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Although the road is a long one, investigators are making exciting progress toward their goal of mapping the human genome. This issue contains a wall chart, Genome Maps III (pages 87 to 102), as well as Research Articles, Articles, a Perspective, and News stories relating to genome mapping. [Illustration: Susan Nowosiawski, Washington, DC]
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This has been a busy year for the Human Genome Project. Increasingly, researchers sense that many of the project’s goals, which seemed grandiose when they were first proposed, are now realistic. The research presented in this issue of Science exemplifies some of the best and most exciting advances in genome research.

The X chromosome is a focus of major research activity because it is the location of a myriad of genes responsible for disorders including muscular dystrophy and various forms of mental retardation. The current tally of disease-related genes mapped on this chromosome alone is 111. At the center of this issue is a wall chart that shows the progress that has been made in genetic and physical mapping over the entire X chromosome. The wall chart was prepared and reviewed by Jean-Louis Mandel and an international group of investigators. The table of disease-related genes on the X chromosome not only illustrates how much has been accomplished in cloning and characterizing such genes, but also points out some of the hot genes that are sure to be mapped in the near future. A second table, assembled by scientists at the Genome Data Base and GenBank, presents an update of research on all the human chromosomes. Strategies for mapping and their application to the isolation and characterization of disease-related genes on the X chromosome as well as to questions of chromosome inactivation and molecular evolution are discussed in the article by Mandel et al. that accompanies the chart.

For the Human Genome Project to proceed efficiently, there must be cooperation among a large and (not unexpectedly) competitive group of scientists. The article by the NIH/CEPH Collaborative Mapping Group (representing research coordinated by the National Institutes of Health in the United States and the Centre d’Etude du Polymorphisme Humain in France) provides the fruits of an extraordinary collaboration among more than 100 authors to generate genetic linkage maps for 23 chromosomes. The map of each chromosome represents the compilation of many independently generated maps in one accessible format. To provide the best resource for the scientific community, we are publishing, as an appendix at the back of the issue, a table summarizing characteristics and relevant citations for the markers used to build the maps.

The two Research Articles from David Page and his collaborators show that outstanding research accomplishments do not require enormous laboratories. They describe the physical mapping of the Y chromosome by deletion mapping and by assembly of large fragments of Y DNA. This landmark achievement will open a door to understanding human evolution, the development of the Y chromosome, and the basis for abnormalities in the Y. These articles and related scientific advances are explored by Leslie Roberts in the Research News section.

The genetic and physical maps being generated, and the sequence information that is to come, are tools that will be used to pry out the genetic components of complex diseases such as cancer and heart disease. The potential exists to develop preventive strategies and therapies for genetically inherited diseases. Genome maps will also be used to answer fundamental biological questions. Once genes have been mapped along the chromosome it will be possible to determine the functional or evolutionary significance of their relative locations. Christine Farr and Peter Goodfellow have contributed a Perspective in which they explore the hidden messages that have already been found in genetic maps. The Reports section contains papers dealing with other applications of genome technology.

However, technological, economic, and political problems still must be faced before the potential of the project can be realized. An ongoing challenge is to handle the flood of data being generated in a manner that will allow a rapid, unimpeded flow of information in the most user-friendly form. Although technological advances are being made that will decrease the costs of the genome project, the global economic situation is influencing strategic planning. Peter Aldhous in the Research News section discusses some of the problems that have beset the genome project in France.

A banquet of genome-related research and issues has been laid out before you in the pages of Science this week. Enjoy!
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Top Quark Search

Faye Flam's article "Researchers quell quark rumor: The top is still at large" (News & Comment, 24 July, p. 475) raises some issues that are more important to high-energy physics than whether or not the top quark really has been seen. The article states that the disagreement between physicists in the Collider Detector at Fermilab (CDF) collaboration and Gary Goldstein, Krys Sliwa, and Richard Dalitz is "about the significance of the discovery [of candidate top quark events] and the extent to which outsiders like Goldstein and Dalitz should have access to their colleagues' unpublished data." My impression from reading the article is that the work of Goldstein et al. did not receive a fair review and that the "godfather committee" focused its criticism on the fact that the "outsiders" did not have a right to study the data in the first place. Innovative research is always controversial. The very essence of the scientific process is criticizing and responding to criticism.

CDF points to the top quark discovery rumors as reason enough not to share the data. Physicists are by nature conservative when it comes to evaluating the work of someone other than themselves. Upon hearing the rumors, most of my colleagues were intrigued but skeptical. There was no "damage" caused by these rumors, as the article implies.

CDF's accusation that the releasing of the 1988–1989 data violated the unwritten ethics of sharing data with outsiders seems to me to be a straw man. How long do government-supported experimenters have exclusive rights to data? Even the data from the Cosmic Background Explorer satellite were released after more than a year of analysis. The current procedure is analogous to theorists copyrighting their ideas and not allowing anybody to use them until they decide to permit their use. Of course CDF should have first shot at analyzing its own data, but after 3 years why should it not be available to everyone in the scientific community?

In order for CDF to continue doing the top-rate physics it is known for, scientific disputes should not be judged in secret; outside experts should be allowed to examine the issues.

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I wish to respond to Flam's article "Researchers quell quark rumor: The top is still at large." When Flam contacted me a few weeks ago asking that I comment on the status of my work on top quarks at the Collider Detector at Fermilab (CDF) and on the article which appeared in the 27 June 1992 New Scientist, I declined any comment. I did so because the physics analysis as well as the internal CDF review of all top quark searches is still under way. While I still consider any comments to reporters premature, I feel compelled to set the record straight.

In 1991, Goldstein and Dalitz developed an elegant method (1) for analyzing the one, already published, CDF high transverse-energy "electron-muon" event. In February 1992, I suggested to Goldstein, my colleague at Tufts University, a modification to their original method in order to extend the Dalitz-Goldstein analysis technique to events of the "lepton+4jets" type. In close collaboration, Goldstein, Dalitz, and I jointly developed a computer program modifying the original method of Goldstein and Dalitz. The resulting technique, along with Monte Carlo modeling, but not involving any experimental data, has been submitted for publication. Goldstein and I presented informal progress reports on the modified method to CDF in March and April 1992.

In addition to being on the faculty at Tufts University, I am also a member of the CDF collaboration and the leader of Tufts' CDF Group. Having developed, together with Goldstein and Dalitz, a modified analysis technique, I proceeded to apply this modified method to the analysis of CDF experimental data. I am in agreement with statements by CDF spokespersons that only persons intimately familiar with software developed by the CDF collaboration and with the experimental configuration can perform a credible analysis of such data applying proper corrections and taking into account various features of the actual detector instrumentation.

I made available to Goldstein summary files of lepton and jet momenta for a small number of interesting events identified by my analysis and informed him of some preliminary results of my CDF data analysis. I did not believe that sharing my progress and results from some interesting events with a colleague who had co-developed the method "violated an unwritten code of ethics by sharing data with outsiders," as
suggested in Flam’s article. I have not given access to either the actual raw CDF data or to any subset of raw or “processed data” which could provide the basis of any conclusive physics analysis.

I respect the CDF policy of not releasing data until they are validated and until such release is authorized by the CDF internal “blessing” procedures. I have no dispute with the CDF policy; we are all aware of situations where sporadic events or partial indications have led to mistaken claims and retractions.

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REFERENCES

Detecting Explosives

Because airline luggage inspection is an important application of science and technology, we would like to clarify some points discussed in A. Fainberg’s excellent and comprehensive article “Explosives detection for aviation security” (20 March, p. 1531).

The “associated production” technique is singled out by Fainberg as one of the four newer nuclear methods for detecting explosives. We have been evaluating this method for the Department of Energy (DOE), primarily for national security applications such as arms control verification of nuclear (or chemical) weapons, which include a conventional high-explosive component. To our knowledge, no DOE funds are now directed toward airport security.

The strongest advantage for associated production (which is usually referred to as the “associated-particle” method for neutron-inelastic scattering) is its ability to penetrate, identify, and image explosives, that is, to provide a separate tomographic image of each elemental constituent within sealed containers. All chemical elements having larger atomic numbers than 4 (beryllium) are measurable. In particular, data have been collected by Nuclear Diagnostics Systems (NDS) showing detection of more than a half dozen high explosives (such as C4, PBX, and TNT) on the basis of carbon, oxygen, and nitrogen ratios. Because of this wide-ranging capability for nondestructive examination, applications of this technology have been pursued not only for arms control and luggage inspection but also for drugs and other contraband.

Fainberg mentions the need for “an appropriate, reliable accelerator.” In fact, NDS has developed a state-of-the-art, compact-sealed, continuous deuterium-tritium accelerator that incorporates a tritium target and an alpha-detecting scintillator. An electrode focuses the ion beam so that neutrons are produced from a small “spot” (with a diameter of 1 millimeter) needed for imaging. This design differs significantly from well-logging neutron generators.

Ten of the accelerators have been built and improved since 1985 and used by NDS. Their average operating life was about 2000 hours at an output of 10⁶ neutrons per second; seven are still operable at less than 10⁶ neutrons per second. A full system was recently delivered to Argonne National Laboratory and was operating the next day. A rate of more than 10⁷ neutrons per second was achieved during qualification tests. Because the associated-particle method strongly discriminates against background, operating radiation levels are lower than for other high-energy radiation generator techniques.

The signal and background for a specific application depend on the neutron output, the efficiency and solid angle of the gamma-ray detectors, pulse pile-up, accidental coincidences, and other factors. The optimum neutron output is about 10⁶ neutrons.

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per second for the systems developed by NDS for physical security. For these reasons, a further increase in neutron output will not reduce the required measurement time. Because luggage inspection requires relatively low amounts of irradiation, an increase in intensity and lifetime is not needed for the NDS sealed-tube neutron generator.

As Fainberg points out, the most effective system would integrate different types of sensors and detectors. An option that he does not mention is to directly use complementary and synergistic information to maximize detection probability while minimizing false-alarm rates and inspection times. For example, rather than sequential AND/OR logic, the actual integration of the data from an x-ray unit linked to an associated-particle system would provide improvement. In a piece of luggage, a suspicious geometric object imaged by x-rays could be probed for high explosives by the associated-particle method. This would substantially increase the detection confidence of the combined x-ray–associated-particle system while reducing the overall false-alarm rate.

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NSF’s New Home

Kudos to National Science Foundation (NSF) director Walter Massey for indicating his unwillingness to dip into the NSF research and development (R&D) budget to fund the NSF’s new building in the event that it receives no overall budget increase in fiscal year 1993 (Science-Scope, 24 July, p. 471). Many who have visited the existing quarters agree that a new home is well deserved. But Massey, in the tradition of his predecessors since Vannevar Bush, has signaled with his stance that NSF remains committed to optimizing substantive opportunities for basic R&D funding. Like scientists at many campus laboratories supported by NSF, Massey and his staff continue to forego many of the amenities enjoyed by colleagues in other careers so that available funds can be applied to the substance of scientific work.

The upgrading of both the aesthetic and functional quality of the space in which science is administered and conducted cannot be long ignored, however, particularly if science is to succeed in attracting its share of top new talent. For now, Massey seems to recognize that NSF might need to continue its vigorous promotion of science from existing offices, along with many working scientists who strive to continue to produce pathbreaking research in some of the more cramped corners of our nation’s campuses.

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Epistemology and Anthropology

If paleoanthropology is really so “underaxiomatized” and “conceptually or paradigmatically” impoverished (G. A. Clark, Letters, 31 July, p. 597), we’d better get it straightened out epistemologically-wise. I’m on Clark’s side, I think—we’d better rush a few axioms, paradigms, and even lowly concepts in there, refute a few Popperian hypotheses for good measure, and knock those protocols into shape.

But it isn’t just Clark’s epistemology that constitutes a “deplorable situation.” Perhaps I could be allowed to say where I’m “coming from” with an empirical observation (no “explicit ... inferential basis” here). If Clark doesn’t start paying the English language the respect it deserves, it will be more than the “epistemological infrastructure” of his discipline that goes down the tubes into the great paleoanthropological midden. “I can’t stand it any-
more! You're driving me ... crazy . . . .
Golly," Mr. Clark!

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AAUP's Role

The slug ("San Diego State faces the tenure police") heading the item in the 31 July ScienceScope (p. 603) is in such bad taste as to be appalling. If the writer had been on the San Diego faculty, I dare say he/she would have regarded it as entirely appropriate that the American Association of University Professors (AAUP) should conduct an investigation to decide whether the university had no choice about laying off faculty and had acted fairly in deciding who was to be dropped. It would be unseemly to prejudge the matter, but university administrators at other sites have been known to protect their prerogatives at the expense of faculty and to use "downsizing" as an opportunity to cut opponents down to size.

If the American Chemical Society, the American Physical Society, and the Federation of American Societies for Experimental Biology do not check listings against the AAUP's censure list, that speaks worlds about their indifference to academic freedom, not about the legitimacy of AAUP's role in defending that freedom.

"Tenure police," my foot! Has Science joined Representative Dingell in concluding that academia is one grand corrupt savings and loan association?

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 Corrections and Clarifications

In the News & Comment article "Is the wolf finally at the door?" by David P. Hamilton (10 July, p. 157), several decimal places were dropped when the difference between the Bush Administration's requested 1993 National Institutes of Health budget and that agreed upon by a House of Representatives subcommittee was reported. The correct amount is $200 million, not $200,000.

In This Week in Science for 12 June (p. 1495), the first sentence of the item "Oxytocin is a peptide hormone secreted from the posterior pituitary that causes uterine contractions and is used to induce labor."
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Ask for more details and a reprint of the reference.

1. Dynamic changes in HIV-1 quasispecies from azidothymidine (AZT) treated patients. FAESB Journal 6 (1992), Wahlberg, J., Albert, J., Lundberg, J., Cox, S., Wahren, B., Uhlen, M.
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30. P. Farci, unpublished data.


35. We thank B. Hollinger for strain R of HCV, P. Lusso for critical comments, and T. Heishman and L. Moore for editorial assistance. Liver biopsies from one chimpanzee were evaluated by the late H. Popper, the rest were evaluated by one of us (S.G.).

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nature of the so-called central engine, which supplies the energy needed to accelerate beams of particles to relativistic velocities.

One of the most exciting discoveries in recent years was reported in the paper by Krichbaum et al., who detected radio emission from several quasars and blazars that appear to vary in strength by some 10 percent on the surprisingly short time scale of only a few hours. The reality of the rapid variations was convincingly demonstrated by simultaneous observations, made with the 100-meter radio telescope in Germany and the Very Large Array telescope in New Mexico, with remarkable agreement to a fraction of a percent.

If the variations are intrinsic to the source, simple light travel time arguments suggest that the dimensions of the radiating region are incredibly small, less than a few light hours across. Even allowing for the effects of relativistic time dilation, the apparent size of the radiating region is too small to account for the high radio luminosity by the same synchrotron radiation process generally believed responsible for the radio emission from galaxies and quasars.

Attempts to interpret the observed variations as an extrinsic effect of the intervening medium are attractive because they avoid embarrassing theoretical problems. One idea is that the rapid variability is due to gravitational microlensing by stars located in intervening galaxies. However, the observed variations are wavelength-dependent, whereas gravitational effects should be achromatic. According to the discovery team, refractive interstellar scintillation from propagation effects in the interstellar medium "is a more plausible cause of the rapid radio variations" that they observed. However, in one of the most extreme examples, the radio variations were accompanied by rapid optical variations that appear to be correlated with them and clearly cannot be due to propagation effects through the ionized interstellar medium. Further observational and theoretical studies of intraday variability of blazars are expected to give a wealth of information about the physical conditions in the nucleus of galaxies and about particle acceleration mechanisms. If the correlation between intraday radio and optical variability of blazars is confirmed and extended to other objects, astronomers will be forced to interpret the variability in terms of an intrinsic phenomenon, presenting new challenges to their interpretation.

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