proved list. The Texas board has also required all textbooks mentioning evolution to include in their preface a statement warning that evolution is presented as a theory, not a fact. (J. B. Golden, director of textbooks, explains that the Gablers were able to use an appeals procedure adopted by the school board in the early 1960's. "It's a good old democratic procedure—it's worked very nicely," he says.)

Evolutionists claim to see the creationist movement as a closely coordinated, nationwide campaign supported by rich and powerful backers. "This is an organized and well-financed campaign," Mayer told the NABT meeting, his evidence being the time and effort devoted by creationists to their activities. "It seems evident the Seventh-Day Adventists and the Creation Research Society have embarked upon a plan to exert considerable pressure," says W. Earl Sams, a consultant at the California Department of Education. On the other hand, creationists claim that their societies are supported only by subscriptions, that their members act only as individuals, and that there is no organized campaign. Whatever the truth, creationists have certainly been active in several states. The Bible-Science Association, whose newsletter is intended to popularize the scientific writings of the Creation Research Society and others, has already established branch chapters in ten towns across the country. The aim of the chapters is to hold seminars and "work towards getting creationism into the schools." Members of the Creation Research Society have approached state boards of education in Louisiana, Indiana, Tennessee, Florida, and Michigan. The Gablers in Texas turned their attention to science textbooks (they had previously worked on history books) at the suggestion of Thomas G. Barnes, a physics professor at the University of Texas, El Paso, and a member of the Creation Research Society. The anti-evolution suit filed in Washington, D.C., this August is a separate development. The plaintiff, William Willoughby, religious editor of the Washington *Star & Daily News*, is not a member of the Creation Research Society. His suit, which he says was filed in the interest of the 40 million evangelical Christians in the United States, requests that the BSCS books be withdrawn and that the National Science Foundation, which spent $7 million in developing them, spend a like amount on research into creation theory.

Whatever the merits of the creationists' particular beliefs, their concern to safeguard the religious heritage of their children is legitimate, as is the concern of biologists to be alone in determining the content of biology classes. The respective interests may be reconcilable, though past wounds are not the only obstacle to agreement. The antagonists on each side probably present a more serious threat to the other than they realize. Biology teachers are probably more persuasive than they would like to admit. And the lobbying activities of creationists open the door for any other sectarian interest, religious or political, to get science textbooks altered to their liking. Having espoused the creationist cause from the start, the California state board will be hard put to find a solution that satisfies both sides.—NICHOLAS WADE

Politics of the Ocean: View from the Inside

It was April of 1970, and Washington's small marine science community was in a quandary. More than a year had passed since an advisory commission appointed by former President Lyndon Johnson had strongly urged the creation of a National Oceanic and Atmospheric Administration (NOAA). Now the dream of a "wet NASA" or of anything faintly resembling a new superagency for the oceans was rapidly evaporating. President Nixon's interest in marine affairs had dwindled precipitously after his election, his budget bureau opposed such an agency, and worst of all, his advisory committee on government reorganization—the secretive Ash Council—also had the deep six in mind for NOAA.

What the marine science community sorely needed, Edward Wenk writes in his new book, *The Politics of the Ocean*,* was a champion. And who should find himself cast in the unlikely role of the man who bailed out NOAA? According to Wenk, it was the former attorney general, John N. Mitchell, whose prior and subsequent interest in oceans and the atmosphere seems to have been limited mainly to swimming and breathing.

"Time and tactics to refloat the grounded NOAA were both running out," Wenk writes. "But one possibility appeared when Senator [Ernest F.] Hollings realized that he had access to one of the most powerful figures in the Administration, and one to whom the President regularly turned for advice."

Hollings, it should be explained, is chairman of the Senate subcommittee on oceans and the atmosphere, and he and a number of others in Congress had been working hard for several years to establish a focal agency for marine science and technology. Hollings had special access to Mitchell, as the senator belatedly realized one Sunday morning in April, partly because he sits on the appropriations subcommittee that dispenses money to the Justice Department, partly because he and Mitchell had known each other for years, and mostly because Mitchell owed the senator—a Democrat from South Carolina—a considerable favor. At the attorney general's personal request, Hollings had joined the fight to confirm President Nixon's unpopular Supreme Court nominee, South Carolinian Clement Haynesworth.

A few days later, the senator cashed in his chips in a conversation with Mitchell. Wenk, as the executive director of a White House advisory council on marine affairs, attended. So did John Whitaker, a geologist who serves the President's Domestic Council as the chief staff man for science and environmental affairs.

Wenk recalls that Mitchell initially balked at the idea of recommending to the President a new cabinet-level agen-

* E. Wenk, Jr., *The Politics of the Ocean* (Univ. of Washington Press, Seattle, 1972), 590 pp.; $14.95.

cy for the oceans. But a little coaching from Hollings led him to the conclusion that NOAA could reasonably become a semiautonomous part of some existing agency, perhaps Commerce or Interior. After all, Mitchell reasoned, hadn't the Federal Bureau of Investigation enjoyed a great deal of freedom within the Justice Department?

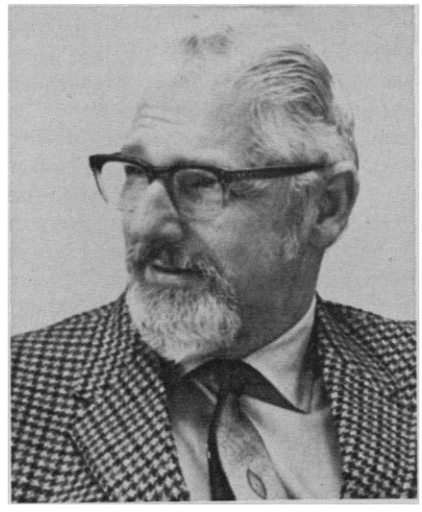
The meeting with the attorney general was not the only source of pro-NOAA advice for the President, of course. Wenk himself wrote a long letter advocating that the new agency be established, and this probably had some influence. In any case, President Nixon spurned the advice of NOAA's opponents and 2 months later signed the long-awaited Reorganization Plan No. 4. Thus was NOAA launched.

Wenk's book is sprinkled liberally with such insider's anecdotes. They range in time from an account of an extraordinary campaign of lobbying for federal funds by the ocean science panel of the National Academy of Sciences (NAS) in the late 1950's to a circumspect tale about a minitantrum staged by Spiro Agnew that preceded the Vice President's withdrawing from his statutory duties as chairman of the White House Council on Marine Resources and Engineering Development. (The council, of which Wenk served as executive director, is now defunct.)

Certainly Wenk was well situated to watch the action. A former Westinghouse engineer, he moved to the Library of Congress in 1959 to become the Legislative Reference Service's first adviser on science and technology, and later helped organize the Library's respected Science Policy Research Division. During the Kennedy Administration, Wenk spent 3 years under presidential science adviser Jerome Wiesner as staff director of the Federal Council for Science and Technology (FCST), an interagency coordinating group. After his second stint at the Library of Congress, he moved back to the White House staff in 1966 as executive director of the newly formed marine resources council and remained there until the council dissolved last year. Wenk is now on the engineering faculty of the University of Washington.

More than an anthology of tales out of school, his book recounts in almost overwhelming detail an era in which the government's interest in marine science affairs burgeoned.

In the late 1950's, as Wenk depicts it, oceanography was a backwater of



Edward Wenk, Jr.

American science characterized by a fractious academic leadership infatuated with yachting, having an impotent industrial lobby, and eliciting virtually no visible interest on the part of Congress or the White House. Out of the $4.8 billion the federal government then was spending on R & D, marine science and technology received $24 million, or one-half of 1 percent.

And yet, by the late 1960's, academic sea lords had largely put aside institutional rivalries, moored their yachts, and learned how to lobby. Staunch advocates of oceanography, and new subcommitees devoted to its advancement, had emerged in Congress. The White House now sported its own live-in salesman for marine science in the form of an advisory council headed by no less a figure than the indefatigable Vice President Hubert Humphrey. And best of all, *mirabile dictu*, ocean R & D now commanded a respectable 3.5 percent of the government's $15 billion outlay for R & D.

What happened in between, as Wenk makes abundantly clear, was not a spontaneous awakening. Nor, he maintains, was the government responding to the kinds of external crises —such as threats, real or imagined, to national security and prestige—that opened the federal treasury to physics and the space sciences.

Perhaps more than anything else, the book provides an unusual view, albeit through the eyes of a highly partisan participant, of the ways in which government administrators conceive and shape national policies for which Presidents ultimately take credit.

"There was no underwater Sputnik," Wenk writes, and "no threat or effective lobby" to impell an interest in the oceans. Thus the marine science community found it necessary to haul itself up by the bootstraps "by bending events, persuading people, . . . even generating new institutions."

The Eisenhower Years

The selling of the marine sciences began in 1956 at the instigation of what Don K. Price has described as a "group of government oceanographers [who] decided that their activities needed to be greatly built up." †

Their instigation, Wenk says, took the form of a letter that year from the Chief of Naval Research to the NAS, requesting a major study of "the national needs for an expanded program of maritime research." The academy obliged, and the report that its Committee on Oceanography released in February 1959 produced a clamor of congressional support that exceeded nearly everyone's wildest dreams.

Indeed, Wenk notes, "It generated many of the political events that followed . . . and until 1966 provided the most significant single impulse toward a new era of American exploration of the sea."

In retrospect, the report's impact seems all out of proportion with its merits. Its demands were modest (it asked a doubling over the next decade of the $24 million then being spent on marine science), it scarcely mentioned policy issues, and anyone could tell that much of the money requested would go to research institutions represented on the committee.

But, as Wenk points out, this was the "heyday of blind faith in science." What's more, committee members Harrison Brown, Roger Revelle, and Sumner Pike (a shrewd and well-connected businessman from Maine) were determined not to let its message fall on deaf ears. With the approval of NAS president Detlev Bronk, these three members assiduously briefed key members of Congress on the report's great significance during the weeks before its release. Hubert Humphrey, ever after a friend of oceanography, was among those briefed. So was Warren Magnuson, a Democratic senator from coastal Washington State and the powerful chairman of the Senate Commerce Committee who, before long, would earn the nickname of "Mr. Oceanography." To facilitate these

† Don K. Price, *The Scientific Estate* (Harvard Univ. Press, Cambridge, Mass., 1965), p. 209.

sales sessions, Wenk notes, Sumner Pike, a former member of the Atomic Energy Commission, arranged for congressional junkets to his estate at Lubec, Maine—at Navy expense.

The results were spectacular. Two days after the report's release, Humphrey was on the Senate floor delivering a stirring call for support of marine science. "Within a few weeks," Wenk writes, "Congressmen were making speeches, introducing resolutions and bills, and holding hearings, all focused on uncritical implementation of the [academy] proposals."

Although the hearts and minds of Congress had been won, the reception at the White House was chilly. Like a number of scientists at that time, Eisenhower's science adviser, George B. Kistiakowsky, resented the academy committee's Fuller Brush approach to science policy and was not bashful about saying so. Moreover, there were private grumblings among members of the President's Science Advisory Committee to the effect that "oceanographers were not first rate scientists," and were therefore less deserving of federal largesse than, say, high-energy physicists. In the end, the FCST set up a subcommittee to coordinate federal marine science programs, but Wenk indicates that it accomplished little.

The Kennedy Years

Attitudes of the White House swiftly changed with the inauguration of President Kennedy and the installation of a new science adviser, Jerome Wiesner, Wenk says. The Kennedy years were characterized by a giddy upward spiral of R & D research budgets and, for once, marine sciences climbed along.

Accelerating the flow of money, however, proved to be an easier task than streamlining the management of federal marine science programs. During the Kennedy Administration, Congress began what proved to be an arduous campaign to knit together programs in 29 bureaus and 11 agencies or departments; a measure of success finally was achieved late in the Johnson Administration.

The Kennedy inauguration was hardly over when the marine sciences got their first big break from the White House. Nearly every day, Kennedy and his closest advisers, Wiesner among them, would gather in the Oval Office for conversation. And it wasn't long, Wenk writes, before the "five o'clock club" began casting about for new legislative initiatives that the President might pass on to Congress in fulfillment of his dramatic inaugural address.

Early in February of 1961, Theodore Sorenson, the President's chief counsel and speech writer, let it be known that Kennedy's years in the Navy and his love of yachting "might make him sympathetic to a push in marine affairs," to quote Wenk. Ocean R & D had already grown to consume $60 million of the federal R & D budget. But Wiesner's staff obliged anyway by drawing up a $30 million post-Christmas package of new and expanded research programs. (Roger Revelle, who now was science adviser to Secretary of the Interior Stewart Udall, helped too, Wenk says.)

Sorenson had some mild objections to the package, but not because it was too expensive: He said it failed to enunciate any new thrusts of maritime policy.

That oversight was easily remedied, however, and, only a few weeks after the whole project had started, Kennedy delivered a special message to Congress requesting the new national program for oceanography that Wiesner's staff had hurriedly conceived. Thoroughly primed, Congress was only too happy to oblige, and even added another $6 million for good measure, thereby boosting the ocean budget for fiscal 1962 to $97.5 million.

"To those who may have assumed the [President's] add-on was the product of long, extensive staff work and argument," Wenk comments, "this account may be a source of amusement, and perhaps a lesson."

While all this was going on, the FCST's Interagency Committee on Oceanography (ICO) was evolving as something of a resident salesman for the marine sciences within the White House. Representative John Dingell (D–Mich.), then chairman of the subcommittee on oceanography, persuaded Wiesner to let Wenk (who by now had moved to the White House as FCST staff director) focus his attention on the ICO and make it a "showcase" of interagency cooperation. That decision freed Wenk, as he points out, to shed any pretense to neutrality and to turn the committee into an effective machine for building up marine science and technology programs still further during 1962 to 1964.

The Johnson Years

Federal support for marine science and technology reached an administrative high watermark during the Johnson Administration, according to Wenk. And its rate of growth, which faltered briefly in the early 1960's after the postinaugural spurt of 1961, resumed its upward spiral.

In Wenk's view, 1966 was an historic year, marked by passage of the Marine Resources and Engineering Development Act, a law that Wenk describes as a "triumph of long-range vision, skilled draftsmanship, and potent statecraft." (Some of his friends in Washington, however, question whether it was really *that* far reaching. They point out that its only remaining vestiges are a policy statement endorsing federal support of marine science and the federal sea-grant program, which was tacked on at the last minute.)

A montage of the more promising pieces of previously unsuccessful bills, the marine resources act did three things: It formally declared that support of marine R & D was a national policy; it set up a presidential advisory commission to suggest how federal marine programs might be reorganized (the commission ultimately recommended setting up NOAA); and, perhaps most important, the act established the White House Marine Resources Council, and placed it under the Vice President, thus making him, in Wenk's phrase, "the nation's chief oceanographer."

Up until the veto deadline, Wenk says, no one knew whether Johnson would sign the bill. The budget bureau and the Office of Science and Technology opposed it, but its congressional authors—principally Senator Magnuson and his aide, Dan Markel—were banking on the President noticing the similarity to the 1958 Space Act which Johnson, as a senator, had fought for.

The first inkling of Johnson's support for the space bill's saltwater analog came when Magnuson's wife Jermaine sidled up to the President during a reception and asked him if he really had the heart to scuttle a bill her husband had worked so hard to pass. Johnson, who had known the Magnusons socially for years (Johnson was best man at their wedding) was a bit surprised, but recovered quickly. "Honey," he replied, "for you I'll sign it." And he did.

The 1966 law came just in time to head off an impending slump in the fortunes of marine science. The academy report was obsolete by now and the academy itself had stopped its lobbying in the wake of the Project Mohole debacle. Moreover, Congress

had begun asking pointed questions about the relevance of oceanography to national goals, and the ICO, which was composed mostly of the heads of federal marine science programs, found itself in the unusual and embarrassing position of being "unable to rationalize further growth," the oceanography budget having risen to $135 million by 1964.

Wenk had left the FCST for the Library of Congress, but returned to the Executive Office in 1966 to head the newly formed marine council under Vice President Humphrey. As Wenk saw the council's role, it was to be a vigorous advocate for marine science, and most definitely not a neutral arbiter of policy. His objectives were to soothe rivalries among government oceanographers that could harm them all, to apply pressure on Congress and the budget bureau to keep the money flowing, and, of course, to rationalize growth. "If putting fuel in the oceanography tank was the name of the game," Wenk writes, "what purposes would justify that addition."

In its quest for rationale, the coun-

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RESEARCH NEWS

Photovoltaic Cells: Direct Conversion of Solar Energy

Solar cells that generate electricity by means of photovoltaic processes are the predominant source of power for space satellites. Because such cells convert sunlight directly into electricity without an intermediate thermodynamic cycle, and because sunlight is a large and inexhaustible resource, this technology is an inherently attractive source of power. At present, solar cells are not competitive with other means of generating electricity for terrestrial use, but their long-run potential has attracted increasing attention. Recent improvements in cell fabrication and manufacturing methods have stimulated novel proposals for utilizing solar energy on a large scale. Among the applications being studied are the solar-powered house—which some proponents believe could be a reality within 10 years—centralized generating station, and, as a more distant possibility, large orbiting power stations that would transmit energy back to earth.

Of the difficulties that stand in the way of terrestrial applications, the key problems are those of reducing the cost of solar cell arrays more than a hundredfold, increasing their useful lifetimes, and developing methods for the storage of energy. The relatively small numbers of cells produced for spacecraft are manufactured by costly batch processes and assembled by hand. Radiation damage in space or corrosion by humidity and other environmental agents on earth typically degrades the performance of unprotected cells well before the 20 to 30 years expected of power plants, and there is general agreement that encapsulation of cells in glass or plastic will be necessary. For terrestrial applications, the rotation of the earth and the uncertainties of cloud cover make solar energy an intermittent resource, and, as a result, some must be stored for use when the sun doesn't shine. Space power stations do not suffer from the intermittent availability of sunlight, but for them to become feasible, the cost of transporting the components into orbit will have to be greatly reduced.

Nonetheless, there is considerable optimism among those working on direct conversion of solar energy, which has the advantage, they point out, of avoiding virtually all of the environmental contamination problems associated with other sources of power. New and unfamiliar technologies are not required—photovoltaic cells were among the first semiconductor devices to be developed. But in recent years, according to a report by the National Academy of Sciences (*1*), there has been very little support for research aimed at improving solar cells and also no financial incentive for major industrial development efforts. The report concludes that the efficiency with which existing silicon solar cells convert sunlight to electricity, about 13 percent, might well be increased to 20 percent.

Silicon cells have been the mainstay of space power systems, but cadmium sulfide and gallium arsenide cells have also been developed and tested. In operation, positive and negative charges are generated within the cells by the absorption of solar photons. The charges diffuse across the cell until they either recombine or are separated and collected by an electrical inhomogeneity, typically a p-n junction between two semiconductor regions. Existing silicon cells develop about 0.5 volt, so that large numbers of cells must be arranged in series to achieve high voltages. The output is direct current, which in a practical power system would have to be inverted to alternating current before distribution to the consumer.

Silicon solar cells are made from single crystals of the material, and production of these crystals has always been a costly and awkward process. In a promising development, however, continuous ribbons of silicon have been grown at Tyco Laboratories in Waltham, Massachusetts. In the Tyco process, which was originally developed for continuously growing single crystals of sapphire, the ribbon is formed from a die that controls the shape of the emerging crystal. According to A. I. Mlavsky of Tyco, the process can already produce crystals at the rate of more than 2 centimeters per minute and could easily be automated to produce 100 crystals simultaneously. Although the process works well for sapphire and has produced silicon crystals with very few dislocations, the silicon is not yet of high enough quality for solar cells. The problem is that molten silicon is a highly reactive substance, very nearly a universal solvent, and it appears to be dissolving part of the die and thus introducing impurities into the silicon. A search for better die materials is continuing, and, if successful, could effectively lower the cost of silicon solar cells.

A second significant factor in the cost of silicon solar cells is that of the raw material. Although silicon is an abundant element and is available in metallurgical grade at $600 per ton, the cost of the extremely pure material needed for cell manufacture is 100 times higher, and its production consumes large amounts of energy. Assembling of solar cells into large arrays is also expensive and not easily automated. Although some have speculated that costs of silicon solar cell assemblies

(Continued from page 732)

cil sometimes went to unusual lengths. At one point, it assigned staff member Robert Kay to an exercise cryptically dubbed "Sigma M," in which Kay was to think up broad new reasons for expanding federal support for marine R & D. Try as he might, though, Kay never came up with any persuasive new "unifying themes."

Actually, given Johnson's proclivity for screening his staff for "new initiatives" to slip into speeches and spring on the public from time to time, weighty new arguments hardly seemed necessary.

Johnson is said to have kept one of his chief aides, Joseph Califano, busy trolling for new ideas, and Wenk's staff cooperatively dropped a few into the net every time Califano happened by. Thus, for example, in preparing for the 1968 budget, the council picked through more than 100 ideas from various agencies and from PSAC; from these it selected nine programs—worth $41 million—for sale to the President. Johnson bought them all, practically sight unseen, and ticked them off in a message to Congress in March 1967: A boost for the sea-grant program, development of fish protein concentrate to feed the hungry of the world, improved coastal weather prediction, and so on.

Apart from whatever merit these programs had in their own right, their selection also reflected careful consideration by the council more along Machiavellian lines. Whereas an erudite John Kennedy might see the virtue in supporting science for its own sake, the council was now with a "product of the Texas hill country," and its sales pitch had to be adjusted accordingly. Everyone recognized Lyndon Johnson's concern for the downtrodden of the world, so why not feed them concentrated fish? And every Texan appreciated the destructiveness of tornadoes and hurricanes, hence the appeal of better coastal weather prediction.

The marine resources council, Wenk says, deliberately soft-peddled basic science:

> It was increasingly clear that Johnson was disenchanted with science advocates and lukewarm to his own science adviser. . . . Don Hornig became less and less at home in the White House. Moreover, on the theme of "What have you done for me lately?" Hornig was under pressure to demonstrate the contribution science could make to victory in Vietnam through defoliation chemicals and remote

acoustical surveillance. In that antagonistic atmosphere, it was clear that emphasis in our marine program had to be placed clearly on social, economic, and political goals of the nation as interpreted by LBJ.

The Nixon Years

And what of the Nixon Administration? Apart from its reluctant establishment of NOAA, Wenk gives it low marks, as any one salesman might who had the door slammed on his foot. For what seemed to be initial enthusiasm for maintaining the pace of growth enjoyed under the Democrats quickly palled under the Republicans. In a campaign speech in Miami in 1968, Nixon vowed to create something he called the Sea Exploration Agency but that was the last anyone heard of that idea. In 1969, Agnew, in an initial spurt of enthusiasm, enunciated a five-point program for expanding ocean research, and that was the last anyone heard of *that* idea.

Wenk particularly takes the Nixon Administration to task for failing to press for planned management of the nation's coastal zones—an issue the Administration prefers to treat as a segment of larger land-use policy issues. While some might think that approach makes sense, Wenk argues that the effect has been to do nothing at all about coastal zone problems.

In some of his criticism, Wenk is open to accusations of partisanship. In addition to his past ties with Democrats, he is effusive in his praise of Humphrey's intellect, energy, and administrative ability as head of the marine council and plainly scornful of Agnew. In all likelihood, though, the difference has more to do with who did what for oceanography than with Wenk's personal political leanings.

Certainly Wenk's experience with Agnew was not a happy one. Having succeeded Humphrey as head of the council, Agnew attended only one meeting, in 1969, and that proved a disaster. Arriving too late for a thorough briefing on the controversial budget issues to be discussed by agency heads, Agnew tried to moderate the argument and failed. "Everyone sensed his growing panic, even a desire to stop the meeting," Wenk writes. Thereafter, the Vice President refused to attend council meetings unless a verbatim script for all participants were prepared in advance, an order Wenk says was impossible to fill.

With the leadership of the council declining "under a Vice-President more

inclined to partisan politics than to federal management," Congress cut off its funds and the council expired in June 1971.

With it, Wenk contends, died a noteworthy experiment in government administration, and one that left a vacuum in leadership for marine science and technology at the highest level.

That may be, but it is also possible that the Nixon White House prefers no leadership to leadership from advisory councils that carry torches for special causes. As Wenk admits, "We ran an honest game, but definitely not a neutral one."—ROBERT GILLETTE

RECENT DEATHS

John F. Baggett, 85; former president, Kentucky Wesleyan College; 14 September.

Earl L. Boggs, 68; former professor of education, University of Virginia; 17 September.

Everett C. Bracken, 63; head, postdoctoral section, research fellowships branch, National Institute of General Medical Sciences; 12 October.

Max R. Brunstetter, 70; former provost, Teachers College, Columbia University; 14 October.

Philip Cooper, 63; clinical professor of surgery, University of Florida; 2 October.

Samuel H. Dolbear, 86; mining engineer consultant, Behre Dolbear & Company; 5 October.

Paul Friedman, 73; associate clinical professor emeritus of psychiatry, Mount Sinai School of Medicine; 12 October.

Bernard Glueck, 88; psychiatrist, formerly at University of North Carolina Medical School; 5 October.

Lauren B. Hitchcock, 72; former professor of chemical engineering, University of Virginia; 15 October.

Nils O. Myklestad, 63; professor of aerospace and mechanical engineering, University of Texas, Arlington; 23 September.

Erratum: In the report by E. Matin *et al.* "Metacontrast and Saccadic Suppression" (*Science* **178**, 179–182, 13 Oct. 1972), there were several errors in the first two columns on page 180. These were the result of changes made by the editors after the authors had returned the galley proofs.

1) The size of each of the five squares in the fixation array was 6 minutes of arc by 6 minutes of arc (6′ by 6′ visual angle); it was not 1.8 by 1.8 m or 6 by 6 feet as printed.

2) The size of the slit beneath the target square was 2 minutes of arc (horizontal) by 30 minutes of arc (vertical); it was not 0.6 m by 9 m as printed.