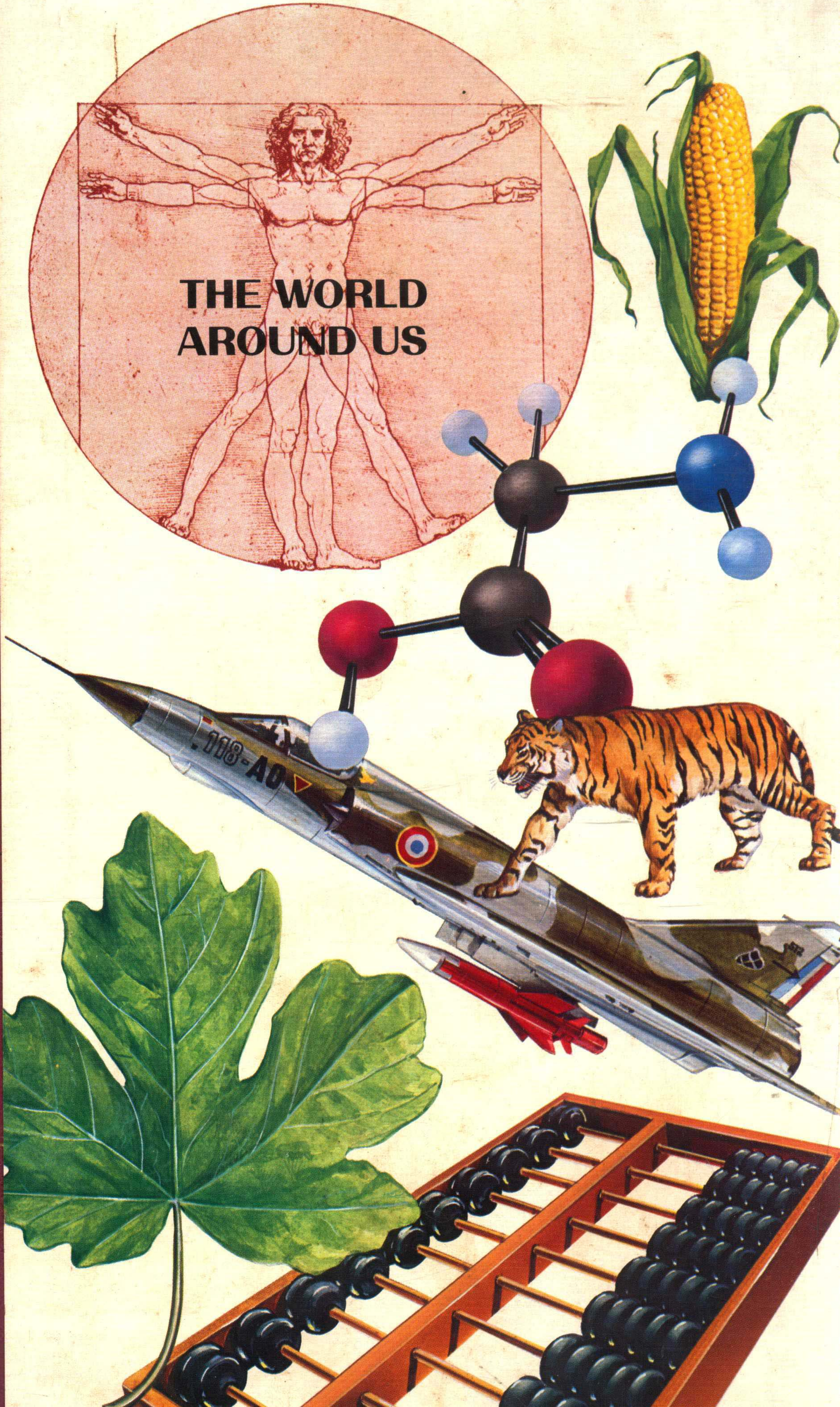
SCIENCE AND TECHNOLOGY ILLUSTRATED

THE WORLD AROUND US



Science and Technology Illustrated

The World Around Us

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The World Around Us

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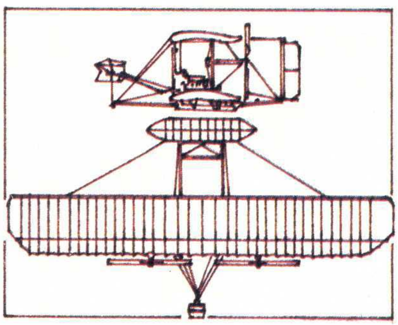

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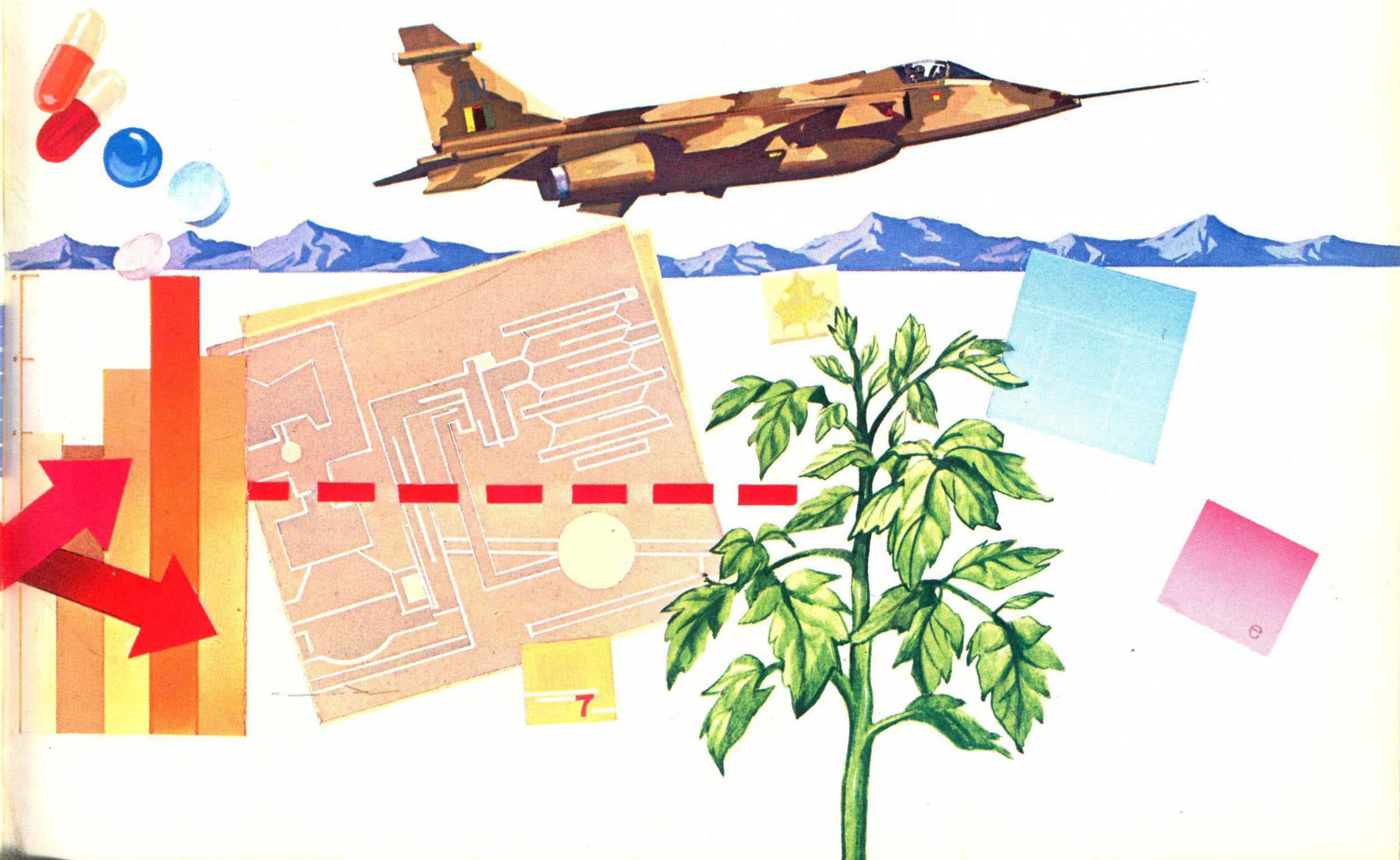
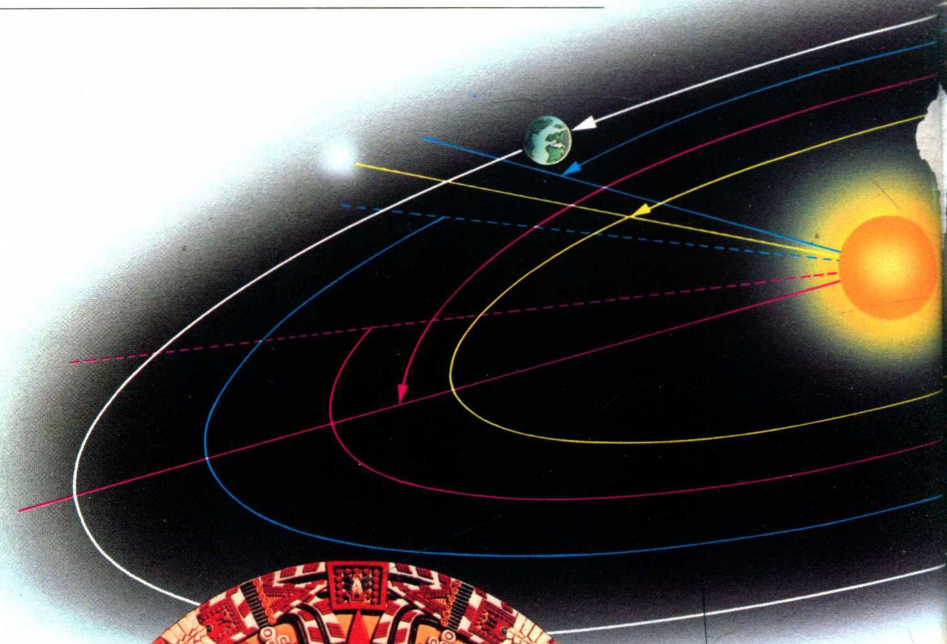


Calendar

A calendar is not only an object but a system: both the diary listing the year's months and days that we give as a Christmas present and the result of thousands of years of mathematical calculations based on cycles of the Sun, Moon, and life on Earth. Calendars, which are human constructs used to divide time into orderly and named periods, began in many ancient civilizations as methods for keeping track of religious observances—especially agricultural programs: when to plow, when to plant the seed. They are based on both the movement of the Earth around the Sun and the Moon's orbit around the Earth. The patterns that have been accepted by many peoples—the year, month, and day—are echoed in nature in the annual blooming of flowers, women's menstrual cycles, and the dew on the grass every morning. The shortest basic unit of time is the second—approximately the time of the average human heartbeat.

The time period based on the length of time it takes the Earth to revolve around the Sun is known as the solar or tropical year. The lunar year, on the other hand, consists of 12 synodic months, each comprising the interval between one new (thin crescent) Moon and the next.

You might think that, with all these signs from nature, people would have had no difficulty at all working out a calendar. Unfortunately, the signs don't all point to the same year. The 12 lunar months, of 29.53059 days each, come out to 354.36706 days, while one solar year is 365.242199 days, a difference of almost 11 days. Since many religious observances are based on the passages of the moon (for a fuller description, *see* MOON), most calendar makers have grappled with the same dilemma: how to compensate for the difference between the two different types of year. Think of them as two people of different heights marching in the same parade; one is short (the lunar year), and one is tall (the solar year). The short person has to take extra steps to keep up with the tall one. Calendar makers have faced this problem by devising various ways of helping the lunar year "catch up" to the solar one. Most calendars have varied the number of days each month to bring both years to a close at the same time. The Gregorian calendar, used in the West since 1582, has months that vary in length from 28 to 31 days, as every child knows who has sung the children's nursery rhyme, "Thirty days hath September. . . ."

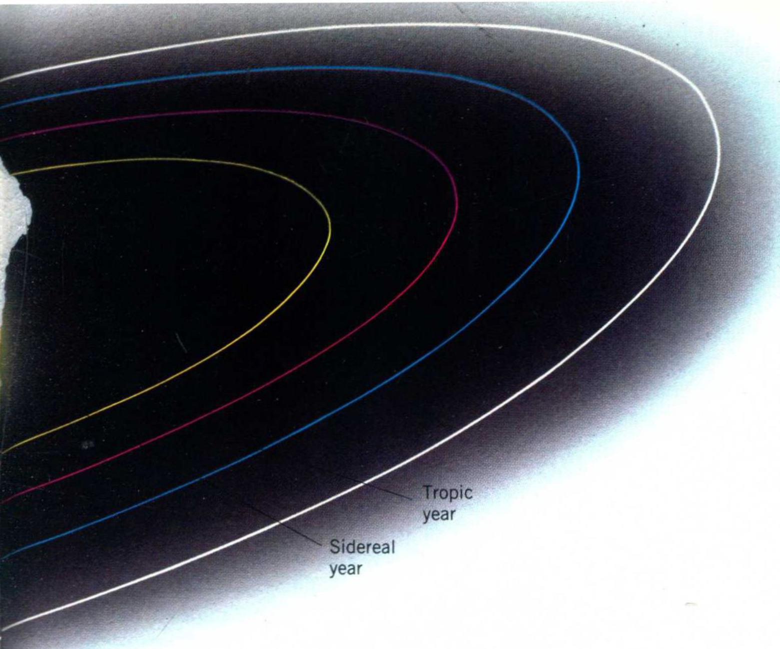


The Julian Calendar

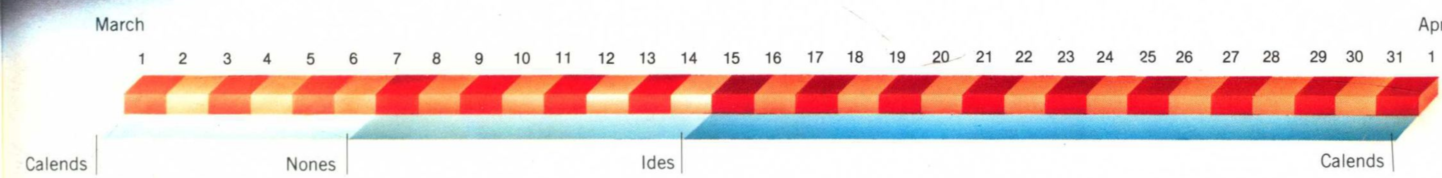
The Egyptian and Roman years developed into the Julian calendar, which was used for more than 1,500 years. The Roman Republican calendar, introduced around 600 B.C., was a lunar one, short by 10.25 days of a 365.25-day tropical year. It included an extra (intercalary) month every 2 years, which fell in late February, much as our current February 29 occurs every 4 years to make up for the quarter-day we miss each year. Nonetheless, by 50 B.C., the lunar year had fallen 8 weeks behind the solar one, and it was clear that the Romans were out of sync. A new calendar was adopted in the mid-1st century B.C. by Julius Caesar, with 365 days and an extra day every 4 years, between February 23 and 24. But by 1545 A.D., the calendar had fallen 10 days behind the solar year, because the Julian calendar was 11 minutes and 14 seconds short per year—which amounted to nearly 1.50 days in 2 centuries and 7 days in 1,000 years.

The Gregorian Calendar

Since Easter was based on the lunar year, the Church became concerned, and in February 1582, Pope Gregory XIII issued a bull drawn up by the Jesuit astronomer Christopher Clavius. The year was established at 365.2422 days, which made it 3.12 days short every 400 years. To compensate, leap years were kept, but no centennial year would be a leap year unless divisible by 400. As a result 1700, 1800, and 1900 were not leap years, but the year 2000 will be. Festivals and holidays depend on the day Easter falls, which is calculated on the basis of an elaborate table according to the movements of the Sun and Moon.



Generally speaking, the calendars that are used to regulate the affairs of men have been designed to correspond with the four seasons. For certain scientific purposes, though, other types of calendars may be more useful. Astronomy, for instance, makes use of three different kinds of years—sidereal, anomalistic, and tropic. The tropic year corresponds most closely with calendars in general use. The three years, as shown in the illustration at left, are defined according to different aspects of the Earth's orbit.



Left: Aztec stone calendar.

Above: Striped bar shows the Roman system of dividing the month into sections according to certain key days; the *calends,* the first day of each month; the *ides,* at midmonth; and the *nones,* the ninth day before the ides.

Most calendars are lunar calendars, based in some way on the phases of the Moon. Though the way months are counted may vary, primitive societies generally adopted the 7-day week, since it corresponds to the Moon's changing quarters.

Right: Perpetual calendar, which makes it possible to determine the day of the week on which any given date fell or will fall. It also permits transformation of Julian dates into corresponding dates on the Gregorian calendar.

PERPETUAL CALENDAR

Century letter code

Century	Julian calendar B.C.	Julian calendar A.D.	Gregorian calendar in use from October 15, 1582
1	E	U	
2	R	N	
3	S	I	
4	U	V	
5	N	E	
6	I	R	
7	V	S	
8	E	U	
9	R	N	
10	S	I	
11	U	V	
12	N	E	
13	I	R	
14	V	S	
15	E	U	1582
16	R	N	E
17	S	I	R
18	U	V	U
19	N	E	I
20	I	R	E
21	V	S	R
22	E	U	U
23	R	N	I
24	S	I	E
25	U	V	R
26	N	E	U
27	I	R	I
28	V	S	E
29	E	U	R
30	R	N	U
31	S	I	I
32	U	V	E
33	N	E	R
34	I	R	U
35	V	S	I
36	E	U	E
37	R	N	R
38	S	I	U
39	U	V	I
40	N	E	E
41	I	R	R
42	V	S	U
43	E	U	I
44	R	N	E
45	S	I	R
46	U	V	U
47	N	E	I
48	I	R	E
49	V	S	R
50	etc.	etc.	etc.

Year within century

				U	N	I	V	E	R	S
1	29	57	85	3	2	1	0	6	5	4
2	30	58	86	4	3	2	1	0	6	5
3	31	59	87	5	4	3	2	1	0	6
4	**32**	**60**	**88**	0	6	5	4	3	2	1
5	33	61	89	1	0	6	5	4	3	2
6	34	62	90	2	1	0	6	5	4	3
7	35	63	91	3	2	1	0	6	5	4
8	**36**	**64**	**92**	5	4	3	2	1	0	6
9	37	65	94	6	5	4	3	2	1	0
10	38	66	94	0		5	4	3	1	
11	39	67	95	1	0	6		4	3	2
12	**40**	**68**	**96**	3	2	1	0	6	5	4
13	41	69	97	4	3	2	1	0	6	5
14	42	70	98	5	4	3	2	1	0	6
15	43	71	99	6	5	4	3	2	1	0
16	**44**	**72**	**100**	1	0	6	5	4	3	2
17	45	73		2	1	0	6	5	4	3
18	46	74		3	2	1	0	6	5	4
19	47	75		4	3	2	1	0	6	5
20	**48**	**76**		6	5	4	3	2	1	0
21	49	77		0	6	5	4	3	2	1
22	50	78		1	0	6	5	4	3	2
23	51	79		2	1	0	6	5	4	3
24	**52**	**80**		4	3	2	1	0	6	5
25	53	81		5	4	3	2	1	0	6
26	54	82		6	5	4	3	2	1	0
27	55	83		0	6	5	4	3	2	1
28	**56**	**84**		2	1	0	6	5	4	3

For centuries not beginning with a leap-year

0	SUNDAY
1	Monday
2	Tuesday
3	Wednesday
4	Thursday
5	Friday
6	Saturday
7	SUNDAY
8	Monday
9	Tuesday
10	Wednesday
11	Thursday
12	Friday
13	Saturday
14	SUNDAY
15	Monday
16	Tuesday
17	Wednesday
18	Thursday
19	Friday
20	Saturday
21	SUNDAY
22	Monday
23	Tuesday
24	Wednesday
25	Thursday
26	Friday
27	Saturday
28	SUNDAY
29	Monday
30	Tuesday
31	Wednesday
32	Thursday
33	Friday
34	Saturday
35	SUNDAY
36	Monday
37	Tuesday
38	Wednesday
39	Thursday
40	Friday
41	Saturday
42	SUNDAY

Jan.	Feb.	Mar.	Apr.	May	June	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
2	5	5	1	3	6	1	4	0	2	5	0

New Calendars

Not everyone is happy with floating holidays and months that begin and end on different days of the week. As a result, the International Fixed Calendar and the World Calendar have been proposed. The first contains 13 months (an extra—Sol—between June and July) and an extra day after June 28; every month begins on a Sunday and ends on a Saturday.

The second, favored by businesspeople, divides the year into quarters of 91 days each, with an extra day at the end of the year. January 1, April 1, July 1, and October 1 are all Sundays. These calendars, like every system since the time of the Egyptians, Aztecs, and Mayans, all prove the truth of an old refrain: "What a difference a day makes."

Calorie

Counting calories has become a worldwide pastime. Every dieter knows that taking in food with too many calories makes you gain weight, that you can "work off" calories by exercising, and that some foods are higher in calories than others.

What we call a calorie is officially a kilocalorie, or 1,000 of the calories used to measure heat energy in a laboratory. One calorie (the laboratory kind) is the amount of energy or heat it takes to raise a single gram of water 1°C. This heat is a form of energy—a fact first recognized in 1843 by the English physicist James Prescott Joule.

Scientists determine the calorie count or caloric value of a given food by using a calorimeter, an instrument that measures the amount of heat given off by the food when it is burned. We don't really consume calories, although that is the conventional way of putting it; we eat foods that, when burned by our bodies, produce energy that is measured in caloric units.

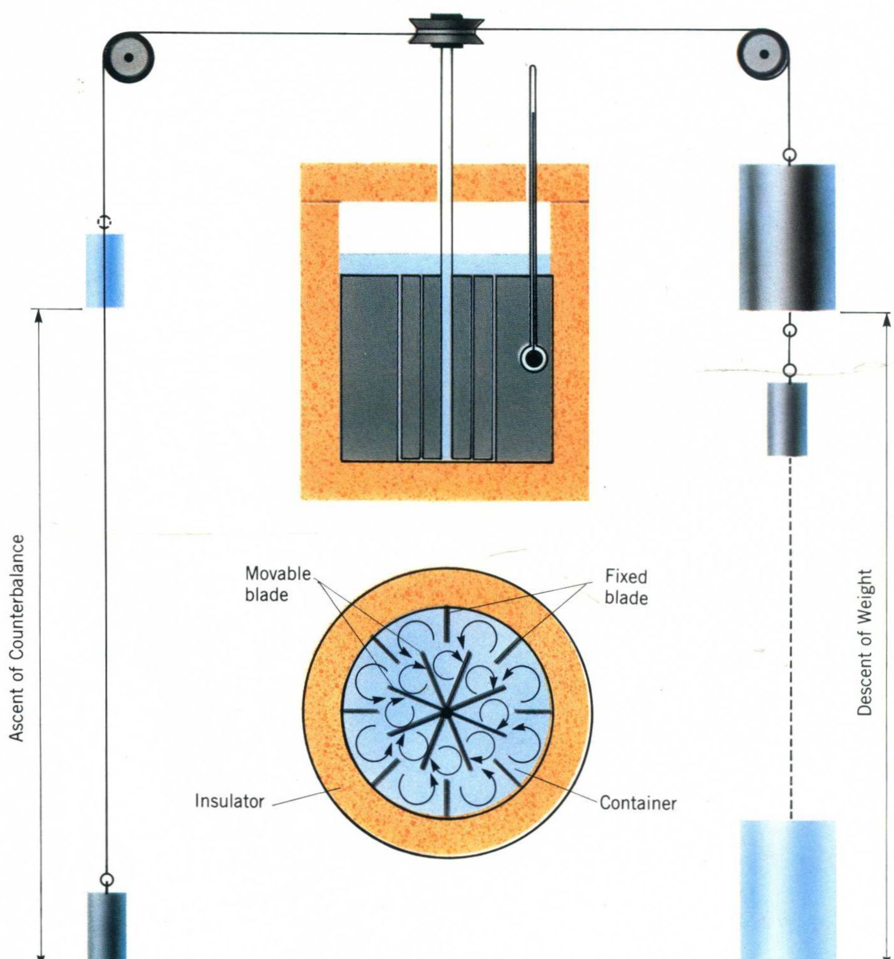
If you have ever put a very hot food—say, hot bacon grease—into a cool metal pan and then accidentally touched the pan, you probably sustained a nasty burn. That is because the heat from the food had quickly been transferred to the metal pan. A calorimeter, which is used to measure the heat produced during mechanical, chemical, or electrical reactions, also works on the principle of heat transfer.

Calorimeters differ in design, but they all consist of the same basic parts: a container, in which the sample material is placed, surrounded by a jacket (often filled with water), and a thermometer. When the reaction takes place inside the container, heat is transferred to the jacket. The experimenter reads the thermometer, which registers the jacket's temperature (or that of the water inside the jacket), and, with corrections for various inconsistencies, can tell how much heat has been produced in the reaction.

Calorie Consumption

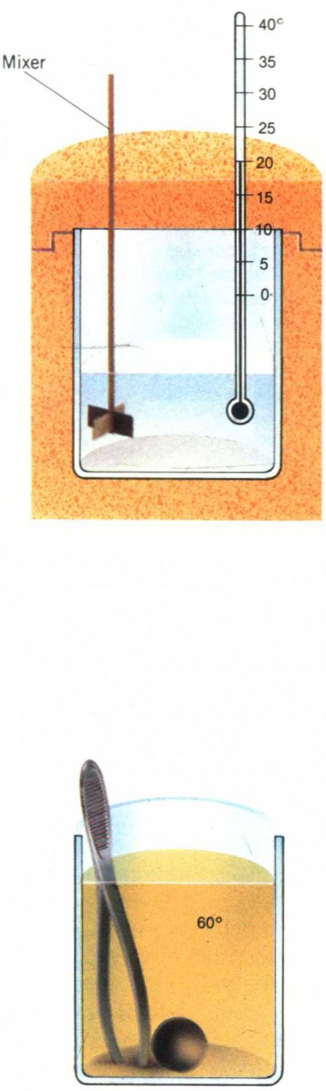
The relationship between calorie intake and exercise is the key to weight control. As you burn food, you produce energy, which is counted in caloric values. That energy is used in the work of your internal organs, in maintaining body temperature, promoting growth, working, and exercising. If you don't burn all the energy, the unneeded fuel doesn't just sit in a tank. Instead, it is stored in your body as fat. If you consume more calories than you burn, you gain weight. However, on days when you burn more calories than you consume, your body can draw on its stored fat to produce energy. That is why you lose weight when you go on a diet.

Depending on physical size and activity level, people need between 2,000 and 4,000 calories per day. A basketball player



Experimental apparatus with which Joule measured the mechanical equivalent of heat, demonstrating that it is a form of energy. The falling weight causes the paddles inside the calorimeter to spin. The motion heats water inside the device, and the increase in temperature is measured with a thermometer. It is then possible to establish how much physical force is required to produce a given amount of heat.

CALORIMETER FOR THE MEASUREMENT OF SPECIFIC HEAT



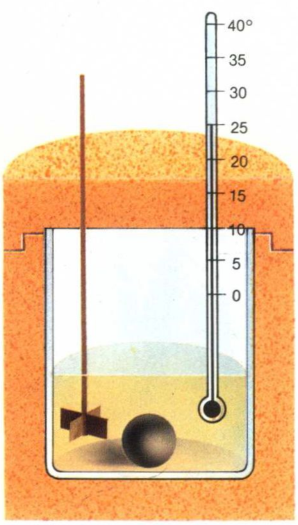
who is 7 feet (2 m) tall burns up more calories than a newborn baby, for example.

Burning Calories

By including exercise in their weight-reduction programs, dieters can count the calories burned in work and play. They lose weight not just by limiting their calorie intake, but also by burning more of the calories they consume. Table 1 gives examples of the number of calories used up in various sports and everyday tasks.

Calorie counting for exercisers and eaters may soon be a thing of the past. In honor of physicist Joule, the word "calorie" is scheduled to be replaced by the unit "joule" in international measure. (One calorie equals 4.18 joules.) Someday we may all consult our joule charts before sitting down to lunch. In any case, we will still have to consume fewer joules in order to lose weight.

See also NUTRITION.



Calorimeters are used to measure the specific heat of different materials. Specific heat is the ratio of the amount of heat required to raise the temperature of a given mass 1°C. to the amount of heat required to raise an equal mass of water 1°. In simple terms, it is the measure of the capacity of different materials to store heat energy.

In the example shown, the calorimeter is being used to determine the specific heat of iron by measuring the temperature increase when a heated ball of the metal is placed in a quantity of cooled water. The paddle is used to ensure even circulation of the water within the device.

In the beaker at left, the heated metal ball loses heat to the water, and the water gains heat from the ball until the two substances have the same temperature.

CALORIES BURNED BY A 155-POUND (70-KG) ADULT IN DIFFERENT PHYSICAL ACTIVITIES

ACTIVITY	CAL/HOUR
Bicycling	175
Working in kitchen	70
Driving a car	63
Eating	28
Awake in bed	7
Running	490
Swimming	553
Using electric typewriter	70
Walking (normal pace)	140
Walking (brisk pace)	238

CALORIC VALUE AND NUTRITIONAL CONTENT OF COMMON FOODS

Food	Quantity	Protein (gr.)	Fat (gr.)	Carbohydrates (gr.)	Calories
Skim milk	(1 cup)	8	0	12	80
2% milk	(1 cup)	8	5	12	120
Whole milk	(1 cup)	8	10	12	160
Vegetables	(1/2 cup)	2	0	5	25
Fruit (orange)	(100 gr.)	1	1	10	40
Bread (dinner roll)	(25 gr.)	2	0	15	70
Lean meat	(30 gr.)	7	3	0	55
Medium fat meat	(30 gr.)	7	6	0	80
High-fat meat	(30 gr.)	7	6	0	100
Polyunsaturated fat	(5 gr.)	0	5	0	45
Saturated fat	(5 gr.)	0	5	0	45

Cambrian Period

In 1835, English geologist Adam Sedgwick decided that a bafflingly complex, fossil-rich group of rock layers in northern Wales all came from a single long stretch of time he called the Cambrian period. "Cambrian" itself came from "Cambria," a Latinized version of the Welsh word *cymry* ("people"), which became popular among 19th-century writers as a poetic name for Wales. The fossils in Sedgwick's rock layers were of the oldest animal life on Earth that possessed shells. Many were from an extinct creature called a trilobite, an ancestor of today's horseshoe crab but once the lord of the planet.

Geologists carve up the history of the planet into four eras, each hundreds of millions of years long, and further divide each era into shorter periods, which mark stages in evolutionary history. The Cambrian is the first period of the second great geological era, the Paleozoic. It marks the beginning of the play of life—the initial, mysterious emergence of complicated organisms. As Sedgwick discovered, the beginning of the Cambrian was marked by the sudden appearance of large invertebrates—animals without backbones—on the globe.

Between the Precambrian era (the 4,000-million-year span from the formation of the globe to the first Cambrian fossils) and the Cambrian period there occurred an evolutionary divide. On one side are traces of the simplest, earliest types of life, whereas on the other, a scant few million years later, are fossils from every group of related invertebrate species known. All lived in the warm, murky oceans covering much of the globe.

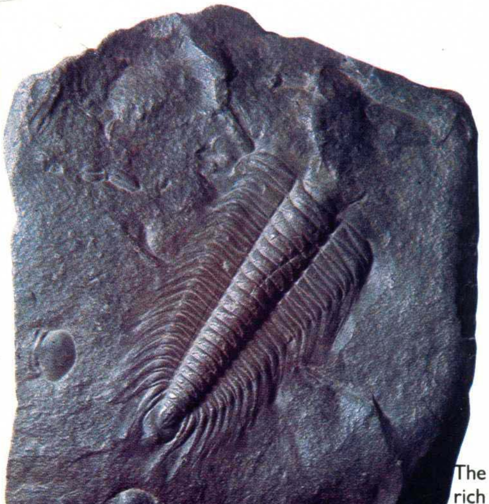
In both the Cambrian and Precambrian periods, the seas were rich in marine plants, primarily single-celled, blue-green algae. Sheetlike mats of algae covered vast areas of shallow water, leaving curious wavy structures called stromatolites in formations of limestone.

Trilobites

During this period of rapidly developing life, the most important invertebrates were the trilobites. Almost three-quarters of all known Cambrian fossils are trilobite fossils. These omnipresent creatures were arthropods—invertebrates with jointed legs and bodies—ranging in size from a tiny quarter-inch (0.5 cm) to species nearly

Mil yrs	Era	Period
	Mesozoic	Quaternary
1.8		
70		Tertiary
135		Cretaceous
190	Cenozoic	Jurassic
225		Triassic
270		Permian
350	Paleozoic	Carboniferous
400		Devonian
440	Cambrian	Silurian
500		Ordovician
570	Archeozoic	Algonkian
3,500		Archean

Map shows dry land masses as they existed during the Cambrian period, beginning around 570 million years ago and lasting for 70 million years. From today's point of view, the great events of the Cambrian were the evolution of an oxygen-rich atmosphere and the emergence of complex invertebrate life forms.



The seas of the Cambrian were shallow, warm, and rich with life. Single-celled organisms, particularly algae, filled the waters, but more complex life forms were present, too. These included jellyfish, mollusks, and trilobites, a primitive invertebrate now extinct.

During the Cambrian period the seas were the dominant theater of life. The period was marked by the sudden appearance of complex life forms belonging to the phyla Arthropoda and Mollusca. This remarkable evolutionary leap is usually explained as a result of the increasing oxygen content of the atmosphere, caused by the emergence of photosynthetic algaes that fixed free carbon dioxide gas and released oxygen as a waste product.

Still, paleontologists are surprised at the lack of a clear fossil record of intermediate forms of life between single-celled marine organisms and complex forms like the invertebrate trilobites.

2 feet (50 cm) (0.5 m) long that may have weighed as much as 10 pounds (4.5 kg). Their bodies were covered by an external skeleton, an exoskeleton, similar to those of crabs and shrimp today. Unlike these modern species, however, trilobites had bodies divided lengthwise into three segmented sections called lobes. Each outer lobe segment had a pair of small leglike appendages, one with sense and feeding organs and one that the trilobite used to push itself around. Most had a pair of compound eyes, but some were sightless.

As individual trilobites grew, they molted, shedding their exoskeletons and developing new ones. These molted exoskeletons are the most commonly found trilobite fossils. The frequency with which they are found has allowed paleontologists to see trilobites at every lifestage. Although their habits are understood fairly completely, researchers are still puzzled by the mystery of how such complex organisms could spring into existence without geologists finding traces of their ancestors—just like the rest of the Cambrian invertebrates.

Evolution of the Ocean

No sure explanation has been forthcoming, but the most convincing hypothesis is that the origin of the many kinds of Cambrian shelly invertebrates is linked to the history of the Earth's atmosphere and ocean. In the late Precambrian era, there was little oxygen in the air, only 1 percent of the present level. The earliest single-celled plants and algae used photosynthesis (a process that transforms carbon dioxide, water, and energy from the Sun into nourishment) to create oxygen during the last half of the Precambrian era. The steady disappearance of carbon dioxide gradually made the ocean less acidic. At the start of the Cambrian, a threshold level may have been reached, allowing life to develop with explosive rapidity. Since the time of Sedgwick, geologists and paleontologists have been seeking to trace that rapid development, looking to find clues that can help them understand the transition from one dominant species, the trilobite, to another, the human race.

"You push the button," said George Eastman. "We do the rest." And with that slogan, the 34-year-old inventor from Rochester, New York, introduced the first simple, inexpensive camera in 1888. Although cameras had existed for over 40 years, they had alway been complicated and expensive contraptions. Eastman's Kodak cost $25, a larger sum then than now, but it was the first camera that allowed ordinary people to take snapshots easily and quickly.

Since that time, millions of cameras have been made, and uncounted numbers of photographs have been taken. The ability of average people to document their daily existence—birthdays, vacations, holidays—has created enormous changes in their perception of themselves and humanity in general. The cameras made today are much more sophisticated than those first sold by Eastman, which could only have their film developed if you mailed the entire camera directly to him, but the basic principle of the modern machines remains exactly the same.

Photography is the process of making images on layers of light-sensitive chemicals coating paper or plastic film. These images are usually made in cameras, which can be thought of as machines designed to take advantage of the special properties of these light-sensitive chemicals. Cameras themselves consist of a lightproof box called the body, or housing, which contains the lens and an apparatus for holding and moving the film; a shutter, which controls the amount of light striking the film; and a viewfinder, so photographers can see what they are shooting. (Actually, Eastman's first Kodaks didn't have a viewfinder—you were supposed to guess.) In addition, more complicated and expensive cameras have reflex lenses, which help you focus the picture, and automatic exposure controls, which automatically adjust the amount of light permitted to go through the lens.

Body and Lens

The camera body is designed to permit light to hit the film from only one source, the lens. Light from the subject of the picture—say, a birthday cake with its candles about to be blown out by a child—goes through the lens, which focuses the image of the child on the film. Usually, a single lens cannot focus all the light correctly; these lens aberrations are generally corrected by making the light pass through a second or even a third lens, until the final image is sharp and clear.

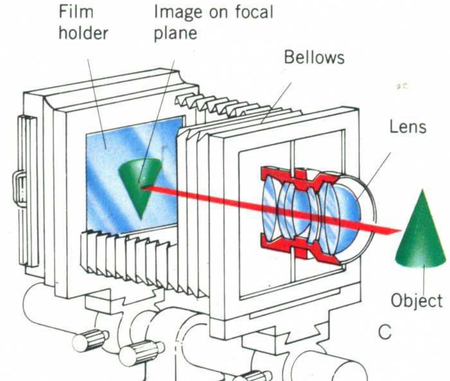
Two factors affect the sharpness and clarity of the image: the focal length of the lens, and its aperture or speed. The focal length is the distance at which light rays converge after going through the lens. You can see this yourself by holding a magnifying glass at arm's length and slowly drawing it toward you. At first, the image in the glass will be blurry; then, it will suddenly jump into focus. The distance between your eye and the magnifying glass at that point depends on the focal length of the lens, which in turn depends on its size. The smaller the lens, the closer you have to get to it before you can see clearly.

Generally speaking, the image is proportional to the focal length of the lens. A standard lens for a camera that uses rolls of 35-millimeter film (film with frames that are 35 millimeters, or about 1⅓ inches, wide) has a focal length of 50 mm and is called a 50-mm lens. A 100-mm lens will produce an image four times as large, but because the film remains the same size, only one-fourth of the image will fit into the picture. If a 50-mm lens can capture an entire birthday cake, a 100-mm lens might be useful for a closeup of the candles. Many cameras have removable lenses for just this reason—to allow photographers to change lenses and snap pictures closer in or farther away without actually having to move.

The speed of the lens, which is a function of its aperture, or opening, is a measure of the light it is actually letting into the camera. Most adjustable 35-mm cameras have a system of overlapping metal leaves resembling the top of a vegetable steamer that fits over the lens. This apparatus can be opened or closed, increasing or reducing the area that transmits light

Modern 35-mm reflex camera. The term 're-flex' refers to the optical system, which permits through-the-lens viewing of the object to be photographed.

Below: Bellows camera, now used almost exclusively for studio work with film in large formats.



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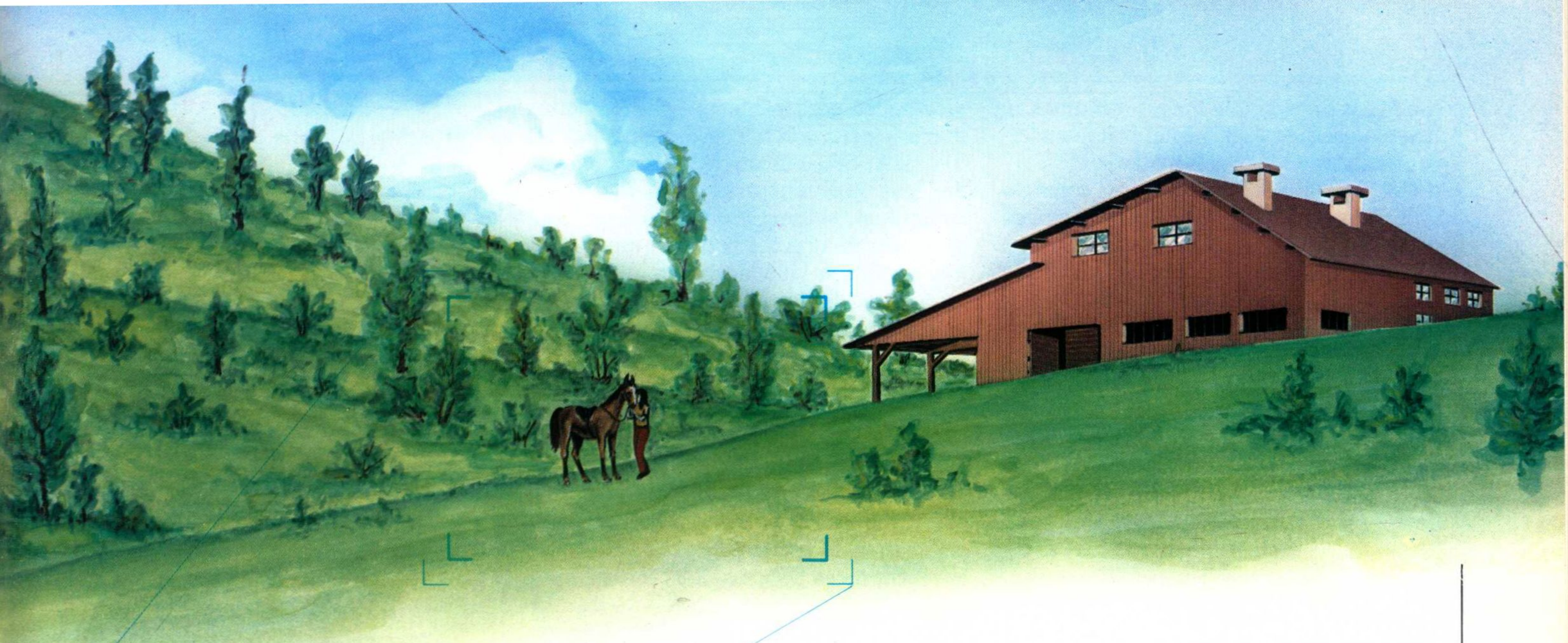
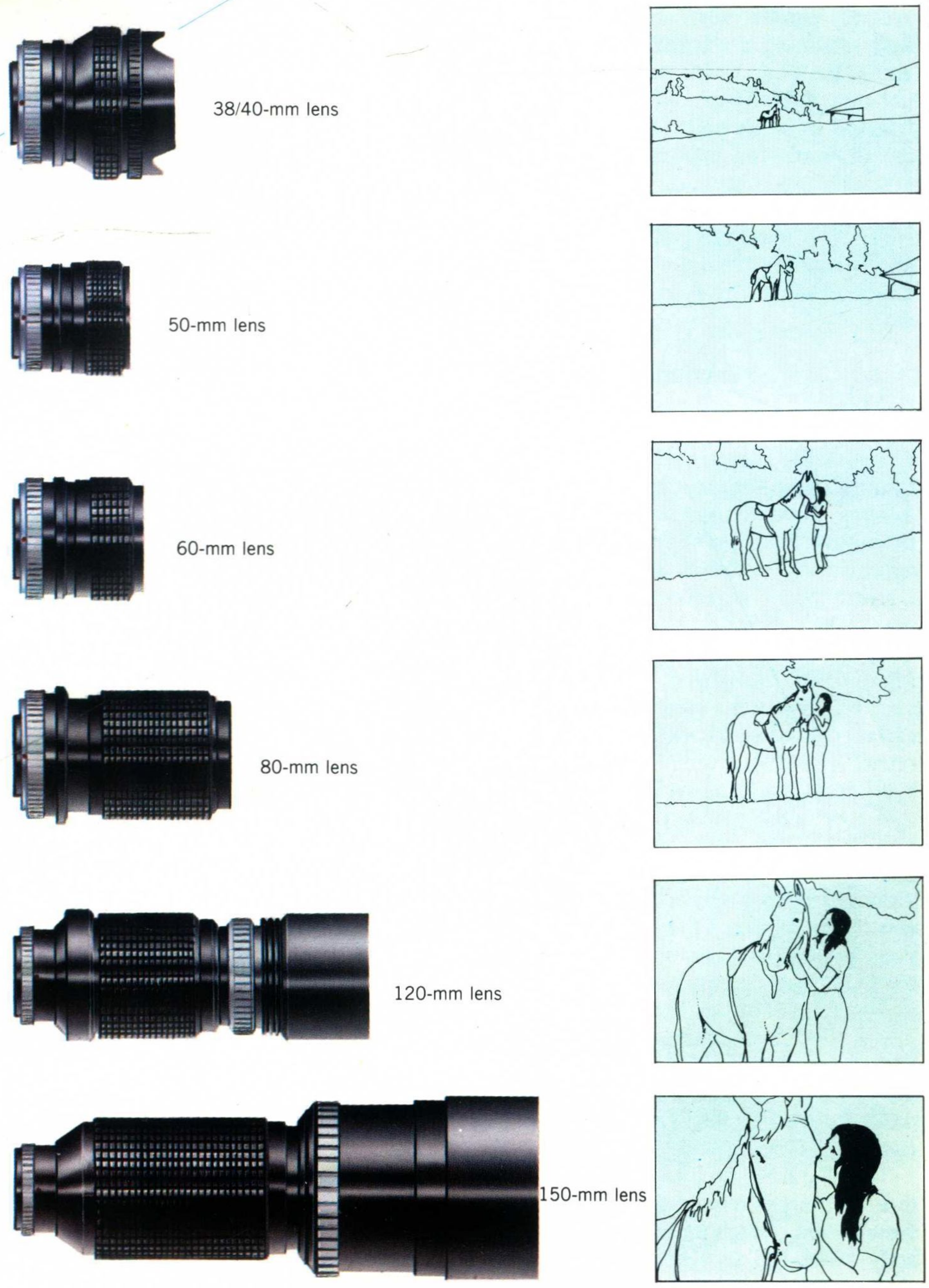


Right: Selection of different lenses for use with a 35-mm reflex camera. The images along the edge of the page show the visual field captured by each of the lenses from the scene above, which appears as it would to the naked eye of the photographer.



into the camera body. The size of the open region is called the effective aperture; the ratio of the effective aperture to the focal length of the lens is called the lens aperture. As an example, a 100-mm lens with an effective aperture of only 25 mm would have a lens aperture of 25:100, which reduces to 1:4. Photographers call the second number the *f*-stop for that aperture, and in this example would write it as *f*/4. Squeezing the aperture further shut to 12.5 mm would produce a lens aperture of 12.5:100, which reduces to 1:8 for an *f*-stop of *f*/8. Because halving the diameter of the effective aperture reduces its area by three-quarters, doubling the *f*-stop means that only a quarter as much light enters the camera. The *f*-stops of most lenses are usually written so that the order represents a reduction of about a half in the ability of the lens to let in light. The customary order is *f*/1.4, *f*/2, *f*/2.8, *f*/3.5, *f*/4, *f*/5.6, *f*/8, *f*/11, and *f*/16, going from large to small apertures.

Shutter

Most modern cameras have shutters just in front of the film to regulate the length of the exposure. If the film is struck by too much light for too long, it becomes an overexposed wash of white; if it is underexposed, it remains solidly dark.

Focal-plane shutters (the most common kind) consist of two small blinds mounted on spools to either side of the gate, which is the rectangular hole behind which the film passes. Resembling window blinds turned on their sides, the shutter blinds are rolled and unrolled by springs. While you focus the camera, one blind is unrolled, covering the film frame to be exposed. The blind on the other side of the gate is rolled up.

When the photographer presses the shutter release, the blind covering the gate quickly rolls onto its spool, exposing the film to the light from the lens. Then, after a brief, preset interval, the second blind follows the first. For short exposures, the second unrolls very quickly after the first—forming a narrow slit that travels across the film. In this way, each individual area of the film is only exposed for the fraction of a second that the slit crosses it, allowing for exposures as short as 1/1,000th of a second. The film behind the shutter is wound around a spool in the center. It is loaded by pulling the end away and tightening it around a second spool, which is wound by a crank atop the camera body.

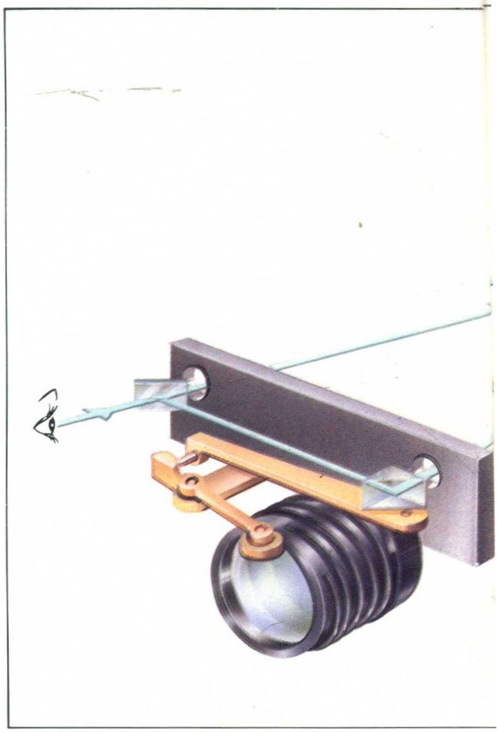
Viewfinder

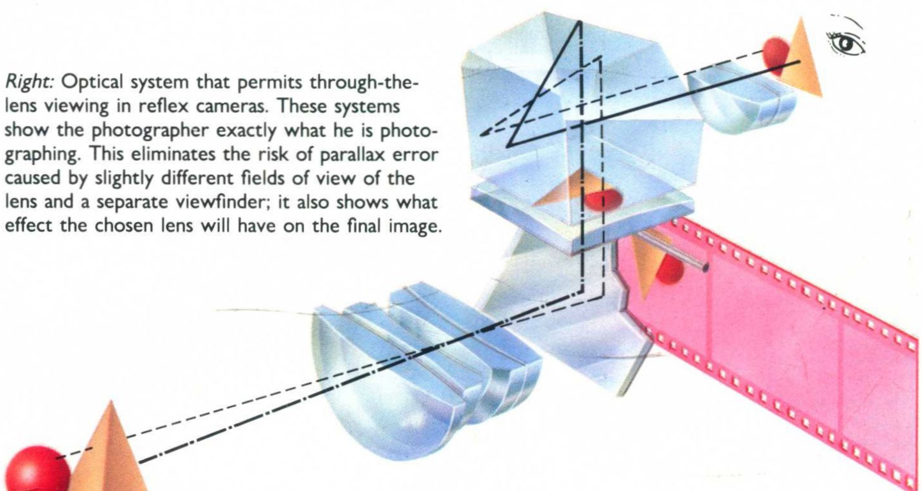
There are two principal types of viewfinders, direct-vision and reflex. Direct-vision models are simply tubes that go through the top of the camera housing. By looking through the back, you can peer through to the front of the tube and see an approximate version of what the lens sees. Unfortunately, direct-vision viewfinders do not tell you if the focus is correct or even if your finger is accidentally covering the lens. In addition, they do not work very well when the subject is close to the camera. Because the viewfinder is an inch or two (3-4 cm) away from the lens, it has a different angle of vision—a difference that especially shows in closeups. Similarly, your left and right eyes are near enough that the variation in their points of view for distant objects is insignificant. But if you look at a finger held up before your nose through one eye, then the other, the finger will occupy two separate places in your field of vision. The difference means that direct-vision viewfinders cannot give accurate indications of what is in the frame during a closeup; it is like using the left eye of the camera to tell what the right eye is seeing.

To solve these problems, most good 35-mm cameras have single-lens-reflex viewfinders, which enable you to see exactly what the lens sees. This type of viewfinder uses a mirror—the deviating mirror—placed between the lens and the film gate. Set at an angle of 45 degrees to the lens, the mirror bounces the image straight up, shining it either on a ground-glass screen atop the body or, more commonly, into a viewing prism. The prism refracts the light until it emerges through an eyehole in the back.

When the shutter release is pressed, the same spring that unrolls the blinds before the film gate also yanks the deviating mirror away, blocking off your vision for an instant but letting the light fall on the film. Afterward, the mirror swings back into place, the film is advanced, and the camera is ready to take another picture. If you have just taken a shot of the candles being blown out, you are now ready to capture the excited cutting of the cake. The resulting prints or slides will last for years, part of the nearly endless stream of everyday images caught permanently in the years since George Eastman encouraged people to push the button and let the camera do the rest.

See also LENS; PHOTOGRAPHY.





Right: Optical system that permits through-the-lens viewing in reflex cameras. These systems show the photographer exactly what he is photographing. This eliminates the risk of parallax error caused by slightly different fields of view of the lens and a separate viewfinder; it also shows what effect the chosen lens will have on the final image.

Below: Camera for use by amateurs. Its small size is made possible by the use of small-format film, 16 mm in this case. Film grain, though, limits image quality when photographs are printed.

Right: Control systems of a modern automatic camera. Integrated circuits control shutter speed and diaphragm aperature, set the flash, and even focus the image.