LETTERS

Meteorological Satellites

The article "A silver lining for the weather satellites?" by M. Mitchell Waldrop (News and Comment, 14 Dec., p. 1289) is timely in drawing attention to the problems besetting the operation and replacement of the weather satellites. Although the article correctly notes that the primary mission for both polar orbiters and the GOES geostationary satellites is in support of weather forecasting, it does not point out that such satellites are also vital in areas related to climate, where the loss of a satellite results in the irretrievable loss of data and a break in the climate record. Such losses can be devastating to climate studies and climate forecasts.

For weather forecasting purposes, the loss of GOES-5 on 30 July 1984 was mitigated by moving GOES-6 from its position over the Pacific Ocean to a location south of Texas. It seems that a replacement satellite is unlikely to go up before October 1985 at the earliest—a gap of more than a year. A similar previous loss of the GOES satellite over the Pacific occurred from 25 November 1982 to 28 April 1983, which happened to coincide with the largest El Niño event in this century (*Science*, 16 Dec. 1983, p. 1189). An El Niño signifies a substantial anomalous warming of the sea surface in the tropical Pacific Ocean. It coincides with substantial perturbations in cloudiness and precipitation in the same area and is linked to major anomalies in the global atmospheric circulation. At the time of the 1982–1983 El Niño, devastating anomalies in weather and short-term climate occurred all over the globe—ranging from drought in Australia, India, Indonesia, and Africa to floods in Peru and Ecuador, coastal flooding in California and along the west coast of South America, displaced storm tracks across the United States, and unusual hurricane tracks (with Tahiti's worst modern hurricane and a rare November hurricane in Hawaii). The GOES satellite over the Pacific potentially provides unique data on cloudiness, precipitation, winds, and sea surface temperatures that signal the onset of such events. This information is vital for seasonal forecasting, but the data for that period are lost and irreplaceable.

A new international program called TOGA (Tropical Oceans Global Atmosphere) gets under way in January 1985 for a decade and has as its objectives to describe, understand, and predict the time-dependent behavior of the tropical oceans and the global atmosphere, including such phenomena as El Niño events. A crucial and central role is to be played by data from meteorological satellites. Continuous satellite coverage is regarded as an extremely high priority by the meteorological and oceanographic scientific community.

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Lead and IQ Scores: A Reanalysis

Although it is widely acknowledged that lead at high doses damages children's brains, the demonstration of neurotoxicity from lesser doses continues to be debated. In 1979, my colleagues and I evaluated neuropsychological performance in asymptomatic children whose past lead exposure had been measured and classified by the lead content of their teeth. Teeth were collected from each child, and dentine lead concentrations were measured for each subject. Those subjects whose dentine lead concentrations were not concordant by defined criteria were excluded from the analysis. Included subjects were classified dichotomously as those exposed to "high" lead concentrations (<20 parts per million) or "low" lead concentrations (<10 parts per million). After 39 socioeconomic covariates were controlled in the analysis, subjects exposed to high lead concentrations were found to have significantly lower Wechsler IQ scores than their low-exposure counterparts (*1*). When our study was reviewed by a panel of consultants to the Environmental Protection Agency, certain elements of the design were criticized, and the panel concluded that the study neither confirmed nor rejected the conclusion that lead was toxic at the doses observed (*2*). These criticisms were discussed in a News and Comment article by Eliot Marshall (25 Nov. 1983, p. 906).

The major criticisms of the panel report can be summarized as follows: (i) fathers' education should have been controlled instead of fathers' socioeconomic status (SES); (ii) raw IQ scores should have been entered into the analysis rather than age-adjusted scores, and age should then have been controlled as a separate covariate; (iii) the analysis of variance design we employed tended to maximize the difference between groups. The critics suggested using multiple re-

Table 1. Analysis of covariance, dependent variable, verbal IQ. Covariates entered into the original model were parents' IQ, mother's age at subject's birth, mother's education, father's socioeconomic status, and number of live births.

Lead	Mean verbal IQ	*F*	*P*
	Original model		
High	99.20	4.58	0.03
Low	104.10		
	Father's education substituted		
High	99.30	4.13	0.04
Low	103.80		

gression analysis with backwards elimination to examine the data.

To respond to these criticisms, we first replaced fathers' SES by fathers' education and then repeated the analysis. This substitution had only minimal effect on the significance of the differences observed in the original model (Table 1).

Next, using multiple regression and entering dentine lead as a dummy variable, we compared results obtained by using raw IQ scores and entering age as a covariate with those obtained by using age-adjusted scores without age in the model. Entering age and raw IQ score reduced the coefficient for lead when verbal IQ was the outcome, but *P* values were not materially altered. In both cases *P* was <0.05 (Table 2).

We then calculated the mean dentine lead concentration for each child from all specimens available and, using subjects' lead concentrations as a continuous variable, reanalyzed the data using a backward elimination multiple regression analysis. This brought back into the analysis those subjects previously dropped because of discordant lead concentrations and increased the sample size from 158 to 221. Mean dentine lead was entered with 10 nonlead covariates into the regression analysis. The criterion for excluding variables was set at $t = 1.0$. In the final model, the coefficient for lead was significant at $P = 0.029$ (Table 3). In the original publication, the significance of the observed difference in verbal IQ scores evaluated by analysis of covariance was 0.03.

We report here, for the sake of brevity, the effect of lead on one outcome, verbal intelligence. The reanalysis of performance IQ and of full-scale IQ showed effects similar to those shown in our original study. We conclude that the effects of lead on IQ are robust and are not biased by using SES instead of education as a covariate, or by using scaled IQ scores instead of raw scores. Nor were the results dependent on the form of the data analysis, whether analysis of covariance or multiple regression with ordinary least squares or backward elimination. The stability of the results, in the face of different covariate specifications and statistical procedures, is probably

Table 2. Multiple regression coefficients, dependent variable, and verbal IQ; $n = 142$.

Variable	Raw scores	*t*	Age adjusted scores	*t*
Age (months)	0.8581	7.25		
Parents' IQ	0.3422	4.41	0.3808	4.46
Mother's education	−1.2770	1.12	−1.5138	1.21
Father's SES	−0.2678	0.24	−0.0459	0.03
Mother's age at birth	−0.899	0.49	0.0114	0.05
Number of live births	−1.2161	1.85	−1.3589	1.91
Lead concentration	−4.0010	1.98*	−5.0452	2.31*
Constant	−48.5384		72.4527	
F	14.14		9.19	
R^2	0.39		0.26	

*$P < 0.025$.

Table 3. Backward elimination multiple regression analysis, verbal IQ, and final model; $n = 221$.

Variable	*B*	*T*	*P*
Mean lead concentration	−0.1716	−2.202	0.029
Mother's education	0.14451	−2.815	0.006
Number of live births	−0.1314	−2.056	0.041
Parents' IQ	0.2551	4.226	0.000
Father's age	−0.4491	−1.975	0.050
Mother's age	0.6079	1.962	0.050
$R^2 = 0.29$			
$F = 10.95$			

due to at least two factors: the neurotoxic potency of lead and the fact that, in this sample, lead is not correlated with other variates that affect IQ. This sample was selected because the children were offspring of white working-class parents, and thus some of the problems of confounding in studies that sample from inner-city populations were avoided. In that regard, the sample reported here is probably more representative of the majority of children in this country.

These results, combined with recent reports from England and Germany (*3*), support the assertion that doses of lead lower than those that are clearly symptomatic are neurotoxic. These data may have relevance to the current regulatory and legislative initiatives directed at the control of airborne lead.

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NIH Study

The Delegation for Basic Biomedical Research takes note of the report of the Institute of Medicine's Committee for the Study of the Organizational Structure of the National Institutes of Health (NIH) (News and Comment, 30 Nov., p. 1055). The document is an adequately thorough analysis of NIH's structure and operating mode and makes recommendations on such matters as increasing the authority and flexibility of the office of NIH's director; controlling the proliferation of institutes; the desirability of setting up a Health Sciences Board to advise the Assistant Secretary for Health on proposals that would alter the structure of NIH; and problems of overlapping jurisdictions between federal health agencies.

We heartily endorse the proposal concerning the director's office. Proliferation of institutes clearly tends to dilute the NIH mission. We agree that the process should be slowed but are aware that the problem is fraught with difficulties. The Health Sciences Board concept has some merit, which, however, is compromised by the danger of its becoming politicized and so another unneeded bureaucratic accretion.

But we have the sense of "here we go again." Every few years we take the federal government's brightest jewel out of its velvet bag and ponderously examine it for flaws! Each time we express our delight at its loveliness, note a few minor blemishes, and return it reverently to the safe. This most recent study of NIH brings little new to light. The NIH remains a brilliant exception to the widely held view that big government is wasteful government. The NIH is a superb federal agency that has borne America to its present position of international leadership in biomedical science. What operational difficulties it is experiencing today are almost entirely attributable to inadequate funding. Indeed, a study of NIH's present situation may be likened to examining the victim of a strangulation in progress. Evaluation of the victim's performance capabilities are bound to be compromised by steadily mounting asphyxiation. Removal of the noose and introduction of fresh air are essential before a clear picture of the subject's condition can be ascertained.

The fundamental truth of NIH is that it has been operating under steadily rising budgetary stringencies for some 14 years. Careful assessment of its needs relative to obligations shows that it currently requires an additional $2.5 billion to bring it into optimum function. Money, then, and some sensible attention to protecting it against continuing legislative efforts to dilute its mission, are the two simple needs for NIH, an agency that has proved itself to be remarkably cost effective in the service of the protection of our people's health.

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Vaccines Against Parasitic Diseases

In her article "The search for a malaria vaccine" (Research News, 9 Nov., p. 680), Gina Kolata states, "A malaria vaccine, when it comes, will be a first. There has never been a vaccine against a parasitic disease." This statement is incorrect.

Babesiosis affects more than 1 billion cattle, sheep, pigs, goats, horses, dogs, and cats worldwide and is similar in many respects to malaria. Bovine babesiosis has been effectively controlled in Australia and in many other countries since the turn of the century by a live, attenuated vaccine. Between 1.5 and 2 million doses are distributed in Australia each year and, as a consequence, outbreaks of this usually fatal disease have declined to very low levels. This vaccine is injected only once to confer life-long protection.

In the United States, a dead vaccine, Anaplaz, has been widely used for about 20 years to combat anaplasmosis in cattle. This disease, like babesiosis, is haemotropic, being transmitted by a tick vector.

In Israel and India, a tissue-cultured vaccine against another tick-transmitted haemoprotozoan cattle disease, *Theileria annulata*, has been in wide use for the last 20 years.

A successful vaccine is also widely used in Europe against the lungworms of cattle and sheep, *Dictyocaulus* spp. Like the preceding vaccines, it is highly effective and has been in widespread use for about 20 years.

Work on experimental parasite vaccines has resulted in the isolation of a series of highly defined antigens from *Babesia bovis* that confer a high degree of cross-protection against a range of virulent heterologous *B. bovis* strains. Such vaccines are likely to be much more effective than the hoped-for malarial vaccines, for their use appears to have no geographical limitations. Similar advances are also being made with vaccines against *Theileria* species, helminths, cestodes, and arthropod parasitic diseases of cattle and sheep.

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Erratum: In the report "Complete development of hepatic stages of *Plasmodium falciparum* in vitro" by D. Mazier *et al.* (25 Jan., p. 440), the name of Professor M. Gentilini was mistakenly omitted from the list of authors.

Erratum: In the letter from Deam H. Ferris (11 Jan., p. 118), the last sentence of the second paragraph should have read, "The trypanosome spread by the tsetse fly cannot be distinguished morphologically, physiologically, and according to isoenzymatic tests from American stocks carried by tabanids; the disease is the same."

Erratum: In the report "Peroxisomal defects in neonatal-onset and X-linked adrenoleukodystrophies" by S. Goldfischer *et al.* (4 Jan., p. 67), the first sentence of the abstract should have read: "Accumulation of very long chain fatty acids in X-linked and neonatal forms of adrenoleukodystrophy (ALD) appears to be a consequence of deficient oxidation of very long chain fatty acids, a function that has been attributed to peroxisomes."