A recent traveler to Moldova and Armenia describes the state of health care in these former Soviet republics. Recent statements by South Africa's President Thabo Mbeki concerning HIV and AIDS have drawn much criticism, "[h]owever, some of Mbeki's views highlight still unanswered and pertinent questions." From a survey of the various movements plants exhibit to a suggestion of what to call "zoologically inspired robots," readers respond to *Science*'s recent special issue "Movement: Molecular to Robotic." And the impact that the introduction of sulfonamide drugs in 1948 had on the poultry industry and the role of these drugs today are discussed.

Health Care in Former Soviet Republics

Richard Stone in his News Focus article "Stress: The invisible hand in Eastern Europe's death rates" (9 June, p. 1732) highlights a serious problem in the countries of Central and Eastern Europe and especially those of the former Soviet Union. I recently visited Moldova and Armenia. If you ask medical doctors there about the current health service, they say it is chaotic and many times worse than in Soviet times. Diseases such as tuberculosis and hepatitis are on the increase. A large part of the problem is that many patients don't have the money to buy drugs or even anesthetics. The result is that the hospitals are short of patients and doctors are unemployed. Stone's article ends with a statement that "improving life expectancy in Eastern Europe lies with the region's economy." In Moldova and Armenia, I saw no signs of such improvement and hence am rather fearful for the future, as most likely the populations of these countries are as well.

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Contributions to the U.S. Space Program

The News of the Week article "Goldin shakes up NASA's life sciences program" (Andrew Lawler, 12 May, p. 938) does not include mention of the many contributions that Arnauld Nicogossian, former chief of NASA's Office of Life and Microgravity Sciences and Applications (OLMSA), has made to our nation's space program. Despite flat budgets for OLMSA over the past 6 years, Nicogossian's leadership has increased the office's extramural research community from about 650 to more than 900 researchers from nationally recognized institutions. Working with the National Institutes of Health and the National Science Foundation, Nicogossian has been instrumental in establishing the Life Sciences competitive peer review process, which requires all NASA scientific research to undergo vigorous peer review by independent external panels. Nicogossian should also be credited with spearheading an interdisciplinary research program in biology, physics, and chemistry, which uses biologically inspired technology as the basis for integration. This effort is attracting a new generation of scientists to NASA, as well as several Nobel laureates.

Whether serving as the associate administrator for OLMSA or as chief health and medical officer, Arnauld Nicogossian will continue to do an outstanding job providing NASA with world-class leadership and expertise.

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Mbeki and AIDS in Africa

Jon Cohen, in the News of the Week article "AIDS researchers decry Mbeki's views on HIV" (28 Apr., p. 590), accurately conveys the response that most scientists have to South Africa's President Thabo Mbeki's revisiting of the extensive evidence that HIV causes AIDS. However, some of Mbeki's views highlight still unanswered and pertinent questions. Despite the fact that various hypotheses have been put forward and numerous studies carried out, it is not yet clear why HIV and AIDS is spreading so rapidly in sub-Saharan Africa. In the absence of any satisfactory explanation for the overall phenomenon, there is logic in President Mbeki expressing a desire to consider whether there might be an "African" approach to the problem that differs from the response to AIDS in the West. Further research will reveal if there are significant factors that are specific to the African AIDS situation.

Something that needs to be investigated is whether the helminthic parasitic infections that are prevalent in Africa (but not in most developed countries) predispose individuals to AIDS and, for that matter, to tuberculosis, a disease that often occurs in AIDS patients. The body's predominant reaction to most worm infestations is a T helper cell type 2 (T_H2) immunological response. There is evidence that this immune profile allows the causative microorganisms of AIDS and tuberculosis to flourish (*1*–*4*). Future research should show whether mass deworming of human populations would represent a "local" approach, as envisaged by President Mbeki, to help control the spread of HIV and AIDS. Treatment of certain non-HIV sexually transmitted diseases has already been carried out in Africa in an attempt to reduce the incidence of HIV infection (see "Study of HIV transmission sparks ethics debate" by Gretchen Vogel, News of the Week, 7 Apr., p. 22). Indeed, on 9 July 2000, a workshop on "Helminth Infection and AIDS" is to be held in Durban, South Africa, as a satellite meeting of the 13th International AIDS Conference.

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Many Modes of Movement

The interesting array of articles for the special issue "Movement: Molecular to Robotic" (7 Apr., pp. 79–106) examines the biology of movement for animals with endoskeletons, animals with exoskeletons, robots, and molecules, but movement in an entire kingdom—the plant kingdom—is overlooked. Movement in plants is based on physical mechanisms that are very different from most animal movements, and movements have been a central factor in the evolution of many plant adaptations. Mechanisms include hydraulic shifts operating by means of osmotic engines (*1*), differential growth, fracturing of structures due to localized desiccation, and cell separations or dissolution leading to projectile actions.

Examples of movements based on hydraulic shifts include the cyclic flapping of leaves and the opening and closing of some petals and flowers. Cells on one side of a petiole, pulvinus, stem, or pedicel will lose water, whereas cells on the opposite side will maintain or even in-

crease turgidity, and movement of leaf, stem, or flower will occur. These osmotic engines are driven principally by ionic pumps across the cell membrane that usually transport K^+ or Ca^{2+} (or both), and in some cases, such as the leaf folding in the sensitive mimosa plant, an action potential is involved.

Examples of movement by differential growth on opposite sides of a plant organ include phototropism, gravitropism, the opening and closing of some flowers, and the coiling of stems and tendrils. In the case of the stilt palm (*Iriartea gigantea*) (*2*), the trunk is held aloft on supporting brace roots, and movement of the tree toward a light-gap can occur by differential growth of the brace roots on the lighted side and abandonment of such roots on the shaded side (see the figure).

The stilt palm "walks" toward a lighted area by differential growth of its stilt-roots.

Another group of movements involves localized cell degradation to produce a throwing action. Such movements include the explosive projection of pollen, spores, or seeds, which occur when tension is released in a cluster of cell walls that have degraded, resulting in a catapult-like action.

Movement can also occur by negative growth. Below-ground bulbs or stems can move down to a desirable depth by means of contractile roots. These roots have been found in more than 90% of the plants studied (*3*). They become thickened and develop extensive wrinkles as the root contracts. The irreversible contraction effect is achieved by a combination of thickening and shortening of individual cells along the root axis, combined with programmed cell death of layers of cells in the root cortex.

And finally, there is a large array of thigmo movements, movements stimulated by touch (mechanical perturbation) (*4*). The coiling of tendrils around an object involves two component movements (*5*): an initial movement (involving a contractile adenosine triphosphatase) resulting in hydraulic changes that lead to rapid coiling, followed by differential growth on opposing sides of the tendril, which allows the tendril to continue coiling around the support. There is evidence that such thigmo coiling movements involve the classic stimulus-response syndrome, including the opening of calcium channels and a probable sequence of phosphorylations.

Another example of thigmo movement is the motor pulvinus of the sensitive mimosa plant (*Mimosa pudica*) (*6*). When a leaf is touched, the signal is transmitted to the base of the leaf by a lever action. An action potential is generated. Special structures called tannin vacuoles in the motor cells at the base of the leaf, analogous to the sarcoplasmic reticulum in muscle sarcomeres, release Ca^{2+} into the cytoplasm. This causes actomyosin microfilaments to contract, opening putative potassium channels in the plasma membrane. The K^+ effluxes, drawing water after it by the osmotic engine mechanism. The turgor of these cells thus decreases, causing the leaf to bend downward as a result of the turgor differential between the upper and lower sides. Action potentials then travel up and down the stem, activating motor cells at the bases of other leaves.

In conclusion, the various movements performed by plants are special in that they are primarily based not on contractile proteins, but on physical and cellular alterations. The wide array of repositioning movements and adaptations for reproductive effectiveness has evolved principally as components of photosynthetic and reproductive strategies.

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In the "Movement" special issue, the News article "In nature, animals that stop and start with the race" by Elizabeth Pennisi (7 Apr., p. 83) misses one of the neatest examples. Once fish discovered the energetic advantages of "burst-and-coast" swimming (*1*), they also discovered the advantage of coasting above the surface of the water, to minimize drag and increase the distance covered by the coasting phase—hence, "flying fish." This was also discovered (independently) by flying squids, which inherently have a burst-and-coast mode of locomotion.

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I was writing up notes from Gary Taubes' News article, "Biologists and engineers create a new generation of robots that imitate life" (7 Apr., p. 80). Taking the notes was a bit troublesome because of the lack of a convenient term to categorize robots based on cockroaches, spiders, snakes, fish, and so on. The descriptive phrase "zoologically inspired robots" worked, but was a bit clumsy. The answer was then obvious—"zoobots."

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A Chicken in Every Pot, Thanks to Sulfonamide Drugs

In his Review article "Drug discovery: A historical perspective" (special issue on Drug Discovery, 17 Mar., p. 1960), Jürgen Drews focuses particular attention on the sulfonamide class of drugs and its impact on treating human disease. The historical importance of sulfaquinoxaline, first introduced by Merck under the direction of Max Tishler in 1948 (*1*), may not be widely appreciated, however.

Herbert Hoover's political sound bite in the 1928 presidential election, which equated "a chicken in every pot" with "two cars in every garage," may best reflect how luxurious a commodity chicken once was. Sulfaquinoxaline enabled a revolution in the practice of poultry production, by allowing birds to be raised economically in broiler houses at high density (*2*) through the control of infection by the parasite *Eimeria* and the subsequent economically devastating effects of the coccidiosis caused by it (*3*). In turn, these developments led to a dramatic fivefold decline in the price of poultry that has continued unabated to this day (see the figure).

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Today, the development of resistance has greatly reduced the role of the sul-