FAIRS

IBM

Paul Rand

The IBM Pavilion

New York World's Fair 1964–5

Welcome to the IBM Pavilion.

Walk, through these pages, into a cool shaded garden where new sights, new sounds and new ideas are scattered among a grove of steel trees.

Follow the winding pathways in this man-made forest to the intriguing world of computers—and then on to the People Wall and the Information Machine, the huge elevated theater that appears to float on a green canopy high above the grove of trees.

The Information Machine—with its unique People Wall—is the heart of the IBM show. But if, like all shows, it is meant to amuse and entertain you, there is also a more enduring purpose. We want to share with you some of the excitement we feel about one of man's most valuable tools—the computer. We want to dissolve some of the mystery that makes computers seem remote and strange, and show how these complex machines are based on some rather simple problem-solving methods, similar to those people use in making decisions in everyday life.

The shows are starting up. You can begin your tour at any of the attractions of the IBM Pavilion. Let's begin with one in the heart of the garden itself . . .


IBM

Little Theaters

For hundreds of years, puppets have been entertaining and instructing young and old alike. At the IBM garden, they are up to their old tricks. In three theaters on a terrace among the trees, the mechanical actors set out to make us laugh–and learn. Here, in the Singular Case of the Plural Green Moustache–complete with Baker Street idioms and imported British accents–Sherlock Holmes unravels the mysterious disappearance of the Glasgow Express. The great detective solves the crime through a simple set of questions and answers, to the astonishment of the faithful Dr. Watson.

Holmes: Look at this problem as a series of simple true or false statements.
Watson: Holmes, this isn't catching us any railroad bandits!
Holmes: On the contrary–true or false, on or off, is or isn't, right or wrong–this two-sided logic can solve crimes, and a crime solved is a criminal caught.

The Holmes-Watson dialogue proceeds to test whether or not three railroad switchmen told the truth about the arrivals and departures of the missing train. Through a series of "yes-no" questions, Holmes comes to the startling solution.

Holmes: Then there is only one remaining possibility – all three statements were false. . . .
Watson: Fantastic, Holmes. But why would all three railroad men have lied?
Holmes: Elementary, my dear Watson. Did it not strike you that each of the three was a man with a moustache of a singular green hue?
Watson: And the leader of the Paddington mob is a man with a green moustache!
Holmes: Correct! I suspect we shall have a visitor shortly –

And sure enough, Holmes' deductions lead to the capture of the Paddington mob and its leader. In explaining the solution to the amazed Watson, the great detective points out that he used the same simple logic that is used in programming a computer. Programmers must tell a computer in great detail exactly how the machine should process information logically. By following the programmer's instructions, the computer can make a series of "yes-no" decisions about each new batch of information it receives, so that it can solve complex problems automatically and swiftly.

Across the way another puppet theater is presenting "Computer Day at Midvale." The townspeople have gathered to hear the mayor dedicate Midvale's new computer. To many people – including His Honor – the computer appears to have burst upon the scene suddenly and confusingly. The mayor, somewhat given to oratorical license, tries to explain the computer's importance, while his oversimplifications are corrected by an expert who shares the platform with him.

Never at a loss for words, the mayor triumphantly states at the end that now he understands the computer is "awesomely simple, marvelously complex, slowly programmed, incredibly speedy, shockingly naive and highly sophisticated."

Meanwhile, in a third theater still another play is under way – "Cast of Characters." The characters are the machines and the many people of different skills that must be teamed together to make an effective information-handling system. People, the Narrator emphasizes, are the key to problem-solving – "people who can with intelligence and understanding interpret the output of the machine in a way that is meaningful in our real-life situation . . ."

Optical Scanning and Information Retrieval

Left: *The Probability Machine is a device resembling an enormous upended pinball game. Thousands of plastic balls are dropped from the top of the machine, bouncing down at random from peg to peg until they land in compartments at the bottom. No one can tell in advance where any individual ball will land – but the distribution of all the balls in all the compartments is regular and predictable. These experiments repeatedly test an important aspect of the Theory of Probability–and show how science uses "chance" to detect the laws of order in a world of random events.*

Across the way, where the crowd is watching the bright lights of a display board spell out numbers and messages, you can see one of the newest developments in information-handling devices. For here is a machine that can read numbers just as you write them down.

At two long counters, visitors are asked to select any date since 1851, and to write that date on a card. A visitor hands his card in – marked 3-6-1861 – and the operator feeds it into the experimental optical scanner of an IBM data processing system. In a fraction of a second a tiny electronic scanning beam has outlined the contours of each number by traveling around it in a series of continuous circles, in much the same way that children trace letters for penmanship exercises. The electronic scanner identifies this pattern as a specific numeral. Information about the number is transmitted as a series of electronic pulses to a computer at the IBM Pavilion.

The entire number–the date–is then compared with 40,000 numbers in the computer's "memory" or data storage system. Stored with each date is an important news item of the *New York Times*, one for every day since the *Times* started publishing in 1851. This item is now transmitted to the computer's output unit, which prints it on a souvenir card–and also flashes it in lights over the exhibit. There it is for MARCH 6, 1861: PRESIDENT LINCOLN'S INAUGURAL WORDS TO THE SOUTH: 'WE MUST NOT BE ENEMIES.'

The day the World's Fair opened, a visitor at the IBM Pavilion tried to stump the machine by giving it a date in the future. However, the computer had been programmed to cope with such requests. It printed out a souvenir card that read: "THE DATE YOU HAVE REQUESTED WAS FEBRUARY 3, 1970. SINCE THIS DATE IS STILL IN THE FUTURE, WE WILL NOT HAVE ACCESS TO THE EVENTS OF THIS DAY FOR 2,113 DAYS."

Inserting information into a computer from handwritten documents–such as inventory lists, sales slips and scientific laboratory data – has always been one of the slowest steps in automatic information processing. The usual method has been to convert the handwritten data into computer "language" by typing it on a coding machine or punching it on cards. Eventually, machines that can interpret handwriting directly will shorten the time it takes to process information, and will help man take fuller advantage of the electronic speed of computing systems.


MARCH 6, 1861: PRES. L NCOLN'S INAUGURAL WORDS
TO THE SOUTH: 'WE MUST NOT BE ENEMIES.'
NUMERALS RECOGNIZED

Automatic Language Translation

At the next IBM demonstration another crowd has gathered, intently watching a typist copy sentences from a Russian scientific article. A television screen shows the words in the Russian language alphabet as they are typed. Seconds later, another screen shows understandable English sentences being typed automatically on a printer opposite the typist. The demonstrator explains that the English is a direct translation of the Russian text – with a *computer* doing the translating.

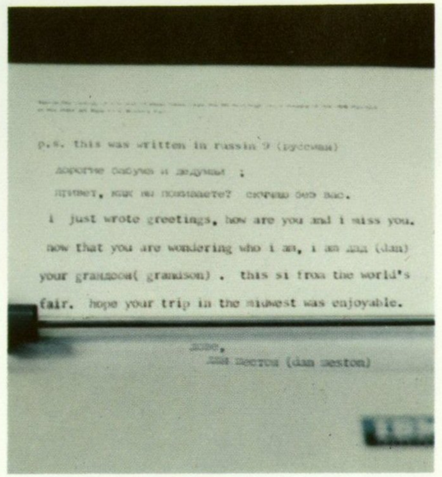
In the few seconds between typing and translation of each sentence, the text has been transmitted 90 miles to an IBM laboratory at Kingston, New York, translated sentence-for-sentence by a computer, and sent back to the output printer at the World's Fair. The English translation is not grammatically perfect, but it's sufficiently clear to tell the interested reader what the subject matter is about, and whether it is worth studying in closer detail.

To make the translation, a light beam searches a plastic "dictionary" disk that has been imprinted with the microscopic code for 200,000 Russian words and their English meanings. It takes 1/40th of a second for the beam to find a word and report its meaning to the computer. Translation, however, is much more complex than merely looking up the meanings of words in a

dictionary. Before a machine can translate any language effectively, language experts must first analyze tens of thousands of words, phrases and sentences and carefully set down the rules of syntax and grammar that describe many of the ways those words and their variations can be used. Then rules must be stored in the translation machine's "memory" device, so that the machine can apply the appropriate rules to each sentence and produce an understandable translation.

Languages are so rich and complex that experts are a long way from the precise definition of all grammatical rules for any language. It may never be possible for a computer to translate the delicate shades of meaning found in a sonnet. For the scientist and engineer, however, machine translation promises to make the world's technical literature more readily available.

Right: *A young visitor at the language translation demonstration peers through a sample of the "dictionary" disk used in IBM's machine translation system. On the original transparent disk, an imprinted band about half an inch wide contains black rectangular code symbols for some 200,000 Russian words, together with their English meanings. On the little girl's sample, the rectangular symbols have been enlarged so they can be seen by the naked eye.*



Today, in an age of rapid scientific discoveries, human translators cannot keep up with the flood of technical information rolling off the world's presses in French, German, Russian and many other languages. For example, only one American scientist out of every thousand reads Russian – yet more than ten billion words on scientific and technical subjects will be written in Russian this year alone. Less than one percent of this will be read by English-speaking scientists, because translations are not available.

Once an automatic language translation system is in operation, translations can be produced by people who don't understand the foreign language with which they are working. It isn't difficult to type in a language you don't understand – even if the language has an unfamiliar alphabet. Using a Cyrillic alphabet typewriter, the typists at the IBM translation demonstration cheerfully copy Russian articles on advanced physics without knowing anything about either Russian or physics.

You can try it yourself at the Fair. Like the boy typing a postcard in the picture above, you simply look up the Cyrillic letters on a chart and then find them on the typewriter. It's slow at first, but if you kept at it you'd soon pick up speed. (At the Fair, we help a little by putting on the chart the Russian equivalent of common English phrases, so that you can type a postcard with a real message in Russian.)

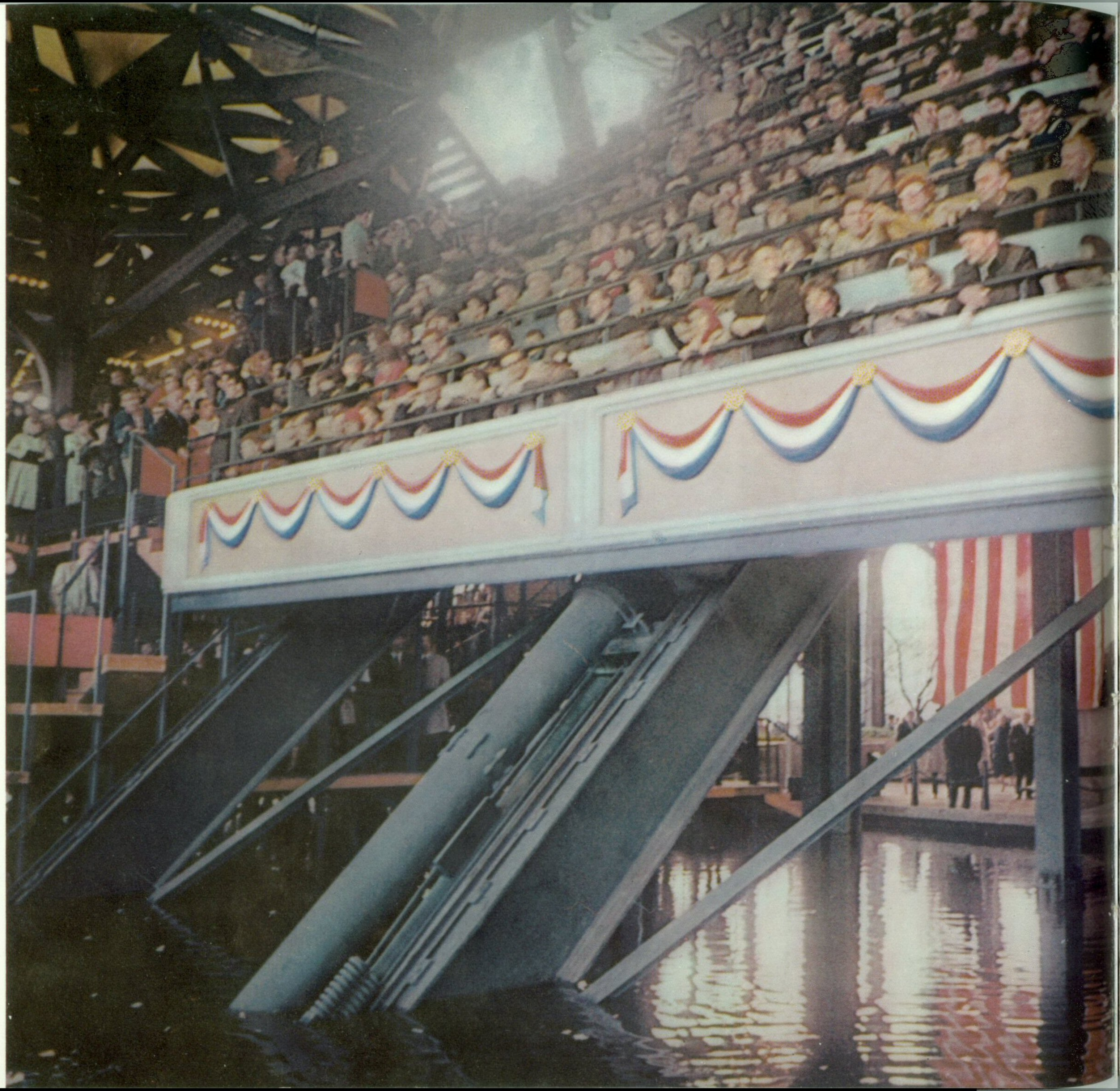
People Wall and Information Machine

Across the grove of steel trees, where twinkling lights spell out INFORMATION MACHINE, you pass through an arch into a maze of elevated walkways. No matter which path you take, left or right, up or straight ahead, all paths lead to your destination: a seat on the People Wall that will carry you into the great theater that rests on top of the trees.

On the walkways, strolling entertainers keep you amused while you wait for the next show. You watch the People Wall descending from the raised theater. Those who have just seen the show file off, and now it's your turn.

You leave the maze and take your seat on the Wall. Before you, the ever-changing fountains of the Pool of Industry send white plumes skyward; below, IBM's reflecting pool riffles in the breeze; above and behind you, through the great doors swung open in the bottom of the theater, you catch a glimpse of the shadowy interior of the Information Machine itself.

Every seat in the twelve tiers of the Wall is taken. About 500 people wait with you to be carried upward into the Information Machine. Suddenly, from an opening in the green canopy overhead, your host drops down, riding a tiny platform. A quick welcome to the Information Machine, and



he disappears up into the theater as suddenly as he arrived. Then the 60,000-pound Wall carries you smoothly upward in full view of Fairgoers on the ground.

You rise into the darkness of the theater, the huge bay through which you entered is drawn up, the world is closed out, and the show begins. You adjust quickly to the dim light inside the Information Machine–and soon you make out the multi-faceted interior, the fifteen screens of various shapes and sizes that line the curved wall. Suddenly your host reappears on a balcony before you. As he starts to explain that this is really an information machine – because it is a way of telling you quickly and vividly all sorts of facts – the screens burst into a blaze of light and color. Some of the pictures move, some are still and flash on for brief moments before vanishing – but always the pictures, the sound, the host himself are woven into a coherent whole.

At the bidding of the host, information leaps at you from all directions. Just to show what the machine can do, he fills the screens with miscellaneous information about himself – his credit card, the change in his pocket, what he had for breakfast, what's inside his closet, even a little chat with his mother up in Schenectady.

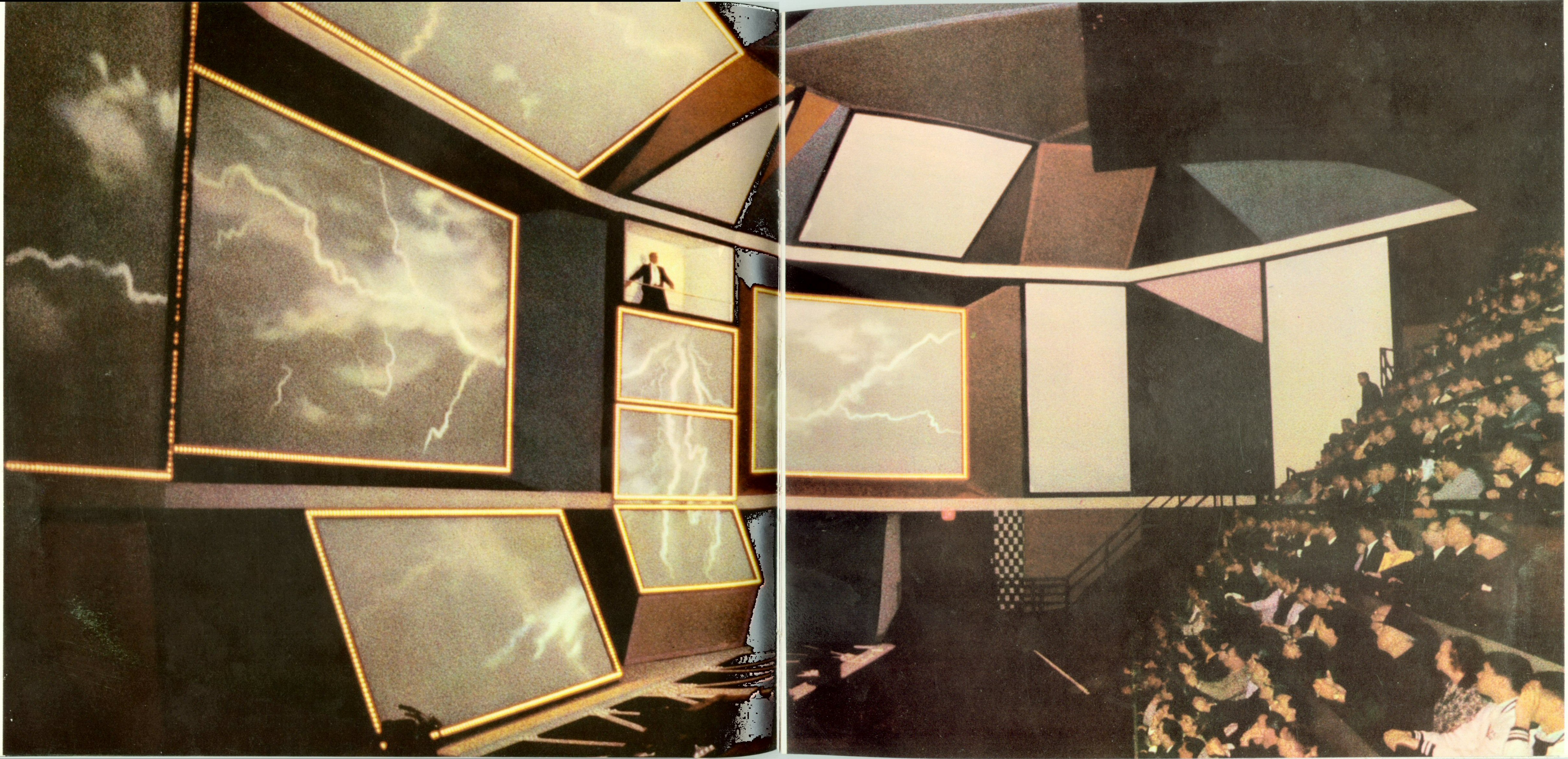
Another example, he announces – and suddenly you are in the roaring midst of a road race. With all screens filled with action, you see far more than if you were actually on the spot: you are in many places at once, on the curves, in the pits, with the onlookers, in the driver's seat, inches from the ground next to the front wheel . . .

"*That's how the Information Machine works,*" your host tells you. "*Now this is how we would like to use it . . . You'll see that the method used today in solving even the most complicated problems is essentially the same we all use daily . . .*"

And now you are surrounded by railroad engines and tracks and freight cars and the things they carry. Running a railroad is a complex problem; to make it manageable, the many parts are reduced to simple terms and abstractions – from apples to barrels, to waybills, to freight cars, to lists, to numbers fed into a computer.

Abstractions – symbols, numbers, formulas – are used by many people to make "models" used in solving real-life situations. Weather forecasting, for example. Gathering weather data is a worldwide job. Fifty thousand observations are made all over the globe, and the information is coded and exchanged among nations. To use this immense amount of data to predict what the weather is going to be, scientists have developed a mathematical model – a series of equations that describe the interaction of weather forces such as winds, clouds, and masses of air at various pressures. The latest weather data are fed into data-processing systems and manipulated mathematically in accordance with these equations. The answers that come out are very practical ones. A reliable weather forecast is important in all sorts of decisions, from estimating how many hot dogs to order for tomorrow's baseball game to determining precisely where and when a hurricane will strike the mainland and what course it will take afterwards.

The Information Machine dramatically illuminates the weather problem. "*Thunder,*" your host demands, "*Lightning!*" With a crash and a flash of light . . . →



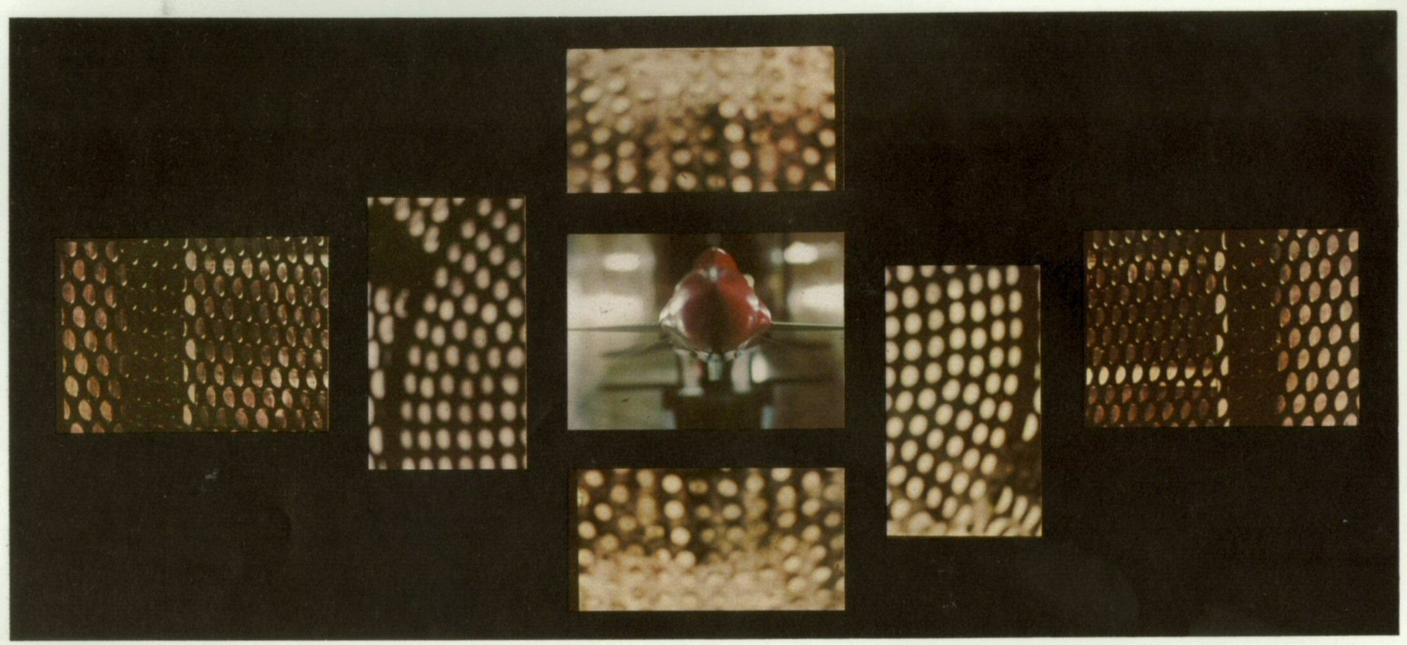
The weather model is a highly complex one that requires teams of specialists and high-speed computers. But as the Information Machine demonstrates, models come in all shapes and sizes.

Listen to a football coach describing a pass play to his team: "*...good fake to the fullback off-tackle, drop back, keying in the defensive halfback. As he rotates up, we want you to hit the right end going up the field and to the corner ...*" The diagram that the coach draws on the blackboard is a model of an actual play—or at least what he hopes the play will be. To the members of the team, the blackboard symbols represent the real thing. The game itself will reveal how good a model-maker the coach is.

Many of the models we use in daily life involve much the same steps as those taken by the football coach—or the scientist. Take such a simple example as planning a dinner party. The hostess faces the challenge of seeing that the guests sit next to people they enjoy and at a distance from those they might not get along with.

The hostess visualizes her first model of the seating arrangement: *The Coopers will be fun ... What does that do to the seating? Let's see ... Jane on Harry's left ... Mrs. Townsend on the right....* Actually, the plan can be more complex than it first appears. There are, after all, thousands of different ways to seat 10 guests along the two sides of a table. As she shifts people around to find the best arrangement, the hostess makes notes and finally draws a rough diagram of the seating plan—her personal model—until she finds the right combination.

Later, a glance down the table as the dinner is under way tells her that her chosen model was the right one—the guests are chatting happily—the party is a success.



Most people think of models as three-dimensional copies of the real thing – like this miniature of the X-15 rocket plane being tested in a wind tunnel. Engineers test this low-cost model to find potential problems and eliminate them before going to the expense of building the actual aircraft.

The flight characteristics of aircraft can also be modeled as equations – and these mathematical models can be manipulated with even greater flexibility than the miniature in the laboratory tunnel. Such a mathematical model can be put through tests simulating every experience a real plane would meet in flight. Here, however, the equations are extremely complex, and paper and pencil manipulation becomes too expensive and too slow. A computer can solve complex equations in minutes or seconds, sometimes in fractions of seconds. Accurately and tirelessly, the computer can trace out the consequences of a thousand possible actions, can pick out the best design from thousands of possible designs, and can shorten development time.

This technique enables engineers to stress-test a design or materials without risk to aircraft or pilot, and at a small fraction of the cost of building a full-scale airplane.

"*. . . Let this be the air, this the plasma, and this the red cell. . . . We represent chemical reactions as mathematical equations. Now if the model – that is, this group of equations – is right, it will behave remarkably like a human system . . . With a computer, we can play with the model directly . . .*"

Those words were captured during a laboratory discussion among scientists developing a mathematical model to study the interaction of oxygen and hemoglobin in the blood. Biological research has always been handicapped by the difficulties of testing how living systems actually work. The interaction of many complex factors makes it hard to study the effect of any one singly, especially since biological processes are often hidden away where they cannot be observed directly. By manipulating the equations of their model in a computer, scientists can perform the equivalent of a physical experiment–before trying the real experiment in the laboratory. Such simulations make possible intensive study of human biological systems, to help determine how they respond when attacked by disease and what treatments have promise of success.

Information – as the Information Machine itself makes plain – is the key to solving problems. But in most cases the information must be processed logically or mathematically before it can be put to work. Usually this means putting the known information into an abstract form. The hostess represents her dining table with a rectangle, the guests with circles and initials. The football coach has a symbol for each of the 22 players and the ball, special symbols for movement. Weather scientists turn winds and air pressures into numbers.

The abstract symbols or numbers can then be put together into a model that describes their relationships and represents the problem. The hostess maps her dining room, a very simple model of a simple problem; she manipulates her model by varying the positions of her guest-symbols until she arrives at the happiest – or "optimum" – seating arrangement. The football coach has a more complicated problem because his symbols must move, so he makes a series of maps on the blackboard. The problems of the aircraft engineer and the weatherman are highly complex and their models become a series of equations. These models contain so many different variables with such intricate mathematical relationships that high-speed computers are used to manipulate the symbols and help solve each problem in a practical length of time.

But even when a computer performs the calculations, it is the human model-maker who is really responsible for solving the problem. His ability to translate information into abstract terms and organize these abstractions so that they simulate an actual situation are all-important. Frequently just making the model tells him a great deal about his problem. As the narrator in the Information Machine says in closing:

"Computer problems, philosophical problems, homely ones – the steps for solving each are essentially the same, some methods being but formal elaboration of others.

"But homely or complex, the specific answers that we get are not the only rewards or even the greatest. It is in preparing the problem for solution, in these necessary steps of simplification, that we often gain the richest rewards. It is in this process that we are apt to get an insight into the true nature of the problem. Such insight is of great and lasting value to us as individuals and to us as a society."

With a burst of music, the pictures on the screens fade away, your host comes back to say goodbye. Below you, the great doors swing open. The People Wall glides slowly back to earth. The show is over.

Typewriter Bar

A visit's not complete until you've told the folks back home about it. Just about everyone who visits the IBM exhibit sooner or later ends up at the typewriter bar. There a whole covey of typewriters stands ready for anyone who wants to type a postcard. And because these are no ordinary typewriters but the unique IBM *Selectric*, every typist has a semi-circle of onlookers watching in fascination as the ball-shaped typing element spins and bounces its way across the postcards.

All day long they come, and on into the evening. A mother writing a distant daughter... a little boy poking at the keys... a sailor writing a quick note home... here a secretary showing her friends how fast she can type... there a dignified Asian visitor in native costume... a college girl reporting back to her sorority... a boy from Iowa telling a friend about the World's Fair–all day long the bouncing spheres whirl tirelessly across the postcards: "I am typing this at the IBM Pavilion. It is very..."

Garden-like groves have always had a special magic. Between brown tree trunks the ancients gathered to speak of the mysteries of the world around them... young people met to sit at the feet of the great teachers of the Athenian Academy... Americans spend long summer Sundays in the joys of the park or picnic.

Perhaps there's something of all of these in IBM's garden at the New York World's Fair. We hope you found here both pleasure and learning – and a renewed wonder at man's ingenuity in building mighty tools to ease him of drudgery, to help him master the physical world, to stretch his mind with new ideas and insights.

IBM Pavilion Designers: *Offices of* Charles Eames and Eero Saarinen Associates

Landscape Architects: Robert Zion, Harold Breen
General Contractor: Gilbane Building Company
Little Theater Presentations: Charles and Ray Eames
Computer Court Designer: Herb Rosenthal

Information Machine Presentation: *Produced by* Charles and Ray Eames
Story: Glen Fleck
Music: Elmer Bernstein

Staff Photography: Charles Eames
Glen Fleck
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F. J. W. Roughton *(University of Cambridge)*

Dinner Party: Joan Shawlee *(Hostess)*
Stuart and Lucia Bailey
Philip and Amanda Dunne
John Houseman
Melinda Hurst
Virginia Kondratiev
Frank and Polly Pierson
Dr. Irwin C. Shiell
Crombie Taylor
Frederick A. Usher, Jr.
Audrey Wilder

Football Sequence: El Camino College
Kenneth Swearingen *(Coach)*

Cooperation Acknowledged: American Airlines, Inc.
North American Aviation, Inc.
The Rand Corporation
Santa Fe Railroad
Southern Pacific Company
U. S. Weather Bureau
UCLA Medical Center
World Meteorological Organization

Special Assistance: John and Midge Morris
Beatrice Cunningham
Hamilton Wright
John Chamberlain
Edward G. Boyle
Harriet Von Breton

MGM Laboratories *(Color)*
Todd-A-O Corporation *(Sound)*
Cinema Research Corp. *(Optical Effects)*

International Business Machines Corporation, Armonk, New York
Printed in USA 501-0001-0

Brochure Design and Typography : Paul Rand