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05.04: Articulating Technical Information

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Articulating Technical Discussions
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Chapter Objectives

Upon completion of this chapter, readers will be able to do the following:

1. Explain and apply strategies for articulating technical discussions to nonspecialist readers.
2. Use audience analysis to decide what information to include or exclude from a document and how to discuss that information.

Articulating Technical Discussions

The ability to explain complex, technical matters with ease, grace, and simplicity so that nonspecialist readers understand almost effortlessly is one of the most important skills you can develop as a technical writer. This ability to "translate" or articulate difficult-to-read technical discussions is important because so much of technical writing is aimed at nonspecialist audiences. These audiences include important people such as supervisors, executives, investors, financial officers, government officials, and, of course, customers.

This chapter provides you with some strategies for articulating technical discussions, that is, specific strategies you can use to make difficult technical discussions easier for nonspecialist readers to understand.

You use your understanding of your audience to decide

- What information to include in the document
- What information to exclude from the document
- How to discuss the information you do include in the document

Articulating is particularly important because it means supplying the right kinds of information to make up for the reader's lack of knowledge or capability. Articulating thus enables readers to understand and use your document.

Some combination of the techniques discussed in this chapter should help you create a readable, understandable translation:

Defining unfamiliar terms	The "in-other-words" technique
Comparing to familar things	Posing rhetorical questions
Elaborating the process	Explaining the importance or significance
Providing description	Providing illustration
Reviewing theoretical background	Providing historical background
Providing examples and applications	Providing the human perspective
Shorter sentences and paragraphs	Stronger transitions

This list by no means exhausts the possibilities. Other techniques include

- *Headings.* See the section on using headings that break up text and emphasize points and on how to construct headings that guide readers from section to section.
- *Lists.* See the section on constructing lists that break up text and emphasize points and on how to construct headings that guide readers from section to section.

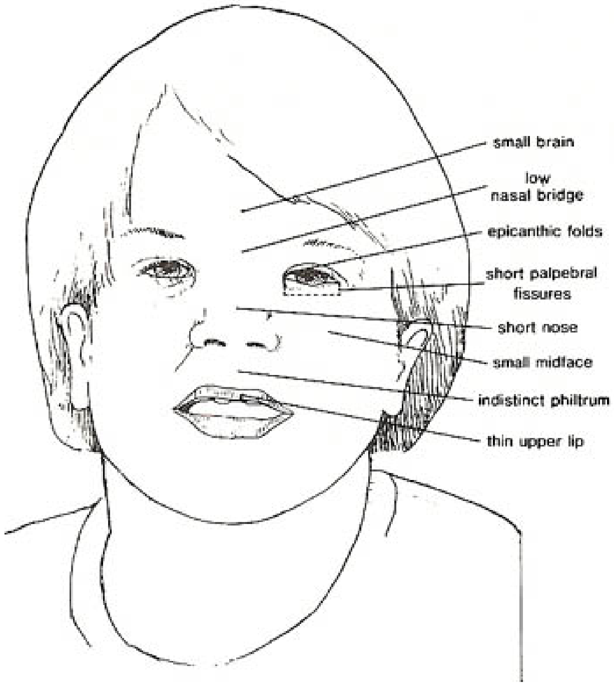
Note to readers: Move your mouse pointer over the highlighted words in the following examples to see discussion.

Definitions of unfamiliar terms

Defining potentially unfamiliar terms in a report is one of the most important ways to make up for readers' lack of knowledge in the report subject.

Facial Characteristics of FAS

Taken as a whole, the face of patients of fetal alcohol syndrom (FAS) is very distinctive. Structural deficiencies are thought to be the result of reduced cellular proliferation in the developing stages of the embryo because of the direct action of the alcohol. The face has a drawn-out appearance with characteristics that include short palpebral fissures, epicanthic folds, low nasal bridge, a short upturned nose, indistinct philtrum, small midface, and a thinned upper vermilion.



Comparisons to familiar things

Comparing technical concepts to ordinary and familiar things in our daily lives makes them easier to understand. For example, things in the world of electronics and computer—a downright intimidating area for many people—can be compared to channels of water, the five senses of the human body, gates and pathways, or other common things. Notice how comparison (highlighted) is used in these passages:

The helical configuration of the DNA strands is not haphazard. The nitrogen bases on each strang align themselves to form nitrogen base pairs. The pairs are T-A and C-G. Each pair is held together by hydrogen bonds. The pairing of the bases serves to fasten the two helical nucleotide strands together much the same way as the teeth of a zipper hold the zipper together. The existence of the complementary base pairs explain the constant ratios of T/A and C/G. For every T there must be a conplementary A and for every G there must be a complementary C.

David S. Newman, *An Invitation to Chemistry* (New York: Norton, 1978), pp. 380-381.

All the death and all the misery from a virus so small that 2-1/2 million of them in a line would take up one inch. Flu viruses fall into three types: A, B, and C. Type A, the most variables, causes pandemics as well as regular seasonal outbreaks; type B causes smaller outbreaks and is just now receiving greater attention; type C rarely causes serious health problems. In appearance, a flu virus somewhat resembles the medieval mace--a ball of iron studded with spikes. Hemagglutinin is the substance that in effect bashes into a cell during infection and allows the virus access to the cell interior where it can replicate.

Stephen S. Hall, "The Flu," *Science 83*, (November 1983), pages 56-57.

Elaborating the process

Explaining in detail the processes involved in the report subject can also help readers. Consider a paragraph like this one, containing only a sketchy reference to the process:

The Video Alert and Control dashboard system, a newly developed system to help drivers avoid accidents, graphically projects an image of hazards in the road.

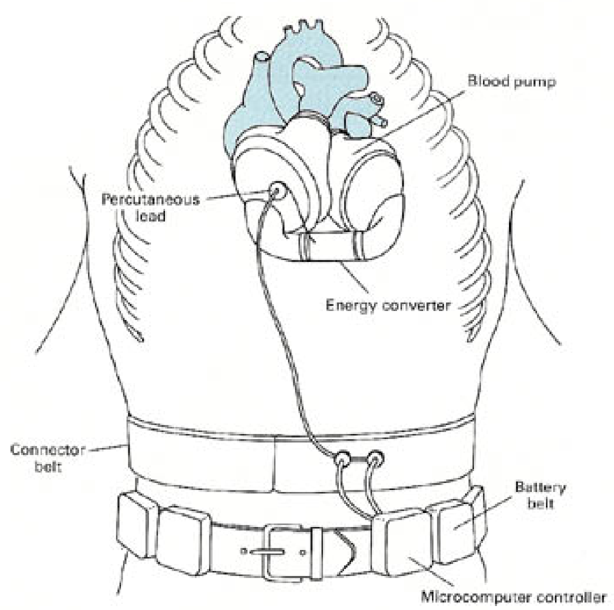
This brief reference can be converted into a more complete explanation as is illustrated here:

The Video Alert and Control dashboard systems uses a number of components to help drivers avoid accidents. The infrared detector is the key detecting device in that it searches for warm objects in or near the path ahead of the car. The infrared detector senses the upcoming trouble well before the driver by sensing warm-bloodedness and then alerts the driver. The infrared detector also senses the heat of oncoming traffic. All of these objects are shown draphically on the video screen. To differentiate wildlife from other cars, the x-ray unit is used to check for metal in the object ahead. Thus, if a warm object is detected with metal in it, the computer reads it as a car and shows it on the screen as a yellow dot. On the other hand, if no metal is detected in the warm object, it is read as an animaland plotted as a red dot...

Providing descriptive detail

Descriptions also help nonspecialist readers by making the report discussion more concrete and down-to-earth:

Jarvik and his colleagues have been working on other designs, such as a portable artificial heart, which they think will be ready for a patient within the next two years. Electrohydraulic Heart Jarvik has been developing electric-energy converters and blood pumps during the past year. The electrohydraulic energy converter has only one moving part. The impeller of an axial-flow pump is attached to the rotor of a brushless direct-current motor, with the impeller and the rotor supported by a single hydrodynamic bearing. Reversing the rotation of the pump reverses the direction of the hydraulic flow. The hydraulic fluid (silicone oil of low viscosity) actuates the diaphragm of a blood pump just as compressed air does in the Jarvik-7 heart design. This hydraulic fluid is pumped back and forth between the right and left ventricles. The energy converter is small and simple and therefore can be implanted without damaging vital structures. It weighs nearly 85 grams and occupies nearly 30 cubic centimeters. The converter requires an external battery and an electronics package, which is connected to the heart by a small cable through the patient's chest. The batteries weigh 2 to 5 pounds and can be worn on a vest or belt. The battery unit requires new or recharged batteries once or twice a day. The cable through which the power is transmitted from the battery to the heart also carries control signals from the microcomputer controller.



Providing illustrations

Illustrations—typically, simple diagrams—can help readers understand technical descriptions and explanations of processes. You can see the use of illustration in the FAS example above: epicanthic folds and the philtrum are defined under the diagram.

Providing examples and applications

Equally useful in articulating complex or abstract technical discussions are examples or explanations of how a thing can be used. For example, if you are trying to explain a LINUX command, showing how it is used in an example program helps readers greatly. If you are explaining a new design for a solar heating and cooling system, showing its application in a specific home can help also.

Continuous Speech Continuous speech causes many problems in computerized speech recognition. For example: "plea" and "please," while some words have similar acoustics, such as "what" and "watt."

Heidi E. Cootes, *Report on Computers that Recognize Speech*, University of Texas at Austin, May 6, 1983.

Now here is a passage with a longer, extended example:

...The user "scrolls" the worksheet right and left or up and down to bring different parts of it into view. Each position (that is, each intersection of a column and a row) on a screen corresponds to a record in memory. The user sets up his own matrix by assigning to each record either a label, an item of data or a formula; the corresponding position on the screen displays the assigned the label, the entered datum or the result of applying the formula.

Hoo-Mi D. Toong and Amar Gupta, "Personal Computers," *Scientific American*, (December 1982), pp. 99-100.

Shorter sentences and paragraphs

As simple a technique as it may seem, reducing the length of sentences can make a technical discussion easier to understand. Consider the following pairs of example passages, the second versions of which contain shorter sentences. (The passage still needs other translating techniques, particularly definitions, but the shorter sentences do make it more readable.) Notice, too, that shorter paragraphs can help in the articulating process, not only in the example below but throughout this chapter.

Original Version: Longer Sentences

UV-flourescence was determined on aliquots of the hexane extracts of subsurface water using the Perkin-Elmer MPF-44A dual-scanning flourescence spectrophotometer upon mousse sample NOAA-16, considered the best representative of cargo oil. Every day that samples were processed, a new calibration curve was developed from serial dilutions of the reference mousse (NOAA-16) at an emission wavelength of ca. 360 nm, and other samples were compared to it as the standard. Emission was scanned from 275-500 nm, offset 25 nm from the excitation wavelength, with the major peak occurring at 360 nm for the reference mousse solutions. In each sample, the concentration of flourescent material, a total oil estimate, was calculated from its respective flourescence, using the linear relationship of flourescence vs. concentration of the reference mousse "standard," with a correction factor applied to account for the reference mousse containing only about 30 percent.

Revised Version: Shorter Sentences

UV-flourescence was determined on aliquots of the hexane extracts of the subsurface water. These measurements were performed using a Perkin-Elmer MPF-44A dual-scanning flourescence spectrophotometer. Mousse sample NOAA-16 was used as the best representative of cargo sample. Other samples were compared to it as the standard. Every day that samples were processed, a new calibration curve was developed from serial dilutions of the reference mousse (NOAA-16). Tests were run at an emission wavelength of ca. 360 nm. Emission was scanned from 275-500 nm, offset 25 nm from the excitation wavelength. The major peak occurred at 360 nm for the reference mousse solutions. In each sample, the concentration of flourescent material, a total estimate, was calculated from its respective flourescence. The linear relationship of flourescence vs. concentration of the reference mousse "standard." A correction factor was applied to account for the reference mousse containing only about 30 percent oil.

Stronger Transitions and Overiews

Transitions and overviews guide readers through text. In difficult technical material, transitions and overviews are important. (For in-depth discussion, see transitions.)

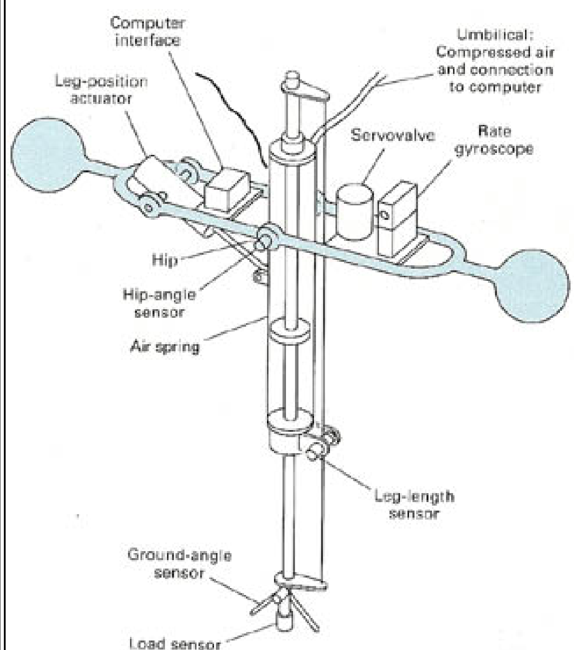
- *Repetition of key words*. As unlikely as it may seem, using the same words for same ideas is a critical technique for comprehension in technical discussions. In other words, don't refer to the hard drive as a "fixed-disk drive" one place and as "DASD" (an old IBM term meaning direct access stationary drive) in another. Same goes for verbs: stick with either "boot up" or "system reset," and don't vary.
- *Arrangement of key words*. Equally important is how you introduce keywords in sentences. If your focus stays on the topic in each sentence of a paragraph, place the keyword at or near the beginning of the second and following sentences. However, if the topic focus shifts from one sentence to the next, use the old-to-new pattern: start the following sentrnce with the old topic and end the sentence with the new topic.
- *Transition words and phrases*. Examples of transition words and phrases are "for example," "however," and so on. When the discussion is particularly difficult and when repetition and arrangement of keywords is not enough, use transition words and phrases.
- *Reviews of topics covered and topics to be covered*. At certain critical moments within and between paragraph (or groups of paragraphs) occurs a transitional device that either captures what has been discussed in a short phrase, previews what is to be discussed in the following paragraphs, or both. The latter device is also called a topic sentence.

The "in-other-words" Technique

In technical writing, you occasionally see questions posed to the readers. Such questions are not there for readers to answer; they are meant to stimulate readers' curiosity, renew their interest, introduce a new section of the discussion, or allow for a pause:

When an animal runs, its legs swing back and forth through large angles to provide balance and forward drive. We have found that such swinging motions of the leg do not have to be explicitly programmed for a machine but are a natural outcome of the interactions between the controllers for balance and attitude. Suppose the vehicle is traveling at a constant horizontal rate and is landing with its body upright. What must the attitude controller do during the stance to maintain the upright attitude? It must make sure that no torques are generated at the hip. Since the foot is fixed on the ground during stance, the leg must sweep back through an angle in order to guarantee that the torque on the hip will be zero while the body moves forward.

On the other hand, what must the balance servo do during flight to maintain balance? Since the foot must spend about as much time in front of the vehicle's center of gravity as behind it, the rate of travel and the duration of stance dictate a forward foot position for landing that will place the foot in a suitable spot for the next stance period. Thus during each flight the leg must swing forward under the direction of the balance servo, and during each stance it must sweep backward under the control of the attitude servo; the forward and back sweeping motions required for running are obtained automatically from the interplay of the servo-control loops for balance and attitude.



Two-Dimensional Hopping Machine

Marc H. Raibert and Ivan E. Sutherland, "Machines that Walk," *Scientific American*, (January 1983), p. 50.

*Asking rhetorical questions as an articulating techniqu*e

Sexy Technical Communication Home

Explaining the Importance

Some translating articulating work because they motivate readers. Sometimes readers need to be talked into concentrating on difficult technical discussion: one way is to explain to them or to remind them of the importance of what is being discussed. In this example, the last paragraph emphasizes the importance):

It was Linus Pauling and his coworkers who discovered that sickle cell anemia was a molecular disease. This disease affects a very high percentage of black Africans, as high as 40 percent in some regions. About 9 percent of black Americans are heterozygous for the gene that causes the disease. People who are heterozygous for sickle cell anemia contain one normal gene and one sickle cell gene. Since neither gene in this case is dominant, half the hemoglobin molecules will be normal and half sickled. The characteristic feature of this disease is a sickling of the normally round, or platelike, red blood cells under conditions of slight oxygen deprivation. The sickled red blood cells clog small blood vessels and capillaries. The body's response is to send out white blood cells to destroy the sickled red blood cells, thus causing a shortage of red blood cells, or anemia. The sickle cell gene originated from a mistake in information. A DNA molecule somehow misplaced a base, which in turn caused an RNA molecule to direct the cell to make hemoglobin with just one different amino acid unit among the nearly 600 normally constituting a hemoglobin molecule. So finely tuned is the human organism that this tiny difference is enough to cause death. Since the disease is nearly always fatal before puberty, how can a gene for a fatal childhood disease get so widespread in a population? The answer to this question gives some fascinating insight into the mechanism and purposes of evolution, or natural selection. The distribution of sickle cell anemia very closely parallels the distribution of a particularly deadly malaria-causing protozoan by the name of *Plasmodium falciparum*, and it turns out that there is a close connection between sickle cell anemia and malaria. Those people who are heterozygous for the sickle cell gene are relatively immune to malaria and, except under reasonably severe oxygen deprivation such as that found at high altitudes, they experience no noticeable effects due to the sickle cell gene they carry. Half the hemoglobin molecules in the red cells of heterozygous people are normal and half are sickled. Thus, under ordinary circumstances the normal hemoglobin carries on the usual respiratory functions of blood cells and there is little discomfort. On the other hand, the sickled hemoglobin molecules precipitate, in effect, when the malaria-causing protozoan enters the blood. The precipitated hemoglobin seems to crush the malaria protozoan, thus keeping the malaria from being fatal. The significance of all this should be pondered.

David S. Newman, *An Invitation to Chemistry*, pages 387-388.

Explaining the importance as a way of articulating technical discussions

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Providing Historical Background

Discussion of the historical background of a technical subject helps readers because it gives them less technical, more general, and sometimes more familiar information. It gives them a base of understanding from which to launch into the more difficult sections of the discussion:

Now that alcohol is being used in more and more social settings, it extremely important to recognize its teratogenic effects. Teratogenic, or malforming, agents produce an abnormal presence or absence of a substance that is required in physical development. Although Sullivan first reported on the effects of maternal drinking during pregnancy in 1899, the serious implications of his findings were virtually ignored for the next 50 years. It was not until the dramatic identification of a pattern of malformations, termed the fetal alcohol syndrome (FAS) by Jones et al in 1973, that the scientific community acknowledged the potential dangers of heavy maternal alcohol use. Since then, there has been increasing recognition that alcohol may be the most common drug in causing problems of malformations in humans.

Each morning in the soft, coral flush of daybreak, a laser dawns on Mars. Forty miles above frigid deserts of red stone and dust, it flares in an atmosphere of carbon dioxide. Infrared sunlight kindles in this gas a self-intensifying radiance that continuously generates as much energy as a thousand nuclear reactors. Our eyes are blind to it, but from sunrise to sunset Mars bathes in dazzling lasershine.The red planet may have lased in the sun for eons before astronomers identified its sky-high natural laser in 1980. The wonder is that its existence was unknown for so long. In 1898, in *The War of the Worlds*, H.G. Wells scourged earth with Martian invaders and a laserlike death ray. Pitiless, this "ghost of a beam of light" blasted brick, fired trees, and pierced iron as if it were paper.

In 1917 Albert Einstein speculated that under certain conditions atoms or molecules could absorb light or other radiation and then be stimulated to shed their borrowed energy. In the 1950s Soviet and American physicists independently theorized how this borrowed energy could be multiplied and repaid with prodigious interest. In 1960 Theodore H. Maiman invested the glare of a flash lamp in a rod of synthetic ruby; from that first laser on earth he extorted a burst of crimson light so brilliant it outshone the sun.

Allen A. Boraiko, "The Laser: 'A Splendid Light,'" *National Geographic*, (March 1984), p.335.

Historical background as an articulation technique

Reviewing Theoretical Background

To understand some phenomena, technologies, or their applications, readers must first understand the principle or theory behind them. Theoretical discussions need not be over the heads of nonspecialist readers. Discussion of theory is often little more than explanation of the root causes and effects at work in a phenomenon or mechanism. In this example, the writer establishes the theory and then can go on to discuss the findings that have come about through the use of NMR on living tissue.

To the extent that objections persist about the validity of modern biochemistry, they continue to be about reducing the processes of life to sequences of chemical reactions. "The reactions may take place in the test tube," one hears, "but do they really happen that way inside the living cell? And what happens in multicellular organisms?" One technique is beginning to answer these questions by detecting chemical reactions as they occur inside cells, tissues and organisms including those of human beings. The technique is nuclear-magnetic-resonance (NMR) spectroscopy. It relies on the fact that atomic nuclei with an odd number of nucleons (protons and neutrons) have an intrinsic magnetism that makes each such nucleus a magnetic dipole: in essence a bar magnet. Such nuclei include the proton (H-1), which is the nucleus of 99.98 percent of all hydrogen atoms occurring in nature, the carbon-13 nucleus (C-13), which is the nucleus of 1.1 percent of all carbon atoms, and the phosphorus-31 nucleus (P-31), which is the nucleus of all phosphorus atoms.

Theoretical background as an articulation technique

Sexy Technical Communication Home

Combining the Articulating Techniques

This last section concludes the techniques for articulating difficult technical prose to be presented here. However, take a look at writing in fields you know about, and look for other kinds of articulating techniques used there. Now, here are several extended passages of technical writing that combine several of these strategies.

Fine-tuning the spectrum To know lasers, one must first know the electromagnetic spectrum, which ranges from long radio waves to short, powerful gamma rays. The narrow band of the spectrum we know as visible, or white, light is made up of red, orange, yellow, green, blue, and violet light. These frequencies, as well as all radiation waves, are jumbled or diffused, much as noise is a collection of overlapping, interfering sounds. Laser light is organized and concentrated, like a single, clear musical note. In lasers, nature's disorder is given coherence, and photons—the basic units of all radiation—are sent out in regular ranks of one frequency. Because the waves coincide, the photons enhance one another, increasing their power to pass on energy and infomation. The first devices to emit concentrated radiation operated in the low-energy microwave frequencies. Today, laser technology is extending beyond ultraviolet toward the high-energy realms of x-rays. Each wavelength boasts its own capacities as a tool for man. A laser's beam can be modulated into an infinite number of wavelengths using flourescent dyes like those produced at Exciton Chemical Company in Ohio. At Hughes Research Laboratories in California, a blue-green laser reflected at an acute angle aneals silicon microchips, while a low-energy red laser monitors the process. **Harnessing light** As a bow stores energy and releases it to drive an arrow so lasers store energy in atoms and molecules, concentrate it, and release it in powerful waves. When an atom expands the orbits of its electrons, they instantly snap back, shedding energy in the form of a photon. When a molecule vibrates or changes its geometry, it also snaps back to emit a photon. In most lasers a medium of crystal, gas, or liquid is energized by high-intensity light, an electric discharge, or even nuclear radiation. When a photon reaches an atom, the energy exchange stimulates the emission of another photon in the same wavelength and direction, and so on, until a cascade of growing energy sweeps through the medium. The photons travel the length of the laser and bounce off mirrors—one a full mirror, one partially silvered—at either end. Photons, reflected back and forth, finally gain so much energy that they exit the partially silvered end, emerging as powerful beam. **Out of the darkness: laser eye surgery** Sight-saving shafts of light able to enter the eye without injuring it, lasers are revolutionizing eye surgery. Using techniques of New York opthalmologist Frances L'Esperance, eye surgeons employ four levels of laser energy. Exposure time ranges from 30 minutes for low-energy photoradiation to several billionths of a second for photodisruption. With microscopic focus, beams weld breaks in the retina or seal leaking blood vessels by photocoagulation. A painless 20-minute operation call an irridectomy relieves this excess fluid buildup of glaucoma. When an artificial lens is placed behind the iris, the supportive membrane often grows milky. A laser beam is pinpointed on the taut tissue in a series of minute explosions. This photodisruption causes the tissue to unzip and part like a curtain. Bloodless scalpels, lasers can make extremely delicate incisions, cauterize blood vessels, and leave tissue unaffected only a few cell widths away. **Beams that heal** Surgical trauma, the jarring aftermath of the surgeon's knife, may one day be consigned to the annals of primitive medicine—thanks to a procedure called "least invasive surgery" by its growing number of practitioners. Using an endoscope, surgeons can view the interior of the body and operate with the least amount of damage. An end view of the flexible tube ... shows a large optical fiber to light the way. Smaller openings facilitate fluid suction and gas suction. A forceps, controlled by a cable near the microscope viewing lens, extracts tissue for analysis. A laser, controlled by dials to the left of the eyepiece, streams from another tube, ready to perform wherever the doctor directs it. Twisting and probing wit the end of the scope, he can identify and coagulate a bleeding ulcer in the stomach or blast tumors in the esophagus. The beam is fed through the scope by an optical fiber from a laser machine ... that might cost the hospital from $20,000 to $150,000.

Allen A. Boraiko, "Lasers: A Splendid Light," *National Geographic*, (March 1984), pp. 338-346.

Articulating techniques used in combination