isting motif or to create their own, enabling new motifs to be identified as desired. The new motifs are treated in the same way as any of the preexisting database options and can be given a name and placed on any Feature Map. Almost any entry or any search function in the program can be edited, and once the searches are done, they can be fine-tuned by filtering the results so that only selected data sets are displayed.

OMIGA's ability to perform alignment of multiple related protein sequences (up to 500) with the CLUSTAL W algorithm demonstrates the power of the program. Amino acid residues are color-coded to depict their properties (for example, acidic or basic) and can be viewed with a corresponding secondary structure analysis. Many aspects of the display can be edited, including the color-coding. In addition, the alignments can be adjusted by the user, residue by residue, to specifically remove or introduce gaps, giving one freedom to experiment with alignments outside the constraints of the program.

OMIGA 1.1 is supported by full documentation and online help. The on-screen help files are comprehensive and easy to follow, although the set of instructions for how to carry out a secondary structure analysis of an amino acid sequence did not work in our trial. The full User Guide and Reference Manual can be viewed on screen or printed at high resolution. In general, the OMIGA 1.1 package is free of bugs, with one notable exception. The software was tested with numerous DNA and protein sequences of various lengths, which it handled flawlessly. Nevertheless, the program consistently caused crashes whenever a compositional analysis was performed in a fully expanded window. Of serious concern was that it purged all of the project files one of the times it crashed. The compositional analysis can also be done in an unexpanded window, so it is possible to avoid crashes, but this bug should be fixed.

OMIGA 1.1 is a powerful and comprehensive sequence analysis package that is very easy to learn and use. Any user with some experience with Windows 95, or with other sequence analysis programs, can quickly adapt to the software and immediately find it useful. Although the novice may have some difficulty using the product at first, the intuitive feel of OMIGA, together with the excellent help files, should make the experience quite painless.

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1. Available from Textco at www.textco.com.

PERSPECTIVES: ANCIENT METALLURGY

Metallic Reflections

Jeffrey Quilter

Recent discoveries of gold tombs, such as the Lord of Sipán of the Moche culture, hailed as the "New World's King Tut," and the remarkably preserved ice mummies of sacrificial Inka maidens, have refocused attention on ancient Peru's rich cultural legacy (*1*, *2*). Both, however, were late blooms attached to roots deep in the ancient past, exemplified by early maritime settlements in Peru (*3*). Now, as reported on page 1108 of this issue, Burger and Gordon (*4*) have uncovered the earliest New World metallurgy—cold-worked copper foils—providing the opportunity for a comparative examination of the development of this important technology. The new findings also reveal the unique ways in which ancient Peruvians used technology for their own means and ends.

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The study of the prehistoric civilizations of ancient America has often swung between two poles: a search for generalized stages of development in comparison with the Old World or the perception of New World societies as unique. Nineteenth century views of cultural evolution did not fit comfortably with societies such as the Maya, who had a full written language and excelled in art and architecture yet had little in the way of metallurgy, or the Inca, who ran a vast empire and had advanced metal skills but no writing. Did New World cultures follow unique cultural trajectories? Were they influenced by outside civilizations? And were they comparable in any way with cultural developments known elsewhere? In the case of Andean metallurgy, the answers to these questions seem to be that the technology was a local development that followed its own path, both similar to and different from that of the Old World.

Metallic sunshine. Central American gold disk, demonstrating the use of the metal's reflective properties.

PHOTOS: COURTESY OF DUMBARTON OAKS LIBRARY

The early date determined by Burger and Gordon for the cold-hammered copper foil at Mina Perdida (*4*) strongly suggests that metallurgy had a long period of development in America and was neither a transoceanic import nor developed full-blown, ex nihilo. Although New World metallurgy had its own origins, it shared many patterns with the Old World in its subsequent development. In both hemispheres, cold working was eventually augmented with casting (both mold and lost wax) and elaborate assembly techniques, including folding, bending, hammering, and the use of staples and solder. Furthermore, the first purposes to which metal technology were applied were not industrial but rather tied to social and ideological concerns. In Central Europe, precious metal jewelry enhanced the status of chiefs and similar social leaders (*5*). At Mina Perdida, foil was likely used to elaborate ritual display, probably also in aid of a growing, although still relatively weak, social elite.

We do not know exactly what kinds of rituals took place on top of the pyramids at Mina Perdida, but they almost certainly involved activities that reenacted fundamental social myths with much spectacle and display. Part of the evidence for this is the remarkable puppetlike figurine that Burger and Salazar-Burger (*6*) found on the same terrace where four of the copper fragments (*4*) were retrieved. The fact that the recov-

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ered metal is in the form of foil suggests that the material was used for its reflective properties and its ability to cover the surfaces of other materials; the addition of gold on one fragment further supports this view. Thus, it is likely that sheet metal was used to adorn people or ritual objects, to offer to the gods, or, flashing in the light, to impress audiences witnessing or participating in ceremonies.

To the ancients, natural forces, especially the sun with its life-giving rays that provided sustenance for humans, were more important than anything else, and metal that could capture and redirect light must have been seen as akin to fragments of the sun itself (*7*). Materials specialists Lechtmann (*8*) and Hosler (*9*) have both noted the emphasis on light, sound, and color in the creation of ornaments that included larger sheet-metal reflective disks and tinkling bells.

Just as the energy of the sun is absorbed by all it touches, gold seems to have been thought of as imbuing other metals with its power (see figure). Thus, when alloying was elaborated in the New World, it occurred as much to infuse baser metals with the essence of gold as to provide structural properties to the objects produced. This seems to have been a distinctly Native American approach to metallurgy, just as some New World peoples valued the scent of gold alloys as much as or more so than the colors of these materials.

Curious creature. Gold snuff spoon in the shape of a monkey from Chavin.

By the time of the arrival of the Spanish, Native American metal craftsmen rivaled their European counterparts in the sophistication of their technical skills, but the ideological and social constructs in which they worked were very different. Whereas the Spanish were caught up in the early stages of modern capitalism, for Native Americans, gold was of great value, but it was not a commodity; for some Americans, gold was considered the "feces of the gods," valuable to humans but, ultimately, the waste products of greater truth and beauty.

Although the earliest American metallurgy highlights both the differences and similarities and the value of metal working between the Old and New Worlds, its discovery and analysis underline our own value systems as citizens entranced with the tools of modern science. The work reported by Burger and Gordon, for example, required the use of sophisticated microprobe equipment. Yet the more fundamental scientific and human values of patience, care, and attention to detail are exemplified by the conduct of the authors of the report and their archaeological team. Less careful supervisors might have rushed their excavators to uncover more architecture at a faster rate, because large building plans are always impressive in archaeological reports. Such an approach might easily sweep away or overlook such tiny but important fragments. But in this case, as in so many others, slow and deliberate work and careful observation (very different from Hollywood's Indiana Jones) led to a remarkable discovery.

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PERSPECTIVES: ION CHANNELS

Exciting Times for PIP_2

Frances M. Ashcroft

Fats have many negative connotations in Western society, yet at the cellular level lipids and lipid metabolites are essential for cell function. Not only are they important structural components of cell membranes, they also generate—or even serve as—signaling molecules that mediate the action of hormones or transmitters. Two reports published in this issue on pages 1138 and 1141 (*1, 2*) add a further twist to the story by revealing a new role for membrane phospholipids in regulating the activity of the adenosine triphosphate (ATP)–sensitive potassium channel (K_{ATP} channel), a membrane protein that acts as a gated pore to control the movement of potassium ions into and out of the cell.

K_{ATP} channels are important in the physiology and pathophysiology of many tissues: in pancreatic β cells, they couple changes in blood glucose concentration to insulin secretion; in vascular smooth muscle they regulate vessel tone; and in cardiac tissue they are involved in action potential shortening during ischemia (*3, 4*). The channel derives its name from the fact that it is blocked by intracellular ATP, a molecule more widely known for its ability to power chemical reactions within the cell than as a channel regulator. One problem has puzzled people for years: why is K_{ATP} channel activity observed in the intact cell at cytoplasmic ATP concentrations that would be sufficient to inhibit the channel almost completely in an isolated membrane patch? The problem is particularly acute for the K_{ATP} channel of the β cell. Although this channel is half-maximally inhibited by an intracellular ATP concentration K_i of ~10 μM in excised patches, substantial channel activity is observed in intact β cells under conditions where measured cytosolic ATP is 3 to 5 mM (*3*), and estimates of the ATP sensitivity in the intact cell suggest a K_i of ~1 mM (*5, 6*).

Baukrowitz *et al.* and Shyng and Nichols suggest a solution to the puzzle (*1, 2*). They show that the membrane phospholipid phosphatidylinositol-4,5-bisphosphate (PIP_2) has a dramatic effect on the ATP sensitivity of the K_{ATP} channel. Addition of 5 μM PIP_2 to the cytosolic side of the membrane reduced the half-maximal inhibitory concentration of ATP from ~10 μM to more than 3 mM within 10 min (the slow time course presumably reflects progressive incorporation of the

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