich S. Weibel, Summit, N. J. / Bell Telephone Lab., Inc., New York, N. Y. / An electronic analog multiplier which establishes a signal proportional to the product of a first factor signal and a second factor signal.

2,805,022 / Rulon G. Shelley, Downey, Calif. / North American Aviation, Inc., Calif. / A vector filter system for filtering a vector quantity expressed in a coordinate system free to rotate.

2,805,363 / George T. Baker, Taplow, and Wincenty Bezdel, London, Eng. / British Tele-Communications Research Lim., Taplow, Eng. / A single state binary counting circuit.

2,805,374 / Donald McL. Frothingham, Darien, Conn. / Barnes Eng. Co., Del. / A data conversion system.

2,805,407 / Robert L. Wallace, Jr., Plainfield, N. J. / Bell Telephone Lab., Inc., New York, N. Y. / A magnetic register.

2,805,408 / Harold J. Hamilton, Glendale, Calif. / Librascope, Inc., Glendale, Calif. / A magnetic permanent storage and emitting device including a reference portion.

2,805,409 / Lyle W. Mader, Silver Springs, Md. / Sperry Rand Corp., Del. / A data shifting register from magnetic core devices.

Sept. 10, 1957: 2,805,862 / Maurice Soubrier, Paris, France / — / A method and means for recording chiefly on magnetic carriers.

2,806,096 / Nathan Huff Christopher, Falls Church, Va. / — / A reading head for perforated tapes.

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REMARKS:

Eastern Joint Computer Conference

(Continued from page 30)

taneous transmission of speech with little effect on the speech quality. Experiments have been carried out using up to four IBM data transceivers on a single telephone channel simultaneously with speech.

2. A SELF-CHECKING SYSTEM FOR HIGH-SPEED TRANSMISSION OF MAGNETIC TAPE DIGITAL DATA

E. J. Casey and D. W. Fritze
Remington Rand UNIVAC, St. Paul, Minn.

The communications requirements of integrated data processing systems are discussed. Typical data origins, media, codes, formats, and quantities are considered; and data processing, retransmission, and transmission speed and accuracy needs are briefly analyzed prior to a presentation of the logical design and specifications of the Transrecorder. Experimental results obtained in the laboratory and in phone channel tests are also given.

3. COMMUNICATIONS BETWEEN REMOTELY LOCATED DIGITAL COMPUTERS

F. P. Forbath
Collins Radio Company, Cedar Rapids, Iowa

Communication between digital computers doing historical and real-time computations and between accounting type equipment is required on a rapidly increasing scale. Limitations of data communications between remotely located stations severely hamper the advancement in data transfer. Means of adapting the communication links to the stringent requirements of the computers are discussed, followed by a description of Kineplex system.

4. COMMUNICATIONS SWITCHING SYSTEMS AS REAL-TIME COMPUTERS

A. E. Joel
Bell Telephone Laboratories, Whippany, N. J.

Communication switching systems are probably the oldest known form of real-time digital data processing systems. This paper describes the similarities and differences between communication switching systems and digital computers and then analyzes some of the design features which are made necessary in communication switching systems as a result of its real-time information processing aspects.

5. AN INTRODUCTION TO THE BELL SYSTEM'S FIRST ELECTRONIC SWITCHING OFFICE

R. W. Ketchledge
Bell Telephone Laboratories, Whippany, N. J.

The first fully electronic telephone central office will be put into experimental Bell System service in late 1959. The electronic switching system consists of electronic voice frequency switches controlled by electronic memory and logic. Operation of the system is outlined, and the characteristics of its components are described.

6. TRAFFIC ASPECTS OF COMMUNICATIONS SWITCHING SYSTEMS

J. A. Bader
Bell Telephone Laboratories, New York, N. Y.

To design a communications switching system which provides a satisfactory grade of service at minimum cost, an understanding of the nature of the offered traffic is necessary. This paper discusses the character of the input sources and the effect of service criteria on the capacity of the system. Traffic engineering methods with some examples are discussed.

Friday, December 13, 9:00 A.M.

Session IX: Document Reading, Pattern Recognition and Character Synthesis. Session Chairman: Howard Engstrom, National Security Agency, Washington, D. C.

1. THE USE OF AN IBM 704 IN THE SIMULATION OF SPEECH RECOGNITION SYSTEMS

G. L. Schultz
International Business Machines Corp., Poughkeepsie, N. Y.

The simulation approach to the problem of speech recognition requires the construction of a device to select speech events for study and an analog-to-digital converter to transform the acoustic speech signal into a digital representation for use in an IBM 704. This paper discusses the selection device, the analog-to-digital converter, and the set of calculator program thus far evolved.

2. AN AUTOMATIC VOICE READOUT SYSTEM

C. W. Poppe and P. Suhr
Fairchild Controls Corp., Long Island, N. Y.

Capable of being employed with either analog or digital computing systems, the Automatic Voice Readout System offers a new approach to the man-machine coupling problem in real-time computers. The basic system which consists of a vocabulary storage unit, a word sequence control unit, and an input control unit is described and its application to real-time computers discussed.

3. EXPERIMENTAL USE OF ELECTRONIC COMPUTERS IN PROCESSING PICTORIAL INFORMATION

L. Cahn, R. A. Kirsch, L. C. Ray and G. H. Urban
National Bureau of Standards, Washington, D. C.

An input device has been connected to the SEAC computer which can digitalize a photograph and copy it into the SEAC memory. Results of experiments in the analysis and synthesis of pictorial information using this equipment and output equipment produces a photograph from SEAC are given. Equipment capabilities, programming techniques, and areas of application are also discussed.

4. OPTICAL DISPLAYS FOR DATA HANDLING SYSTEM OUTPUT

J. Ogle
Burroughs Corporation, Paoli, Pa.

The human being is still an important part of most computing and data handling systems, and consequently there is a need for techniques for presenting information more efficiently and with greater interpretive reliability. Two specific devices are described which display digital information and prerecorded message or graphic information with maximum use of available display area.

5. DEVICES FOR READING HANDWRITTEN CHARACTERS

T. L. Dimond
Bell Telephone Laboratories, Murray Hill, N. Y.

Nearly all business information processed by computers originates with humans. It is therefore desirable to provide inexpensive means to convert the original record to machine readable form. This paper describes methods and devices which permit machine reading of handwritten arabic numbers and block letter, either as it is produced or later from the written record.

6. AUTOMATIC REGISTRATION IN HIGH-SPEED CHARACTER SENSING EQUIPMENT

A. I. Tersoff
Intelligent Machines Research Corp., Alexandria, Va.

A high-speed system for scanning and analyzing ordinary typewritten or imprinted information on documents is described. This system employs a high resolution mechanical scanner and photo multipliers to convert the optical image into electrical signals. A special locator circuit is employed in the character sensing system to provide automatic registration. Examples are given of its application to various character sensing equipment.

7. THE NCR HIGH-SPEED ELECTROMAGNETIC PRINTER

J. M. Seehof
National Cash Register Co., Hawthorne, Calif.

Designed to operate in conjunction with an electronic data processing system at a rate of 1,000 to 10,000 characters per second, this device operates on the principle of recording a latent magnetic image on special paper, which is essentially magnetic tape with a white top coat. Technical problems involved in recording patterns of desired resolution and means of encoding directly from a computer are discussed.

Some Uses of Computers

(Continued from page 23)

—Calculation of influences of competitive strategy on markets, prices, profits

B. ACCOUNTING AND BUSINESS OPERATIONS

1. Not Peculiar to the Oil Industry

Personnel, such as:
—Payroll; distribution; pay checks; pension and retirement records; saving plans; U.S. bonds.

Sales, such as:
—Sales analysis and forecasting; royalty records; degree day product movement control.

Control of accounts, such as:
—Billing; accounts receivable in detail, aging, statements; purchases; accounts receivable.

Operating reports, such as:
—Operating statements; production and yields; maintenance and repair records; transportation.

Cost accounting, such as:
—Process costs; maintenance costs; job order costs.

Plant and equipment, such as:
—Land and buildings records; lease records; transportation equipment records.

General and corporate, such as:
—Trial balance; budgetary control; tax accounts and reports (including Social Security); stock and dividend accounting; economic studies.

2. Peculiar to the Oil Industry

Production, such as:
—Oil and Gas Accounting (detailed analyses of volume of gas or oil from each producing well, each leasehold, by interest ownership—including value, taxes, royalties, earnings . . . and consolidated checks to interest owners)
—Lease and well expense investment records
—Well, reservoir, and storage records
—Depletion accounting

Pipelines, such as:
—Double set of depreciation records, by pipe segment, and nature of lease—to meet ICC requirements; to tie-in with company books, if not on ICC basis.
—Widespread payroll requirement.

Refining, such as:
—Daily replacement of stock report; bulk station status for production scheduling
—Bulk station wholesale sales and billing accounting
—Scheduling of refinery shutdown and maintenance

Marketing, such as:
—Billing on either Open Item or Balance Forward Basis (Due to advance order procedure to stock retail outlets with batteries, tires, lubes—with deals and delayed payments)
—Degree Day Delivery Scheduling—in which oil moves to selected accounts in accordance with temperature
—Costing of lubricating brands, made at various localities from varying feed stocks, with varying shipping and storing

ADVERTISING INDEX

Following is the index of advertisements. Each item contains: Name and address of the advertiser / page number where it appears / CA number in case of inquiry (see note below) / name of the agency if any.

READER'S INQUIRY

If you wish more information about any products or services mentioned in one or more of these advertisements, you may circle the appropriate CA Nos. on the Reader's Inquiry Form on p. 32 and send that form to us (we pay postage; see the instructions). We shall then forward your inquiries, and you will hear from the advertisers direct. If you do not wish to tear the magazine, just drop us a line on a postcard.

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Here's the mobile, stored-program electronic computer with large capacity...direct print-out of answers

Compact, completely mobile . . . Royal Precision LGP-30 will today furnish you with high-speed electronic computation *wherever you want it* — give you more time for *creative* engineering. And at the lowest cost ever for a complete computer system!

Unusual capacity. Operating from any convenient wall outlet, the self-cooled LGP-30 allows you to work your linear programming *on site.* Used *right at your desk* for any other problem, LGP-30 gives you the greater flexibility of stored-program operation...speed, memory (4096 words) and capacity comparable to equipment many times its size and cost. (In one application, for instance, LGP-30 handled a linear program with as large a matrix as 46 x 27.) Answers are printed out directly in a format which requires no deciphering.

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Wide scope of petroleum applications. Among the jobs for which LGP-30 is now being widely used in the petroleum industry are: pipeline problems, mass spectrometer problems, analysis of oil field production, flash point calculations, pumping and batching scheduling, correlation of seismic records, reservoir engineering studies and well-logging interpretations.

Exceptional value; complete service. Smallest initial investment ever for a complete computer is combined with low operating and maintenance costs. Service facilities are available coast-to-coast.

For further information and specifications, write Royal McBee Corporation, Data Processing Equipment Division, Port Chester, N. Y.

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