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Snapshot of the magnetic field inside Earth’s core simulated by a geodynamo model. Magnetic lines of force are gold where they are inside, or blue where they are outside, the solid inner core. The Earth’s axis of rotation is vertical in this image. The field is directed inward at the inner core north pole (top) and outward at the south pole (bottom). The maximum magnetic intensity is about 30 millitesla. See page 1887 and a related report on page 1883. [Image: G. A. Glatzmaier and P. H. Roberts]
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Heinrich events go south?

Heinrich events mark abrupt episodes of discharge of icebergs from the continental ice sheet covering North America during the last glaciation. The climatic causes of these events and whether they are local or hemispheric in scale are not clear. McIntyre and Molfino (p. 1867) show that peaks in abundance of a marine alga in a high-resolution climate record from the equatorial Atlantic Ocean spanning the last 45,000 years are coeval, within age-resolution, of the last several Heinrich events. They suggest that the cycles, which occurred about every 8400 years, are caused ultimately by variations in Earth's orbit.

Zipping around

It was recently shown by Song and Richards that the Earth's inner core is spinning faster than the mantle by about 1° per year. Su et al. (p. 1883), using independent observations of 29 years of seismic waves traveling through the core, suggest that the inner core is indeed rotating faster, perhaps by as much as 3° per year ahead of the mantle. Glatzmaier and Roberts (p. 1887; cover) simulated the geodynamo and find that the inner core's superrotation may be explained by the coupling of the inner core's magnetic field with an eastward-moving thermal wind in the fluid outer core.

Slippery when wet

The cause of the magnitude 7.2 Kobe, Japan, earthquake in January 1995 is unknown. Zhao et al. (p. 1891) developed a tomographic model of the velocity structure of the crust beneath the epicenter and the extended aftershock zone. Their images show that the hypocenter of the earthquake was in a distinctive zone, characterized by low P-wave and S-wave velocities and a high Poisson's ratio, suggestive of the presence of fluids that may have helped facilitate the earthquake.

Quickly ironed out

Following the Big Bang, debris accreted together in the inner solar system to form planetesimals. Lee and Halliday (p. 1876) measured 182W isotopic anomalies in meteorites, which are produced by decay of 182Hf (half-life of 9 million years), to date the accretion and segregation of iron cores (which prefer W relative to Hf) in some of these parent bodies. The tungsten isotopic anomalies of iron meteorites (perhaps representing cores) are similar to anomalies in metal grains in ordinary chondrites (silicate mantle and crust). This result suggests that the parent bodies and their cores formed at the same time and within a few million years of the origin of the solar system.

Fits of forgetfulness

Adult zebra finches are capable of recognizing and remembering songs of other birds, and the duration of the memory varies with song type. Chew et al. (p. 1909; see Perspective by Doupe, p. 1851) monitored neuronal activity in the auditory centers of awake zebra finches while they were presented with various songs. An unexpected finding was that the birds appeared to forget the song only at six narrow windows with durations of 1 to 4 hours during 4 days of testing. These windows marked periods of gene expression and protein synthesis that were required to maintain the longer lasting memories. Thus, it appears that remembering these songs depends on quantized waves of macromolecular synthesis.

Extended damage

After traumatic brain injury, changes in the permeability of neurons to various ions can contribute to the extent of actual damage to neurons. Zhang et al. (p. 1921) show that one part of this change involves the calcium channel known as the NMDA-type glutamate receptor. After neurons have been subjected to traumatic stress, the molecular characteristics of the NMDA receptor change such that the channel becomes more permeable to calcium ions. This influx of calcium ions in turn promotes further neuronal damage.

Tiny test tubes

The inner cavities of carbon nanotubes could be utilized for the controlled production of encapsulated nanostructures and as small test tubes. However, numerous problems remain, such as the controlled filling of the tubes and the activity of the tube walls. Ugarte et al. (p. 1897) studied the filling of nanotubes with a molten silver salt and showed that a minimum tube diameter of about 4 nanometers is required. The decomposition of the silver salt within the tubes to form silver particles leads to high pressures in the tubes and to production of oxidizing gases that erode the tube walls.

Start me up

Expression of cytokines such as interleukin-4 (IL-4) requires several transcription factors, including members of the NF-AT family (nuclear factor of activated T cells), but low levels of cytokine expression in reconstituted systems suggests that unknown proteins act in NF-AT-mediated transcription. Hodge et al. (p. 1903) have now identified a protein, NIP45, that shows little similarity to other known proteins, but that, in combination with the NF-AT protein and c-maf, activated the IL-4 promoter. Transient overexpression of these proteins in B cells led to endogenous production of IL-4.
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Plagiarism in China

I am glad that the Chinese scientific community finally succeeded in disclosing a case of plagiarism (News & Comment, 18 Oct., p. 337). The case was an open secret, of which I became aware when I was conducting research in Beijing in early 1996. I talked with the two authors who disclosed the case in the *Journal of Dialectics of Nature*. From what I learned then, it appears that there was pressure not to publicly discuss the case. The article was first submitted to another journal for publication. I was told later by one of the authors that three journals declined to publish it.

I applaud the Chinese scientists for adhering to their upright attitude toward scientific research and, most important, to their independence from interference.

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U.S.-Chinese Collaborations

Jeffrey Mervis, in his article “Both sides point finger in tiff over China dig” (News & Comment, 1 Nov., p. 715) about a conflict between Chinese and American geoscientists working in western China, reports an unfortunate occurrence, from which readers might conclude that systemic impropriety on the part of Chinese scientists and institutions was to blame.

I do not presume to know the details of the incident, but I emphatically urge caution against generalizing that such incidents are characteristic of fieldwork in China or that they in any way typify relations between U.S. and Chinese scientists. I spent a month in China doing fieldwork at the same time (and, in fact, on a very similar subject) as Lucas, Geissman, and Molina-Garza, and I was fully and generously hosted by my Chinese colleagues. I did not spend one yuan. Both the individual scientists and the institutions I worked with were extremely gracious, and the trip was scientifically productive and enjoyable.

It would be wrong to impugn the Chinese scientific community on the basis of this unfortunate incident. Let us hope that an amicable and mutually satisfying resolution to this dispute can be found and that ongoing and future U.S.-Chinese collaborations will not be imperiled by escalation into inappropriate venues.

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Paleoindians in the Brazilian Amazon

Anna C. Roosevelt et al. (Article, 19 Apr., p. 373) present results of excavation of Caverna da Pedra Pintada at Monte Alegre, an important early site in the Brazilian Amazon. A valuable critical review of other putatively pre-Clovis age [earlier than about 11,200 carbon-14 years before the present (B.P.)] South American sites is buried in the footnotes of their article. Ironically, after questioning the validity of these dates, Roosevelt et al. advance the culture disclosed at Monte Alegre as a Clovis contemporary, with the stated implication that North American Clovis was not “the sole source” of human migration into South America: “Clovis is evidently just one of several regional traditions.”
However, they state, lithic manufacture techniques of the Monte Alegre culture "resemble those of other Paleoindian and upper Paleolithic cultures." Obviously, the South American Paleoindians must have descended from some North American culture which was not initially adapted to tropical forest environments and which was ultimately derived from Northeast Asia. Clovis, ubiquitous in North America and attested as far south as Costa Rica (1), is the best candidate.

The central question is, Is the Monte Alegre culture really as old as Clovis? If not, was there enough intervening time for a Clovis-derived culture to traverse 5000 miles to Amazonia and be transformed there into a locally adapted, forest-foraging community, manufacturing small-stemmed points?

On the basis of characteristics of the lithic industry, Roosevelt et al. divide the Monte Alegre "Paleoindian" occupation of Caverna da Pedra Pintada into three sequential phases—Initial, Early, and Late—and 56 radiocarbon dates are assigned to one phase or another. In fact, with few exceptions, the dates associated with all phases are indistinguishable, generally falling in the interval of 10,600 to 10,100 B.P. The most precise dates (50- to 70-year sigmas) for the Initial occupation actually overlap with four of the Early dates, around 10,600 to 10,350 years B.P. The four dates that appear to fall within the Clovis range (11,145 to 10,875 B.P.) have larger standard errors (135 to 310 years) and are most plausibly interpreted as statistical outliers [as suggested by C. Vance Haynes, Ken Tankersley, and Dena Dina cause (A. Gibbons, News, 19 Apr., p. 346)].

Previous discussion of the chronological relationship of Monte Alegre and Clovis has not taken into account the recent evidence of major carbon-14 anomalies in this period. Roosevelt et al., noting that precise calibration of radiocarbon dates in this range is not yet feasible, present their dates in uncalibrated form, while parenthetically observing that the estimated calendrical dates may range from about 14,200 to 10,500 B.P. Data presented by Edwards et al. (2) suggest that there is a radiocarbon "plateau" extending from about 12,300 to 11,000 calendrical years ago, when atmospheric ratios of carbon-14 to carbon-12 dropped by 15%. Apparent radiocarbon ages of about 10,400 to 10,000 B.P. fall somewhere within this actual span, but cannot be readily distinguished or pinpointed. This might explain why the dates for the Monte Alegre Initial, Early, and Late phases appear contemporaneous. In contrast, Clovis-associated dates of about 11,200 B.P. calibrate to about 13,000 to 13,500 calendrical years ago. Thus, there may have been an interval of anywhere from 700 to 2000 years between Clovis and the Initial phase of Monte Alegre. Because the Clovis culture seems to have exploded across the whole of North America and into Central America within the space of a few hundred years, this seems to provide enough time for their descendants to have reached Amazonia and to have adapted to local environments.

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References

For more than 25 years, Brazilian archaeologists have been documenting the presence of late Pleistocene people (11,300 to 10,000 years B.P.) at several sites in the eastern tropical lowlands of South America (1). Roosevelt et al. state this, but appear to broadly dismiss these sites as uncertain human localities. Several sites are far less dubious than they imply. In short, Roosevelt et al.'s finding is not unique; it merely adds
Roosevelt et al. jeopardize the credibility of their data by saying they have produced evidence that "changes understanding of the migrations and ecological adaptations of early foragers." It has long been recognized that the Paleoindian diet consisted mainly of plants and small animals (1). South American lithic assemblages dating from before 11,000 years B.P. are numerous, diverse, and distinct from Clovis (2). There is no evidence that the neotropical rainforest was uninhabitable before the advent of agriculture, a moot issue because paleoenvironmental data increasingly support more open vegetation in central Amazonia before about 8000 years B.P. (3).

The features described for Pedra Pintada by Roosevelt et al.—including lithics, hearths, plant remains, modern terrestrial and aquatic fauna, and rock art—are also found in the earliest levels of Boquete Rock Shelter in Minas Gerais, also dated at about 11,000 years B.P. (4). The excavations at Pedra Pintada expand the spatial distribution of this early cultural tradition.

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Response: The preceding letter writers represent opposite views of the peopling of the Americas. Feidel suggests that Clovis big-game hunters dating to about 11,200 years B.P. were the earliest Paleoindians and ancestors of all others (1). Dillehay and Meggers suggest that there were both Clovis-age and pre-Clovis-age human occupations in South America (2).

We took a middle ground in our article. Although we found all pre-Clovis South American sites problematic, we found (p. 383) evidence for occupations of the same age as Clovis and Folsom, but with different cultures and ecological adaptations, which is not compatible with Clovis as the sole ancestor. The cave at Monte Alegre in Brazil is in the Amazon's equatorial lowlands, a region which many researchers had thought uninhabitable by primary hunter-gatherers (3).

Feidel, ignoring other eastern South American sites, argues against the contemporaneity of the Amazonian culture with Clovis. He suggests that Monte Alegre is 700 to 2000 years younger and could be its descendant. This age gap, however, is based on a statistically questionable comparison favoring a greater age for Clovis than for the Amazonian culture.

Feidel drops as outliers the four earliest Amazonian dates between 11,145 and 10,875 years B.P. because of their "large" standard deviations, from 135 to 310 years.

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and accepts eight “more precise” dates with errors of less than 80 years, which are between about 10,600 and 10,400 years B.P. He states that the dates of the different Amazonian periods are the same, but, on the contrary, they are significantly different (n = 30, t = 66.27, P < 0.000001), according to Ward and Wilson’s test of contemporaneity (4), as are the lithic frequencies (n = 30,420; $\chi^2 = 9558.59$, df, 12; $P < 0.00001$).

Along with Tankersley, Dincauze, and Haynes, whom he cites, Feidel does not acknowledge that the oft-quoted age of Clovis of about 11,200 years B.P. is based on a small selection of early outlier dates with a much larger standard error range than that of the Amazonian dates, so dropping only the Amazonian dates because of their “large” errors applies a different standard for North and South American dates.

Accepted Clovis dates of 11,200 years B.P. or earlier have errors of from 200 to 600 years, with one exception (5). Dates with errors of 100 years or less are much younger, from 10,980 to 10,600 years B.P. (a charcoal date with inherent age), similar to those in the Folsom range; the only Clovis date with an error under 80 years is 10,840 years B.P. ± 70 years (SMU-42, also a charcoal date). These significantly different older and younger Clovis date sets are not from different stratigraphic contexts within sites, whereas the early Amazonian dates are. The only apparent difference is that the earlier dates were run primarily on problematic samples of inadequate size and questionable human association, or with inherent or geological carbon effects (5, 6).

Calibrating dates to correct for changes in atmospheric carbon isotopes does not change the picture (5, 7). Although Feidel gives a calibrated range of 13,500 to 13,000 calendar years ago for Clovis, that is not the calibration for the accepted age-range of Clovis, which is 11,200 to 10,900 carbon-14 years B.P. and calibrates between 13,000 and 12,800 calendar years ago. The earliest Monte Alegre calibrated dates with “large” errors are 13,054 to 12,799 calendar years ago, compared with 13,107 to 12,728 calendar years ago for Clovis dates with comparable errors. Monte Alegre dates with errors under 80 years begin at 12,465 calendar years ago, compared with the single Clovis date of that precision, 12,766 calendar years ago (another charcoal date with inherent age).

Although Feidel points out that calibrations of the later Amazonian radiocarbon dates overlap because of isotope plateaus, he does not mention that this also applies to Clovis and Folsom and that the large errors of pre–11,000 years B.P. Clovis dates give their two-standard-deviation calibrated range more overlap with the later Amazonian dates than the earliest Amazonian dates have with them. Calibration shows no gap of 700 to 2000 years between Clovis and Monte Alegre.

As for the Clovis migration, there are no dated Pleistocene sites related to Clovis in Costa Rica, Panama, or northern South America, as we pointed out (p. 383). Who, then, were the ancestors? Given the evidence for open-water fishing at Monte Alegre, they could have been coastal people who traveled the often-suggested route along the now-submerged Pleistocene seacoasts of the Pacific. Aided by coastal resources and water craft, they could have moved south more rapidly than those on foot in the interior.

Dillehay essentially restates our conclusions (pp. 374, 382) about Brazilian sites dated at about 11,000 years B.P., but says that the dates of the sites are more certain than we stated. As we noted, however, even after 25 years, essential data (radiocarbon dates with standard errors, sample materials, and levels; lab numbers; geochronal and stratigraphic context; lithic drawings and

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Forests

References and Notes

Indeed, we disagree. The other idea put forth by Meggers, that there are numerous South American cultures distinct from Clovis that have been dated as older than 11,000 years B.P., is also much debated, as we discussed (p. 383) and as Feidel’s letter indicates. Finally, Meggers’s statement that the Boquete site is similar to Pedra Pintada mirrors our assessment (pp. 382–383) of such central Brazilian sites. However, as we pointed out, this is an arid upland area, so the sites could not resolve the long-standing questions about early human occupation of equatorial lowland rainforests (9).

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References and Notes

3. That the central Amazon was already a rainforest at the time is shown by palynological data cited by P. Colinaux et al. [Science 274, 85 (1996)] and data in our article (pp. 379–381) showing tropical forest species with stable carbon isotope ratios of closed canopy tropical rainforest, carbon-13/12 isotope ratios of −27 to −35 per mil, corrected for seed fractionation [L. L. Tieszen, J. Archaeol. Sci. 18, 227 (1991)], not of open forest or savanna.
6. The Clovis site (Blackwater Draw) samples were non-cultural pond plants from sand at upwelling artesian springs in contact with geological carbon sources [J. J. Heister, Blackwater Locality No. 1: A stratified early man site in eastern New Mexico (Fort Gurwin Research Center, Southern Methodist University, Dallas, TX 1972)]. Water plants in the southwest are dated too old because they incorporate geological carbon metabolically [P. E. Damon, C. V. Haynes, A. Long, Radiocarbon 6, 91 (1964)]. The Lehner, Lange-Ferguson, and Murray Springs samples were on charcoal, which has inherent age (p. 383) of about 300 years, to judge from the difference between high-precision bone amino acid and charcoal dates from Clovis (9) and Folsom (J. Hofman, J. Field Archaeol. 22, 421 (1995)) sites. Bone dated to earlier (continued on page 1934)
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Canada Debates Species Protection Act

As Canada considers adopting its first law to protect endangered species, scientists have become embroiled in a heated debate over whether a bill unveiled this fall will be too weak to protect plants and animals at risk of extinction.

A government advisory panel of biologists, environmentalists, and industry groups began drafting an endangered species act in 1995, and last May released a final proposal. Like the U.S. law, it would prohibit harming species at risk or damaging their nests or dens. But critics point to several gaps that turned up when the Environment Ministry presented the draft bill to Parliament this fall. One is its scope: The law would protect only aquatic species, some migratory birds, and any species on federal lands. That would leave unprotected about 60% of the 254 species listed as at risk, including animals that cross national borders, such as the grizzly bear, peregrine falcon, and burrowing owl. Beyond this, "the big shortcoming," says ecologist David Schindler of the University of Alberta, is that the law wouldn't mandate protection of habitats. Also troubling to scientists is that the bill would give final say on listing species not to the experts, but to the federal Cabinet.

The bill is less aggressive than some would like, says Stewart Elgie of the Sierra Legal Defence Fund, in part because Ottawa wants to leave it to provinces to protect species on their lands. But Elgie and others say only a national law makes sense. More than 200 scientists are expected to sign a letter urging Prime Minister Jean Chretien to strengthen the final bill, which will be hashed out in the coming months.

NTT Labs to Get New Bosses

Japan decided last week to split its national phone company, Nippon Telegraph and Telephone (NTT), into three pieces under a plan that will preserve the company's $2.9 billion research enterprise. But the deal, a compromise between NTT and Japan's Ministry of Posts and Telecommunications (MPT), also means the labs will have to sharpen their sales pitch to the rest of the company and the entire industry.

Under the plan, NTT would be divided into one long-distance and two local-service providers, all fully owned by a new parent holding company. NTT's applied research would be parcelled out among the service providers, while basic research on materials, optoelectronics, and quantum-effect electronics would continue under the holding company.

The ministry had long wanted to break up NTT to foster competition; NTT had resisted, partly because of the possible impact on the labs (Science, 12 April, p. 186). As for the compromise, says NTT spokesperson Atushi Touno, "there won't be any deterioration of NTT's R&D strengths." But Eiichi Tanaka, an MPT policy official, notes that researchers will need to sell their results to the service providers or firms outside the group.

Masao Kawachi, head of research planning for NTT's Basic Research Labs, is cautiously optimistic. "If the holding company plan works well, negative effects could be minimized, but we're not sure just how it will go," Kawachi says. The reorganization must clear several legal hurdles, but could take effect in 1999.

Lawmakers Jostle for Committee Chairs

Members of Congress are winding up their postelection scramble to run committees, and some new faces are appearing on panels affecting science.

The big change in the Senate is the replacement of retiring Appropriations Committee chair Mark Hatfield (R-OR), a fan of biomedical research, by Ted Stevens (R-AK). Meanwhile, James Jeffords (R-VT) is replacing Nancy Kassebaum (R-KA) as chair of the Labor and Human Resources Committee, which hopes to write a new authorization bill for the National Institutes of Health. Dan Coats (R-IN)—an abortion opponent—had indicated he might challenge Jeffords for the job, but in the end, he did not. Capitol Hill scuttlebutt had it that Coats might head a new health subcommittee, but staffers now say no such panel is planned.

Russian Research on the Ropes

Russian science may be in even more trouble than observers have realized, according to new data in a draft report from a Russian government think tank. Russian Science and Technology at a Glance 1996, to be released early next year by the Center for Science Research and Statistics (CSRS) in Moscow, contains eyebrow-raising statistics on everything from the country's scientific brain drain to the decline of federal R&D spending.

Perhaps the biggest surprise is the rate at which Russian scientists are fleeing to other countries or other professions. CSRS estimates that the number of researchers has plummeted nearly 50%—from about 1 million in 1990 to 518,700 in 1995.

That's not necessarily bad for commerce, as more than half the ex-scientists have begun new careers within Russia, and a move of talent to banking and other sectors "is gainful for the economy," says CSRS deputy director Leonid Gokhberg. But there's a dark side, he says: Some of the best scientists have gone abroad, and "less qualified personnel continue to stay in R&D." Indeed, adds Gerson Sher, executive director of the Civilian Research and Development Foundation, a U.S. organization that funds East-West collaborations, the latest figures "suggest a real cataclysm going on there."

Meanwhile, funding of Russian research has dropped off a cliff. The federal R&D budget has declined from roughly $10 billion in 1990 to just $2.45 billion in 1995, or from 2.03% to 0.73% of gross domestic product. "R&D still enjoys a low rank among the government's priorities," says Gokhberg. In addition, while total university enrollment is up, fewer science students are receiving advanced degrees. In 1992, universities awarded more than 29,000 candidate and doctoral degrees in the sciences, but in 1995, only about 14,000.
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In 1964, a group of physicists at Princeton University began meeting regularly to plan an experiment that would detect radiation left over from the earliest moments of the Big Bang. Outlandish as this enterprise must have sounded to their colleagues, it was in fact long overdue. Alpher and Herman had predicted some 20 years before that this radiation is a testable feature of Gamow’s Big Bang model. In retrospect it is curious that no one in the intervening 20 years detected the cosmic background radiation (CBR). Indeed, as Partridge details, it is quite accurate to say that the CBR was not detected. Rather, the people who detected it during this time—and there were several—were not the same people who expected it and would have been able to identify it as “cosmic.” Conversely, the cosmologists were notoriously unlucky in their attempt to understand the astronomical observations.

All such problems would undoubtedly be put to rest by the group assembled at Princeton: Dicke, Peebles, Roll, and Wilkinson understood clearly what it was they were looking for. Even more to the point, Dicke had worked in the Radiation Lab at MIT during World War II and had designed the type of instrument that was necessary to detect the CBR. As Partridge tells it, during one of their lunch meetings the group was interrupted by a telephone call. The other three heard only Dicke’s side of the conversation. Most of the time Dicke was silent, occasionally repeating a phrase—“horn antenna” or “liquid He calibrator”—which was familiar to them because they were building just such instruments. When Dicke hung up, he said, “Well boys, we’ve been scooped.”

And what a scoop it was! The call came from Arno Penzias, who, together with Robert Wilson, had been unsuccessful in attempts to get rid of the excess noise in their radio antenna. When the dust settled, it became clear that the cosmic background radiation had indeed been discovered, the Big Bang model became widely accepted, and Penzias and Wilson were awarded the Nobel Prize in 1979. (Given the history of near misses detailed by Partridge, it might have been appropriate to include Bernice Burke in the Nobel citation, since he was the one who informed Penzias and Wilson of the doings of the Princeton group and thus precipitated the fateful phone call.)

Perhaps the most important lesson to come out of the delayed discovery of the CBR is that it is extremely difficult to be well versed in both the theory and the observation of the CBR. This remains true today. Observers have to listen to theorists drone on about “the tightly coupled limit,” “acoustic peaks,” and “active vs. passive perturbations” while we theorists struggle to understand the differences between HEMTs and bolometers, calibration uncertainties, and side-lobe pickup.

Partridge’s book goes a long way toward bridging the gap between these two groups of scientists. He successfully reduces radio astronomy to a chapter, picking out the pieces that are essential to the CBR. He then methodically goes through experiment after experiment, describing the techniques and instruments used to make the measurement and the sources of error that each group was faced with. None of this comes off as dry, for two reasons. First, there are many figures, which are invaluable to someone unfamiliar with the instruments. Second, Partridge has been an important participant in many of these experiments and does not hesitate to throw in his personal opinions and misgivings about the many experiments. These too are extremely valuable to someone who has not been there.

Ironically, the weakness of the book is related to its very importance and relevance. While the strides in the field from 1964 to the early 1990s were indeed impressive, it has since been recognized that anisotropies in the CBR contain even more information than anyone had realized. Particularly since the detection by the COBE satellite of these anisotropies in 1992, much progress has been made on both the theoretical and the observational fronts. For the most part, the book misses these latest developments. For example, the section on statistics focuses mainly on setting upper limits on signals. This was appropriate for the experiments before COBE. Since 1992, though, there have been dozens of detections; the focus has now shifted to techniques for analyzing them. With the MAP and COBRAS/SAMBA satellites due to be launched within the next ten years, the issue of analyzing very large data sets is also becoming essential.

After 30 years, the cosmic background radiation remains the most promising probe of the early universe. Over the next ten years, startling claims will emerge from the CBR community. Estimates of the Hubble constant, curvature of the universe, and
The so-called protein-folding problem—
that is, how proteins adopt and maintain their distinctive configurations or native state—remains one of the major unresolved questions of biology. The processes of protein folding are directly related to the pathology of such diseases as mad cow disease, amyloidosis, cystic fibrosis, and sickle cell anemia. Likewise, protein folding is of import-
ance to biotechnology and the pharmaceu-
tical industries, bearing as it does on the assessment of new biological protein targets, the creation of novel drugs, and the hope-
for ability to predict protein structures.

Research on protein folding was, until recently, primarily the province of biophys-
icians. However, observations over the past decade in molecular genetics, biochemistry, and cell biology have provided novel insights into a family of pro-
teins, known collectively as molecular chaper-
ones, whose functions are to assist in the pro-
cesses of protein folding, assembly, transloca-
tion, and degradation. Indeed, molecular chaper-
ones have been identified as important partici-
ants in numerous biochemical processes in-
volved in the cell cycle and intracellular and intracellular signaling. The discovery of molec-
ular chaperones does not belie the impor-
tance of intrinsic properties of proteins in guiding their folding to the native state. Indeed, it was recognized in the 1960s by Christian Anfinsen that “another large molecule . . . could influence the folding process by intermolecular reactions” that could catalyze these events or enhance the

kinetics of protein folding.

The subject of Chaperonins is a single
well-investigated group of the molecular
chaperone family that falls into the sub-
classes GroE and TCP-1 chaperonins. The
book has a thematic coherence lacking in
more general books on molecular chaper-
ones. Key facts and highlights are presented
in a detailed and balanced fashion, the vol-
ume is well organized, and the chapters are
clearly written and use a common nomen-
clature, a feature that should be appreciated
by readers. Consequently, the volume is an
excellent resource for both students and
advanced researchers. Topics addressed
range from the evolutionary relationships
among chaperonins to their possible roles in
infectious diseases.

Appropriately, the emphasis of the vol-
ume is on the biological and biochemical prop-
erties of chaperonins found in chloroplasts,
photosynthetic bacteria, and mitochondria and
on the regulation and function of chaperonins in
Escherichia coli. The introduction provides a
useful historical perspective on the discovery
of chaperonins; we are reminded of the im-
portance of serendipity in science and of the
convergence of observations from genetics and
biochemistry. Much of the current excite-
ment is provided by in vitro studies of chaper-
onins in protein folding and biophysical
studies on the unique structure of the chaper-
onin oligomer and its role in recognition
and folding reactions. A conceptual under-
standing of the role of chaperonins in protein
folding has been provided by electron micro-
scopic and crystallographic images, which have revealed two seven-membered rings that

Electron microscope reconstruction of chaperonins. Left, GroEL-
GroES toroid; right, cross-sectional view. [Helen Saibil]

pelling picture of a macromolecular structure, a “protein-folding machine,” that can be best
described as a protein test tube or cage that
provides the environment that facilitates the
folding of an unfolded protein to its native
state while restricting inappropriate inter- and
intramolecular interactions, a function appro-
priate to the moniker chaperonin.

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Molecular Aides

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versity of California chancellor.

The Ultimate Resource 2. JULIAN L. SIMON.
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0-691-04269-1.

An updated and much expanded edi-
tion of a 1981 work by an author well
known for his vigorous criticism of envi-
ronmentalists and demographic “doomsay-
ers”; in his view the “ultimate resource” is
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will find ways of meeting the challenges
others worry about.
Phenanthroline should add superoxide dismutase to APP-bound (BP)\textsubscript{3}Fe(III), which effects rapid inner-sphere oxidations via pentacoordination (6, 7).

In summary, batho-based ligands cannot be used to monitor reduction of Cu(II) and Fe(III) that occurs physiologically. In fact, there is at present no easy way to do this because the reduced metals would normally be reoxidized by O\textsubscript{2}, and any indicator ligand that prevents this would concomitantly alter the iron/copper redox properties. In the cases mentioned above, one cannot thus conclude definitively that either APP or LDL is capable of spontaneous physiologic reduction of Cu(II). The same concern applies to a recent report that α-tocopherol acts as a prooxidant in human lipoproteins by reducing Cu(II) to Cu(I) (9); such action probably reflects merely the inclusion of BC to monitor the Cu(I) formed.

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REFERENCES
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Response: We summarize our evidence for the reduction of copper(II) to copper(I) by APP. First, as shown previously by us (1), APP has a high affinity binding site for copper(II), which is located within residues 135 to 155 of APP. This binding site is conserved in the related protein APLP2.

Second, complex formation between copper(II) and a synthetic peptide representing this copper(II) site in the absence of bathocuproine resulted in cysteine oxidation. The oxidized peptide still binds copper as shown by LC-ESI-MS. Recent electron paramagnetic resonance (EPR) analysis (2) showed that the cysteine oxidation is accompanied by the disappearance of the copper(II) signal.

Third, EPR analysis revealed also that copper(II) was not reduced when bound to a peptide representing the copper binding site of APP in which only cysteine was replaced by serine. This shows the importance of cysteine in copper(II) reduction by the APP peptide and that no other reducing agents are required (such as molecular oxygen, possibly present in the buffer).

Fourth, our experiments performed with bathocuproine to measure copper(I) formation showed within seconds the characteristic change of absorbance at 450 nm. Such a rapid change has never been found by us when we incubated copper(II)-bathocuproine complexes in the reaction buffer, without APP or its copper-binding site peptide, even after overnight incubation.

In conclusion, our finding of an enzyme-like activity of APP in the reduction of copper(II) to copper(I) is not solely based on bathocuproine data and does not depend on copper(II)-bathocuproine complex formation.

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Letters to the Editor

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