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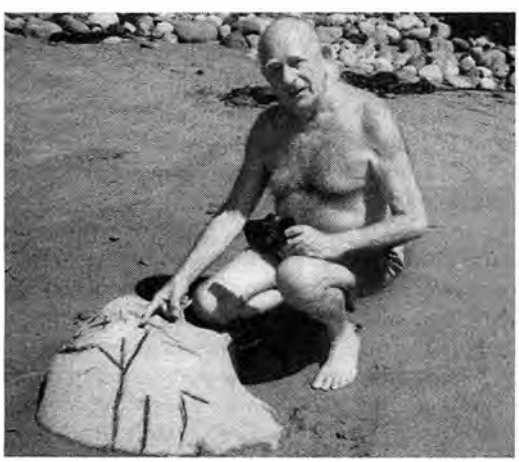
Features



A passion for epigraphy: Barry Fell's son tells the story of how his father came to decipher many ancient scripts (p. 40). Here, Fell poses with a marked rock he found on Pacific Beach, San Diego.

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On the cover: Mozart's opera *Don Giovanni*, being performed in Orange, France. Photograph from the James Stanfield/NGS Image Collection; cover design by Rosemary Moak

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Science: To Be, or Not to Be

Or, How I Discovered the Swindle of Special Relativity

If we wish to assure the survival of science into the new century, we must begin by clearing up the mess we have made of it over the last. Let's start with the swindle called *The Special Theory of Relativity*. Here we have a roof of wastepaper shingles, set upon the house of fraud that Maxwell built. Einstein's alleged great achievement, that "triumph of 20th century physics," was that he *saved the appearances* of the (then well-known) fraud which the great British faker, James Clerk Maxwell, had constructed over the dead bodies of Ampère, Gauss, Riemann, and, finally, Weber.

This is the story of how I came to recognize the swindle Einstein perpetrated. Like most great liars, Einstein tells you what he is doing, albeit in a devious fashion. Like most discoveries, mine came about through an indirect path. Yet, each step is important in its own way. Bear with me, and you too shall see, if you dare.

First Steps

About two months ago, I read in a column by Jeffery Kooistra in *Infinite Energy* magazine (Issue 27, 1999) of a simple and paradoxical experiment, originally proposed by Dr. Peter Graneau, the author of *Ampère-Neumann Electrodynamics in Metals,* and other works. The result so fascinated me that I decided to reproduce the experiment on my own. Two 42-inch lengths of half-inch (i.d.) copper pipe were mounted, each on a separate length of 1×3 lumber, and laid parallel to one another, like rails, about 12 inches apart. The opposite terminals of a 12-volt automotive battery were connected to the copper rails.

When the circuit is completed, by placing a 24-inch length of copper pipe perpendicularly across the two parallel pipes, the shorter pipe begins to roll down the track, accelerating to the end, and sparking and sputtering as it goes in a delightful display.

One familiar with the Ampère angular force (see *21st Century,* Fall 1996, "The Atomic Science Textbooks Don't Teach," p. 21), will see that an explanation based on repulsion between elements of current in the parallel rods, and those in the movable, perpendicular portion of the circuit, is at hand—although, the same motion can be accounted for by the *algebraically equivalent* i×B forces considered in Maxwell's formulations.

The paradox which the designer of the experiment wished to demonstrate comes in the next part. If we replace the 24-inch copper pipe with an equivalent length of steel pipe, the steel pipe rolls in the opposite direction! Why? I asked Dr. Graneau, who was kind enough to provoke my added interest by telling me that he didn't know, and that he didn't know of anybody who did.

Ampère's Theory of Magnetism

It seemed to me, first of all, that the steel pipe must be experiencing a magnetization under the influence of the current. If so, the question, as I saw it, remained of what was the influence of the other parts of the circuit on the presumed magnet. I recalled that Ampère devoted the largest portion of his famous 1826 *Memoire* to developing a theory of magnetism, attempting to subsume the entirety of magnetic effects known to him under his law for the force between current elements.

To accomplish this, he made use of the beautiful concept (suggested to him by his close friend, Augustin Fresnel) of the "magnetic molecule." By this he meant a small, resistance-free, circular current, which he believed to be present in the atomic structure of all things. In the case of ferromagnetic materials, Ampère supposed these molecules to be aligned in parallel columns, compounding their force to produce the total magnetic effect.

In the *Memoire,* Ampère shows that a magnetic solenoid would produce a rotational moment on a current element, or portion of a circuit, located outside; but that in the case of a complete circuit, there would be no moment. I wondered

if, in the case of the backward-moving steel pipe, the other parts of the circuit formed by the copper rails might not act separately from the portion of the circuit passing through the steel pipe. Another experiment, prepared for a classroom demonstration on these topics, had suggested such a possibility.

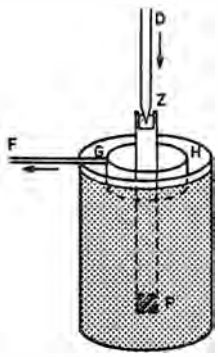
In the latter case, I wished to show that a magnetized, hollow steel cylinder acted differently than did a classical Ampère solenoid (which had been made by winding a wire around a hollow plastic tube of the same dimensions as the steel cylinder). I had had difficulty achieving any significant magnetization of the steel cylinder, which was made from a section of tubing used for carrying electrical conduit—what electricians call EMT. However, shortly before the classroom demonstration was to take place, I noticed that if the steel tube was wound with wire like the plastic one, and a current run through it, the difference in the form of the magnetization could be demonstrated. To wit, an iron nail or other magnetizable object is drawn into the center of the Ampère solenoid, but only to the outside ends in the case of the steel cylinder.[1]

At the time, I concluded, without giving it much thought, that the magnetization produced in the steel cylinder when the current was flowing was simply the predominant effect, making the contrivance behave (when the current was on) more like a permanently magnetized piece of steel than an Ampère solenoid.

After reading a part of the Ampère *Memoire,* I saw the possibility that this same sort of effect might be at work in the case of the backward-rolling steel pipe. It might be possible to convert the case Ampère describes, of a rotational moment created by a solenoid on part of a circuit, to the case in hand. The calculation is, however, difficult, and the experiments necessary to verify it even more so. I have not had the opportunity, yet, to pursue it.

Maxwell's Fraud Summarized

Had anyone else done so? Unfortunately, the Ampère *Memoire* is almost never read today; only a small portion of the 200-page work was ever translated into English, and even French speakers rarely, if ever, trouble to work through it. The reason is that James Clerk Maxwell, in the middle of the 19th century, made a new mathematical formulation of the laws of electricity, which he claimed was *algebraically equivalent* to that of Ampère and Ampère's successor in the development of the electrical laws, Wilhelm Weber.



SCHEMATIC OF THE AMPÉRE APPARATUS (1822)

Ampère's apparatus for causing a magnet to rotate on its own axis—a motion which Faraday had deemed impossible. ZP is a cylindrical magnet immersed to half its length in a beaker of mercury; the small cavity at Z is also filled with mercury, allowing contact to be made with one end of a battery coming from D. GH is a metallic ring linked to the other terminal of the battery through F. When current is applied, the magnet ZP rotates continuously.

Source: From Christine Blondel, *Ampère et la creation de l'electrodynamique* (Paris: Bibliotheque Nationale, 1982) p. 115

Not only did Maxwell make this formulation, but, one must add in all honesty, British political-military hegemony at the time *imposed* the new view on many reluctant, sometimes even obstinately so, opponents on all continents.

Maxwell's formulation, however, eliminated consideration of the angular component of the force between current elements. It also removed the most fundamental of Ampère's assumptions—the unity of electricity and magnetism—by introducing the concept of a *magnetic field.* There is no *magnetic field* in any of the writings of Ampère, nor of his successors in electrodynamics, Carl Friedrich Gauss, Wilhelm Weber, and Bernhard Riemann. Magnetism, for them, is considered an epiphenomenon of electricity; it is the force of electrodynamic attraction or repulsion acting between circuits of electricity, called *magnetic molecules* (and which came to be known later as *electrons*).

This forgotten part of the history of the subject is most important to what we are about to show.

The First Unipolar Machines

But to return to the thread of our story, I soon became aware of some closely related developments. In 1840, Wilhelm Weber, who then shared with Gauss the leadership of the worldwide association for the study of the Earth's magnetic forces known as the *Magnetische Verein,* published in the journal of that society a paper titled "Unipolar Induction." In it, he described his study of a phenomenon first discovered by Ampère.

Begin with a cylindrical steel rod, magnetized along its axis. If the lead wires from a battery are brought into contact with the magnet such that the magnet is not constrained in its motion (as by brushes), one brush touching it at the top of its central axis, and the other along the circumference of the cylinder and roughly midway between the two poles, the magnet will rotate around its own axis for as long as the current continues to flow. Ampère created such an electric motor, which Faraday had deemed impossible, in 1822.

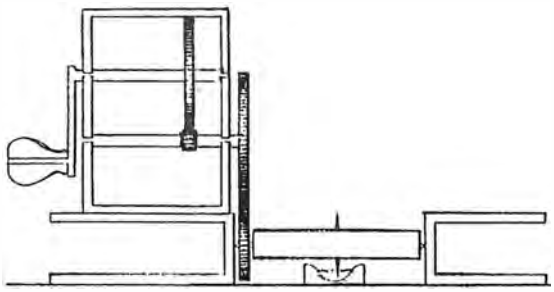
Unipolar induction, a term apparently due to Weber, by which he seems to mean induction of an electrical current in one direction only (pure direct current in our modern terms), refers to the converse situation. The magnet is rotated, as by a crank, generating an electric current in the lead wires. Weber had some difficulty accounting for the phenomenon, until he modified what he thought was Ampère's conception of the magnetic molecule to suppose that two separate magnetic fluids (north and south) were contained within the magnetic molecule, and that the portion of the current flowing through the magnet followed a path midway between them.

After Weber, many more studies were made of the unipolar induction. In the 1870s, E. Edlund in Sweden showed that the magnet could be kept stationary, and, instead, a steel cylinder which surrounds it, but which need not be in physical contact with it, could be rotated, producing the same effects. The American physicist E.H. Hall mentions the researches of Edlund as having contributed in some important way to his 1879 discovery of the transverse current phenomenon, now known as the Hall Effect.[2]

In another form of the unipolar induction, a rotatable steel disk is situated between two steel plates bearing opposite magnetic poles. Brushes with lead wires

running from them are brought into contact with the disk at a point near its center, and at a point, or points, along the circumference. Upon rotation of the disk, a significant current is generated in the wires. Description of this form of the apparatus, called a *unipolar* or *homopolar generator,* can be found in older textbooks on electrical principles.

In one book, I learned that such machines were being produced commercially by the General Electric and Westinghouse Companies in the 1920s. Such devices can produce very high, pure direct currents, without the need for rectifiers or commutators, but have the disadvantage of producing only low voltages.



WILHELM WEBER'S UNIPOLAR INDUCTION MACHINE OF 1839

The cylindrical magnet, shown in cross section in center, is attached to a geared handcrank device at left. A metal ring around the center of the magnet makes contact with a dish of mercury placed below it. When the crank is turned, a current flows from a wire placed in the mercury dish around to the right-hand end of the magnet, and back through the magnet itself to the mercury dish.

Source: From Wilhelm Weber, "Unipolare Induction," in *Resultate aus den Beobachtungen des magnetischen Vereins im Jahre 1839* (Leipzig: Wedmannschen Buchhandlung, 1840)

Forbidden Words

Readers familiar with the ways of physicists may know, however, that raising the topic of unipolar generators and motors among them is most likely to produce grimaces, embarrassed smiles, or other looks of dismay. The reason for this only became clear to me a short time ago. Up to that time, I had naively thought that there was some doubt as to the actual existence of the effect, so negative is the reaction to the mere mention of the words.

Now I understand, what many already knew, that it is part of the codified religion of the self-anointed priesthood known as academically accredited 20th-century physicists, that such a topic is not to be discussed. The reason is, that Einstein said so.

I began to suspect so just recently, when, a friend, after seeing a demonstration of the backward-rolling steel pipe, opened up a 1950s textbook on electrodynamics to the section on "homopolar generators." In it, the author described a generator of the rotating disk type just described above. The author went on to say that if the disk is kept stationary and, instead, the magnetic plates surrounding it are rotated, no current is generated!

Students often have difficulty grasping why this should be so, the author tells us. But, he explains to them that they must understand that when the magnets are rotated, the magnetic field lines do not rotate with them![3] Further, the textbook author suggests, one must consider the *inertial framework* of the observer and the apparatus. Finally, he tells us, that when students still don't yield, he clears things up by presenting them with another case. He then describes a more complicated experiment involving the relative motion of magnet, steel bar, and ammeter, in which eight different outcomes are possible. And there the chapter ends. Surely, then, everything is clear.

Enter Einstein

I am in some ways naive, but one does not live a large portion of one's life in New York City without developing a certain instinct for knowing when he is being swindled. A look into yet another but older textbook (under what perverse impulsion I know not), brought me nearer to the truth. For here, on page 8, just upon entering the topic of electrostatics, we are told that, before going any further, we must become familiar with the concept of *inertial frames.* (That was 1930, when everybody was not so familiar with this idea.) For situations arise in which an observer in one inertial frame will measure an electric field and no magnetic field, while another might measure both an electric and a magnetic field, for example. If we do not take into account inertial frames, we are warned, many problems in electrodynamics, especially those involving rotating magnets will create difficulties for us.

Just at that point I began to suspect the exact nature of the swindle. Was it possible, that—despite all the talk of moving trains, clocks, and shrinking rods—the anomaly being addressed in Special Relativity was actually the much more mundane case before me—the asymmetry between motion of the magnet and motion of the disk? Then I remembered the title of Einstein's famous paper, "On the Electrodynamics of Moving Bodies." Suddenly, its first paragraph made sense:

"It is known that Maxwell's electrodynamics—as usually understood at the present time—when applied to moving bodies, leads to asymmetries which do not appear to be inherent in the phenomena. Take, for example, the reciprocal electrodynamic action of a magnet and a conductor. . . ."

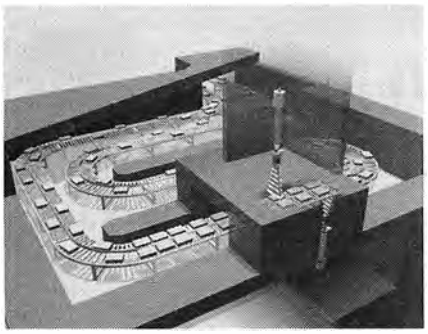
Was Einstein talking about anything other than the anomaly of the sort manifested in the unipolar generator? If there were any doubt, one needed only to turn to "II. Electrodynamical Part, Section 6. Transformation of the Maxwell-Hertz Equations for Empty Space. On the Nature of the Electromotive Forces Occurring in a Magnetic Field During Motion." There, in the last paragraph we read:

"Furthermore it is clear that the asymmetry mentioned in the introduction as arising when we consider the currents produced by the relative motion of a magnet and a conductor, now disappears. Moreover, questions as to the 'seat' of electrodynamic electromotive forces (unipolar machines) now have no point."

And so, a true physical anomaly has been caused to disappear by the introduction of an arbitrary postulate—and an absurd one, at that. Thus are Maxwell's equations "saved." Could a magician do better?

There, dear reader, is the fraud—or a big part of it—which today's well-paid fraternity of professional physicists are committed to defend.[4] Heed and respect these hoaxsters if you wish. You will pay, like Faust, with your soul. Science, like

Continued on page 7



Courtesy of Titan Corporation

Artist's conception of the Titan "SureBeam" electronic pasteurization plant in Sioux City, which can process 80,000 hamburger patties per hour.

William C. Jones

Freeman: "Whether or not the Apollo program was a dead end will ultimately be determined by what we do in the future."

Laurence Hecht

Bob Holzknecht at the Kennedy Space Center, 1992.

USDA ISSUES REGULATIONS FOR MEAT IRRADIATION—FINALLY

The U.S. Department of Agriculture issued its long-awaited regulations for the irradiation of meat, including ground beef, Dec. 14, and meat producers are expected to begin test marketing in spring 2000. Food Technology Inc., based in Mulberry, Florida (formerly called Vindicator), and the Titan Corporation, which has a new electron-beam pasteurization facility in Sioux City, Iowa, both are ready to process meat and meat products.

CHINESE TO BECOME THIRD NATION WITH A MANNED SPACE PROGRAM

Ending months of speculation and expectation, the Chinese government announced that at 6:30 A.M., Nov. 20, Beijing time, a new version of the Long March rocket, the 2F, placed the "Shenzhou" space vehicle into orbit, as an unmanned test of the spacecraft that will later carry Chinese astronauts into space. This makes China only the third nation—the Soviet Union and the United States are the first two—to develop and test a manned spacecraft. Although the spacecraft resembles the Soviet/Russian Soyuz vehicle, there have been significant modifications. Even on this unmanned test flight, the Shenzhou was outfitted with technology to allow it to dock with another spacecraft, indicating that the Chinese plan to begin a long-term program to put men in space.

APOLLO PROGRAM WAS THE BEGINNING, NOT A 'DEAD END,' FREEMAN ASSERTS

Speaking at the annual Congress of the International Astronautical Federation in Amsterdam Oct. 6, *21st Century Science & Technology* Associate Editor Marsha Freeman countered the myth promulgated by the media and numerous space "historians" that the Apollo program, announced by President Kennedy in 1961, was a "dead end." The paper was presented in commemoration of the 30th anniversary of the first Moon landing. It was the war in Vietnam and the false idea that spending money for space conflicts with helping the poor, that prevented Lyndon Johnson from continuing an aggressive space program, Freeman asserted. As for being a "dead end," Freeman said, "Christopher Columbus's voyages could have been a dead end, if no one had followed him, or if the first colonists had died, and others had decided it was not worth the risk. Therefore, whether or not the Apollo program was a dead end will ultimately be determined by what we do in the future."

BOTH MARS '98 MISSIONS LOST; POLICY TO BE REEVALUATED

On the heels of the Sept. 23 loss of the Mars Climate Orbiter, the result of a navigational error, engineers and scientists have been unable to establish contact with the Mars Polar Lander, since its descent to the surface of Mars Dec. 3. Investigations into the Climate Orbiter failure pointed to overwork by the team at NASA's Jet Propulsion Laboratory as one of the causes for the human error. After that failure, many commentators questioned the "faster, better, cheaper" policy implemented by NASA Administrator Dan Goldin, considering the difficulty of missions to Mars. There will be a re-evaluation of whether Mars missions require more resources than are being allocated for the upcoming year 2001 missions.

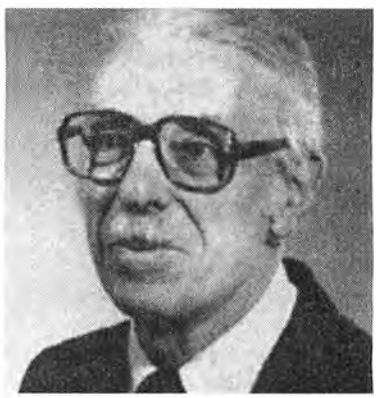
ROBERT HOLZKNECHT DIES; FOUNDER OF 'THE OZONE TRUTH SQUAD'

Bob Holzknecht, an indefatigable fighter for the truth about CFCs, and familiar to many readers as the founder of the Ozone Truth Squad, died in Cocoa, Florida, Oct. 6, of prostate cancer, at age 77. A graduate of Virginia Polytechnic Institute, Bob worked as an engineer in the Apollo program, and later founded an automotive air-conditioning company. From his World War II Purple Heart, to his work to save CFCs, to his fight against cancer—living eight years, after his doctors told him he had only six months—Bob demonstrated his courage and tenacity. His generosity and good humor were exemplary. He was a good friend of *21st Century,* and we will miss him.

IN MEMORIAM

THOMAS H. JUKES (1906–1999)

Scientist and Humanitarian



by J. Gordon Edwards

Thomas H. Jukes, an emeritus research chemist at the University of California at Berkeley, died of pneumonia Nov. 1, after a short illness. He was 93, and was still working at the university. In recent years, he had been associate director of the space sciences laboratory, and he had served as a consultant to NASA.

Throughout his long career, Jukes was an advocate for truthfulness in environmental matters and for integrity among American scientists.

Born on Aug. 25, 1906, in Hastings, England, Jukes emigrated to Canada in 1924. After receiving an undergraduate degree from Guelph University and a Ph.D. in biochemistry from the University of Toronto in 1933, he taught briefly at Princeton University and then moved to California, inspired by the writings of Mark Twain and Bret Harte. In California, he enjoyed hiking, climbing, and camping in the Sierra Nevada.

From 1942 to 1959, Jukes worked at the Lederle Pharmaceutical Laboratories in New York, where he did pioneering work in chemotherapy as a treatment for cancer, finding several new effective drugs. He discovered the role of folic acid antagonists, including methotrexate, for cancer therapy. He also proved that pantothenic acid is a vitamin, that niacin cures pellagra, that a deficiency of B-12 can cause childhood convulsions, and that riboflavin and choline are essential nutrients for many animals.

In 1950, Jukes and his wife, Marguerite, established a new chapter of the Sierra Club in New York. This was the first chapter outside of California, and it became very successful. They later returned to California, where Jukes became a professor of medical physics and biophysics at the University of California at Berkeley, and a lecturer on nutritional health. He engaged in classical research on nucleotides and the amino acid code, and he conducted many seminars on the sequences of DNA molecules. He was frequently honored as "Man of the Year" by biological and biochemical organizations.

After the emphasis of the Sierra Club changed from appreciation of the environment to attacking biological research, medical entomology, agriculture, and forestry, Jukes and many other scientists could no longer support the Club. He remained active, however, in the Explorers Club, the American Alpine Club, and many other outdoor groups, and he was a leader in the Trustees for Conservation. He still maintained friendships with many true environmentalists, including Ansel Adams, Horace Albright, Norman Borlaug, Norman Clyde, Francis Farquhar, August Frugé, and Dick Leonard.

The Fight over DDT

When Rachel Carson's book, *Silent Spring,* was lauded by the Sierra Club in 1962, Jukes was appalled that "the book failed to mention that DDT had saved more lives and prevented more illnesses than any other chemical in history." He explained that, "I felt it was my duty as a scientist to do what I could to publicize the facts about DDT."

Jukes became a leader of the group of scientists who opposed the public hysteria generated by environmental extremists, who wanted to ban DDT and other pesticides. His publications were always based on accurate data, and were appreciated by sincere biologists. Dr. Jukes wrote that "any action taken against DDT will have worldwide repercussions, and millions of non-white people will die as a direct result if the manufacture of DDT is stopped." History has proved Jukes to be absolutely correct.

Readers of *21st Century* and dozens of other scientific journals in America and Europe were impressed by Tom's efforts to protect human beings from insect-borne diseases that are the major cause of malnutrition, starvation, suffering, and death in Third World countries. Jukes was very effective in exposing the untruths about DDT that were the basis of much environmental propaganda. He discussed the lies about DDT in writings and speeches, and testified in hearings throughout North America. His activities undoubtedly helped save the lives of thousands of human beings who would otherwise have died of malaria, typhus, plague, encephalitis, and other disease that could be controlled by DDT or similar insecticides.

In a spring 1992 article in *21st Century*, Jukes recounted how he and other scientists, including this author, were called "paid liars" for DDT in a *New York Times* article, and had sued for libel and won in 1976. The *Times* then appealed the case, the first it had lost in many years, and the appeal was conveniently heard in the U.S. Second Circuit by Judge Irving Kaufman, a close friend of *The New York Times* publisher, Arthur Ochs Sulzberger. Kaufman ruled on behalf of the *Times*.

Jukes's article was occasioned by the death of Kaufman in February

1992. Kaufman had previously gained national attention by his sentencing of Julius and Ethel Rosenberg to the electric chair.

Dr. Jukes worked with many groups to publicize the truth about DDT: the U.S. National Academy of Sciences, the World Health Organization, the Pan-American Health Organization, the U.S. Public Health Service, the Centers for Disease Control, the American Council on Science and Health, the Council for Agricultural Science and Technology, the American Farm Bureau Federation, the Terra Society, the Council for Environmental Balance, Sponsors of Science, and dozens of similar organizations.

A Champion of Science

During his decades of involvement with those organizations, Jukes wrote several books, chapters in many other books, and hundreds of significant scientific articles. He urged that science be employed as fully as possible for the relief of human suffering from malnutrition and disease. Where insect-borne diseases were responsible for severe epidemics, his dedication to protecting human lives resulted in confrontations with genocidal activists, opportunistic propagandists, and pseudo-environmentalists. He was attacked by groups that sought worldwide population reduction by unleashing malaria and other insect-transmitted diseases, including the Sierra Club and the National Audubon Society.

Dr. Jukes's favorite author was William Shakespeare and he loved classical music.

This remarkable man will be remembered, with reverence, not only as a stellar scientist, but also as one of the great humanitarians of our time.

Jukes is survived by his wife, Marguerite, two daughters, one daughter-in-law, and seven grandchildren.

Dr. J. Gordon Edwards, who worked closely with Jukes in the fight for DDT, is Emeritus Professor of Entomology at San Jose State University in California, where he has taught biology and entomology for more than 50 years.

Editorial

(Continued from page 4)

all creative practice, is a precious tradition of thought, which begins with a profound and religious love for one's fellow man, and most of all, for those among one's predecessors who have ventured into that fearful territory "from whose bourn no traveller returns": the realm of independent, creative thought. Nothing will so quickly turn a gifted thinker into a hopeless sack of lost potential, as moral compromise.

There is the challenge for science, as we enter the new millennium.

—Laurence Hecht

Notes

1. This was the subject of an early challenge by Michael Faraday to Ampère's hypothesis of the magnetic molecule. Faraday reasoned that if Ampère's conception were correct, the two cylinders should show the same magnetic effect; but his experiments showed that they behaved differently. Ampère showed that Faraday did not understand the conception: the large circular windings of the solenoid are only *macroscopic* analogues of the very small circular currents hypothesized to reside within the atomic structure of the magnet. Thus, the geometry of the currents in the two cylinders is entirely different, and Faraday's experimental conception is fundamentally flawed.
2. It might, or might not, be relevant to the case at hand that, shortly after his discovery of the transverse current, which was accomplished in a thin layer of gold deposited on a glass plate, Hall discovered that iron produces a transverse current in the opposite direction.
3. Professor O'Rahilly, author of *Electromagnetics,* (1938) calls this argument, which had already been employed in his day, "hypostasizing one's own metaphor." Today, we might use blunter language.
4. Let us allow each man the benefit of the doubt. Some among this fraternity have been so credulous, in their pursuit of fame or money, as to be truly ignorant of the fraud they are paid to uphold. Today, even educated physicists usually lack the historical background to understand how troubling was the challenge posed to Maxwell's system by such asymmetries. Maxwell's nasty fraud—the usurpation of half a century's hard work, steered by the greatest mathematical physicist of modern times, Carl Friedrich Gauss—was in trouble. And people were alive who knew, and still resented, the arbitrary and entirely *political* manner in which the Ampère-Gauss-Weber electrodynamics was unseated.

   Maxwell, who did *no more* than create a mathematical system which successfully misrepresented all the hard work of Ampère, Gauss, Weber, Riemann and others, had made a big blunder, or several. The Ampère-Gauss-Weber electrodynamics was relativistic, in a non-silly sense; it was atomistic; Gauss knew that the propagation of electrodynamic force was not instantaneous (Weber, Kohlrausch, and Riemann had measured it in 1854, years before Maxwell ever proposed the electromagnetic theory), and was seeking since no later than 1835, a "constructible representation" for it, as Gauss put it in an 1845 letter.

   So Einstein "saved the appearances" of Maxwell's flawed electrodynamics. He should be called the modern Ptolemy. Maxwell is the true "Newton" of modern times. Just as one of scientific history's most over-inflated impostors, Isaac Newton, reformulated Kepler's work into an inferior formal system, so Maxwell did the same for the work of Ampère, Gauss, Weber, and Riemann.

   Perhaps the defenders of Maxwell's system prefer to remain in ignorance for the simple reason that the patent untenability of their position becomes only more clear, the more they know of its true history. For example, let one of the anointed priests of this profession respond today, to the devastating blow to their entire straw edifice which Ampère had struck in an 1822 letter to Faraday. Explaining that a *perpetual motion* was impossible, Ampère showed that the force between current elements which could be turned into a continuous rotational motion, had to come from the work done within the battery. However, such was not the case if one presumed—as did Biot, Laplace, and later Maxwell—that the force between magnet and magnet could be made equivalent to that between current element and current element. For in that case, continuous rotational motion would be possible between two magnets, a conclusion which violates the principle of energy conservation:

   ". . . dans les autres théories, on devrait pouvoir imiter, avec des assemblages d'aimants disposé convenablement, tous les phenomènes que présentent les fils conducteurs; on pourrait donc, en faisant agir un de ces assemblages sur an autre, produire dans celui-ci le mouvement continu toujours dans le méme sens; ce que dément l'expérience" (cited in Blondel, *op cit.*, p. 117).

Fusion Energy—20 Years Later

by Marsha Freeman

Fusion *magazine, the predecessor of* 21st Century*, made fusion energy a household phrase, and rallied popular support for the McCormack fusion bill of 1980.*

What is the future of fusion energy, the promise of a nearly unlimited supply of high-density energy to power new industries and homes in a growing and developing world? This question, so central to the welfare and future of all humanity, was the subject of a meeting in Washington, D.C., Oct. 19-21, called to commemorate the founding 20 years ago of an organization to promote the rapid development of fusion energy.

Twenty years ago, on Nov. 9, 1979, Dr. Stephen O. Dean, who had been a leader in the nation's thermonuclear fusion program for more than a decade, established Fusion Power Associates, a non-profit industry-based organization. The goal was to promote the development of thermonuclear fusion as a practical source of energy, by providing a greater awareness of the potential of fusion.

At that time, Dr. Dean told *Fusion* magazine: "Fusion science has progressed rapidly in the past few years. It is now important, if not urgent, to pursue more actively, engineering and technology development of reliable, practical fusion energy systems. Fusion has the potential to revolutionize civilization."

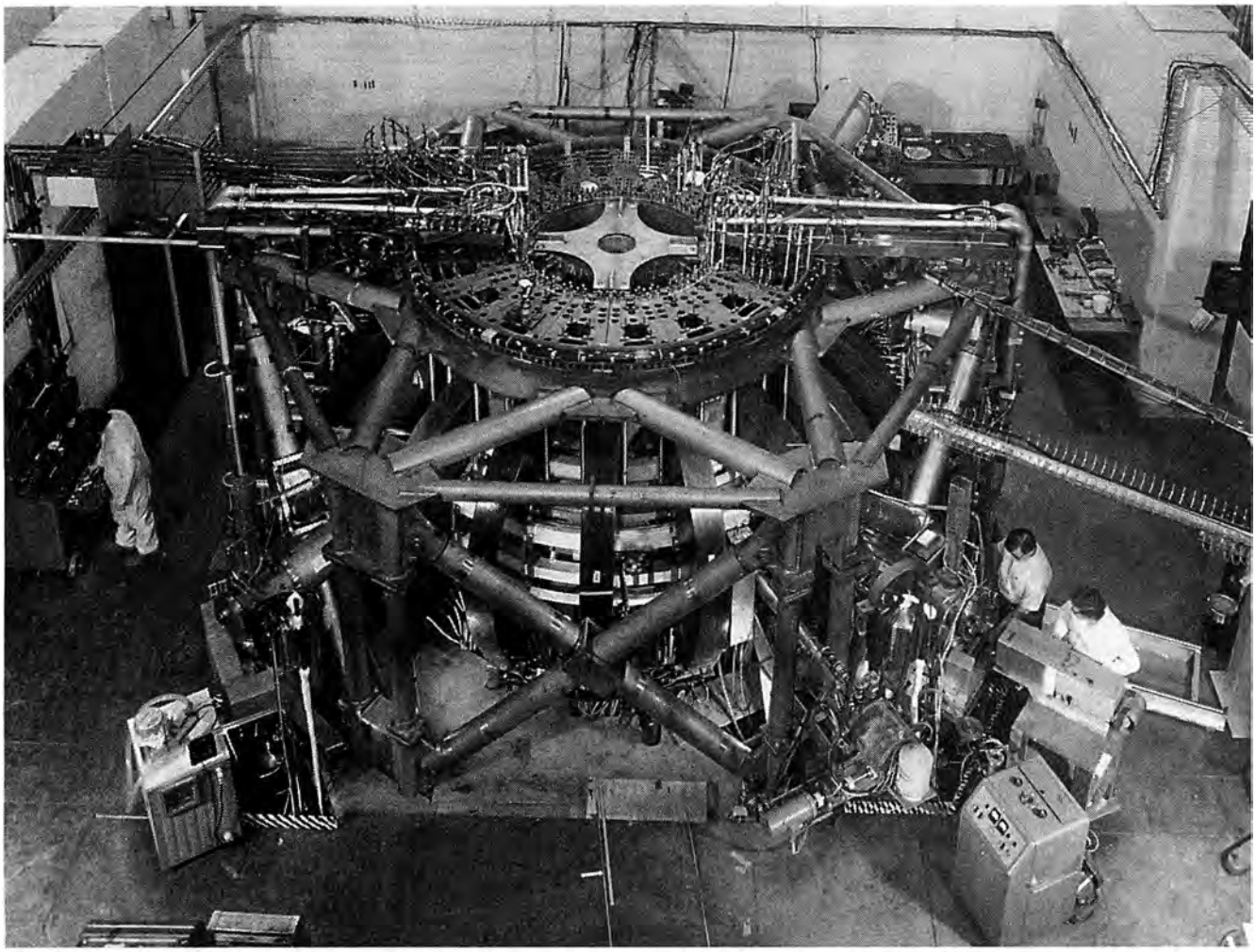
The optimism of Dr. Dean, and the representatives from the federal government and university laboratories, and high-technology corporations who joined him in forming Fusion Power Associates 20 years ago, was based on dramatic progress in fusion research, especially at the Princeton Plasma Physics Laboratory in New Jersey. There, in the summer of 1978, the fusion team had achieved the milestone of heating hydrogen fuel inside the Princeton Large Torus fusion experiment to more than 60 million degrees Celsius, well past the fusion ignition temperature of 44 million degrees. Although there were additional milestones required before practical fusion energy could be achieved, progress was being made.

The development of fusion promised to eliminate, for all time, any worries about an energy "shortage," such as the kind that had nearly wrecked the U.S. economy during oil crisis of the 1970s, because fusion uses as fuel the isotopes of hydrogen derived from seawater, making it freely available and virtually inexhaustible.

The Fusion Act of 1980

In response to this achievement in 1978, the scientific community, the Fusion Energy Foundation, and Congressman Mike McCormack (D-Wash.) began a political mobilization to have this nation make a commitment to develop fusion—the energy process in the stars—as a practical source of energy on Earth. Rep. McCormack introduced a bill into Congress mandating that resources be allocated so the remaining scientific problems in fusion could be solved, and the engineering work and new technology required could be developed leading to an experimental fusion engineering reactor in the 1990s, and a demonstration plant by the year 2000.

The Fusion Energy Foundation, publishers of *Fusion* magazine (the predecessor of *21st Century Science & Technology*), reached out to its many thousands of readers, and started an avalanche of postcards coming in to Rep.



PPPL

The Princeton Large Torus (PLT) in 1978 reached more than 60 million degrees C., well past the fusion ignition temperature.

McCormack's office in Washington, D.C., supporting his fusion legislation.

On Aug. 25, 1980, the House of Representatives passed Rep. McCormack's bill, with only seven dissenting votes. It was passed unanimously by voice vote in the Senate one month later, and signed into law by President Jimmy Carter on Oct. 7, a month before he left office. The bill mandated funding for fusion energy research, in order to carry out a 20-year, $20 billion "Apollo-style" crash program to make fusion power a reality.

The incoming administration of President Ronald Reagan, however, was not to make good on the promise of the McCormack bill. Caught in the web of its "free market" ideology, the Reagan White House insisted that energy technologies should be developed by energy companies in the private sector. Considering what Carter-era Federal Reserve chairman Paul Volcker's double-digit interest rate hikes had done to the possibilities of long-term private investment, even if fusion were virtually around the corner, there was no possibility that the "private sector" would develop it.

The fusion budget, which had reached a high of $468 million in fiscal year 1984, was reduced by $100 million over the next two years. It then languished at a level of about $300 million annually for a decade, preventing the construction of new experiments, leading to the closure of some already existing facilities, and shutting off promising areas of new research. At this stagnant funding level, which decreased in real dollars each year because of the effects of inflation, it became obvious that a fusion engineering demonstration plant would never be built.

'Pure' and Unfunded Science

Then, four years ago, in the aftermath of the 1994 Republican take over of the Congress, the pressure to reduce discretionary spending gave a jolt to the stagnant budget for fusion. It was decided that a "pure science" fusion program did not need to be funded in the range of $350 million per year, and for fiscal year 1996, the program's budget was slashed to $244 million. The following year, it was reduced further, to $225 million.

The justification for this attack on fusion funding was the self-fulfilling prophecy that because there was not enough funding to develop the engineering technologies for fusion, the program should be cut back further, to make it a pure science program, since it would never lead to a practical energy source.

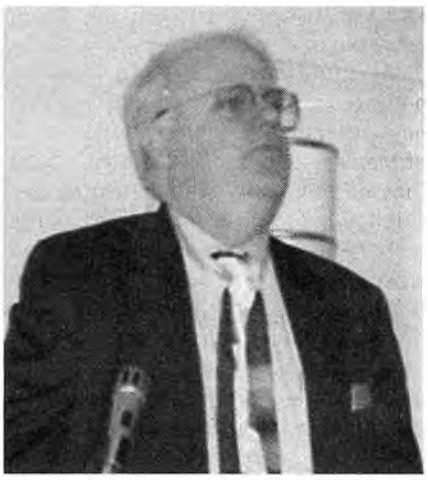
Early in 1999, President Clinton submitted his fiscal year 2000 budget request to the Congress, and fusion was

Carlos De Hoyos

Rep. Mike McCormack in 1981, addressing a Fusion Energy Foundation conference in Washington, D.C. His Magnetic Fusion Energy Engineering Act became law in 1980, mandating an Apollo program-style development effort for fusion.

Marsha Freeman

Dr. Stephen Dean, president of Fusion Power Associates: "We need to rekindle our confidence."



Marsha Freeman

Rep. James Sensenbrenner: An extremist view of developing future technologies.

allocated $222.6 million. In spring 1999, advisory groups to the government began reviews of the status and options for the future of the fusion program, as it was clear that at this reduced funding level, priorities would have to be made, and a restatement of purpose and commitment was needed.

At the same time, scientists in the fusion program, under prodding from the Department of Energy, met for two weeks in Snowmass, Colorado, to review the status of fusion research, and hammer out a policy perspective for the future.[1]

Task Force Report: Problems Solvable

The Fusion Task Force of the Secretary of Energy's Advisory Board (SEAB) issued its final report on Aug. 9. Casting aside the "science only" justification for scanty fusion budgets, the Task Force report stated:

"It is the Task Force's view that the threshold scientific question—namely, whether a fusion reaction producing sufficient net energy gain to be attractive as a commercial power source can be sustained and controlled—can and will be solved." As SEAB chairman Dr. Richard Meserve, told the Fusion Power Associates meeting in October, overall, the report expressed "optimism for fusion."

"The time when this achievement will be accomplished," the report stated, "is dependent, among other factors, on the creativity of scientists and engineers, skill in management, the adequacy of funding, and the effectiveness of international cooperation." This last point had been a rather sticky one, because the United States, under budgetary pressure, had ended its participation in the International Thermonuclear Experimental Reactor (ITER) program the previous year.

The Task Force further stated that, "In spite of the extended effort and expense that will be required, the fusion program deserves support because of its unique energy potential. . . . Indeed, in light of the promise of fusion and the risks arising from increasing worldwide energy demand and from eventually declining fossil energy supply, we simply cannot afford to fail to pursue fusion energy aggressively."

The Task Force report described the funding for fusion energy as "subcritical," and recommended that there be strong support for the direction in which the program had been restructured, after the move to more "basic science," to make it broader than just the conventional tokamak geometry, exploring other methods of confining plasmas to produce fusion.

Discussing the Task Force's report at the Fusion Power Associates meeting, Dr. Meserve remarked that the problem fusion has is one of "political perception—that it's always out of reach. This belies the remarkable progress in which we are getting closer to the scientific answers," he said. He reminded the audience that both Europe and Japan now outpace the United States in spending on fusion research, and that we must realize there is "really a U.S. advantage for international cooperation."

Dr. Meserve assured the fusion scientists at the meeting that his Task Force believes that a $300 million per year funding level is appropriate, and that that message "has been heard from us" by the Department of Energy.

The Fight Continues

To celebrate the 20th anniversary of the founding of Fusion Power Associates, Dr. Dean organized a three-day Symposium in Washington, D.C. to discuss, "Fusion Power for the 21st Century: Science and Technology for the New Millennium." It was evident from some of the presentations what the obstacles are in providing sufficient resources to the fusion program to move toward solving the scientific challenges, broadening the effort to include new innovative approaches, and developing the technologies that will be needed for energy production.

Opening the Fusion Power Associates meeting, House Science Committee chairman James Sensenbrenner (R-Wisc.) patted Congress on the back for having added $27.4 million to President Clinton's $222.6 million fiscal year 2000 request in the budget. He then stated his view that funds for programs such as fusion are not projected to increase in the foreseeable future, and justified that by the outrageous claim that "18 years ago, spending for fusion was

$400 million per year, and nothing came out of it."

An uninformed view was also expressed by Dr. Michael Holland, fusion program budget examiner at the Office of Management and Budget. He stated that at the OMB, "we see fusion as a science program, and not an energy technology program. Scientific excellence is the criterion," he said, for support. He suggested that because basic research was the "target" of the program, whether or not we are progressing toward an energy goal should only be examined "periodically," perhaps "every five years, every seven years, every ten years. . . ." In Dr. Holland's view, fusion should not be compared with other potential energy sources for funding, but with high energy physics, and other basic science.

A distinctly different view was expressed by the administrators in the Department of Energy, which oversees the magnetic fusion energy program. Dr. Ernest Moniz, the Undersecretary of the Department of Energy, told the Fusion Power Associates meeting that he does not "see a conflict between the science and energy goals" in the program. He referred to the fact that many studies that have been done have concluded that the goal should be a $300 million per year budget for fusion research and development, and agreed that the cases they made for that level of support were quite convincing.

Dr. N. Anne Davies, Associate Director for Fusion Energy, in the Department of Energy's Office of Fusion Energy Sciences, directly answered the question that has plagued the fusion program over the past four years. Is fusion a science or an energy program? "Yes, to both," she said. Both goals are not contradictory, she said, and she likened the research in fusion, in its theoretical and practical applications, to that of Pasteur in immunology.

Regarding international cooperation, Dr. Davies reminded the audience that the United States now has only one sixth of the world fusion program. "We want to have an international forum to coordinate and involve other programs, beside Russia, Japan, and the European Union," she said. Looking at fusion from a broader perspective, she added that for fusion to become an energy choice in the future, there must be "long-term optimism," and the "rehabilitation of nuclear energy," which would be indicative of the optimism required.

'Rekindle Our Confidence'

On March 1, 1979, Dr. Stephen Dean put together some thoughts upon leaving the Department of Energy, where he had been the Director of Magnetic Confinement Systems Division in the Office of Fusion Energy. He stated that the remarkable results that had been obtained in the fusion program in the previous six years were largely the result of the "attitude and determination" of the people who had the courage to make bold decisions, and take some risks.

He expressed his concern of "an emerging conservative management approach which seems to ask, 'how slow can we go without stopping?' and which seems to prefer another year of conceptualizations, and then another, and then another. "We need to rekindle our confidence," Dr. Dean said—advice that would be well taken today.

Notes

1. The full proceedings of the Fusion Summer Study held at Snowmass, Colorado can be viewed on the Internet at: http://www.ap.columbia.edu/SMproceedings/

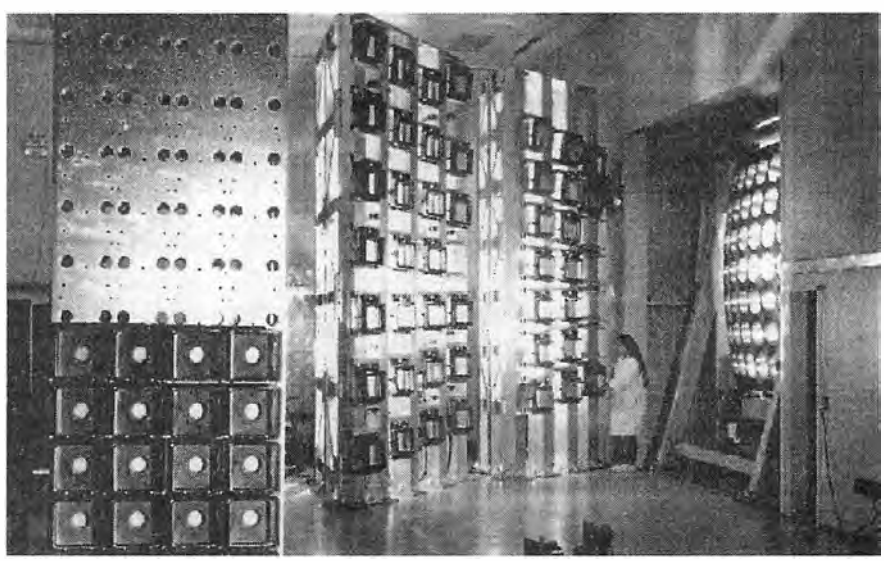
High Energy Gains Expected From NRL's Short-Pulse Laser

by Charles B. Stevens

Nike, the high-power gas laser located at the Naval Research Laboratory (NRL) in Washington, D.C., now generates 4,000- to 5,000-joule pulses of ultraviolet wavelength light with pulse lengths of less than 4 billionths of a second (4 nanoseconds).

Named after the Greek goddess of victory, Nike is a krypton fluoride (KrF) gas laser, designed to explore the utilization of this type of laser for inertial confinement fusion and, in particular, so-called direct-drive targets.

Nike's unique features are the excellent beam uniformity and potentially high efficiency of this kind of laser—both of which are about an order of magnitude greater than the high-power glass lasers, which are currently the main workhorse in inertial confinement research.

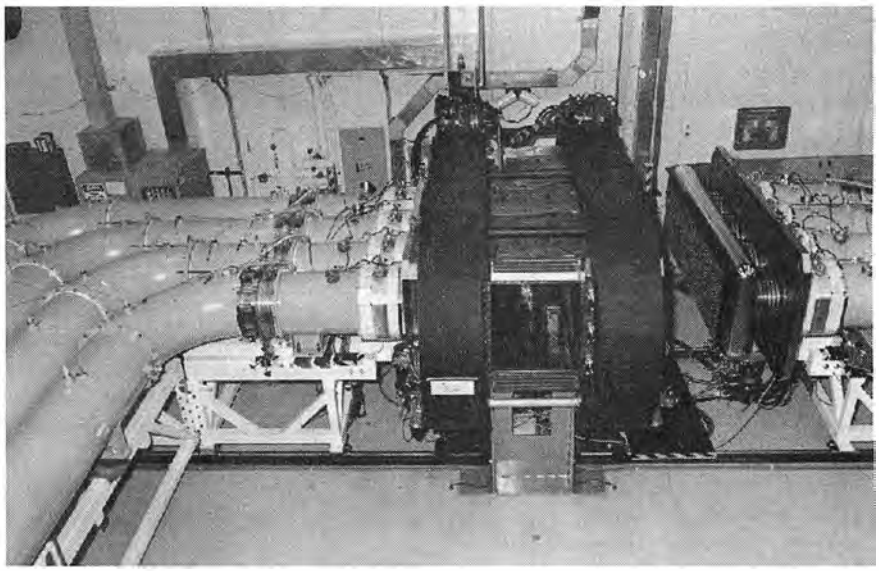


NRL

Part of Nike's propagation bay in which the 56 separate beams are recombined, to form one short pulse. The room is 155 feet long. The temperature throughout can be held to within plus or minus 0.5°F. An automatic alignment system can simultaneously align the paths for the 56 beams coming out of the electron beam amplifier, in just a few seconds.

By utilizing the Nike-type laser, together with a technique called induced spatial incoherence for optical smoothing, non-uniformities in the laser beam focal profile can be held to less than 1 percent in one beam, and less than 0.3 percent with a 44-beam overlap. This is 10 times better than what has been achieved with the best high-power glass lasers at these short wavelengths, which are required to drive high-gain inertial confinement targets.

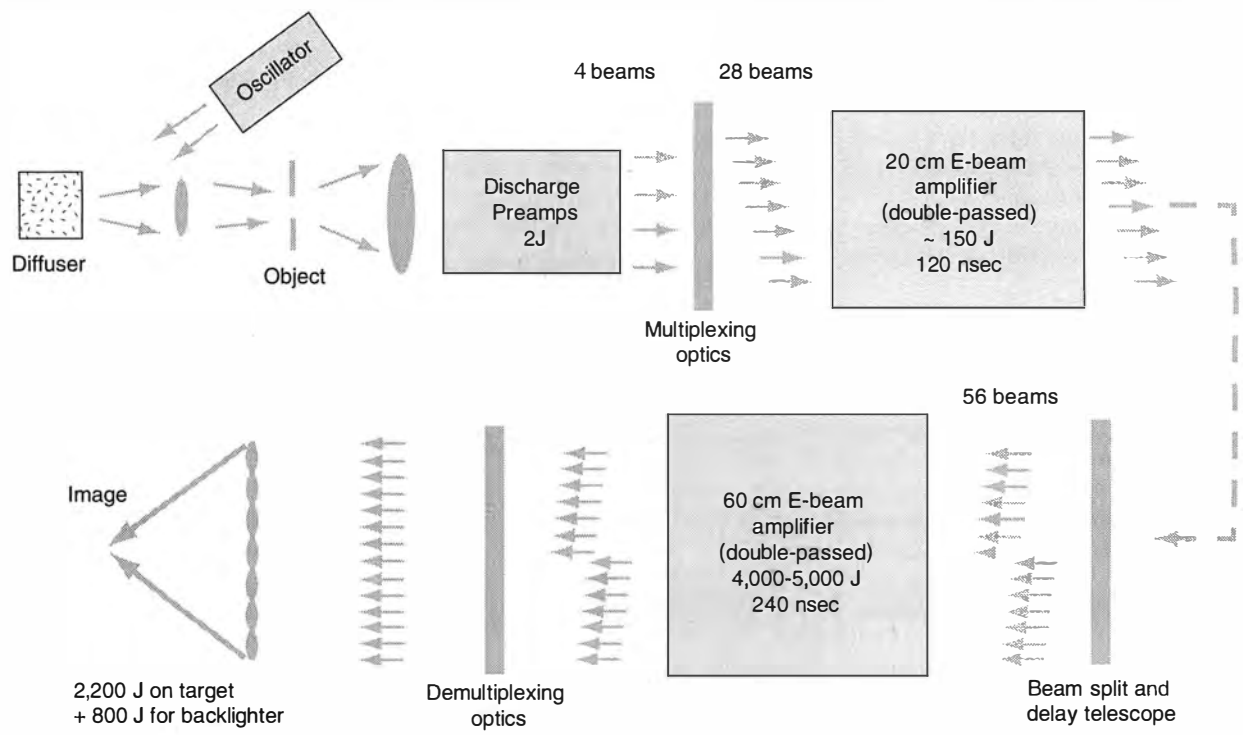
It should be possible to get significant fusion energy output gains—that is, the fusion energy generated in the pellet target divided by the laser energy input to ignite it—with only 200,000 joule KrF pulses. Gains as high as 100 could be achieved with under 1-million-joule KrF pulses. In addition to providing a potentially useful facility to explore the science of inertial confinement, KrF laser technology could also provide the basis for efficient, high-repetition-rate lasers, needed for economical laser fusion electric power plant operation and rocket engines.



NRL

The Nike laser's electron-beam amplifier.

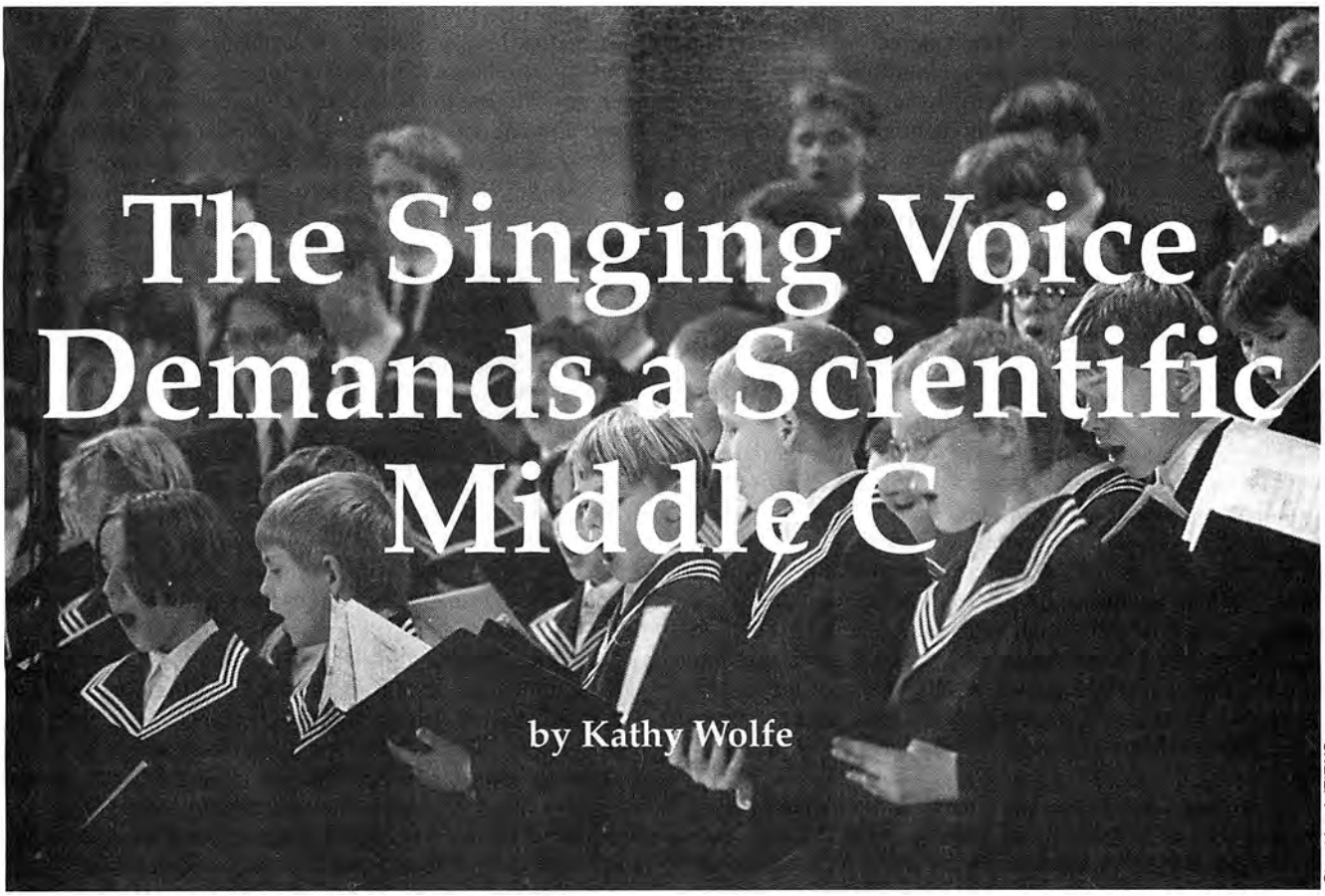
This author toured the facility, recently completed at NRL, with a group of participants in the October 1999 conference of Fusion Power Associates.



GENERATING NIKE'S OUTPUT

The laser utilizes both discharge preamplifiers and electron-beam-pumped amplifiers. Because the electron-beam amplifiers have an inherent long-pulse duration, their long-pulse-length output must be physically "multiplexed" into 56 separate beams, which pass through the amplifier successively, and are then recombined with mirrors to form a short pulse on target.

Source: NRL



The Singing Voice Demands a Scientific Middle C

by Kathy Wolfe

Stuart Lewis/EIRNS

We need a renaissance of Classical culture, to do away with the false distinction between art and science, and to set the standard pitch for Classical music at its scientific measure of C=256.

In August 1999, the well-known Italian tenor Carlo Bergonzi and Vatican radio musicologist Maestro Arturo Sachetti announced a new initiative in Italy to lower the standard pitch for Classical music, from its postwar levels of A = 440 and above, down to C = 256 cycles per second (hertz), an A of 430-432. They also announced that for the Verdi centennial in 2001, singers at Bergonzi's Busseto conservatory will perform *Don Carlos,* and other great operas by Giuseppe Verdi, with full orchestra, at the original C = 256 pitch, which Verdi himself demanded.

This musical news item is of enormous interest to anyone who cares about the future of science in Western civilization. It is, in fact, the latest shot in what has become a centuries-long war against the fatal philosophical separation between Science and Art made by Immanuel Kant in the 18th century. *Naturwissenschaft* (natural science), wrote Kant, is entirely objective and rooted in the physical world. Man, he insisted, cannot really know much for certain about the physical world, but can only receive sensory impressions of physical data and try to catalogue these as best he can. On the other hand, *Geisteswissenschaft* (spiritual science, or Art), he claimed, is entirely subjective, and man may, and should, do as he will with it ("Art for art's sake").

The St. Thomas Boys Choir of Leipzig, which dates back as an institution to the time of Bach, in concert in Washington, D.C. in February 1998.

The acceptance of this false distinction, deriving from Kant's philosophical error, has led to a sterility of thought among today's scientists, who are often very good at manipulating the existing theorem lattice of scientific hypotheses, but have proven incapable of discovering *new* physical principles, such as those which seem necessary to discover a cure for AIDS, or to develop commercial nuclear fusion power. If scientists, according to Kant, are unable, in principle, to create new ideas about the physical universe, but must merely process incoming sensory data as if they were fleshy computers, then they will be unable to create new hypotheses about the basic functioning of the universe at its extremes, such as the sub-molecular or inter-galactic levels, where new breakthroughs in science must occur.

Kant's insane and untruthful paradox has also created the degeneration of modern art. This process escalated after World War II, when painters such as Jackson Pollack decided to "feel free to throw paint at the wall," and composers such as John Cage and Philip Glass, began to throw any arbitrary noise onto

tape and call it "Classical music." Most of what passes for Classical music today makes rap music look rational.

Especially arbitrary has been the enormous rise in the standard pitch, of which most modern musicians, let alone scientists or the general public, are entirely unaware. The issue is at the crux of the relation of music to science, for, clearly, the cycles per second of the vibration of a string is a scientifically measurable event. During the postwar period, most American musicians have believed that an A of 440 cycles was some sort of physical fact of life. In 1982, at the beginning of this research on tuning, when this writer called the largest piano company listed in the New York City "Yellow Pages," I was actually told, "A has been at 440 forever, since Biblical times."

True Classical Pitch

The fact is, however, that during the 450-year period from the 1430 Florentine Renaissance to the 1880s, all great music—from the Renaissance masters such as Josquin, through Bach, Mozart, Beethoven, Brahms, and Verdi—was composed based on a middle C of 256 cycles per second, which gives an A between A = 430 and A = 432. Musicians did this because C = 256, as this article will document, is based on the natural *registers* of the human singing voice, which are built into the human body. As such, neither the registers, nor the scale based upon them, were allowed by the great composers to be subjected to the whims of the followers of Immanuel Kant.

In a culture of mass education for children in music, which we must re-create today, it has been determined for centuries that the average child has to make a *register shift* in the center of his or her natural vocal range, in what was eventually named the region between F and F#. The basic scale octave was invented precisely for this reason, so as to have four notes lie in the children's lower "chest," or "first" register, and then introduce the register shift, and have four notes lie in the upper "center," or "second" register. The different vocal "colors" of the different registers were immediately seen to be capable of expressing different poetic ideas, and so the voice had to be trained to differentiate registeral colors.

"Middle C" at precisely C = 256 is the only note upon which an octave, based there, is divided in half by the average human child's register shift. Furthermore, because the great composers were trained to sing as children, they wrote in the language of such mass literacy, and assumed that human vocal registration, and C = 256 based upon it, would be the common framework for all music.

Performance at today's higher pitches results in the ruination of singers' voices, as the "goal posts have been moved." Passages which once were written expressly to accommodate the biological register shift, are now pushed up just high enough to strain the voice above the register shift in the most harmful way possible. The deformation is not physically large in terms of hertz—C = 256 compared to C = 263 at A = 440, for example—but may be compared to the deformation caused by eyeglasses which are mis-focussed just enough to blur images out of recognition.

Most important, raising the pitch also destroys the idea-content of all music, instrumental as well as vocal, because composers used changes in registeral coloration to underline specific new ideas being introduced. Deforming the voice registers wrecks the composer's basic framework.

The so-called "standard" pitch of A = 440, on the other hand, turns out to be based on nothing whatsoever. Musicians such as Carlo Bergonzi and leading record archivists believe that during the 1950s, the pitch at the Metropolitan Opera in New York City was much lower, perhaps as low as A = 435. After the post-World War II popularization of radio, conductors and record companies began promoting higher tunings for the sake of making what they called "a more brilliant sound," which would carry farther—especially useful for record sales, when broadcast as a radio signal.

Furthermore, the record companies and conductors have continued to raise the pitch arbitrarily, as one would change skirt lengths, to A = 445 and above. By 1988, pitch was as high as A = 448 cycles at La Scala in Milan and many other European opera houses, where it remains today. The premier piano maker, Steinway & Co., actually issued a press release in 1993, announcing that it was raising the standard pitch of its pianos, from A = 440 to A = 442, in response to the general rise in pitch. Opera singers the world over were furious, because their voices were being strained to the limit in performing most of the pre-1900 repertoire.

On April 9, 1988, at the Schiller Institute's conference titled "Music and Classical Aesthetics," held at the Casa Verdi in Milan, Italian researchers, led by soprano Liliana Gorini, announced new historical evidence that Giuseppe Verdi, Italy's greatest composer, had, in 1884, demanded C = 256 as the necessary pitch for Classical music performance. They presented newly found letters by Verdi, and other documents, demanding a ceiling for the pitch at A = 432, at the highest. Verdi, in fact, had pressured the Italian government to pass a decree standardizing the pitch to A = 432, because, as Verdi wrote at the time, "Why should the note called A in Paris or Milan, become a B-flat in Rome?"

Why Middle C Is Middle C

Looking back into the history of music, this writer and other Schiller Institute researchers discovered that C = 256 had been the core principle of music since the Renaissance, part of the concept that "sine scientia, ars nihil est" (without science, art is nothing), as the inscription on a 16th century harpsichord proclaims (Figure 1). Music, the Schiller Institute researchers found, was based on certain God-given, biophysical principles built into the human singing voice, and the voice, being part of the physical universe, therefore must obey certain, non-man-made, scientific laws.

Professors of the old Italian *bel canto* method of vocal instruction noted the enormously efficient power of this particular method, in sheer physical terms. The most familiar example of *bel canto* today is that vanishing species, the opera singer, who can fill a hall of 4,000 seats with a bare voice, without requiring any amplifying equipment. (Today's pop singers can not fill a living room without an amplifier.) *Bel canto* also exhibits the quality of "least action," in which the smallest physical effort produces the most powerful result. Renaissance teachers would place a candle before the student's mouth, and note that when a *bel canto* tone is produced, the flame does not move, despite the voice's carrying power.

The vocal experts also point to the 1430 "Cantoria" sculptures of children singing in choirs, created by Lucca della

Robbia in the Cathedral of Florence. It had been the Renaissance method, they said, to mass-educate children from a very early age in *bel canto,* seen in the "round" position in which the children are shown holding their mouths (Figure 2). This "round sound" must be carefully trained, such that the pitch each of the boys is singing may be determined from the size of each mouth opening, according to *bel canto* instructors.

Figure 1

The inscription on this harpsichord, modelled after the 1584 harpsichord design by Hans Moermans, encapsulates the Classical idea: "Without science, art is nothing."

Source: Courtesy of Frank Hubbard Harpsichords, Boston, Mass.

Figure 2
YOUNG BOYS SINGING *BEL CANTO*

One of the "Cantoria" marble relief series by Lucca della Robbia, 1430, in the Cathedral of Florence. The Renaissance method was to mass-educate young children in bel canto, *which can be seen in the round position of the children's mouths.*

Source: Photo by Nora Hamerman/EIRNS

Until the end of the last century, the basic principles of *bel canto* were taught as a form of mass literacy to all school children. In other words, *bel canto* is based on a culture in which not one or two talented individuals, but an *entire population,* is being taught to sing properly at a very early age. This explains the large number of skilled composers born during the very short time interval of 1680-1780: Bach, Haydn, Mozart, Beethoven, Schubert. All of these composers were taught to sing as children. Music was a language to them, which they had learned as children.

The basic elements of *bel canto* training are registration, elevation, roundness of sound, and vibrato. All of these are produced using physical attributes of the universe, including the human mind and body, which exist for us to discover. *Bel canto* masters also point especially to the old Renaissance principle of registration, the need to master the given register shifts built into the human singing voice. A register is defined as "a series of notes produced by the same position of the vocal tract." In singing up the scale past a certain point, the mind must learn to shift the vocal mechanism to a new registral position, or the voice will "crack." Each register had a unique quality, allowing singers to vary the color of the voice.

Registration becomes evident as soon as a child begins training. A child singing up the scale will begin to shout at a certain point, unless trained to use the mind to make a creative change of some kind. After hundreds of years of training children to sing, Renaissance musicians found that the average child has to make a *register shift* at certain points in the scale. It may be done by singing more softly on the note of the shift, or by shifting to a new vowel sound, but it changes the way the notes are physically produced (Figure 3).

It was found that the average human child's voice develops best when taught to shift to a new register on the second half of this scale. In fact, it was in this way, as noted, that "Middle C" became Middle C: Only the octave of eight notes which starts there, will find itself divided in half, by the child's register shift, between Fa and Sol, at F#, or Fa#. The register shift was thus built into the average human voice, and the scale conforms to it. Voices which shift here are called soprano, and all children, if taught to sing from age 5 (as is proper), experience this basic register shift for several years, until puberty.

As children mature, girls develop into adult sopranos and mezzosopranos, while boys develop a lower octave and become tenors, baritones, and basses. However, the intervals of

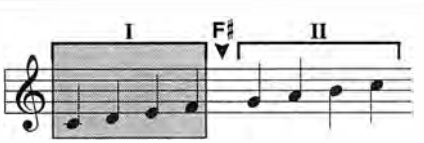


Figure 3
THE CHILD'S UNIVERSAL DIVISION OF THE C OCTAVE

The average child's voice develops best when taught to shift to a new register on the second half of the C scale. Source: All figures are adapted from A Manual on the Rudiments of Tuning and Registration, Book I, *(Washington, D.C.: Schiller Institute, 1992)*

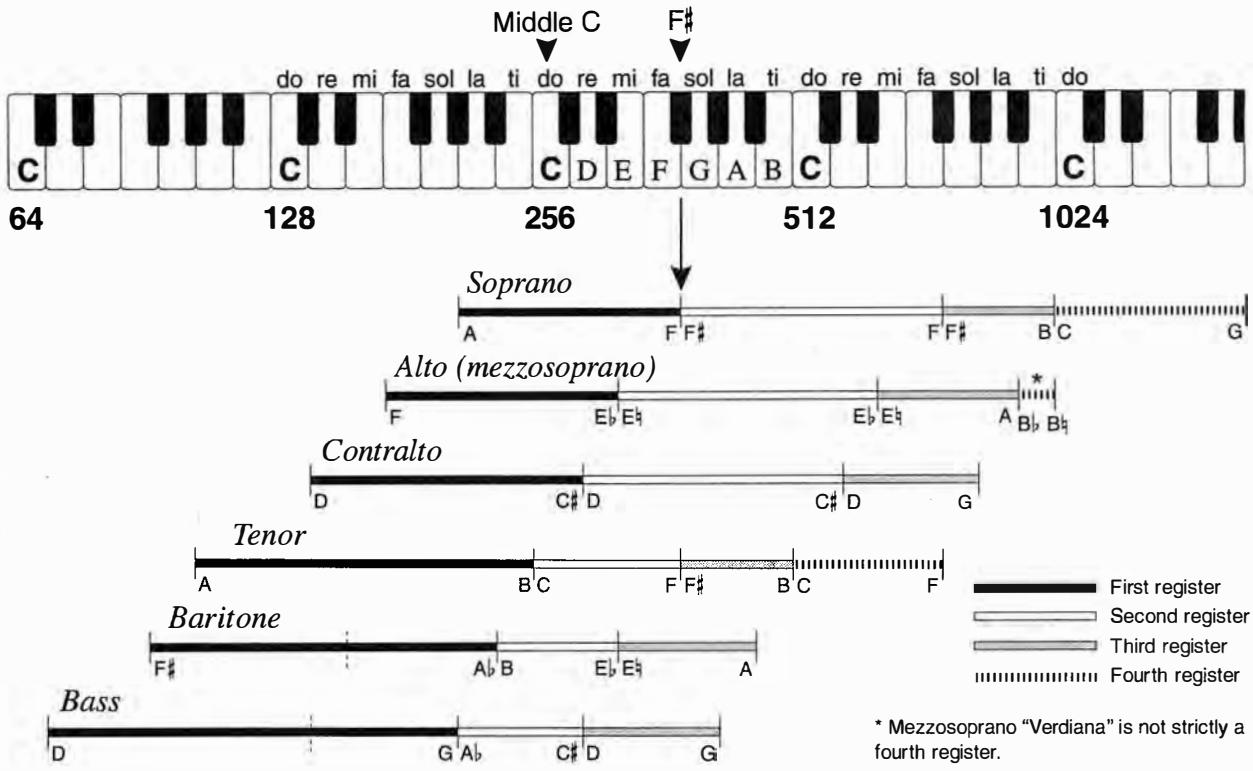


Figure 4
THE SIX SPECIES OF THE HUMAN SINGING VOICE
The main register shifts are absolutely determined; lower and upper extremes of range are given according to a survey of the ranges used in Classical bel canto vocal compositions.

each voice are still divided into three or four qualities of the distinct voice registers. In addition to the first register and the second register, there are also the higher third and fourth registers, each with its own different register shift point (Figure 4).

Elevation or "singing in the mask" is the conscious, mental placement of the focus of the voice in the head, rather than in the throat. "The mask" refers to the bones and sinus cavities above and around the eyes, as covered by the Greek drama mask. Placed here, the voice is most easily governed by the mind, and gives the greatest amplification of tone. Leonardo da Vinci studied the principle of this in his drawings of the major sinuses. As with the wood of the violin body, the bones of the head are tuned to set up sound shock waves when tone is focussed there. Little or no air actually escapes the vocal chords when this is done properly; there is no percussive effect of air molecules onto air molecules involved in propagation of the tone.

Figure 5
YOUNG SINGER WITH A CANDLE
This oil painting of a "Young Singer with a Candle," dating from the early 17th century, strongly suggests that the quintessential bel canto *experiment was well known at that time. The youthful singer is shown with a wide-open, rounded mouth, inches away from a candle whose flame does not waver—indicating the laser-like properties of the properly produced voice. The anonymous artist is known only as the Maestro della Candela, the Candle Master.*

Source: Arado De Luca photo/Doria Pamphilij Gallery, Rome

Thus, the traditional test of *bel canto,* is when the singer with the finest tone can sing directly into a flame and yet cause no flicker (Figure 5). One probable hypothesis as to why this is the case, is that a magnetic impulse between the bones and mucus membranes of the sinuses, and the air surface, creates an electromagnetic shock wave around the

Continued on page 18

Lyndon LaRouche and C=256

The campaign to lower the standard musical pitch to C = 256 was initiated by economist and statesman Lyndon H. LaRouche during the early 1980s. LaRouche argued for a cultural Renaissance, in which scientists and the entire population would be trained in Classical poetry, music, and the arts, along with physics and mathematics, as a unified field. To move science forward, scientists would have to learn to think metaphorically, or, as LaRouche had titled one article, "Poetry Must Begin to Supersede Mathematics As the Basis for Physics."[1]

Stuart Lewis/EIRNS

The movement to lower the standard musical pitch to C=256, was initiated by Lyndon LaRouche in the early 1980s, as part of his campaign for a Classical cultural renaissance

There would have to be a frontal attack on Immanuel Kant's separation of Naturwissenschaft (science) and Geistwissenschaft (art), LaRouche wrote.

During 1981-1982 discussions of the structure of the universe described by Plato in his *Timaeus,* to develop the necessary concept of physical space time for a revolution in physics, LaRouche noted Plato's description of a fundamental 256-fold nature of the cosmos. Knowing that C = 256 had for centuries been the pitch used in physics, yielding an A of 430-432, and that music had been part of the science curriculum from ancient Greece through the Renaissance, LaRouche hypothesized that C = 256 must have once been the unified pitch for both science and Classical music. If so, this were yet another demonstration of the insane irrationalism of modern music, he stated. If John Cage didn't just plain sound bad enough, here we have modern musicians pushing the standard A to 440, and world opera house pitches to A = 442, 445, and even 450 in Europe, for no decent reason.

In 1982, LaRouche invited Maestro Jose Briano of the National Autonomous University of Mexico to teach the original Renaissance Italian *bel canto* singing method in the United States. Pointing to the 1430 "Cantoria" sculptures of children singing in choirs by Lucca della Robbia in the Cathedral of Florence, Briano said that it had been the Renaissance method, to mass-educate children from a very early age in *bel canto,* seen in the "round" position in which the children are shown holding their mouths. This "round sound" must be carefully trained, he noted, such that even the pitch each of the boys is singing may be determined from the size of each mouth opening.

Briano instructed researchers of the Schiller Institute, founded by Lyndon LaRouche and his wife Helga Zepp-LaRouche, in the *bel canto* principle of registration, the need to master the biologically given register shifts that are built into the human singing voice. Each register had a unique quality, allowing singers to vary the color of the voice.

During 1985 experimental seminars with singers, conducted at C = 256, LaRouche demonstrated that Beethoven had written his "Six Songs by Gellert" song cycle to require the lower pitch. Only at C = 256, he showed, would the registers of the human singing voice shift, from one registeral color to a new registeral color, so as to emphasize shifts in the meaning of the poetry, and to match the way Beethoven had intended the poetry to be declaimed.

The Schiller Institute Campaign

On April 9, 1988, at the Schiller Institute's conference "Music and Classical Aesthetics" held at the Casa Verdi in Milan, Italy, Italian researchers led by soprano Liliana Gorini announced new historical evidence that Giuseppe Verdi, Italy's greatest composer and nation-builder, had in 1884 demanded a *ceiling* for pitch at A = 432, based upon C = 256. Italian baritone Piero Cappuccilli demonstrated the superiority of the lower "Verdi A." Singing Verdi's "O de' verd'anni miei" from *Ernani,* and "Il balen" from *Trovatore,* first at the low C = 256 pitch, and then at modern high pitch, he made clear which was "the natural voice," as he put it. Verdi's tuning gave the far more natural tone.

In July 1988, at a Schiller Institute press conference in Rome, two Italian Senators announced a bill to make A = 432 mandatory at state institutions. Thousands of the world's leading singers have signed on to this concept, in the form of a "Petition to Lower the Standard Pitch." Signators include Dame Joan Sutherland (soprano), Carlo Bergonzi (tenor), Piero Cappuccilli (baritone), Luciano Pavarotti (tenor), Placido Domingo (tenor), Sherrill Milnes (baritone), Christa Ludwig (mezzo), Giuseppe di Stefano (tenor), Elly Ameling (soprano), Birgit Nilsson (soprano), Dietrich Fischer-Dieskau (baritone), and Cornelius Reid (leading vocal textbook author).

Notes

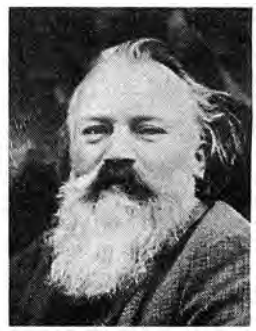
1. *Fusion* magazine, Oct. 1979, p. 10.

www.arttoday.com
Johann Sebastian Bach
(1685-1750)

Wolfgang Amadeus Mozart
(1756-1791)

www.arttoday.com
Ludwig van Beethoven
(1770-1827)

Library of Congress
Franz Schubert
(1797-1826)



Library of Congress
Johannes Brahms
(1833-1897)

"During the 450-year period from the 1430 Florentine Renaissance to the 1880s, all great music—from the Renaissance masters such as Josquin, through Bach, Mozart, Beethoven, Brahms, and Verdi—was composed based on a middle C of 256 cycles per second, which gives an A between A = 430 and A = 432."

Continued from page 16

singer. This renders the area around the singer transparent to the propagation of an electromagnetic tone.

The third element of *bel canto*, the *round sound* which is "aperto, ma coperto" (open, yet covered), means that the sound in the mask must be not merely resonant, but have the richness and depth necessary to support a long legato musical line. It is also available to us in the human form, to be discovered. Sculptures in the Cathedral of Florence show students opening their mouths in a shape of the Italian vowel "o" to produce this round tone.

Vibrato, the fleeting oscillation of the voice between two pitches on either side of the conceived tone, is natural to the voice. It classically defined "human singing," as seen in the fact that most European organs built from the 9th to 18th centuries possess a "vox humana" stop, the stop with a vibrato, in which each note is produced by two pipes, tuned slightly differently.

Learning to Compose by the Human Voice

When a composer sets out to construct a musical composition, he has six species of the adult singing voice—soprano, mezzosoprano, contralto, tenor, baritone, and bass—each containing three or four different register voices, a well-defined pallette of colors, from which to paint. Classical music is composed by people, like Mozart, Beethoven, and Verdi, who were trained to sing as children, to think about ideas in their own voices, in this way. So they will often shift to a new voice register, to introduce new ideas into the music.

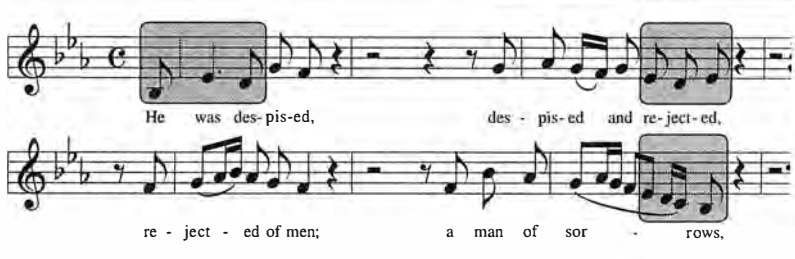
All music, composed for each of these voices, is and has been, since at least the Renaissance, provably constructed around the specific register voice-shift point for each voice.

For example, the aria from Handel's *Messiah*, "He Was Despis'ed," for mezzosoprano, is constructed entirely around the mezzosoprano's register shift at E natural. The singer uses her first register, for notes below the E, and then must shift to her second register, for higher notes beginning with E. Thus, the poetry is:

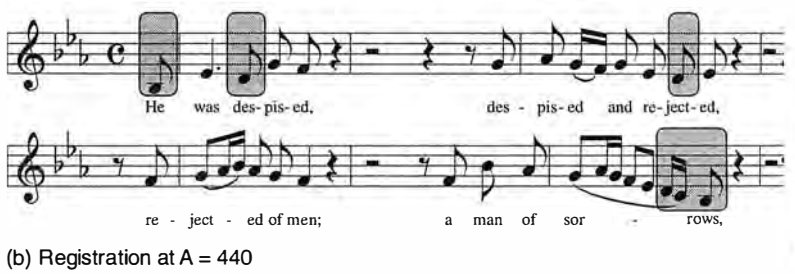
"HE WAS DEspised, despised and REJECTED."

Handel emphasizes: Not only was Jesus despised, but he was even—what is much worse—*rejected*. The human voice shifts to a new register to properly emphasize this poetic irony—but only if music is performed at the Classical pitch, which great composers used from 1430 to Brahms's death in 1897: C = 256 cycles per second (Figure 6a).

Since 1890, however, the mafia which controls our orchestras and record companies, has raised the pitch, to C = 263



(a) Registration at C = 256



(b) Registration at A = 440

Figure 6
HANDEL ARIA AT TWO REGISTRATIONS: C = 256, AND A = 440
The poetry of Handel's aria, "He Was Despised," from the Messiah, is properly emphasized only if the music is performed at the Classical pitch.

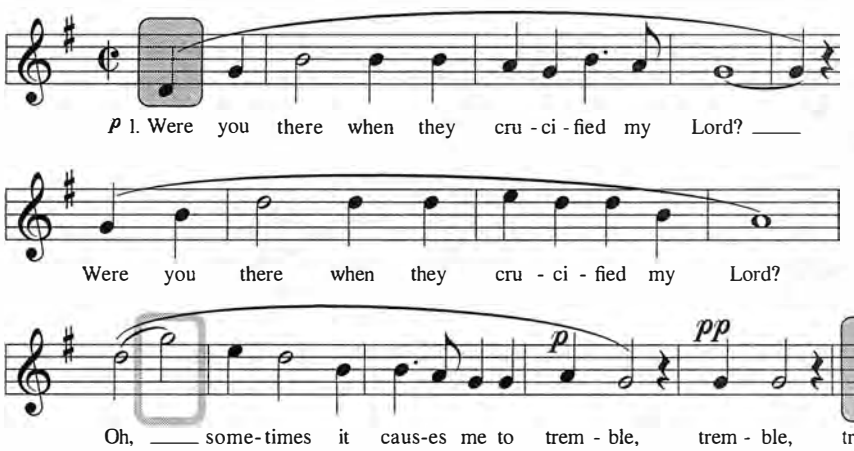


Figure 7
AMERICAN SPIRITUALS COMPOSED AT CLASSICAL PITCH
America's Classical songs, the African-American spirituals, were composed for the Classical pitch, where the register shifts were used to emphasize crucial points in the poetry.

cycles per second, that is, A = 440—and higher. This is just enough to unfocus the voice, like wearing the wrong glasses. At modern high pitch, Handel's poetry is distorted. The mezzo is forced to sing certain notes which belong in the first register, up in the second register instead. This creates incoherency in the poetry, which then is mis-declaimed as "HE was despised, despised and re-JEC-ted" (Figure 6b).

America's classical songs, the African-American spirituals, were also composed on these principles. Composer Hall Johnson used the soprano/tenor register shift at F#, to underscore the verbal action, "*Were* you there when they crucified my Lord?" First, he emphasizes the verb *were* by placing it alone in the first register. Then, to emphasize how awesome it is, he again asks, more urgently: "*Were* you there," shifting *were* into the second register.

Finally, when the soul exclaims, "Oh, it causes me to tremble," the emotional impact is beyond words, and "Oh" rises, yet again, into the third register (Figure 7).

The Inherent Pitch of the Vowels

In the Renaissance, Leonardo da Vinci documented a *second* physical field, another form of "natural beauty," in the voice: The vowels of human speech have their own pitch. Leonardo compares three vowels and puts *a* highest, at the nose; *o* is lower, back in the mouth; and *u* lowest, in the throat (Figure 8).

Leonardo's drawing has been verified in the modern laboratory. Each vowel does have its own inherent pitch, and the changes in pitch from vowel to vowel are the result of the changing geometrical shape in which we hold the vocal tract when speaking each vowel. In Figure 9, the shaded area approximates the volume of the space inside the mouth when speaking each vowel. An Italian *i* (pronounced like the "ee" in "see"), as in "Aida," the highest vowel, is created in the smallest vocal tract space—the space between the tongue and the teeth when the tongue is just behind the teeth. (The reader can verify this by saying "Aida.") The *a* (also as in "Aida"), is made by opening the mouth more, and thus using a larger area inside the mouth. The *u* (as in "too") is made by opening even more, and extending the lips forward like a trumpet horn. This "u" action actually increases the length of the distance from the lips to the vocal cords, making a longer "pipe" of the vocal tract, and so *u* has the lowest vowel pitch.

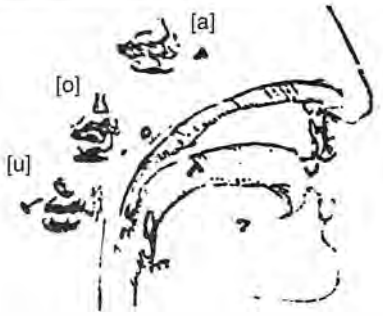


Figure 8
THE INHERENT PITCH OF THE VOWELS
Leonardo da Vinci documented in the Renaissance that the vowels of human speech have their own characteristic speech. Comparing three vowels, he puts a, *the highest, at the nose;* o *is lower, back in the mouth; and* u *is the lowest, in the throat.*

The musical intervals formed by the vocal tract in speaking the vowels ("vocale") are called vocalization. Today's laboratories give pitch measurements that are accurate enough to put on a scale.[1]

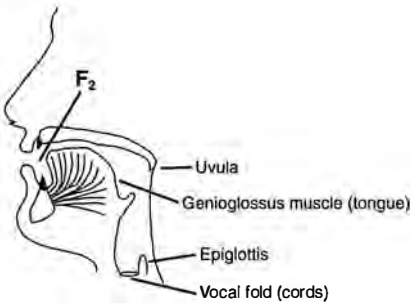
The Classical composers were very attuned to this, and would often cause the musical pitch to rise or fall according to the basic vowel pitch. In one duet, in which just the vowel sound is set to music—without any distractions based on the profundity of the meaning of the lyrics–Rossini understands that when a cat says meow ("miau" in Italian), the vowels' pitch goes from the higher *i* down the scale to the lowest *u* sound. The reader can verify this by simply saying "Miau," and noting how the vocal tract goes from the short *i* space, opens more at *a,* and becomes longest at *u*. Rossini shows this by creating a melody in which the pitch of the notes on the staff also fall when the pitch of the vowels falls. This can be seen visually on the staff, even if you can't read music or hear it in your imagination (Figure 10).

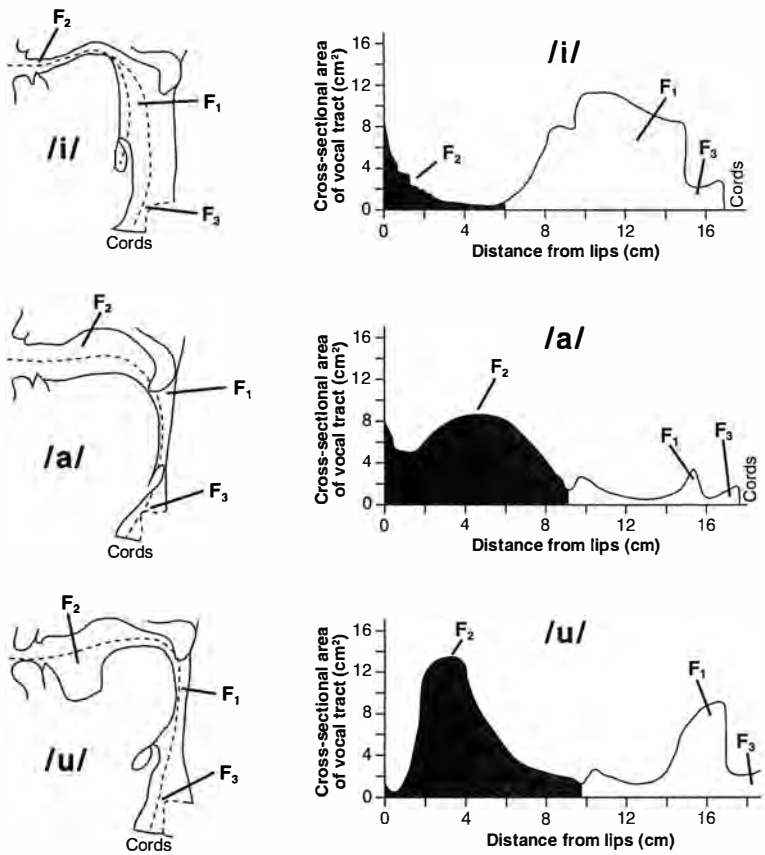
Even the animals speak with their jaws, and must, indeed, obey natural laws.

Man, of course, is meant to think on a higher plane, and to compose meaningful lyrics and even poetry—but man, too, can not violate these principles arbitrarily. Now consider what

Figure 9
PLACEMENT OF THE MOUTH FOR VOWELS I, A, AND U

The shaded area approximates the volume of the space inside the mouth when speaking each vowel. An Italian i, *as in "Aida," the highest vowel, is created in the smallest vocal tract space. The* a *is made by opening the mouth more, using a larger area inside the mouth. The* u *is made by opening the mouth more, and extending the lips forward, like a trumpet horn, which increases the length of the distance from the lips to the vocal cords.* F_1, F_2, *and* F_3 *refer to the formants, or primary resonance peaks associated with the vowel quality of each spoken vowel.*





happens when a musical composer sits down to set a real poem to music—assuming that the original poem was not the product of bestialized cultures such today's, and that the poet could write lines of higher content than "Miau, miau," or, the even less inventive, "She loves you, yeah, yeah, yeah."

In fact, we find that every poem *is a musical score* of a sort, based on its inherent vowel pitches and other basic considerations of language. The prospective composer of music, confronted with the poet's previous output in words, can use the musical score inherent in the poem to advantage—or ignore it at the audience's peril. The simple but profound phrase "Ave Maria," for example, rises from the lower *a* to the higher vowel *i*, and falls again back to *a*.

Accordingly, different Classical composers respect this, and treat the same text with a similar rising and falling pitch for the musical line. Franz Schubert's familiar "Ave Maria" precisely rises from "Ave" to the "i" of "Maria," then falls back again for the final "a," as shown in Figure 11(a). When Giuseppe Verdi set this text, 50 years after Schubert, the Schubert setting was almost certainly unknown to him, and yet Verdi came to the same conclusion. He, too, made the musical line rise from "Ave" to the "i" of "Maria," then fall back again, as in Figure 11(b).

Artistic Beauty vs. Natural Beauty

Thus far, we have concentrated on the physical principles of music, embedded in the universe for man to discover. These principles of *natural beauty* are independent of man. Understanding of the behavior of these

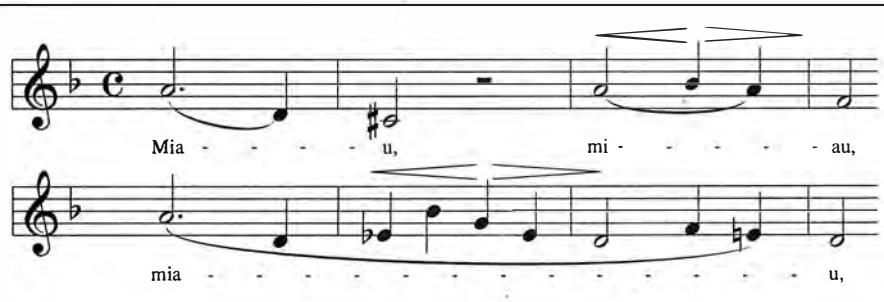


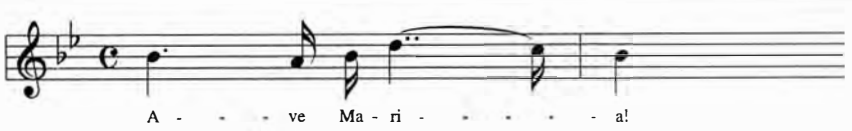
Figure 10
THE CAT'S MEOW, AS ARRANGED BY ROSSINI

This excerpt of "Duetto di due gatti" (Duet of Two Cats) from Rossini's Sins of My Old Age, *parodies the cat's meow, emphasizing the second formant,* F_2. *Formants are not unique to human beings; feline formants have also been measured in the laboratory.*

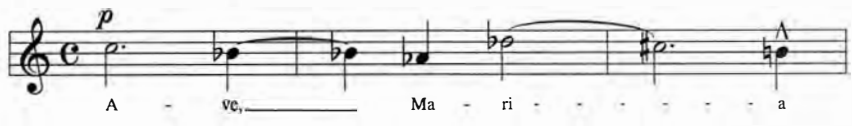
principles is as necessary to a great composer of music as is the understanding of the behavior of flour, water, and sugar under heat, to a great baker. This alone, however, is not sufficient for cake or symphony.

To compose actual Classical music, it now falls to the musician to wield these principles to create something entirely new—to now act, to create a new idea in his mind, in the language of music: *artistic beauty*. Although the principles of natural beauty were previously created for him, the human composer must now create an idea in his own mind, where no idea was before. He must act in the image of the way in which the principles of natural beauty were created in the universe, in *imago viva Dei* (the living image of God).

More daunting, the composer must find a way to use the sounds and other natural beauty of music, to cause the experience of this new artistic idea, to spring into the minds of his audience. The subject of Classical music, is the individual's explicitly cognitive, rather than sensory, relationship to creating the same idea in the sovereign individual cognitive processes of other minds.



(a) Schubert's 'Ave Maria'



(b) Verdi's 'Ave Maria'

Figure 11

How the prosody of a line of poetic text provides the composer with the germ of a musical idea, becomes clear when one compares the same poetry set to music by different composers. Here, the prayer "Ave Maria," as set by Schubert (a) and by Verdi (b). Both rise from the lower "a" to the higher vowel, "i."

Das Veilchen	*The Violet*
Ein Veilchen auf der Wiese stand Gebückt in sich un unbekannt; Es war ein herzigs Veilchen. Da kam eine junge Schäferin, Mit leichtem Schritt und munterm Sinn, Daher, daher, Die Wiese her und sang.	A violet stood on the meadow, withdrawn into itself and unknown; it was a dear little violet. There came a young shepherdess with light step and merry heart hither, hither up through the meadow, and sang.
Ach! denkt das Veilchen, wär ich nur Die schönste Blume der Natur, Ach nur ein kleines Weilchen, Bis mich das Liebchen abgepflückt Und an dem Busen matt gedrückt! Ach nur, ach nur Ein Viertelstündchen lang!	Oh, thought the violet, were I only the most beautiful bloom of Nature, oh, only for a little while, until my sweetheart plucked me up and on her bosom held me fast! oh, only, oh, only a quarter of an hour long!
Ach! aber ach! Das Mädchen kam Und nicht in acht das Veilchen nahm, Ertrat das arme Veilchen. Es sank und starb und freut' sich noch: Und sterb ich denn, so sterb ich doch Durch sie, durch sie, Zu ihren Füßen doch.	Oh, but oh! The maiden came and no notice of the violet made, and trod upon the poor violet. It sank, and died, and rejoiced still: and though I die, so die I, then, through her, through her, at her feet!

Figure 12
GOETHE'S POEM 'DAS VEILCHEN' (THE VIOLET)

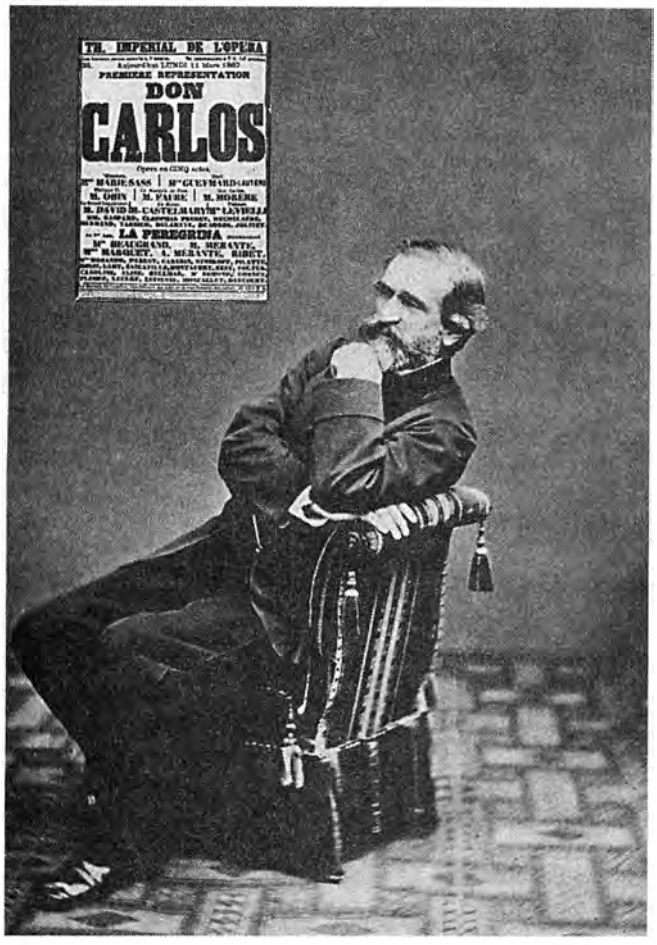
Mozart took Goethe's "violet" and created a musical work far beyond anything in the poem.

The composer can be said to be in the same position as Cardinal Nicholas of Cusa, in his study of the squaring of the circle. While the classical Greeks worked with a series of polygons, inside the circle, and outside, to try to calculate the area, Cusa discovered that no matter how many sides are added to a straight-line polygon, it will never be a circle. In fact, the closer the polygons seem to come to the circle, the more corners or vertices each polygon has—and so the less like a circle the polygons are.

By having the mental rigor to see that the circle, and the curves which come from it, are an entirely new, higher species than the straight-line polygon family, Cusa created modern mathematics. He generated a new system to describe the higher curves, and was the first to prove the existence of new numbers, including the transcendental numbers such as *Pi*.

The moment at which Cusa saw that something new would have to be created, is a unified single idea, or "thought object," an indivisible creative unity which underlies all his subsequent elaboration. One cannot describe in words, what goes on inside the mind at the point that such a new "thought object" is generated; but unless we communicate it to the next generation, the idea dies. To communicate unified ideas at this level, one composes works of art, such as music.

Mozart, for example, during the 1782-1785 period, produced a revolution in music by



Italian tenor Carlo Bergonzi and Vatican radio musicologist Maestro Arturo Sachetti announced a new initiative in August 1999, to lower the standard pitch, and to perform Don Carlos, *and other great operas by Giuseppe Verdi (1813-1901), at the original C 2=256 pitch. Above, Verdi and an advertisement for his opera* Don Carlos.

developing, along with Haydn, the method referred to as *Motivfuehrung* or leading by motif. He used the physical principles of *bel canto* much as Cusa used the polygons. Arraying the intervals of the C = 256 scale, voice registers, their inversions, and other sounds of natural beauty (including vowel sounds) in a particular way, he would cause the unified musical idea in his mind, to leap into our minds.

Mozart's *Motivfuehrung:* The Example of 'Das Veilchen'

At the height of this period, in 1785, Mozart created the first modern Classical *Lied*, working from the poem "Das Veilchen" ("The Violet") by Goethe. The Lied, today thought of as the "art song," is actually German both for "poem" and for "song." Mozart developed the idea that a composer of music must take a poem and completely transform it. The entire point of writing the music was to uplift the text, to create a new musical idea which changes it, to produce something completely new—otherwise, the audience were better off simply reading the poem.

Considering Goethe's poem (which you can read in German and in translation in Figure 12) from the standpoint of Mozart, as if our challenge were to set it to music: How would a mind at Mozart's level proceed? To create a single coherent idea, Mozart would scan the poem as a whole, to discover the single metaphor, the "*un*-heard sound," the *un*spoken poetic idea, conveyed by the entire poem.

A composer will begin hunting the footprints of "unheard" sounds, by looking for singular events, odd spots. From the standpoint of the poem as a whole, the fact that a violet stood in the meadow, or a shepherdess came and sang, is nothing to start a revolution in music. The passage "It sank, and died—" is perhaps more dramatic (she might only have broken a leaf).

Then: "it *rejoiced*"? That is odd. Goethe might have written: "It sank, and died—and cried all night." But instead, the violet rejoiced. And why? "Because it died at her little feet."

This raises a few questions. Does the violet (or the youth in Goethe's metaphor) have, perhaps, a few personal quirks, to rejoice in being thus rudely crushed? Does the violet know this girl? Does he care which girl it is? Or is he just in love with love? Is he truly in love, concerned with the best for his beloved, sometimes thought of as "love above the belt"—or is he being led about by his hormones, a sort of "love below the belt"? Below the foot, perhaps? It may be argued that Mozart's ironic comment upon (and transformation of) the poem starts at the end, based on the musical evidence (Figure 13).

What physical principles does the poem give us? If the poem is a musical score, in the sense that the vowels of speech also have a natural pitch, then the vowel *i* ("ee") is the highest. As

Es sank und starb und freut' sich noch:	It sank, and died, and rejoiced still:
Und sterb ich denn, so sterb ich doch	and though I die, so die I, then,
Durch sie, durch sie,	through her, through her,
Zu ihren Füßen doch.	at her feet!

Figure 13
THE LAST VERSE OF 'DAS VEILCHEN'

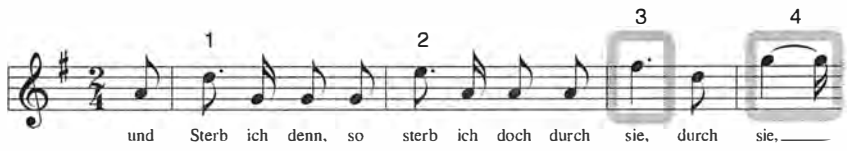


Figure 14
A SHIFT TO THE THIRD REGISTER
Mozart shifts to the third register for the phrase "Durch sie, durch sie" (through her), where there is a rising natural pitch of the vowels. The gray outlines indicate the shift to the third register.

many composers set the same line, "Ave Maria," with a rising note on "-ia," so Mozart saw that, in the German original, there is a rising pitch on the words "Durch sie, durch sie." He set these words, to a rising musical line (Figure 14).

Next, Mozart must chose a definite singing voice, and he decided that a soprano or tenor were more appropriate than a bass or alto, to the lighter *mood* of the poem.

Once a composer chooses a poem to set, and then a species of singing voice, he is directed toward certain key signatures. He needs a key which will let the natural register shift of the singer change quality, to the new register, at a place where the development of the poem requires a new poetic voice.

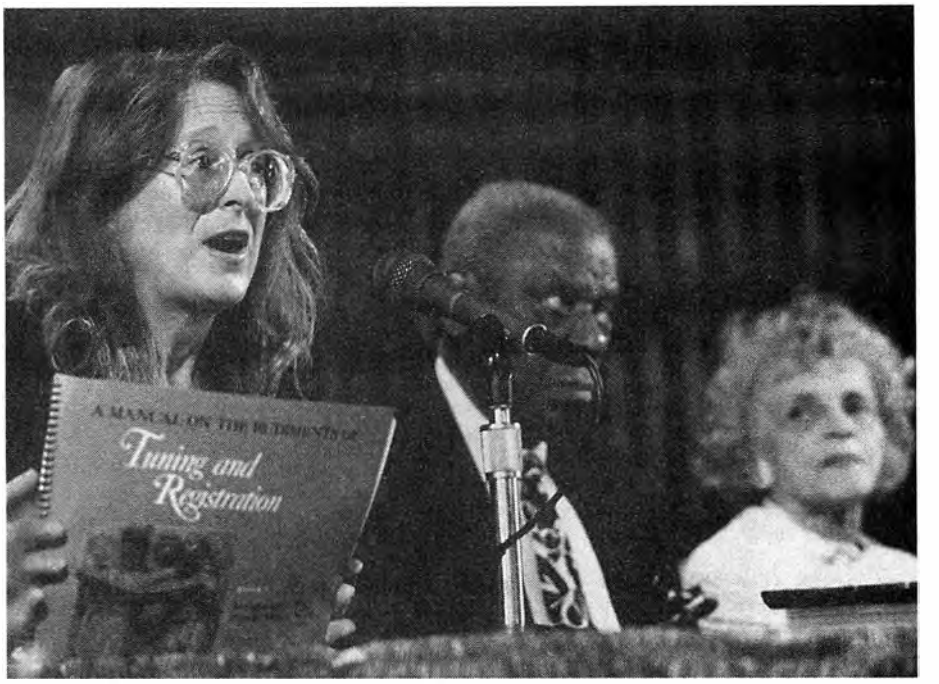
The key of G is a candidate, because it rises to a dramatic high G across a strong register shift at F# for sopranos and tenors. This is precisely what Mozart does. He sets the four beats in the line: "Und *sterb* ich denn, so *sterb* ich doch, durch *sie*, durch *sie*," with the four tones Re, Mi, Fa#, Sol, and creates a register shift on "Durch sie, durch sie" (Figure 14). And so the song ends.

Now look at the very beginning. Mozart treats this finale, in fact, as a unified idea across the entire song. The opening theme of the song also turns out to be based on the same space between Re and Sol, but in an inversion. On "Ein Veilchen auf der Wiese stand," instead of rising from Re to Sol, Mozart rises from Sol to Re (Figure 15).

In the second line, "Gebueckt in sich und unbekannt," he has a counter-statement, or *apposition*, which then falls from Sol to Re, another inversion.

A fine opening motif; but left to itself, it could end up as a Madison Avenue jingle. That's where the Motiv*fuehrung*, "*leading* by motif," comes in. What interests Mozart most about this theme is how fast he can take it apart and generate new ones. The creative composer delights in presenting such a musical idea, only to supersede it with a new musical idea, the same way a scientist loves to invent something new, by overturning what all assumed to be axiomatically fixed.

At the entrance of the shepherdess, Mozart takes apart his first theme in G, and creates a new key of D. If on "Ein Veilchen auf. . ." in the first line, he can move up a fifth from G—Sol, Re—then, in the next stanza, he can move up another fifth, from Re to La, from D to A, on "Da kam ein' junge Schae-



Stuart Lewis/EIRNS

Author Kathy Wolfe (left) discussing the Schiller Institute Manual on Tuning and Registration*, at a National Music Conference for a Marian Anderson National Conservatory of Music Movement, held at Howard University in May 1994. With her on the podium are William Warfield and Sylvia Olden Lee.*

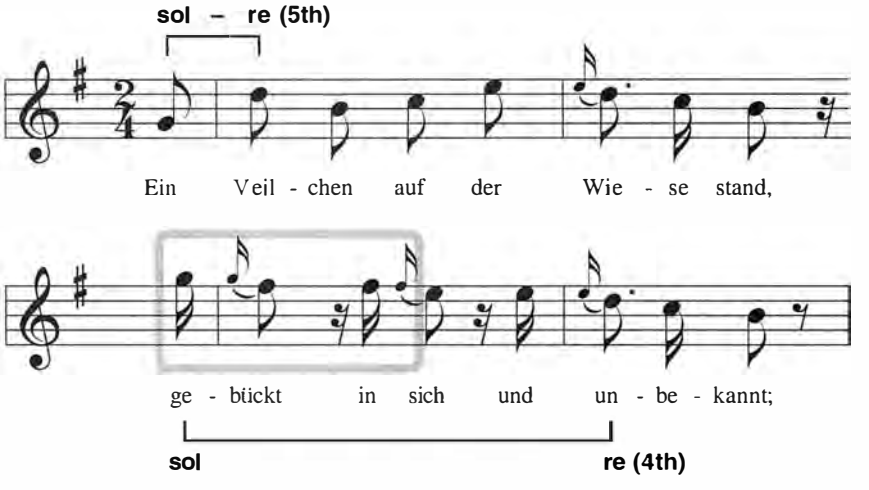


Figure 15
MOZART'S UNIFIED IDEA

Mozart's setting of Goethe's poem exemplified Mofivfuehrung*, or leading by motif. He takes the motif in the opening lines, and plays with it, using it to invent one new musical idea after another, including the use of the piano keyboard as a "singing" voice. In the first line of the poem, the composer rises from Sol to Re. In the second line, he has a counter-statement, falling from Sol to Re. The gray outline indicates the third register.*

ferin" (Figure 16). Mozart does this by inversion again. He repeats the space from the La below, to Re. But the effect of playing with the space between Re and La, between D and A, is to make us now hear D, as the new key. He adds a C# to confirm it.

At the point where the shepherdess sings, Mozart then has the vocalist be silent—and the *piano* sings (up another fifth, to another new key, A) (Figure 17). By now he has changed Goethe's poem completely, with a freedom for the piano which had never been used in a song before, and to which the egotistical Goethe later violently objected.

This quality of change escalates throughout the song in a way which shows that these changes are *one, single idea* of change. At first, Mozart takes a full verse to explore each new key. Then, he overturns themes and creates new keys so rapidly that, by the end, new ideas, singularities, come at an increasingly dense rate.

The central irony, the full transformation of the poem, is accomplished in the penultimate passage, at the surprising words "it rejoiced" ("und *freut'* sich noch") (Figure 18). By this point, the musical development is almost entirely within the keyboard, with the singer in recitative. Here, Mozart has the piano bass voice sing so as with each note to create virtually a new key. Rising through just a few notes, it sings a shocking series of human voice register shifts, first the mezzosoprano register shift from E flat to E, and then the soprano register shift, from F to F#.

The F# under "freut' sich noch" is particularly surprising.

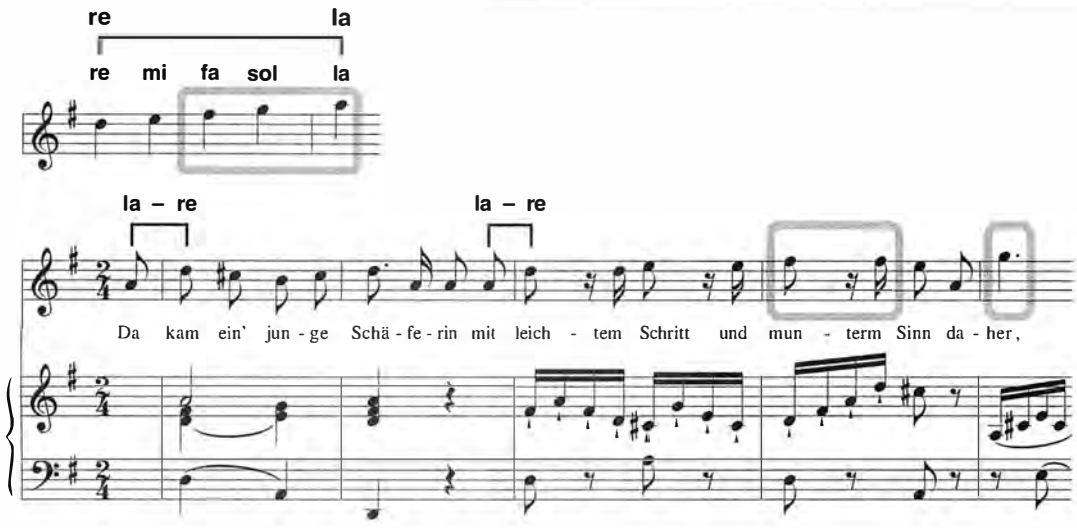


Figure 16
MODULATION
When the shepherdess enters the poem, Mozart takes apart his first theme in G, and creates a new key of D. Here, he moves up a fifth from from Re to La, again using inversion.

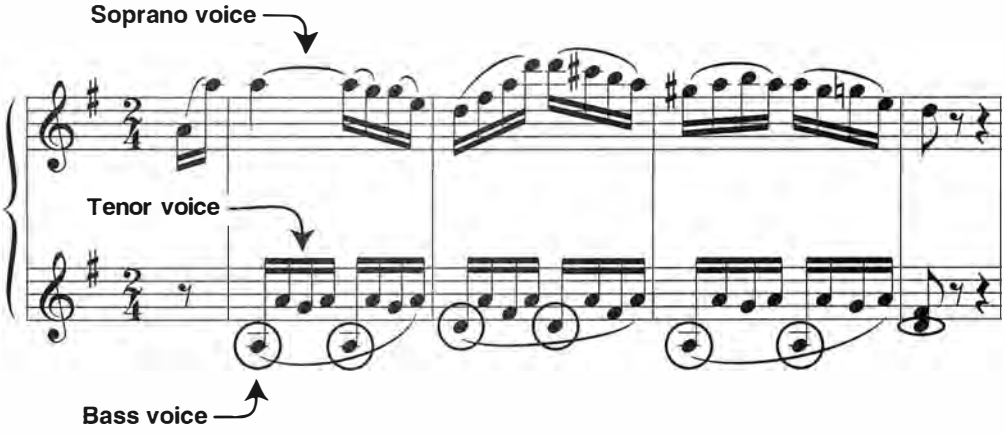


Figure 17
KEYBOARD AND SINGER AS A UNIT
Mozart uses the voices of the piano keyboard to lead the singer, in the same way that each voice in a four-part chorus may lead the other voices.

While it is appropriate to the surprising text, it does not proceed just from that text—but from the song as a whole. Were the performers to stop here, an audience would be upset indeed.

Mozart has used the song to create the musical space of C minor-C major, something more complex and more dense than any other key. This complex musical space, explored more fully in his piano Fantasy K. 475 the same year, gave rise to an entire "C minor-major series" of compositions by Beethoven, Schubert, Schumann, Chopin, and others.

Having destabilized the entire poem, Mozart then completes the idea, by completing the simple G major scale in the final phrase, "und sterb ich denn, so sterb ich doch durch sie, durch sie" (see again Figure 14). The unsettling F# from the bass, now appears high up in the singer's voice on the first "Durch sie," and then resolves up to the high G on the last "Durch sie." This resolution, has the effect of *confirming* that the preceding were important actions, while adding a touch of humor.

We hear the transformation propagate and grow throughout the song, just as an idea is at first subconscious, and then rises into consciousness suddenly; or just as a wave grows gradually, and then suddenly breaks. Mozart has so completely changed the poem that at the end, he even adds a line of text, something completely unheard of, his own afterword. Goethe didn't write it, but Mozart adds the final words: "The poor violet. It *was* a dear little violet."

Schiller Institute

Schiller Institute Press conference in Rome, in July 1988, announcing the campaign for lowering the tuning to C = 256. From left: Arturo Sacchetti, Sen. Mezzopere, Liliana Gorini, Piero Cappuccilli, Sen. Boggio.

A Manual on Tuning and Registration

Mozart's "Das Veilchen"is one of hundreds of musical examples indicating how C = 256 was the Classical standard pitch for the great composers. In January 1992, Schiller Institute researchers, including this author, published *A Manual on Tuning and Registration, Book I,* which gives these and other exhaustive proofs that, in fact, C = 256 was the Classical tuning used for more than 450 years by the great composers from the Golden Renaissance through Beethoven, Brahms, and Verdi.[2] Using more than 300 musical examples selected from an extensive study of the original scores of Bach, Mozart, Beethoven, Schubert, Brahms, Verdi, and other masters, the book documents that all Classical vocal music was meant to be performed at C = 256. Book I on vocal music is to be followed by Book II on instrumental music.

Kathy Wolfe studied Italian bel canto with Maestro Jose Maria Briano and has founded choruses in New York, Baltimore, Houston, Los Angeles, and other cities. She is a co-author of the 1992 Schiller Institute book A Manual on the Rudiments of Tuning and Registration*," and she joined tenor Carlo Bergonzi in presenting the manual at a lecture-master class at New York's Carnegie Recital Hall on April 8, 1993. She also made the first English translation in 1979 of the "Treatise on Music" by the 9th century Arab master Al Farabi, demonstrating that the Arab Renaissance had used the well-tempered system long before J.S. Bach.*

Notes

1. Knowledgeable physicists note that, for centuries, and to this day, C = 256 has been the pitch used in the laboratory. Physicians will tell you that a C of 256 cycles is also the pitch of the tuning forks they use to test the nervous system, and that forks tuned to A = 440, A = 445, or the higher C = 263, which is yielded by A = 440, "just don't work" on the human body, for reasons they cannot explain.
2. Limited copies of the Schiller Institute's *Manual on the Rudiments of Tuning and Registration," Vol. 1, Introduction and Human Singing Voice,* are available (at $30 plus postage) from Ben Franklin Booksellers, P.O. Box 1707, Leesburg, Va. 20177, (800) 453-4108.

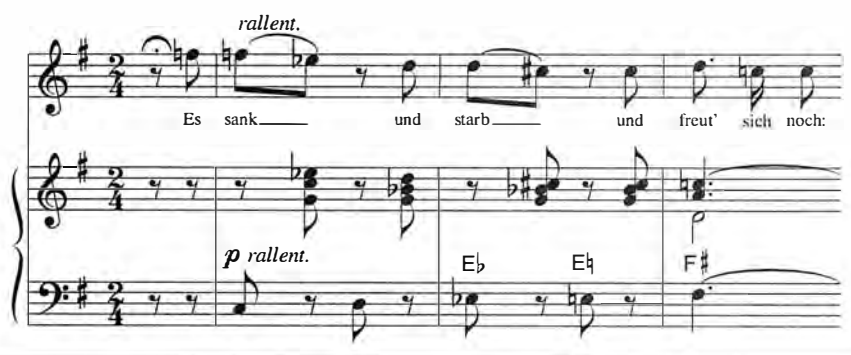
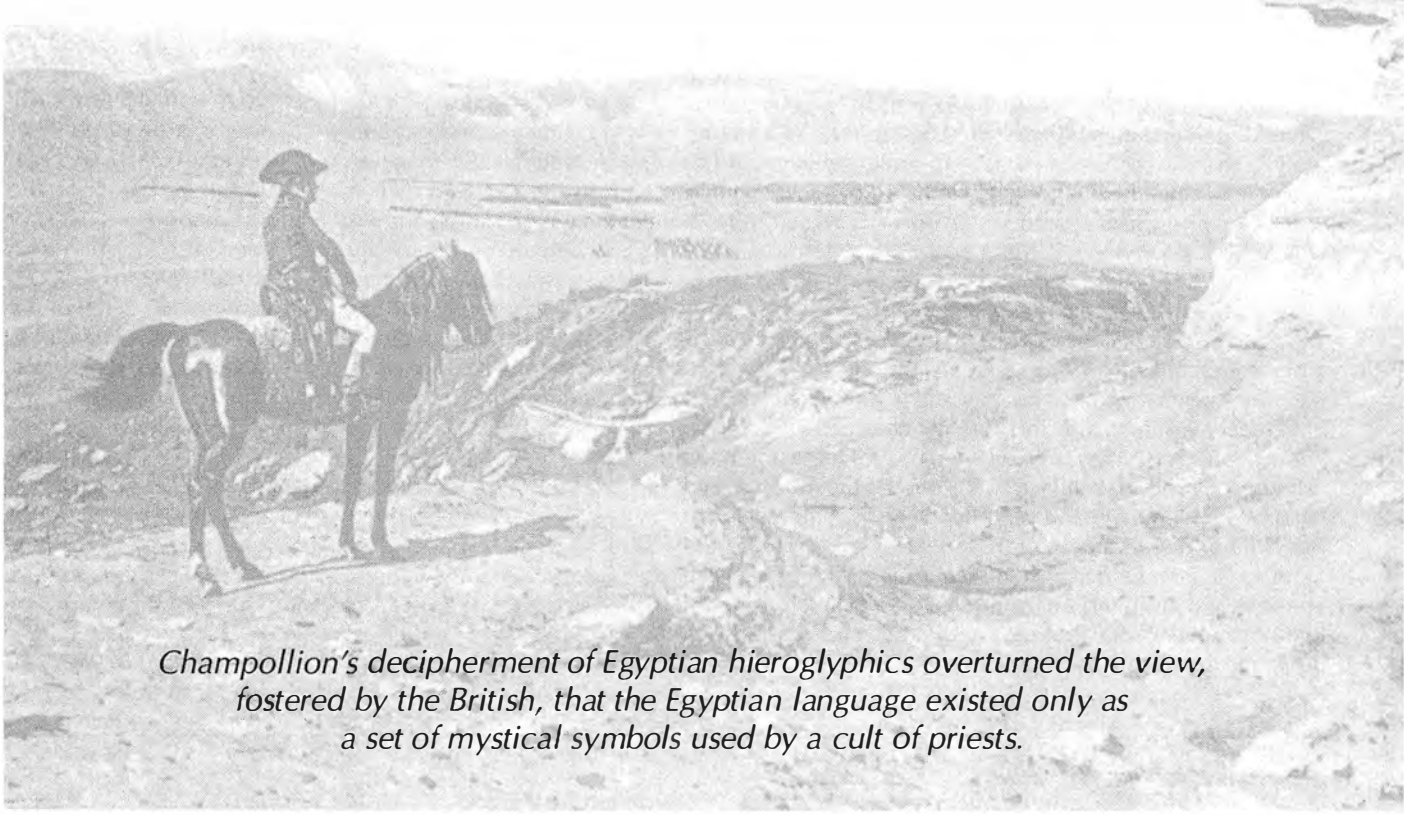


Figure 18
THE FINAL TRANSFORMATION
The full transformation of the poem is accomplished in the next-to-last phrase, at the surprising words "it rejoiced." At this point, the musical development is almost entirely within the keyboard , with the singer in recitative.

Jean François Champollion And the True Story of Egypt

by Muriel Mirak Weissbach



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Champollion's decipherment of Egyptian hieroglyphics overturned the view, fostered by the British, that the Egyptian language existed only as a set of mystical symbols used by a cult of priests.

Exactly 200 years ago, in 1799, an event took place in a small village in Egypt, whose consequences were to shake the foundations of accepted knowledge, and open the way to a scientific understanding of ancient Egyptian civilization. The event was the discovery of the Rosetta Stone, which led to the successful deciphering of the ancient hieroglyphic script, by the great French philologist and historian, Jean François Champollion. Champollion's breakthrough, which came in 1822, constitutes in itself one of the greatest scientific discoveries in the history of philology, and on that basis alone, deserves serious study. At the same time, the process which Champollion pushed to a successful conclusion, represents one of the most crucial episodes in the history of cultural warfare.

The issue was straightforward: Was Egyptian civilization, as the British school claimed, a civilization based on a death cult, practiced by a caste of priests who used hieroglyphics as a magical, mystical instrument of their practice? Or was Egyptian

The French expedition to Egypt in 1798 included a team of 167 scientists, who catalogued Egypt's antiquities, flora, fauna, arts, and industries. Here, the painting "Napoleon and the Sphinx," by J.L. Gérôme.

civilization, as Plato indicated in the *Timaeus,* an ancient civilization based on a scientific culture? Was it a backward society without language, or was it a civilization equipped with a literate language culture that was appropriate to science?

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Jean François Champollion (1790-1832), shown with the opening page of his work cataloguing the hieroglyphic, hieratic, and demotic Egyptian alphabets.

This question, dealt with by the ancients, was placed on the table when the Rosetta Stone was found in 1799. It was in summer 1799, that a man named Boussard or Bouchard, stumbled across a slab of basalt, while working in the town Rashid (Rosetta), at the French Fort St. Julien, about 30 miles from Alexandria. The stone was 3 feet, 9 inches long, 2 feet, 4½ inches wide, and 11 inches thick, and carried inscriptions in three forms of writing: hieroglyphics, Greek, and demotic, which was the Greek term for popular Egyptian script. Under Napoleon, the French had launched an expedition to Egypt in 1798, which included a large group of leading scientists and engineers—from archeologists and draftsmen, to zoologists. The scientists had undertaken a monumental effort: to describe, study, and catalogue all the buildings, statues, inscriptions, and other antiquities; flora and fauna; and arts and industries. The results of their work were published, beginning in 1809, in the *Description de l'Egypte,* a work of 18 volumes with many illustrations.

The Rosetta Stone was immediately transferred to the Institut Nationale, which the French had established in Cairo in 1798. By 1802, copies of its inscriptions had been sent to Paris. Before serious work could be done on it, however, the British appropriated the valuable monument. The British defeated the French at Alexandria in 1801, and expropriated all the booty—artifacts—that the French had in their possession. The most coveted piece among them, was the Rosetta Stone, which the British whisked off to London, and placed securely in the British Museum, where it remains to the present day.

Apparently, what the British reckoned, was that with the

stone in their possession, they could control the research—and the researchers—involved in trying to decipher the inscriptions. Despite their careful control of the stone, they did not succeed.

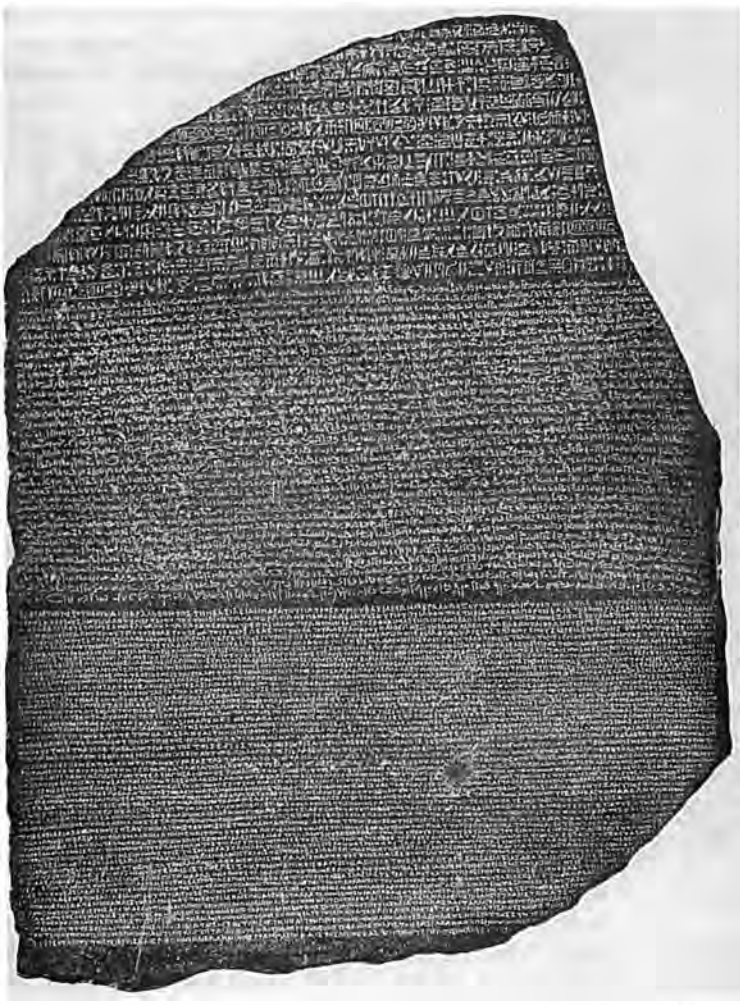
The Task of Decipherment

The first step towards deciphering the script, was to translate the Greek text. This text contained a decree, issued on the occasion of commemorations in Memphis, in 197-196 B.C., of the accession of Ptolemy V Epiphanes to the throne in Egypt. It began with praises sung to Ptolemy V (203-181 B.C.), as a benefactor of the temples of Egypt, who "hath dedicated to the temples revenues in money and in grain" and who "hath incurred great expenses in order that he might bring Egypt into a state of prosperity, and might establish the temples." Not only did Ptolemy give away his own monies, but he reduced taxes in order to promote prosperity, released prisoners, and restored peace after great social turbulence.

Ptolemy V was depicted as a great man, who restored the economy and practiced justice. Therefore, the decree announced, statues to Ptolemy should be set up in all the temples, and festivities should be celebrated in his honor. In addition, the "priests of the other gods shall adopt the name of 'Priests of the God Epiphanes Eucharistos.' " In conclusion, the text reads, "And this Decree shall be inscribed upon stelae of hard stone, in holy, and in native, and in Greek letters." It further specified that these stelae should be set up in the temples, alongside statues of Ptolemy V.

Here, "holy" refers to the hieroglyphic script at the top of the stone, and "native" refers to the demotic, in the middle portion. Whether the passages in these two other scripts contained the same text or not, was not evident. Furthermore, the hieroglyphic text was very partial; large portions of the slab, including its upper right- and left-hand corners, had been broken off, and were never retrieved.

The Rosetta Stone, therefore, belongs to that period in Egyptian history, when it was ruled by foreigners, in this case, by Ptolemy V. It was the official view of the British that hieroglyphics were cult symbols used by the priesthood for initiates, and that they had been adapted by the foreign conquerors, first the Greeks, and then the Romans, to express the names of the foreign rulers, by attributing a phonetic value to each hieroglyph.



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The Rosetta Stone, found by the French expedition near the town of Rashid (Rosetta). Its text has inscriptions in three forms of writing: hieroglyphics on top, demotic Egyptian in the middle, and Greek on the bottom. When the British defeated the French in 1801, they removed it from the Institut Nationale in Cairo, and installed it in the British Museum in London.

In fact, classical literature confirms the use of this script by numerous foreigners in Egypt. It is reported that when the Persian Darius built a canal from the Nile to the Red Sea in 517 B.C., he set up monuments commemorating the achievement, using hieroglyphic script. After Alexander the Great (356-323 B.C.), there continued to be references to the use of the script by Greek authors, through the 1st century, and later also by Roman authors. John Tzetzes, in the 12th century, speaks of Chairemon, an Alexandrian scholar in the 1st century who had written a treatise on hieroglyphics, and knew how to translate into Greek. Clement of Alexandria, about 200 A.D., wrote a major work on hieroglyphics, with the most extensive explanation of the script. Horopollon also authored a treatise on the subject, reportedly in Egyptian, which was translated by one Philippos into Greek. And Herodotus also referred repeatedly to the ancient scripts. Tacitus reported that once, when Germanicus Caesar went to Thebes, he had an old priest read for him the hieroglyphics from the old monuments. (One of them related something of Ramses, a king of one of the very early dynasties.)

In the case of the Greek authors, they referred to three forms of script: hieroglyphic, hieratic (a cursive form of the hieroglyphic), and demotic, all of which, they implied, were different scripts for the same language. Champollion noted, that Clement of Alexandria had written that "even in his time, those among the Egyptians who received education, learned the three genres of Egyptian writing. . ." (*Précis,* p. 321). The knowledge of hieroglyphics died out as the language and script were gradually replaced by Greek, then by Coptic and Arabic. When the Greek Chris-

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A medallion of Ptolemy V, king of Egypt, ca. 197 B.C., whose deeds were commemorated on the Rosetta Stone.

tians moved into Egypt and evangelized, in the 1st through the 3rd centuries, the native population adopted the Greek script, by assigning Greek letters to the sounds of Coptic. Because there were some sounds in Coptic for which Greek did not have letters, they invented seven of their own.

By the end of the 3rd century, hieroglyphics was a lost script. Coptic, which remained as the language of the church, fell out of general use, and was gradually replaced by Arabic, after the conquest of Egypt by the Arabs in 641 A.D. In the 15th century, Coptic was still used colloquially in Upper Egypt, but was dying out of general use, except as a liturgical tongue. Arabic became the language of government, administration, and the general Muslim population, as Arabic is the language of Islam.

During the Renaissance, with the revival of the learning of the ancients, there came a renewed interest in Egypt and its civilization. In 1419, a Greek manuscript of Horopollon's *Hieroglyphics* was found by a Florentine traveller, who took it back to Italy, where it was copied, circulated, and studied intensively. Hieroglyphics, though incomprehensible then, had a significant impact on the visual arts of the Renaissance. (See Erik Iversen, 1963.)

Athanasius Kircher, a German professor in Rome, tried to understand the scripts on the obelisks, transported to Rome by the emperors, which Pope Sixtus V had had erected in the public squares. Kircher, a correspondent of Leibniz, as well as Jablonsky, another correspondent of Leibniz, examined the ancient hieroglyphic inscriptions, seeking to draw comparisons to Coptic. Despite his intuition that a connection existed between Coptic and hieroglyphics, Kircher failed to understand the characters, which he considered esoteric and cabalistic.

The questions that were raised by the early researchers into hieroglyphics, had to do with the nature of the unique script. Was this a "mute script," with no relation to spoken language? Was it an ideographic script, a script made of pictures, whereby each picture signifies a word, an idea, a thing? Or was it symbolic? Or, was it a phonetical alphabet, in which each pictogram stood for a sound?

With the discovery of the Rosetta Stone, the investigations into these questions acquired new vigor, as the existence of such a trilingual text promised to provide a route to the answers. One crucial fact had been intuited, in the second half of the 18th century, by the Danish scholar Georges Zoega, that is, that the writing contained inside ovals, called cartouches, represented proper names—whether of gods, kings, or the less lofty. In the hieroglyphic version, the cartouche was a closed oval, with a perpendicular line at the right end. In the demotic script, the cartouche had the form of an open oval, similar to parentheses.

The most obvious next step, would be to isolate cartouches, assuming that one representing the name "Ptolemy" would appear most frequently. Silvestre de Sacy, a French philologist who was professor of Arabic at the Collège de France in Paris, along with the Swedish scholar Johann David Akerblad (1763-1819), had tried in 1802, to decipher some of the cartouches in the demotic. De Sacy, as Champollion reported, was the first to identify the groups that represented Greek proper names in cartouches in the demotic text of the Rosetta Stone, and to realize that they were alphabetical in nature. Akerblad had taken this further, identifying the phonetical characters in the demotic, by comparison to the proper names in the Greek text.

The Curious Dr. Young

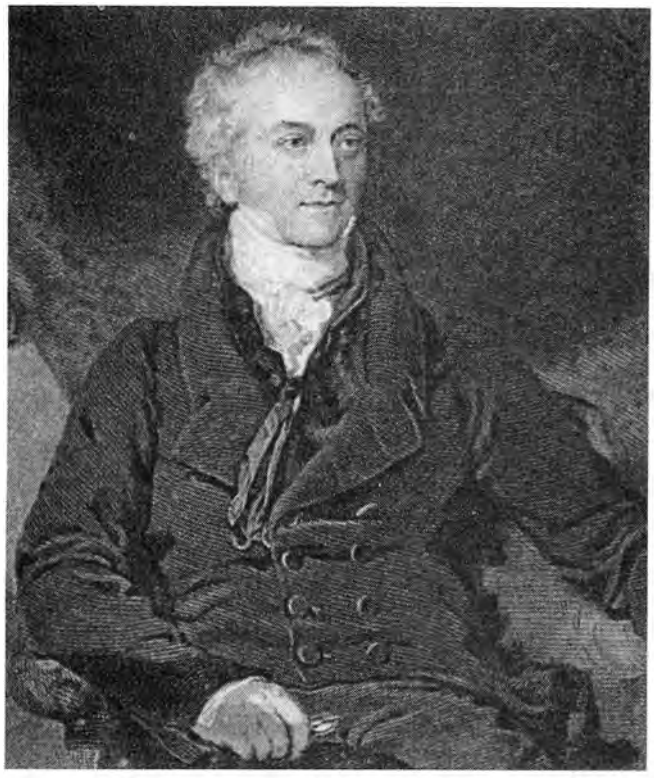
Among those struggling to decipher the proper name "Ptolemy" on the Rosetta Stone, was the British scholar Thomas Young (1773-1829). Young was a physicist and a physician, who was drafted into the Royal Society in 1802, just three years after the discovery of the stone. He had studied several oriental languages but was not a philologist. He

'History Has a Long Memory'

In 1801, when the British tried to seize the Rosetta Stone, the famous zoologist Geoffroy Saint-Hilaire, speaking for the scientific team on the expedition, stated:

"Without us, this material is a dead language, which neither you nor yours [the British] can comprehend. Rather than authorize such iniquity and allow this plundering bordering on vandalism, we will destroy everything belonging to us, we will scatter it in the sands of Libya, we will throw it into the sea, we will burn all these riches. It is notorious that you want to appropriate them. All right, but know that history has a long memory: You will also be guilty of having burned the library of Alexandria!"

As cited in Champollion, *Lettres et journaux écrites pendant le voyage d'Egypte.*



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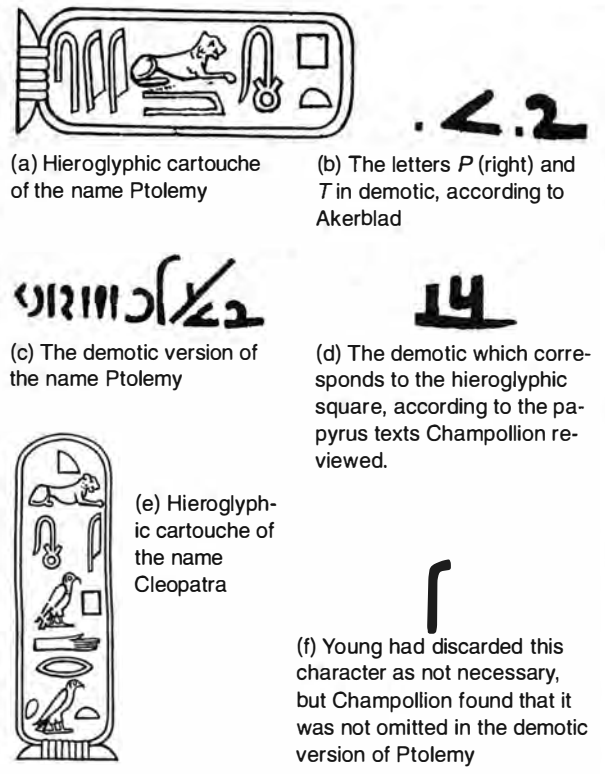
Thomas Young (1773-1829), was drafted by the British Royal Society to decipher the Rosetta Stone, but failed.

became a fellow of the Royal Society in 1804. For some reason, Young received the assignment to work on deciphering hieroglyphics. In 1814, J.W. Bankes discovered an obelisk of Ptolemy IX, at Philae, with a bilingual text, in Greek and hieroglyphics, and immediately made a copy available to Young. The name Ptolemy was sure to be on it.

The same year, Young's friend, Sir W. Rouse Boughton, made available to him a papyrus he had bought in Luxor, with a demotic text. Young also had the Rosetta Stone at his disposal at the British Museum, and it was expected that he would uncover the system behind the curious script.

Significantly, whereas Young was given all the material help required, including copies of other hieroglyphic texts and papyrus texts, Jean François Champollion was systematically denied the same aids. Even Silvestre de Sacy, Champollion's professor and compatriot, played a nasty role in keeping him in the dark. De Sacy wrote to Young on July 20, 1815, advising him to keep his work secret from Champollion. "If I have any advice to give you," he wrote, "it is to not communicate too much your discoveries to M. Champollion." The reason given, was that "he could claim priority in the future" over such discoveries (Champollion, *Précis,* p. 422-423). Champollion, indeed, received a copy of the inscription from Philae—four years after Young had received it.

Despite the considerable advantages he enjoyed in his endeavors, Young failed to decipher the Rosetta Stone, largely because of his faulty empiricist method. For example, Young proceeded to count the number of times a certain word appeared in the Greek text, such as the word "king." He then went to the demotic text, and noted words appearing a similar



(a) Hieroglyphic cartouche of the name Ptolemy

(b) The letters *P* (right) and *T* in demotic, according to Akerblad

(c) The demotic version of the name Ptolemy

(d) The demotic which corresponds to the hieroglyphic square, according to the papyrus texts Champollion reviewed.

(e) Hieroglyphic cartouche of the name Cleopatra

(f) Young had discarded this character as not necessary, but Champollion found that it was not omitted in the demotic version of Ptolemy

Figure 1
HIEROGLYPHIC CARTOUCHES USED BY YOUNG
Young's faulty empiricist method led him to fail in deciphering the hieroglyphic cartouche for Ptolemy. Champollion corrected Young's mistaken guesses in his systematic analysis.

Source: Champollion, *Précis*

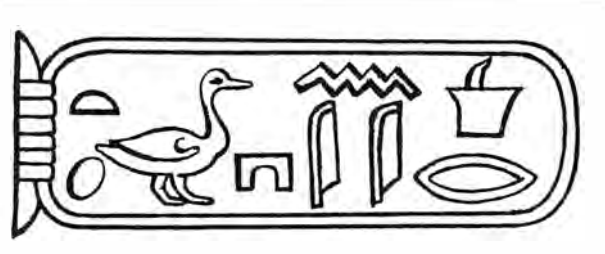


Figure 2
CARTOUCHE OF THE NAME BERENICE
After failing to decipher this hieroglyphic, Young gave up.

Source: Champollion, *Précis*

number of times, and concluded that he had identified the demotic for "king." He had, however, deciphered nothing.

In approaching the proper name Ptolemy, Young displayed the same methodological carelessness. When trying to decipher the hieroglyphic name assumed to be Ptolemy, contained in a Rosetta Stone cartouche (Figure 1a), Young declared the following: "[T]he small square and the half-circle

correspond invariably to the letters *P* and *T,* which Akerblad had identified in the demotic." Figure 1 (b) shows the letters *P* and *T* in demotic, according to Akerblad; Figure 1 (c) shows the demotic version of the name Ptolemy. As Champollion pointed out, the square does not correspond to Akerblad's *P* in any of the papyruses that the Frenchman had seen; rather, the letter appears consistently in the demotic texts, in the form shown in Figure 1 (d).

The square does indeed correspond to the letter *P,* but for reasons which Champollion more rigorously determined: He found the same sign in the name of Cleopatra—Figure 1(e). After having guessed these two letters, Young then asserted that the third figure, resembling a knot, was not "essentially necessary" in that it was often omitted in the hieroglyphics, and was always lacking in the demotic version of Ptolemy.

Here, too, Champollion pointed out Young's error. Champollion reported that he had found this figure omitted only once in the numerous Egyptian monuments that had the name of Ptolemy in hieroglyphics. He noted, that the hieroglyph had often been displaced, located after the figure of the lion, and he emphasized that in the demotic versions, this sign was never omitted—Figure 1(f).

Further, in Young's "decipherment" of the name of Ptolemy, it appears that he attributed to the figure of the lion, the syllables *ole.* As Champollion noted, Young had to consider this sign as representing *ole* because he had denied any meaning to the preceding sign. The next figure, Young took for *ma,* corresponding to the Coptic expression for "place," and to Akerblad's letter for *M.*

Again, Champollion had to point out that this too was an error, as nothing in other texts could support the claim, although the sign must represent the sound *M.* Then, the next figure, two feathers or plumes, Young read as representing *I* or *E,* and compared them to the three parallel lines that were seen in the demotic version. The bent fruit, Young took for a sign meaning "large," and he gave it the sound of *osch* or *os.* Here, Champollion noted, the idea of large is never expressed in this term. He pointed out furthermore that the sign must signify a simple *s* sound, as several other names in Latin terminate in the same symbol.

Then Young went to work on the name Berenice. If he had been lucky in guessing a few characters correctly with his hit-or-miss approach to Ptolemy (Ptolemaios), here he encountered no such good fortune. Young had a copy of this cartouche, from the great southern portal of Karnac (Figure 4). Here, Young claimed that it was again a mixture of syllabic and alphabetical signs, which he compared to children's games. He took the first character, which looked like a basket, which, in the Coptic language, is called *BIR.* He took the oval, similar to an eye without a pupil, to represent *A* (in Coptic, *E*). The jagged line he took to mean "from," corresponding to the sound *N.* The stepladder, Young said, seemed superfluous. The goose, he took to represent *KE* or *KEN.* With this attempt, Young floundered worse than he had with his approach to Ptolemy.

Clearly, the British researcher had no method, no hypothesis; his was a vainglorious attempt to guess the values for the signs.

After this attempt, Young threw in the towel. True, he published the ostensible "results" of his labors in the entry titled "Egypt" in the *Encyclopedia Britannica* of 1818. But he went no further in trying to decipher other names in hieroglyphics, of which there were numerous samples available. The question that arises is, why not? Why did he stubbornly insist, that the hieroglyphics were used phonetically *only* in the case of the proper names of foreign rulers? Why did Dr. Young, with all his political and academic backing, not venture further to decipher other names in hieroglyphics?

It may well be that Young simply did not have the desire. In any case, he was not as impassioned a scholar as Champollion was. Or, as is more probable, he recognized that he utterly lacked the methodological rigor which Champollion so manifestly possessed. Even Young's champion, E.A. Wallis Budge, in his official history of the Rosetta Stone (commissioned by the British Museum), had to take note of the curious fact that Young gave up. Young, Budge writes,

> himself says that a "continued application of the same method to other monuments" would have resulted in the recovery of the whole alphabet. It is impossible not to ask why, since he felt this with such certainty, he did not continue the application of his method to the cartouches of the Persian kings of Egypt, and those of the Roman Caesars? [Budge, p. 208].

The last hypothesis is that Young knew what he was doing, and deliberately failed, in order to "prove" that no such alphabet existed.

Young remains known for his entry "Egypt" in the 1818 *Encyclopedia Britannica,* in which he presented what he claimed was the discovery of the hieroglyphic system. However, as Champollion wrote, the few lucky guesses Young had made, did not constitute a real discovery:

> A real discovery would have been to have really read the hieroglyphic name, that is, to have fixed the proper value to each of the characters it is composed of, and in such a manner, that these values were applicable everywhere that these characters appear [*Précis,* p. 22].

The Power of Hypothesis

Champollion did make the discovery where others failed. What strikes one in reading through his letters, is the passion which drove him forward. What was decisive to this discovery, was passion, concentration—over 15 years—and hard work, day in, day out. From childhood, Jean François had a passion to learn, especially about Egypt. He was extremely fortunate to receive a Classical education, of the sort the great German philologist Wilhelm von Humboldt was to design in Prussia. It was his elder brother, Jean Jacques, known as "le Figeac," who supervised the education of Jean François, "le Jeune." Their father was a book dealer in Figeac, a bibliophile, with a huge library.

Jean-François was an avid reader from an early age, and displayed a lively curiosity for knowledge. When he received a parcel of books from a friend, Jean François exclaimed, "In principle, everything about which nothing is understood interests me. In addition to Hebrew, Syriac, Sanskrit, Tartar, Chinese, Persian, and especially ancient languages, interest me."

In 1799, his brother engaged a religious tutor for him, Dom Calmels, who taught him the languages of the Classics, Greek and Latin, in which he read the works of Plato and other ancients. Beginning in 1801, Jean François moved to Grenoble, where his brother directed his studies. There, in 1802, he attended school under Abbé Dussert, where he began to study Hebrew. The next year, his teacher authorized him to study Arabic, Syriac, Chaldean (Aramaic), and Coptic. Coptic was to become his passion.

With this grounding in ancient tongues, Jean François was able to immerse himself in the Classics. He read not only the Bible in the original languages, but also Herodotus, Strabo, Plutarch, Horopollon, and Clement of Alexandria, all of whom had written about Egypt. Later, in 1807, he moved to Paris with his brother, and attended the Collège de France and the Ecole des Langues Orientales, where he studied Hebrew, Arabic, Persian, Syriac, Chaldean, and Coptic.

Everything that had to do with Egypt fascinated him. It was in 1802, that the commission was formed to edit and publish the *Description de l'Egypte*, a catalogue of the findings of Napoleon's expedition to Egypt. As these volumes were being issued, beginning 1809, Jean François threw himself into their study.

Champollion picked up languages very rapidly and easily, and, what is crucially important, he played with them. His approach was diametrically opposed to that of the academic. For him, languages were tremendous fun. For example, when he was learning Arabic, he started wearing Arab style clothes, and he called himself "al Seghir," meaning "the younger" in Arabic. Another form of play with languages, involved comparing alphabets: He would take the Syriac alphabet, the Aramaic, the Hebrew, and the Arabic, and compare them. Then he would compare them to the Coptic alphabet, the Greek, and so on. This was his form of recreation.

He was fascinated as a child by the way different peoples in the same region of the world, found different ways of writing, which, however, bore certain similarities. This included Etruscan, a language that had not been deciphered. Jean François would go into fits of study, delving into a subject and immersing himself in it for years. So he delved into Etruscan, and in a letter to his brother, at age 18, he reported:

> I am totally immersed in the language, in the coins, in the medals, in the monuments, in the sarcophagi, everything I can find, the tombs, the paintings, etc. about the Etruscans. Why? because the Etruscans come from Egypt.

This extraordinary statement, he was well aware, flew in the face of "accepted knowledge." He added,

> There's a conclusion, that would make the academics climb the walls, those that have a smattering of Greek and Latin, but I have monumental proof.

Champollion had no exalted reverence for academia, and was guided, from an early age, by his impassioned quest for truth, not recognition.

He loved all things Egyptian, but among them, his greatest passion was Coptic, which he knew would be crucial to his life's work on hieroglyphics. Again, in an 1809 letter to his brother, he wrote:

> I have thrown myself into Coptic, I want to know Egyptian as well as I know French, because my great work on the Egyptian papyrus [hieroglyphics] will be based on this language. . . . My Coptic is moving along, and I find in it the greatest joy, because you have to think: to speak the language of my dear Amenhotep, Seth, Ramses, Thuthmos, is no small thing. . . . As for Coptic, I do nothing else. I dream in Coptic. I do nothing but that, I dream only in Coptic, in Egyptian. . . . I am so Coptic, that for fun, I translate into Coptic everything that comes into my head. I speak Coptic all alone to myself (since no one else can understand me). This is the real way for me to put my pure Egyptian into my head. . . . In my view, Coptic is the most perfect, most rational language known.

Still a youngster, Champollion knew to what he would dedicate his life. In fact, as early as 1801, as the news of the Rosetta Stone was spreading through the circles of the intelligentsia, Jean François made a fundamental decision: At the age of 11, he determined that he was going to be the one to decipher hieroglyphics. At the age of 16, in 1806, he wrote to his brother about Egypt:

> I want to conduct deep continuing studies into this ancient nation. The enthusiasm which the descriptions of their enormous monuments ignited in me, the admiration which their power and knowledge filled me with, will grow with the new things that I will acquire. Of all the peoples that I love the most, I will confess that no one equals the Egyptians in my heart.

And when the mayor of Grenoble overheard him talking to his (the mayor's) son, about botany, the mayor asked Champollion if he thought he wanted to study natural sciences. He answered, "No monsieur, I want to dedicate myself to the knowledge of Egypt." He was totally committed to this idea. Without this passionate commitment, he would not have succeeded. But he had it, and with his expanding knowledge, his passion grew. Soon, he began to issue his own thoughts on Egypt. Just weeks before moving to Paris, to attend the Collège de France, Jean François presented a paper to the Academy of Arts and Sciences of Grenoble, on the research he had conducted. It was titled "An Essay on the Geographical Description of Egypt before the Conquest of Cambyses."

The next year, at age 17, he was named a corresponding member of the Academy of Sciences and Arts of Grenoble, and in 1809, he became an assistant professor of ancient history at the University of Grenoble, to which he then moved. At the age of 20, Champollion was teaching courses on the "Antiquity of the World and the Origins of Man, Critical Reflections on the Historians of All Times and All Nations."

Throughout his years in Paris and Grenoble, Champollion was working on the languages of Egypt, including a grammar of Coptic, and dialect variations. He was studying hieroglyphic texts, including copies of the Rosetta Stone, but not exclusively.

Champollion's approach was not that of Young. He had

been studying other sources before the Rosetta Stone was available, and treating them as he had treated different alphabets, when he was a child. Champollion took the demotic script, which appeared on the Rosetta Stone, and compared it with other demotic inscriptions on other papyrus texts. Although he could not read them, in the strictest sense, he tried to identify the simplest traits, or signs, in the writing. And he knew from the record of Herodotus, that this demotic script should be read from right to left.

Further, he also compared the three scripts of which the Greeks had written, the demotic, hieratic and hieroglyphic (Figure 5). He would compare the same documents in different scripts—for example, texts of *The Egyptian Book of the Dead,* in hieroglyphics and in hieratic. And he studied whatever other documents his friends and associates could make available to him. Each new tome of the *Description de l'Egypte* offered more material to examine. It was his comparison of the texts of the *Book of the Dead* and the reproductions of the same, in the *Description de l'Egypte,* which provided the basis for his first breakthrough, in 1821.

Figure 3
EXAMPLES OF THREE ANCIENT EGYPTIAN SCRIPTS
(a) A sample of hieratic script with its transposition into hieroglyphics (b). A sample of demotic script is shown in (c).

Champollion hypothesized that the three scripts were three versions of the same language, which differed only in form. The hieroglyphics were used for sacred writings (as the decree in Greek on the Rosetta Stone indicated) and engraved in stone; the hieratic was a cursive form used for writing on papyrus; and the demotic was, as the name indicated, used by the people.

In the summer of 1821, Champollion wrote that, "the hieratic is nothing but a simplification of hieroglyphic," and that it "should be considered as shorthand for the hieroglyphs." He saw demotic as the last stage of this process. He made up a table of 300 signs, in the three scripts, to demonstrate the unity. Here, too, Champollion was proceeding along the lines of the comparative approach he had developed as a child. He experimented, by taking a word in demotic, and transcribing it into hieratic, and from there, to hieroglyphic, based on his minute study of the traits of the three scripts. He was reproducing the internal system of correspondences.

At this point, in August 1821, when he presented his paper on the hieratic script to the Académie des Inscriptions et Belles-Lettres in Paris, he believed that the nature of the scripts was fundamentally ideographic, that the signs indicated things or ideas, not sounds. As he wrote later, in his letter to M. Dacier, he had shown in his works on hieratic and demotic, that they were not entirely alphabetical, "but often also ideographic, like the hieroglyphs themselves, that is, painting sometimes ideas, and sometimes the sounds of a language." (*Lettre,* p. 41)

Champollion had earlier mooted that the hieroglyphics were phonetical in nature, but he could not determine it for certain. What is important, is that he was concerned not with deciphering a single name, but in discovering how the scripts functioned as a system. His interest, as he later formulated it, was to elaborate a general theory of hieroglyphics.

He attacked the question of whether the system were symbolical, ideogrammatic, or phonetical, with a crucial hypothesis, formulated in December 1821. Returning to the Rosetta Stone, Champollion posited this hypothesis: If the signs are ideographs, and each sign represents a thing, an action or an idea, then there must be as many signs in the hieroglyphic text as words in the Greek text. He counted 486 words in the Greek text, and expected to find fewer in the hieroglyphic text, since that portion was incomplete, only a portion of the text being extant. Instead, he counted 1,419. This meant that there was no way that each hieroglyphic could be an ideograph.

Then he broke the script down into single components of the hieroglyphics, and he came up with 166 simple signs or traits. He hypothesized that these might be phonetical signs. However, with the vast knowledge of languages and alphabets he possessed, it was clear that no alphabet would have as many as 166 letters, corresponding to the discreet number of

(a) Ptolemy Cleopatra

(b) Cleopatra

Ptolemy

Figure 4
PTOLEMY AND CLEOPATRA IN DEMOTIC AND HIEROGLYPHICS

Because demotic proved to be phonetic, Champollion supposed that hieratic and hieroglyphics were also phonetic. By comparing the names Ptolemy and Cleopatra in demotic (a) with the same names in hieroglyphics (b), he was able to see that certain signs were indeed equivalent. The final step was to apply the phonetical values so derived to additional names.

Source: Champollion *Précis*

articulate sounds in human speech. He assumed, as well, that the language probably did not identify vowels as separate sounds, considering that this was the case of most other languages of the region.

Given that the hieroglyphics could be neither strictly ideographic nor strictly phonetical, Champollion was open to other possibilities: For example, were hieroglyphics a combination of the two?

Champollion continued his work on the names contained in the cartouches. The general assumption regarding the hieroglyphics in the cartouches of the Greek and Roman era, had been that the Egyptian priests at the time had adapted hieroglyphic signs—mystical, symbolical secret signs—and attributed to them a phonetical value, in order to express in writing the names of foreign rulers, like Ptolemy, and so on, but that otherwise, the signs had no phonetical value.

In 1822, Volume Five of the *Description de l'Egypte* appeared, with good copies of the Rosetta Stone. Until that time, Champollion had had only very faulty copies of the original in the British Museum. He worked on the cartouche of Ptolemy, experimenting with transposing from the demotic to the hieratic to the hieroglyphic version, which, he found, corresponded to the form on the Rosetta Stone.

From the demotic cartouches, he deduced the alphabetical values for the name of Ptolemy, which he also had on a papyrus recently made available (Figure 4). Considering that in Greek, the names of Ptolemy and Cleopatra had several sounds and letters in common, he examined these two names in demotic, and also noted similar signs—Figure 4 (a). He had received the demotic version of Cleopatra, in the so-called Casati papyrus. Having seen that a foreign name had been given alphabetically in demotic, he assumed that the hieratic and hieroglyphic versions must also be phonetic, that there must be a phonetic series also in hieroglyphics. To prove this, he said, he required two hieroglyphic names. Unfortunately, the Rosetta Stone's hieroglyphic text, with the corners broken off, contained only one name, Ptolemy.

In January 1822, Champollion received a copy of the inscription on the obelisk dedicated to Cleopatra at Philae, with parallel text in Greek, which made it possible to isolate the name Cleopatra. By comparing the name in both scripts, Champollion could readily see that certain signs were equivalent, specifically those representing *P, T, O, L,* and *E*—Figure 4 (b). As he wrote in his later work, *Précis du systeme hieroglyphique,*

> I advanced, for my part, that the square was the letter *P,* for the sole reason that the *P* of the hieroglyphic name Cleopatra, was also expressed by the same character, the square.

The half moon, Champollion determined to represent the letter *T,* "because in all the hieroglyphic texts, the feminine article of the Egyptian language, *T,* is represented by this segment of a sphere. . . ." Champollion had noticed, in his extensive comparative studies of cartouches, in hieroglyphics and hieratic script, that this sign appeared by a woman's name. He called this kind of sign a *determinative.* Through his intimate knowledge of the Coptic tongue, which was the "Egyptian language," he knew that *T* denoted the feminine. In his comparison of the names Ptolemy and Cleopatra, however, he also noted that in the latter, the *T* was designated by a sign looking like a hand. Here, he posited the hypothesis that there could be more than one sign for a single sound; that is, that there were homophones in the hieroglyphic script.

The third sign in the name Ptolemy, which Young had said was not essential, Champollion knew must correspond to *O,* "because it is also in effect the fourth sign of the hieroglyphic name Cleopatra." The next sign, the lion, must be *L,* he concluded, "being also the second sign of the hieroglyphic name Cleopatra." As for the *M,* Champollion "recognized this character for hieroglyphic *M,* first of all because, since all the other elements forming the name Ptolemy were fixed, this sign per force had to be *M.*"

Furthermore, Champollion took the two feathers to be "a complex character, formed of the duplication of a simple feather, which is a short vowel." The double feather, he took for the Greek *H* (eta), and elsewhere as a diphthong, *AI, EI,* and so on. The last sign, he took to represent *S,* as the last consonant of several names in Greek: Ptolemes.

From the decipherment of the two names, Champollion had established the phonetical values for 12 signs (*A, AI, E, K, L, M, O, P, R, S, and T*). He reasoned that, if they could be applied to deciphering other names, the correspondences would be incontestable. Thus, he moved to decipher more names, precisely what Young had declined to do. Collecting cartouches from other documents, among them, those depicted in Volume III of the *Description de l'Egypte,* from Karnac at Thebes, Champollion succeeded in reading other names of

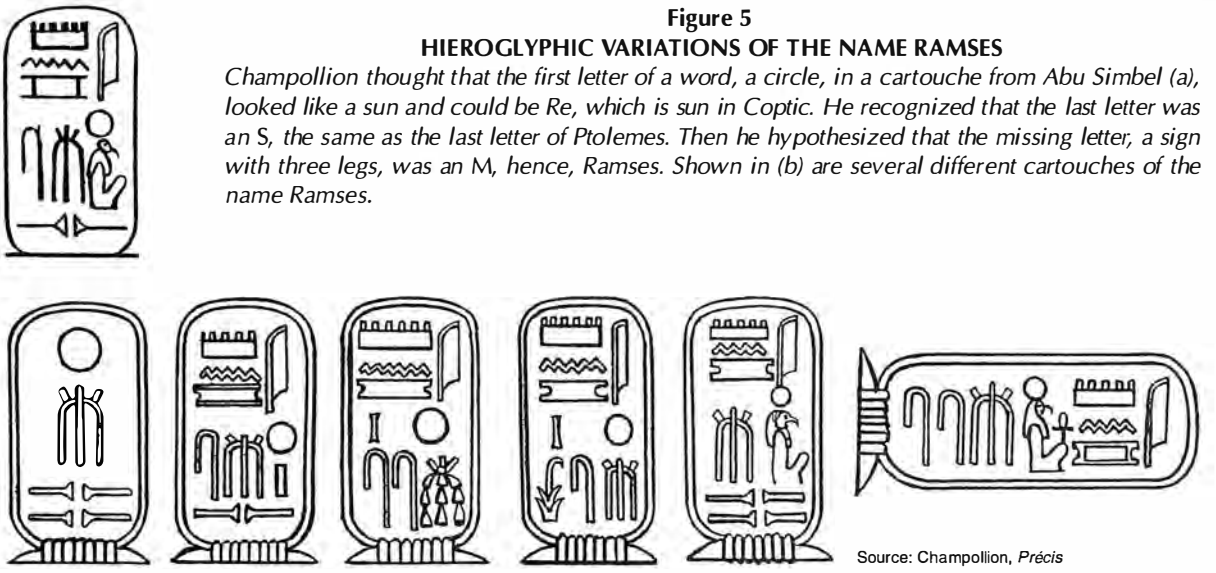


Figure 5
HIEROGLYPHIC VARIATIONS OF THE NAME RAMSES

Champollion thought that the first letter of a word, a circle, in a cartouche from Abu Simbel (a), looked like a sun and could be Re, which is sun in Coptic. He recognized that the last letter was an S, the same as the last letter of Ptolemes. Then he hypothesized that the missing letter, a sign with three legs, was an M, hence, Ramses. Shown in (b) are several different cartouches of the name Ramses.

(a)

(b)

Source: Champollion, *Précis*

Greek and Roman leaders, and, with each name, to generate more letters. Thus, he deciphered Berenice, Alexander, Philip, Arsinoë, Augustus, Tiberius, Caius, Claudius, Nero, Vespasian, Titus, Domitian, Nerva, Trajan, Hadrian, Antonin, and the empress Sabine; the surnames Alexander, NeoCaesar, Germanicus, and Dacicus; and even the title Autocrator, given the emperor.

At this same time, Champollion was also studying other documents, among them the zodiac of Denderah. He noticed that there was a little star behind each name given in hieroglyphics. He thought that the star in this case was a hieroglyph, functioning as a symbol, to identify that the name designated was a star in a constellation. In short, the star was a determinative, like the half-sphere feminine article, identifying a woman.

Although Champollion had succeeded in deciphering the names according to a phonetical system, he still believed, as he wrote in 1822, that the three scripts were ideographic in nature. In 1824, writing of this belief retrospectively in his *Précis*, he said,

> I persisted in this false route up to the moment that the evidence of the facts presented to me the hieroglyphic Egyptian writing from a completely unexpected point of view, forcing me, so to speak, to recognize a phonetical value in a whole collection of hieroglyphic groups, including in the inscriptions that decorate the Egyptian monuments of all ages [*Précis*, p. 299].

The moment when the "evidence of the facts" conflicted with his assumptions, came in 1822. Champollion's friend, the architect Nicholas Huyot, presented him with drawings from the temple of Abu Simbel, which contained two cartouches. The names inscribed within did not resemble any of the names he had deciphered of the Greek and Roman leaders. On the first, he recognized the signs which he had identified as the last character of Ptolemes, an *S*. Then there were other, unfamiliar signs.

Looking at the first sign, Champollion thought it looked like a sun, which he knew was called *Re* in Coptic. He put the *Re* together with the *S*, and hypothesized that the missing letter, a sign with three legs, might be *M*. This would yield *Ramses*, the name of a pharaoh, who was *not* from the Greek or Roman era, but from the earliest Egyptian dynasties (Figure 5).

Not content with this one result, Champollion sought to test his findings, on another name (Figure 6). Moving on to the next cartouche, he recognized two letters, *M* and *S*. Then there was the figure of a bird, an ibis. From his extensive readings of the Classical writers on Egyptian history, including Herodotus and Horopollon, Champollion knew about the system of the Egyptian gods, and recognized the bird as an ibis. The ibis was the symbol, they wrote, of Thot, the god of writing, the inventor of writing. So he hypothesized that the name was Thot-mu-sis, Thutmos. This clinched Champollion's reading of Ramses. Yet, he persisted in seeking further confirmation for this extraordinary discovery of a truly mixed system of writing.

Champollion went further, to look at some of the signs outside the cartouches. He found the sign with the three legs which he had identified in Ramses and Thutmos as signifying *M*, which appeared together with the sign he had identified in

Figure 6
HIEROGLYPHIC CARTOUCHE OF THUTMOS

Another cartouche from the temple of Abu Simbel, Champollion deciphered as Thutmos. Here, he figured that the first character, an ibis, was the symbol of the Egyptian god of writing, Thot.

Source: Champollion, *Précis*

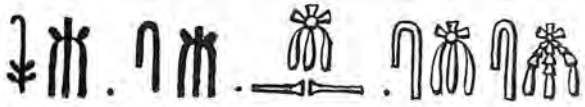


Figure 7
CHAMPOLLION'S KEY: *MS, MIS, MISE*
After figuring out the cartouches of Ramses and Thutmos, Champollion looked again at some of the signs in the Rosetta Stone. He noticed that the character with three legs, which he had identified as M, *often appeared with* S, *and he knew that this could be related to the Coptic verb meaning "to give birth." When he looked at the Greek text on the Rosetta Stone, he then found a reference to "birthday celebrations," and he knew he had made a breakthrough.*

Source: Champollion, *Précis*

both names as standing for *S* (Figure 7). He hypothesized that the two represented the syllable, *MS, MIS, MISE,* which might be related to the Coptic verb, meaning "to give birth." Going to the Rosetta Stone, he succeeded in finding this combination of signs, and then he examined the Greek text, to see if he could find any word linked to the idea of birth. He soon found a reference to "birthday celebrations," and knew that he had made a breakthrough.

Eureka!

At this point, Champollion's biographers report that he left his work and raced out of his house and across the street to the Institut de France, where his brother worked, shouting, "Je tiens l'affaire!"—"I've got it!" Champollion was wild with joy, at having finally penetrated the system of writing, after years of concentrated study. Now, truly, he had found the key to unlock the mysteries of his beloved Egyptian language, and to be able to read what his ancient interlocutors, Thutmos, Ramses, and others had written.

Champollion presented the partial results of his work, in his "Lettre à M. Dacier," which he read Sept. 27, 1822, to the Académie des Inscriptions et Belles-Lettres. After going through the process that led him to decipher the names appearing in the Greek and Roman periods, Champollion announced,

> in Egypt, the use of an auxiliary script intended to represent the sounds and articulations of certain words, preceded the rule of the Greeks and Romans.

He argued that, had the Egyptians invented a phonetic script only at a later date, they would have imitated the Greek and Latin alphabets, something they manifestly did not do. Furthermore, Champollion stated,

> I have the certainty that the same hieroglyphic-phonetical signs used to represent the sounds of Greek or Roman proper names, are also employed in hieroglyphic texts inscribed far earlier than the arrival of the Greeks in Egypt, and that they, at that earlier time, already had the same representative sounds or articulations as in the cartouches inscribed under the Greeks or Romans.

In his *Lettre,* Champollion briefly identified the principle of the hieroglyphic alphabet:

> One conceives then that the Egyptians, whether they wanted to express a vowel, a consonant, or a syllable of a foreign word, would use a hieroglyphic sign expressing or representing some object, whose name, in the spoken language, contained in its entirety or in its first part, the sound of the vowel, consonant, or syllable that they wanted to write [*Lettre,* p. 51].

Thus, the sign of a mouth, whose name is *Ro* in Coptic, would signify the letter *R;* an open hand, called *Tot,* would represent *T,* and so forth.

Champollion also hazarded the hypothesis, that

> one could find, in this ancient Egyptian phonetical script, if not the origin, the model on which the peoples of western Asia may have copied their alphabets, and especially those of the neighboring nations of Egypt.

He argued:

> If you note, in effect, Monsieur, (1) that each letter of the alphabets we call Hebrew, Chaldean, and Syriac, carry a meaningful name, very ancient names, since they were almost all transmitted by the Phoenicians to the Greeks, when they received the alphabet; (2) that the first consonant or vowel of these names is also, in these alphabets, the vowel or consonant that the letter represents, you will recognize with me, in the creation of these alphabets, a perfect analogy with the creation of the Egyptian phonetical alphabet [*Lettre,* p. 80].

In this first announcement of his discovery, Champollion contented himself with stating his conviction, that hieroglyphics had been a phonetical script from the earliest ages. In was only later, in his *Précis du systeme hieroglyphique,* published in 1824, that he presented his decipherment of the names of pharaohs and gods, like Ramses and Thutmos, belonging to the ancient era. In his *Précis,* Champollion developed his full elaboration of the "general theory of the hieroglyphic system."

Précis du Système Hieroglyphiques

Champollion announced in his introduction to the *Précis,* that he would set out to demonstrate, explicitly in opposition to the opinion of Young, the following:

> 1. That my hieroglyphic alphabet applies to the hieroglyphic royal inscriptions of all epochs; 2. That the discovery of the phonetical alphabet of hieroglyphics is the true key to the entire hieroglyphic system; 3. That the ancient Egyptians used it in all epochs, to represent alphabetically the sounds of the words of their spoken language; 4. That all the hieroglyphic inscriptions are in large part composed of purely alphabetical signs, and such as I have determined them. 5. I shall attempt to know the nature of the different sorts of characters used simultaneously in the hieroglyphic texts. 6. Finally, I shall try to deduce from all these propositions, once proven,

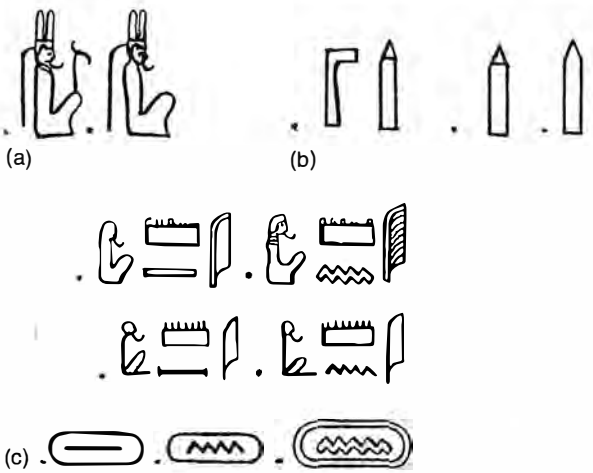


Figure 8
THREE FORMS OF HIEROGLYPHS OF THE NAME AMON

Champollion demonstrated how hieroglyphics can denote a name in three ways: figuratively, in an image (a); symbolically, as an obelisk (b), and phonetically (c).

Source: Champollion, *Précis*

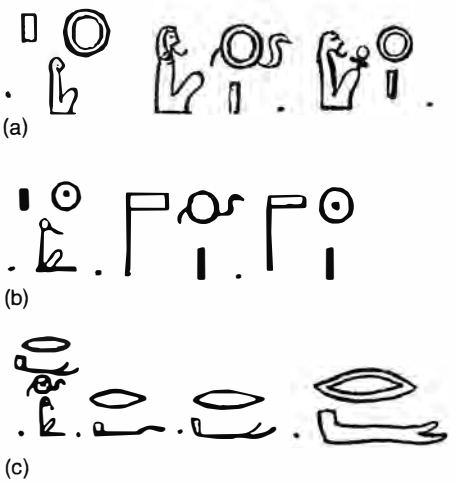


Figure 9
THREE FORMS OF THE NAME RA

In another example, Champollion shows how the name of the god Ra, which means sun, can be depicted symbolically (a), figuratively (b) as a red disc with a perpendicular line underneath it, and phonetically (c) as a mouth (Ro) and an extended arm (the vowel e*).*

Source: Champollion, *Précis*

> the general theory of the hieroglyphic system . . . [which] will give us the full and entire understanding of all hieroglyphic texts.

Champollion's *Précis* is a masterpiece.

After demonstrating the phonetical use of hieroglyphics to write foreign names, under the Greeks and Romans, Champollion hypothesized that the same signs carry phonetical values in other words. He applies them first to grammatical forms, then to the names of Egyptian kings, of all epochs, and then to the names of pharaohs.

He demonstrates how hieroglyphics can denote a name, either symbolically, or figuratively, or phonetically. For example, the god Amon (also Amen, Ammon), supreme god of Thebes, was depicted figuratively through an image of him (Figure 8a), symbolically, as an obelisk (Figure 8b), and phonetically (Figure 8c). Or, take the name of the god Ra (also Re and Ri), king of Thebes, of whom Eratosthenes had written. This is presented as a red disc with a perpendicular line underneath it—Figure 9(a). The name is figurative, in that it depicts the Sun, whose name in Egyptian is *Re;* it is also phonetical, in that the Sun disc, *Re,* stands for *R,* and the line under it, stands for the vowel *E.* The same god's name can also be written phonetically, with a mouth (Ro) and an extended arm (the vowel *E*)—Figure 9(b).

By deciphering the names of the pharaohs of ancient Egypt, and the inscriptions which indicate their genealogy, Champollion succeeded in confirming the chronology of the dynasties, as presented by Manethon, Herodotus, and Diodorus of Sicily—a fact whose significance he did not underestimate. He wrote,

> I therefore had to conclude, and I have concluded from these facts so numerous and so evident, first, that the use of the Egyptian phonetical writing, of which I was the first to publish the alphabet in my *Lettre a M. Dacier,* dates back to the remotest antiquity; and, secondly, that the system of hieroglyphic writing, considered up to now as formed purely of signs that represent ideas and not sounds or pronunciations, was, on the contrary, formed of signs, a large part of which express the sounds of words of the spoken language of the Egyptians, that is to say, of phonetical characters [*Précis,* p. 298].

The phonetical hieroglyphic system, Champollion proved by his decipherments, was in use continually from the 19th century B.C., until the conversion of Egyptians to Christianity.

The French researcher was also fully aware of the implications of his breakthrough for Egyptian studies. "These facts destroy, it is true," he wrote,

> all the systems advanced thus far on the nature of Egyptian hieroglyphic writing; they render void all the explications of texts or monuments hazarded for three centuries; but men of knowledge, for the sake of truth, will easily sacrifice all hypotheses enunciated thus far, and which are in contradiction with the fundamental principle that we have just recognized; all regrets, if there are any in this regard, should diminish and cease entirely, to the extent that one appreciates . . . the results of the works of the moderns, who have devoted themselves to the study of hieroglyphic inscriptions, starting from the absolute principle that the holy writing of the Egyptians was uniquely composed of signs of ideas, and that this people did not know alphabetical writing, or the signs of sounds, but for the Greeks alone [*Précis,* p. 299].

The Elements of the System

In his systematic presentation of hieroglyphic writing, Champollion catalogued 864 forms of signs, which include representations of physical objects (celestial bodies, animals, plants, and so on), geometrical forms, and fantastic creatures (human bodies with animal heads), and so on (Figure 10). The figures are presented in profile, he realized, in order to indicate the direction in which the line should be read; if they face left, it means one must read from left to right. They can also be presented vertically.

Comparing the Egyptian language to the Chinese, Champollion points out that the monosyllabic words of the former, do not end in vowels, and therefore it would not be possible to invent an alphabet based on signs for syllables. Instead, he writes, the inventor of the hieroglyphic alphabet must have analyzed the monosyllables, and separated the consonant from vowel sounds, to which he then assigned signs. These characters were not arbitrary, but, as he had anticipated in his *Lettre à M. Dacier,* were the initial sound of the word, whose image was used as a character.

> A voice or an articulation may have as a sign the image of a physical object, whose name, in the spoken language, begins with the voice or articulation [sound] which one wants to express [*Précis,* p. 363].

Champollion elaborated a complete table for this: Thus, an eagle, called *Akhom* or *Ahom* in Egyptian, stands for *A;* a perfume pan, called *Berbé,* stands for *B;* a knee, called *Ke'li,* stands for *K;* a lion, called *Laboi,* stands for *L,* and so forth (*Précis,* pp. 360-361). One sound, can thus be represented by several different images.

And, in each case, the characters may function phonetically, figuratively, and symbolically. Thus, indeed,

> the hieroglyphic writing is a complex system, a script at the same time figurative, symbolic, and phonetical, in the same text, in the same phrase, I would almost say, in the same word [*Précis,* p. 375].

Not only in the case of proper names, but also in the language as a whole, the figurative and symbolical functions are evident. For example, the word *Het* means "heart," and thus, by extension, spirit and intelligence. To express the idea "fearful," one would write "small heart"; "patient" is "heavy or slow heart"; "proud" is "high heart"; "timid" is "weak heart"; "indecisive" is "with two hearts"; "obstinate" is expressed through "hard heart"; "repentant" is "eating one's heart," and so forth (*Précis,* p. 336).

"Men of knowledge, for the sake of truth, will easily sacrifice all hypotheses enunciated thus far, and which are in contradiction with the fundamental principle that we have just recognized."

Champollion's great work also developed the relationship among the three forms of Egyptian script, the hieroglyphic, the hieratic, and the demotic, which Clement of Alexandria had catalogued and explained. Champollion argued that the hieroglyphic script was the oldest of the three, and that it was used primarily for inscriptions of public monuments, meant to last. As there arose the need for a more expeditious form of writing, the hieratic was developed, as a kind of shorthand of the hieroglyphs. This script, used by priests on papyrus, embodies the figurative, symbolic, and phonetic functions.

The last script to be developed, was the demotic, which is almost wholly phonetic, using symbolical characters only to portray gods and sacred things. Champollion declared, "These three were used at the same time, throughout Egypt." He added that "all the classes of the nation used demotic script for their private correspondence and to record public and private acts that regulated family interests."

The conclusions reached at the end of the *Précis,* dealt the death blow to the British lie, that the hieroglyphic system had been a cult object for a tiny elite. "It is also certain," Champollion wrote,

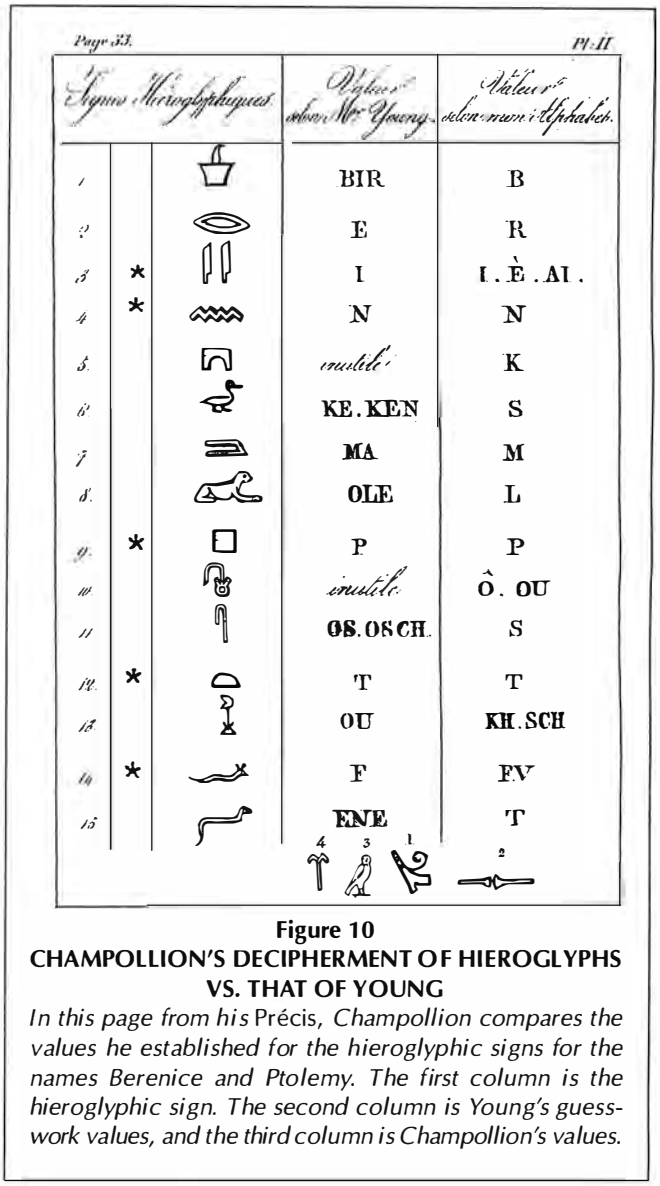
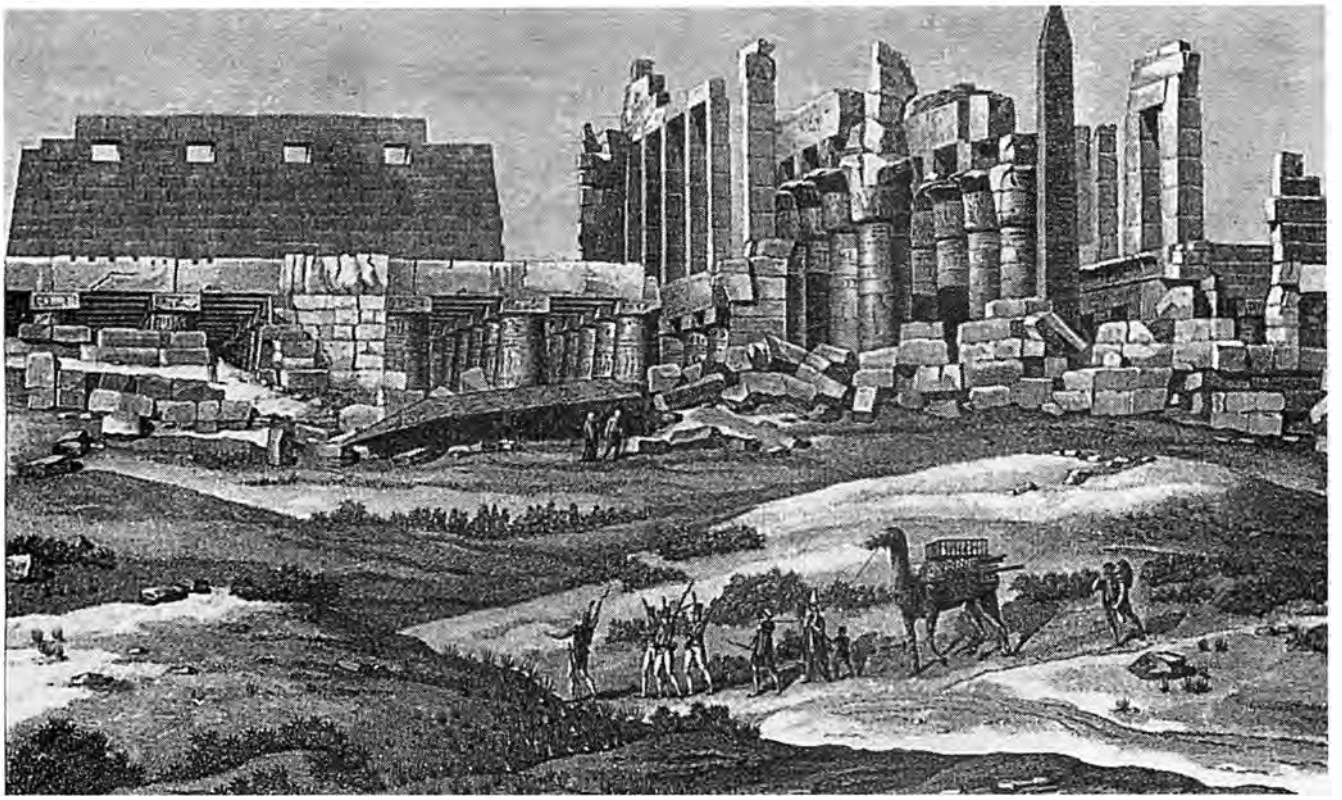


Figure 10
CHAMPOLLION'S DECIPHERMENT OF HIEROGLYPHS VS. THAT OF YOUNG

In this page from his Précis, *Champollion compares the values he established for the hieroglyphic signs for the names Berenice and Ptolemy. The first column is the hieroglyphic sign. The second column is Young's guesswork values, and the third column is Champollion's values.*



One of many illustrations of the ruins of Karnac at Thèbes, in Volume III of the French Expedition's Description de l'Egypte. *The expedition also copied cartouches from the walls of the ruins, which Champollion was able to use to verify his theory*

> as opposed to common opinion, that hieroglyphic writing, that is, the holy system, the most complicated of the three, was studied and understood by the most distinguished of all the classes of the nations—far from being, as had been said so often, a mysterious, secret script, whose knowledge was reserved to the priestly caste, to communicate only with a very small number of initiates. How could one persuade oneself, in effect, that all public buildings were covered inside and outside, by an innumerable quantity of inscriptions in sacred characters, if these characters were understood by only a few initiates?

Champollion added, that the inscriptions were to be found on all sorts of materials, including humble wood, and that even amulets and other personal objects were decorated with them. Given the relatively simple, extremely systematic nature of the alphabet, there should have been little difficulty, he argued, for the general population to learn to read it.

The results of Champollion's years of work, first presented in the *Lettre à M. Dacier,* caused an uproar throughout Europe. The "British" school lined up against him, and resorted to slander, to reject the Frenchman's accomplishments. In Germany, the Humboldt brothers, Alexander and Wilhelm, joined with Jean Letronne and Silvestre de Sacy (who revised his earlier attitude), as well as with Dacier, Fourier, and many other important personalities, to rally to the defense of Champollion. However, the vilification campaign continued.

It was in 1866, that further confirmation of Champollion's findings was made. Another hieroglyphic text was found, known as the Decree of Canopus. When it was successfully deciphered according to Champollion's system, there was no room left for doubt. Jean François Champollion was right.

Muriel Mirak Weissbach, based in Germany, is a member of the editorial board of the political weekly Executive Intelligence Review, *and a specialist in Middle Eastern affairs.*

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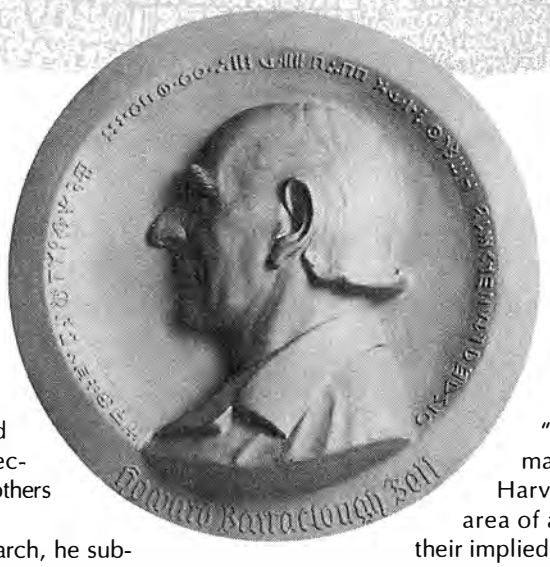
BARRY FELL, EPIGRAPHER

Biography of a Renaissance Man

by Julian Fell

A son's memoir of a remarkable father, who deciphered many previously unknown scripts, and uncovered the true history of Polynesia and the ancient travellers to the New World.



Courtesy of the Epigraphic Society

When describing Barry Fell, one must use the term "academician" because he cannot be classified as an authority of any single discipline; he was substantially productive at several. Barry was an innovative and creative researcher and thinker. He was able to detect connections where it would never occur to others to look.

In each of his broad areas of research, he substantially modified or overturned the conventions and accepted theories of the day. He generated much controversy and intellectual debate. His findings and conclusions were welcomed by some, and respected by others, but he was also opposed by some and strongly condemned by the bishops of the Status Quo when his "heresies" undermined the fundaments of the academic dogmas, upon which rested their careers and reputations.

The field of research which occupied the last 25 years of his life was epigraphy. This is the decipherment, analysis, and translation of ancient scripts. In addition to its language component, epigraphy also turns unknown history, or pre-history, into history. It is this latter effect that has galled the historians and archaeologists. Where a cultural artifact can tell a story, so too can an inscription, only far more so, and often yielding clues to cultural affiliation that the material artifact cannot. Archaeologists, historians, and linguists, guarding their respective intellectual monopolies (turf), have found themselves leap-frogged by outsiders, with Barry Fell pointing the way. The conventional archaeologists ask, "What possible qualification could a marine biologist, even one who was a Harvard professor, have working in the area of ancient language occurrences and their implied prehistoric migrations?

To those who knew Barry Fell, this question does not arise at all. The idea that he could equally be an epigrapher and a biologist was self-evident; and not only these, he had many other capabilities. Barry's unique signature was the innovative and multi-disciplinary nature of his scholarship, both in subject and techniques. Hindsight and better data appearing later show that, whereas he may have made a number of wrong guesses in the details, he had made quantum leaps in the right direction. His critics attack the minutiae, but cannot refute the thesis.

Barry was a zoologist and oceanographer by formal advanced academic certification. He was also an anthropolo-

Howard Barraclough (Barry) Fell 1917-1994. In the background are Easter Island tablets, whose script Fell deciphered in 1988.

gist, linguist, and epigrapher. He wore a number of other hats also. He was a radar engineer. He was a scholar of ancient Greek culture and literature. He committed long tracts of Homer to memory, and he liked to read Plato, Socrates, and other ancient Greeks in their original language. He had a natural facility for languages. He was a teacher and mentor, sometimes kind, patient and supportive and at other times cutting and rigorous. He was a workaholic. He could work around the clock for long periods, often cat-napping on top of his typewriter. He had intense powers of concentration and was capable of working under almost any conditions—except hot weather.

Barry could compose a final manuscript straight out of his mind. He had an encyclopedic mind. He would read and absorb vast amounts of information and had an astonishing ability to memorize and recollect. He was a fabulous lecturer, bringing clarity and simplicity to complex subjects, and he colored his talks with a variety of interesting sidelights. He was a withering debater, where his ability to recall information and articulate from his mental thesaurus stood him in good stead. He had membership in many scholastic societies and served as an officer in a number of them. He had many academic medals, awards, and honorary memberships, including honorary memberships in the Cherokee and Rapa Nui nations. Finding no forum and outlet for the publication and debate of ideas relating to epigraphy, linguistics, and culture in a diffusionist and cross-cultural context, he founded his own academic society for this purpose.

He loved classical music, especially J.S. Bach (cantatas), Handel, Gregorian chants, Mozart, and Stravinsky. He played the flute, recorder, and clarinet, and he built his own cello when he could not find one to buy. He wrote clever and humorous poetry and was a wicked punster, often between languages. He was a sculptor and artist and woodcarver. He had an interest in railroads and ships but hated aircraft, flying, cars, and driving. He loved gardening and was a fanatical grower of tomatoes. He loved cats and tolerated great inconvenience from feline collaborators that insisted on sharing his desks and chairs. He was an astronomer. He maintained collections of books, telescopes, shells, books, meteorites, fossils, zoological and anthropological artifacts, books, minerals, coins, stamps, and books.

A Polynesian Detective Story

Barry Fell considered his major epigraphic opus to be his Polynesian studies. In various forms, these studies spanned almost his entire life and were the synthesis of a wide range of elements that fitted together like a jigsaw puzzle. It was a detective story where, bit by bit, evidence was revealed by discovery, circumstantial occurrence, deduction, and hypothesis. The story of this is essentially the biography of Barry Fell himself, for so much of what was required to accomplish the ultimate result, came as events throughout his life.

Barry Fell's studies of language occurred more or less continuously through his life, and by 1970, had led him to epigraphy. There were two areas of research: Initially, and principally, were Maori and the other dialects of Polynesia, and their origin. Later, came the relics of ancient languages in the Americas and Europe. It was the later, North American works, that were the cause of his controversy, praise, and damnation, although, in his view, these were only a side show to his Polynesian studies. He was of the opinion that in the case of the American studies, others would sooner or later have achieved the same results, had he not been there first.

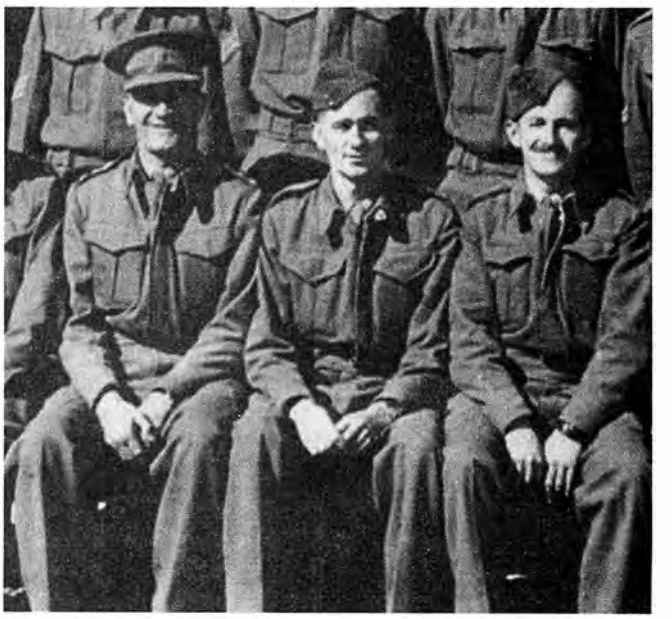
Contributing to his success were the intrinsic factors (above) and circumstances and opportunities that arose in his life, fortunate contact with appropriate teachers and mentors (some brilliant), and sheer, serendipitous luck.

THE EARLY YEARS

Barry Fell grew up in New Zealand. His mother, Elsie Martha Johnston, from Annandale, Scotland, was a remarkable person in her own right. A courageous, devout, self-reliant, and kind person, she had settled alone in Auckland but returned to Britain upon her marriage to Howard Towne Fell, a ship's officer of similar character. Widowed only months after Barry's birth in 1917, she returned to New Zealand, seeing it as a better place for herself and her son. They settled in Island Bay, a suburb of Wellington. Barry was sent to a Protestant elementary school, where an extensive knowledge of the Bible was infused.

When Barry was eight, Elsie Fell remarried and moved to hilly Wadestown, Wellington's highest suburb. Her new husband was Michael Anthony Ryan, son of a pioneer sheep-ranching family. Like Elsie, he was self reliant, strong-willed, and moral, and he loved horses. He was uncompromisingly devout in his Catholicism, to which Elsie converted. He had been a volunteer in the New Zealand Army, and had lost his right arm in France, in 1915. He ran a business manufacturing artificial limbs. He believed that discipline, regimented team sports, and army life built character. He had no patience for anyone who did not share his religious views. He believed that schooling should first address practical matters.

Four more sons duly followed; Shawn, Terence, Anthony, and Liam. Liam died at 18 months, after appendicitis. The



Barry Fell (center) during World War II.

surviving brothers were close, and there was a strong bond between Barry and the younger three.

Barry and his stepfather did not get along: They were opposites, and never formed a father-son relationship. Barry's inclination to read and to study science, and his love of music was, in his stepfather's view, effete and of little practical value. Barry's disinclination towards Catholicism infuriated his stepfather. In turn, Barry hated team sports, hated regimentation, and was utterly indifferent to horses. The Catholic home environment, however, resulted in a solid grounding in the Latin prayers.

Elsie was Scottish to the core, but spoke no Gaelic. Her Scottish neighbor on Weld Street was a Gaelic speaker and had a son of Barry's age, and the two boys were friends in school. Elsie encouraged Barry to visit the neighbor so that he could learn some Gaelic, which is where and how his Gaelic schooling began. Every so often, however, Elsie and the neighbor would have a tiff, which invariably arose from discussions of Scotland. One would make some comment which would be taken by the other as an insult to her clan, and suddenly things got frosty. Each boy was solemnly instructed that he must no longer associate with the other. In time, the affair was forgotten and relations resumed. The boys found these events hilarious, and completely ignored the instructions to terminate their friendship.

An Introduction to Maori Culture

At 13, Barry attended Wellington College, a very traditional and rigorously academic high school. The school attracted some of the most qualified teachers in the country and maintained high standards of scholarship. In what would have been his second or third year of high school, Barry withdrew for a year. The reason given was his health, but no illness has been identified. It may have also been from a need to escape his stepfather. Whatever the reason, it proved very significant in his intellectual development. Through the Boy Scouts, it was arranged for Barry to spend the year in the Hawkes Bay area with a middle-aged bachelor sheep farmer, who lived with his sister and a housekeeper. His host was Francis Hutchinson who, besides running his farm, also engaged in a variety of altruistic community activities and had a passionate interest in learning all about the local natural history and Maori culture. His home was also a private museum. Barry and Mr. Hutchinson had identical interests.

Mr. Hutchinson and Barry very quickly developed a mentor-student relationship that came close to a father-son one. Mr. Hutchinson showed Barry the need to be methodical in one's studies, the need to keep detailed notes of observations, the importance of collections with detailed documentation, and the need to accumulate data on a long-term basis. Mr. Hutchinson shared a mutual respect with the Maori elders, among whom there may have been *tohungas* (Hawaiian *kahuna*). *Tohungas* existed in secret, as Parliament had outlawed them since 1907 (the law was repealed in 1962).

Barry lived for a year surrounded by Maoris and attended school exclusively with Maoris. Barry had three languages which he acquired by contact and immersion: his cradle English, Gaelic, and Maori. As Barry observed later: "I cannot provide proof of formal schooling in Maori. When you are the only *pakeha* [white man] in a Maori world, you just become a part of it."

The Maori elders, in turn, probably recognized in Barry the sort of youth they would try to recruit into their ranks. The elders preserved the history, culture, laws, and lore of their tribes through epic oral recitations, committed to memory. They were always seeking intelligent, dutiful, spiritual, and respectful youths to replace themselves and thereby continue the traditions. Then, as now, most teenagers were more interested in rugby, hunting, fishing, and *wahines* (girls). The elders must have been of two minds: Barry would have been a perfect candidate to become a *tohunga* eventually, but he was a *pakeha* and the *pakeha* government at the time was engaged in cultural suppression.

Ultimately, they told Barry no secrets. They stressed to him, however, the importance of chanting in the precise perpetuation of oral history. Writing it down was not enough; it had to be chanted—but they did not tell him why. It was entirely possible that they did not know; it simply was the tradition.

Barry returned to Wellington College mentally invigorated. His time with Francis Hutchinson had provided structure and focus for his intellectual energies and inclinations. His formal subjects included French, German, Latin, and classical Greek. Of these, the Greek became his lifetime favorite. He developed a passion for classical Greek culture and literature, and absorbed it to such a degree that he could have been an authority on the subject. He committed large tracts of Homer to memory.

Barry developed close relationships with various masters (teachers) at the college. There was Dr. A.C. Gifford, an astronomer of some genius (who made postulations on the lunar seas, which decades later proved to be correct), and Gordon Hislop, who, in addition to being a highly educated teacher, also happened to be a hereditary chieftain of an Otago Maori tribe. Mr. Hislop recognized Barry's interest and respect for Maori subjects, and became his adviser and protector. The Hislop family "adopted" Barry and continued his education in Maori culture. One unforeseen benefit of Barry's "health hiatus" was a rumor, developed in his absence, that he had a weak heart. He found himself summarily dismissed from any further participation in sports. Barry naturally did not contradict the rumor, and continued to hike the hills of Wellington.

Barry earned a pile of prizes for scholastic achievement, and he completed high school in 1934, with six languages under his belt. Barry went on to Victoria University College, completing a bachelor's degree in 1937 and master's degree in 1938. In summers he climbed mountains, and in winter he climbed and skied back down (there were no chair lifts). On visits to Mr. Hutchinson in Hawkes Bay, Barry began anthropological investigations. Some minor cave art initiated a study that led to one of his first papers. Excavations of middens yielded human and Moa (giant extinct bird) bones. One of his professors was Dr. Charles Cotton, a brilliant geomorphologist who could read geological history in a landscape as Sherlock Holmes could read a crime scene. Barry's level of scholarship was such that he was awarded a fellowship (Shirtcliffe), which would enable him to get a Ph.D. at any place he chose.

At this time, Barry came to a crossroads where he had to make a career choice. He was inclined four ways: Polynesian anthropology, Greek, astronomy, or zoology—all subjects he

loved. He decided against astronomy, for its heavy mathematical requirements. Greek would be interesting, but could only lead to a minor teaching career. Maori anthropology offered almost no opportunity for employment, so he chose zoology, for it offered the best employment prospects. He did not diminish his involvement in other subjects; he simply stopped formal schooling in them.

Barry's first choice for doctorate studies was Heidelberg, and second Edinburgh. University authorities in Heidelberg informed him that he could not matriculate until he had passed the required course in National Socialism. Barry arrived in Edinburgh in 1939, by way of Queensland and New Guinea.

THE WAR YEARS, 1939-1946

War broke out, shortly after Barry's arrival in Edinburgh. Being of British birth, he was liable for military service, but the government chose not to conscript students until they had completed their degrees. Through a fortuitous encounter with a policeman, who had come from New Zealand, Barry was able to obtain advantageous private lodging near the university. His thesis project required his residency on the coast in summers, and Barry stayed in a small village, where the common speech was Gaelic. His host family, and the village, undertook to teach Barry as much Gaelic as could be managed; it became a village project. Barry took the time to visit and explore all the local Celtic remnants and ruins.

Barry's contribution to the war effort was as a fire warden at his laboratory. Once a week he would stand an all-night watch, making sure blackout conditions were maintained, and being ready to act in the event of an incendiary impact. Barry's personal papers include sketches of searchlights and flak during bombing raids that he witnessed, but nothing happened at his station.

Barry's doctorate studies were on the embryology of an echinoderm (a marine animal), but his first scientific publications also included the economic implications of predation by an Australian ant, Maori art, disease and diet, and animal distributions and evolution. Upon completing the requirements of his doctorate in 1941, he was summoned into the British Army and ended up in the Royal Engineers as a radar specialist. Throughout the war he led a charmed life; his adventures would fill half a book. His extensive travels were followed by a litany of crashes and sinkings. Most of his personal possessions, including all his records of his Celtic investigations, were sent to the Atlantic sea floor by a torpedo. He emerged without a scratch, but harboring a well-established antipathy to flying and liberty ships.

Gaelic, Radar, and Code-breaking

The epigraphic derivations from this era came from Barry's initial posting to radar operations in the northwest of Scotland. This placed him back into a Gaelic world, surrounded by Celtic ruins, and lots of time to study both. In 1942, he was transferred to the southwest Pacific, initially to detect an anticipated enemy attack on New Zealand, which never materialized. In late 1943, as U.S. Marines wrestled Bougainville (in the northern Solomons) from the enemy, New Zealand forces occupied outlying island groups. Radar pickets were set up to cover the approaches and the then-marooned Japanese enclave at Rabaul. Barry's war souvenirs consisted of native canoe paddles, war clubs, shields, fishing spears, some sea and turtle shells, and a notebook full of observations on natural history and anthropology.

All of Barry's radar work was heavily classified and so remained long after the war. He seldom spoke of it and could mention little. Some of the theoretical principles and feedback testing used in filtering radar signals, to separate true returns from random noise, was used later to test epigraphic solutions. These techniques had close similarities to methods employed by code breakers at Bletchley Park and elsewhere.

THE POSTWAR YEARS, 1946 TO 1964

Barry left the military in 1946, with the rank of major. He joined the faculty of Victoria University in Wellington as lecturer in zoology, becoming an associate professor in 1957. Although professionally a zoologist, Barry participated fully in other activities. He recalled vividly receiving on the same day, a copy of Michael Ventris's paper on the decipherment of Minoan linear B, which had taken months to reach New Zealand, and a recent letter from Ventris's editor, announcing his death in an auto accident.

Barry's zoological research covered the New Zealand and South Pacific-Antarctic echinoderms and more general considerations of evolution. Conventionally and circumstantially, the students of fossils and living organisms operate almost independently. Barry, however, occupied both worlds equally, and he was recruited by the Geological Society of America to compose some echinoderm sections of a global effort to document existing invertebrate paleontological knowledge into an encyclopedic form, to be known as the *Treatise of Invertebrate Paleontology*.

In 1953 and 1954, Barry took his first and only sabbatical. He and his wife, Rene, went to Britain and Denmark. They both learned Danish to fluency, and Barry lectured in Copenhagen. Barry used their extensive travels in Scandinavia to learn the archaeology of the Norse from the earliest (pre-historic) times, up to the relatively recent Viking period. He visited many museums and the actual sites. In the late 1950s, Barry recognized the importance of Russian work in oceanographic studies, and he undertook formal training in Russian, which turned out to be his last modern language. He wrote two papers that were published in Russian.

West Wind Drift

By 1960, Barry had assembled enough evidence to overturn the then-current higher classification of the *Echinodermata* phylum which was based on embryology and the existence of a sessile (attached) stage in development. Barry showed that the embryology was unreliable, and that the structural elements then used in classification were of lesser importance than other elements. Barry's new classification emphasized structures that he showed to be the most fundamental, and which were consistent with the fossil record. Certain taxa were shown to be more primitive than previously suspected, including a sea star whose existence could be regarded as parallel to that of the coelocanth. After two years of

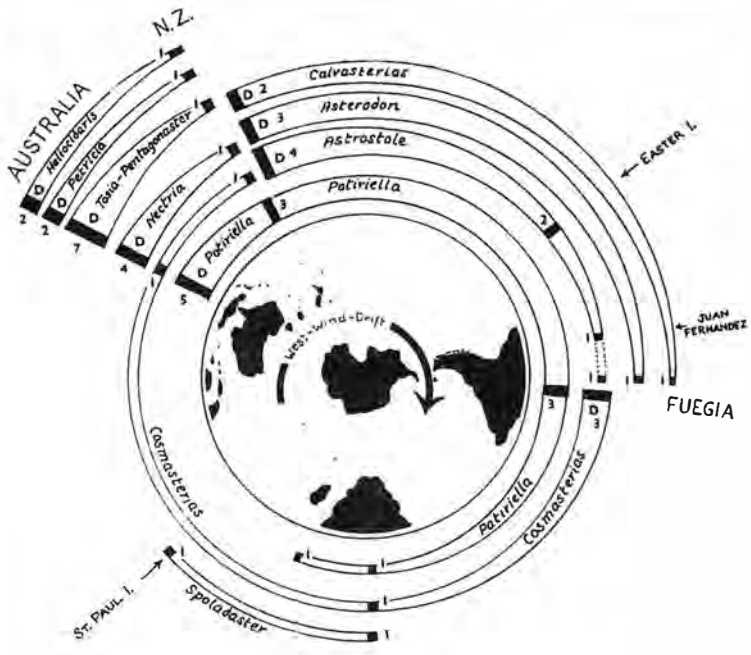


Figure 1
DISTRIBUTION OF ECHINODERMS IN THE CIRCUMPOLAR SOUTH SEAS

Fell's illustration of circumpolar distributions of genera and species of temperate-confined, shallow-water invertebrates (echinoderms) lacking pelagic life stages. Statistical and other mathematical treatments of data developed for living taxa were then applied to fossil distributions and later to linguistic and epigraphic occurrences. This led ultimately to Fell's determination of the origin of the Polynesian language.

Source: H.B. Fell, 1962. "West-wind drift dispersal of Echinoderms in the southern hemisphere," *Nature*, Vol. 193, No. 4817, pp. 759-761

controversy his new classification became the standard, and it stands to this day.

By the early 1960s, Barry's studies of the distribution of echinoderms in the circumpolar south seas revealed some curious trends. When he considered those genera that had a strictly temperate distribution, he noticed that within each genus, there were always fewer species occurring in any location compared to those locations lying to the West. It appeared that there was a site of origin with the greatest amount of speciation, and then a decline in speciation consistently as one moved to the east.

Biogeographers and evolutionary biologists recognize this phenomenon as a symptom of migration and colonization. It is obvious that shallow-water, bottom-dwellers with a pelagic larval stage (living in and moving with water bodies and incapable of active movement) can be (and are) transported by ocean currents. These show down-current distributions. The problem with Barry's southern ocean species, was that there was no identified means of migration, as these animals were shallow-water, bottom-dwellers that had no swimming or drifting life stages. Barry had non-swimmers that were crossing huge bodies of water!

It was conventionally assumed at that time that genera without such methods of ocean-current transportation had to acquire transoceanic distributions by former continental contacts or land bridges. Geologists postulating continental drift (with sea-floor spreading newly proven), were enthusiastic about former continental contacts; and they saw fossil distributions that were not in alignment with existing climactic belts as evidence of former contact and subsequent tectonic movement. Biogeographers, on the other hand, were less convinced. When broadly considered, it was found that these contacts often would have to admit organisms in one direction only, and/or had to be very selective, allowing certain organisms to pass but not others.

This "west wind drift" phenomenon detected by Barry (he coined the term, naming it for the cause of the prevailing current of the southern oceans), required the transoceanic movement of adults. The vector in this case proved to be rafting on the giant southern kelp *Macrocystus*. The study established that: (1) originating locations of the genus which had the longest period of habitation, had also the highest levels of speciation (that is, the largest number of species); (2) shallow-water organisms confined to climactic zones and lacking pelagic life stages also can cross vast oceans; (3) when this occurs, the movement is with existing surface ocean currents, and the resultant distributions follow existing climactic belts; (4) continental contacts were neither required nor implied; (5) a "reverse engineering" of fossil distributions could reveal climactic belts of the time period involved, the geographical origins of a taxon, the direction of the transoceanic migration, and, therefore, the direction of the vector current. The potential of applying this ocean current/animal distribution co-relation to human beings was obvious to Barry, and he started to assemble basic data.

HARVARD UNIVERSITY

Barry's achievements in echinoderm classification, evolution, and zoogeography caught the attention of Dr. Ernst Mayr, ornithologist and renowned documenter of the mechanisms of evolution. Dr. Mayr was the director of Harvard University's Museum of Comparative Zoology (MCZ), which already had a prominent role in the history of echinoderm studies, and required an echinoderm specialist for curatorial and research purposes.

In 1963, Barry received simultaneous offers of positions from the MCZ and the Smithsonian Institution. Barry loved New Zealand, but found himself deputy to a professor whose autocratic manner was causing widespread problems with

staff and students. Seeing no resolution to this problem, Barry decided to take one of the positions offered. For a combination of reasons, Barry chose the Harvard appointment. Although lower-paying, it allowed greater personal and academic independence and flexibility.

At Harvard, Barry found an almost ideal situation. Local shopping facilities and good public transit eliminated the need to own an automobile. The university had outstanding library resources. There was a state-of-the-art computing center. (In 1964, computers cost millions of dollars, were bigger than houses, and had the power of an advanced desk calculator.) As a senior faculty member, Barry was essentially free to set his own teaching subjects and loads. The American style of encouraging student initiative over professorial dictation in graduate studies and undergraduate projects suited his preference to delegate, rather than micro-manage. The museum was flexible and tolerant of personal idiosyncrasies, and research options were unrestricted.

Barry found himself in an intensely intellectual environment that was supportive and inspirational. He said that he felt he was in a "school of textbooks." Almost every senior curator at MCZ was (or became) the author of important books used widely as textbooks in advanced university courses. All of the curators had fascinating personal histories, and could regale the students with tales of bizarre and hazardous adventures. The MCZ, like Harvard as a whole, was truly international, drawing faculty, students, and visitors from all over the world. The museum's natural history collections were some of the best in the world. The student body included some of the brightest and most creative minds available. Thanks to the Sputnik effect, research money was available.

Although Harvard conventionally delegated introductory courses to junior faculty, a new freshman seminar program enabled senior faculty to have close contact with junior students (and vice versa). Barry promptly joined the program, as he liked contact with bright students at all levels, and himself had benefitted greatly from such contacts in his youth. Many of these first-time students became his advisees and research helpers. Barry's wartime experience had shown him that quite young and intelligent persons could rise to achieve unusual results when entrusted with responsibility for important projects. Typically, he would assign tasks to research, and recommend a course of action concerning a practical matter relating to the research and studies of the moment. This could range from aquariums, photography (surface and underwater), equipping a boat for and operating bottom sampling equipment, or computer programming. If Barry was satisfied with the report and recommendations from the student (which was part of the required class work), he would then instruct the student(s) to implement the project.

Typically, the students were initially astonished (they had only months earlier been in a schooling environment where they had to ask for hall passes to go to the washroom). They quickly recovered and rose to the challenge. Barry was seldom disappointed. Mistakes were part of the teaching process and quickly forgotten. Barry infused self-confidence and a "let's try it" attitude, as well as knowledge, into his students. He used grant money to pay undergraduates to help with his research. Both undergraduates and graduates were encouraged to publish results of original work.

Transoceanic Distribution Belts

In addition to his echinoderm research, Barry resumed his "west wind drift" distribution studies, this time extending his search for downwind (or down-current) migrations to other animal groups which met the criteria of shallow-water habitation and a climactically restricted range. During the 1960s, the first volumes of the *Treatise of Invertebrate Palaeontology* began to appear. As one of the authors, Barry was familiar with the series and found in them a flood of usable data. He started plotting the distribution of fossil marine taxa which were typically tied to specific climactic zones (latitudes). These were plotted for each time period. It was anticipated that the result would establish how steady the oceans had been, and reveal when continental drift had taken place.

This was in the mid-1960s, shortly after the confirmation of sea-floor spreading, by the discovery of symmetrically alternating bands of magnetism frozen into the basalt of the ocean sea floors. This provided the driving force for plate tectonics. A reverse extrapolation of this mechanism resulted in a prediction of the former existence of a single great continent (Pangea/Gondwanaland), with a breakup commencing in the late Mesozoic, around 75 million years ago. Barry welcomed the discovery of the geologists, but he had no confidence in the predicted timing of the breakup. It was not compatible with what he knew of fossils and the nature of marine distributions and rates of evolution.

Barry suspected that, overall, the continents had stayed roughly where they are now, relative to one another, since the Cambrian (about 550 million years ago). They may, however, have shuffled back and forth and rotated a bit with ongoing sea-floor spreading, with subduction zones and mountain building cyclically alternating sides on each continental plate.

At about this time, the research ship *Glomar Challenger* started drilling into the ocean floor. One of its first bores was off the Carolina coast. The drill bit wore out in Jurrasic sediment. Barry was delighted—in a single hole, this event had doubled the then-current estimates of the age of the Atlantic Ocean. Barry observed that with a few more events like this, the geologists would bring their estimate of the age of the oceans into line with the fossil record. The ocean floor may be new by way of continuous replacement, but the existing oceans, as global structures, were old.

As Barry plotted the distributions of more than 1,000 genera of invertebrate fossils that met the shallow-water/climactic zone distribution criterion, a peculiar trend of patterns began to emerge. The farther he went back in time, the more the transoceanic belts of distribution (corresponding to the latitudes of oceanic gyres) deviated from the present-day patterns. These past patterns incrementally followed a consistent trend; they did not deviate randomly. Within certain temperate taxa, the fauna of the northern and southern belts were very different in composition, despite a coastal connection between hemispheres along continental margins. Within each hemisphere, the transoceanic composition was constant. Clearly, climate rather than distance was the limiting factor. This hemispherical divergence in composition also eliminated any confusion between the hemispheres.

Mathematical formulae and tests were devised and applied to distinguish directions of taxonomic affiliation and to filter ambiguity at gyre boundaries. (Gyres are cells of circulation

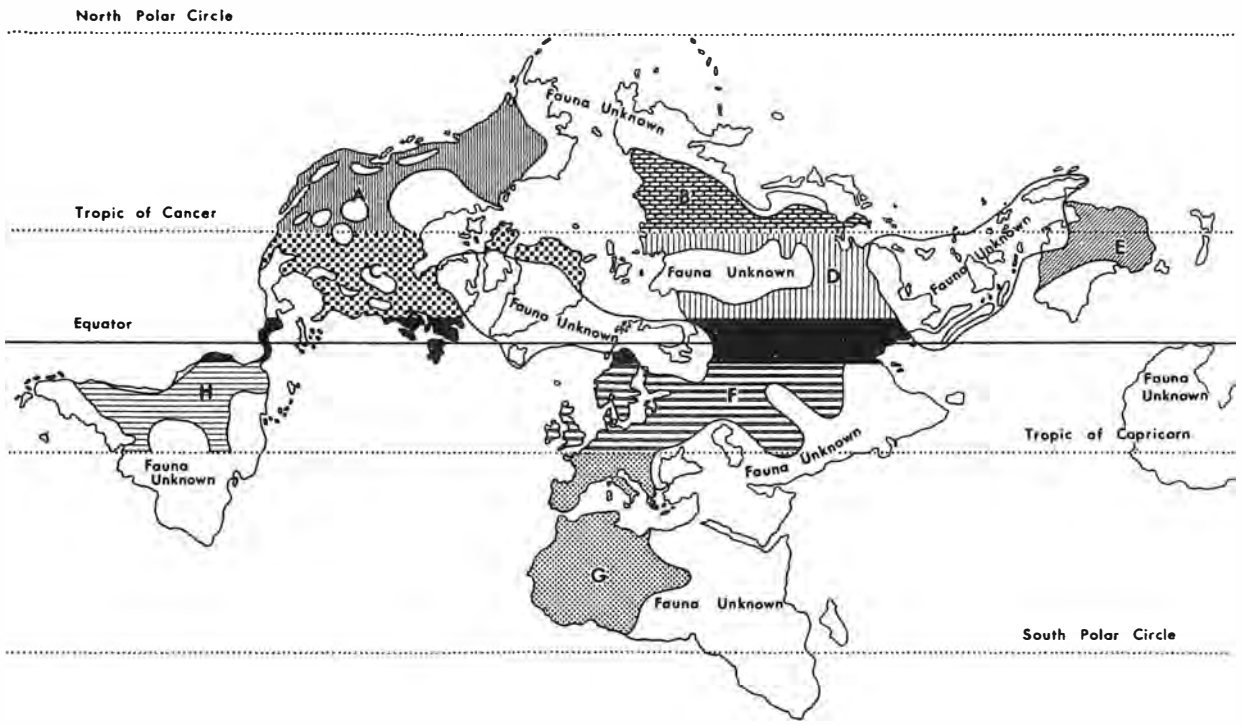


Figure 2
FELL'S WEST WIND DISTRIBUTION STUDIES

Distribution of marine fossils of temperature-confined, shallow-water, ocean current distributed organisms for the Ordovician Period (ca 500 million years ago), as assembled by Fell. Taxa of western North America, Eastern Siberia, and Australia are temperate, closely related, and form a distinct assemblage. Forms from South America, Europe, and Africa form a second, closely related assemblage of temperate organisms. The two groups have little in common, and form separate and parallel belts around the globe in temperate latitudes. These are inclined 70 degrees from the present day climactic belts. This is a Mercator projection map, adjusted to inferred Ordovician grid.

Source: H.B. Fell, 1968. "Biogeography and Paleoecology of Ordovician Seas," in E. Blake, Ed., *Evolution and Environment* (New Haven: Yale University Press)

of oceanic surface water, which are driven by surface winds, which in turn are artifacts of atmospheric circulation, known as Hadley cells.) These mathematical treatments were tested and proven, first on present-day faunal distribution patterns.

Through a number of his undergraduate students, Barry was able to accumulate data on distributions, and punch them onto cards. They then used the Harvard computer to calculate and plot the gyre patterns that best fitted the data, and they redrew a Mercator projection of the planet surface, using the gyre locations and the inferred equator as conventional Mercator latitudes.

What became apparent was:

(1) The oceans had (on average) maintained a steady state from the Ordovician.

(2) The tropic belts had not widened (as had been previously surmised from the appearance of tropical coral reefs north and south of the present belt). Instead, the tropic belt had tilted. The study showed no change in width of climactic belts, which meant that the global climate had, on average, remained much as it is now.

(3) There was no evidence of a change in ocean salinity.

(4) There had been a substantial and consistent shift of the surface crust over the bulk core of the planet. By this mechanism, the location of the poles and equator and all latitudes appeared to have moved (although it was the surface that had moved relative to the planets' grid). This movement ranged over 70 degrees of arc.

Barry placed the North Pole of the Cambrian at a location west of what is now Hawai'i, and its position, over time, tracked in a curve through eastern Siberia, to be the present pole position. This process placed the islands of the Canadian Arctic into a high temperate latitude during the dinosaur era. Antarctica would have had a predominantly tropical-temperate climate during most of the Paleozoic era, and it would have retained a temperate climate in the eastern part (below Australia) right to the Cretaceous.

Polar Wandering

Barry was able to publish several papers on this phenomenon in biologically oriented journals. Looking for a cause, he went on to investigate other implications of this global skin creep (termed polar wandering after its consequent effect on latitudes and longitudes). This included a refinement of the statistics of random and skewed distributions; some electronic

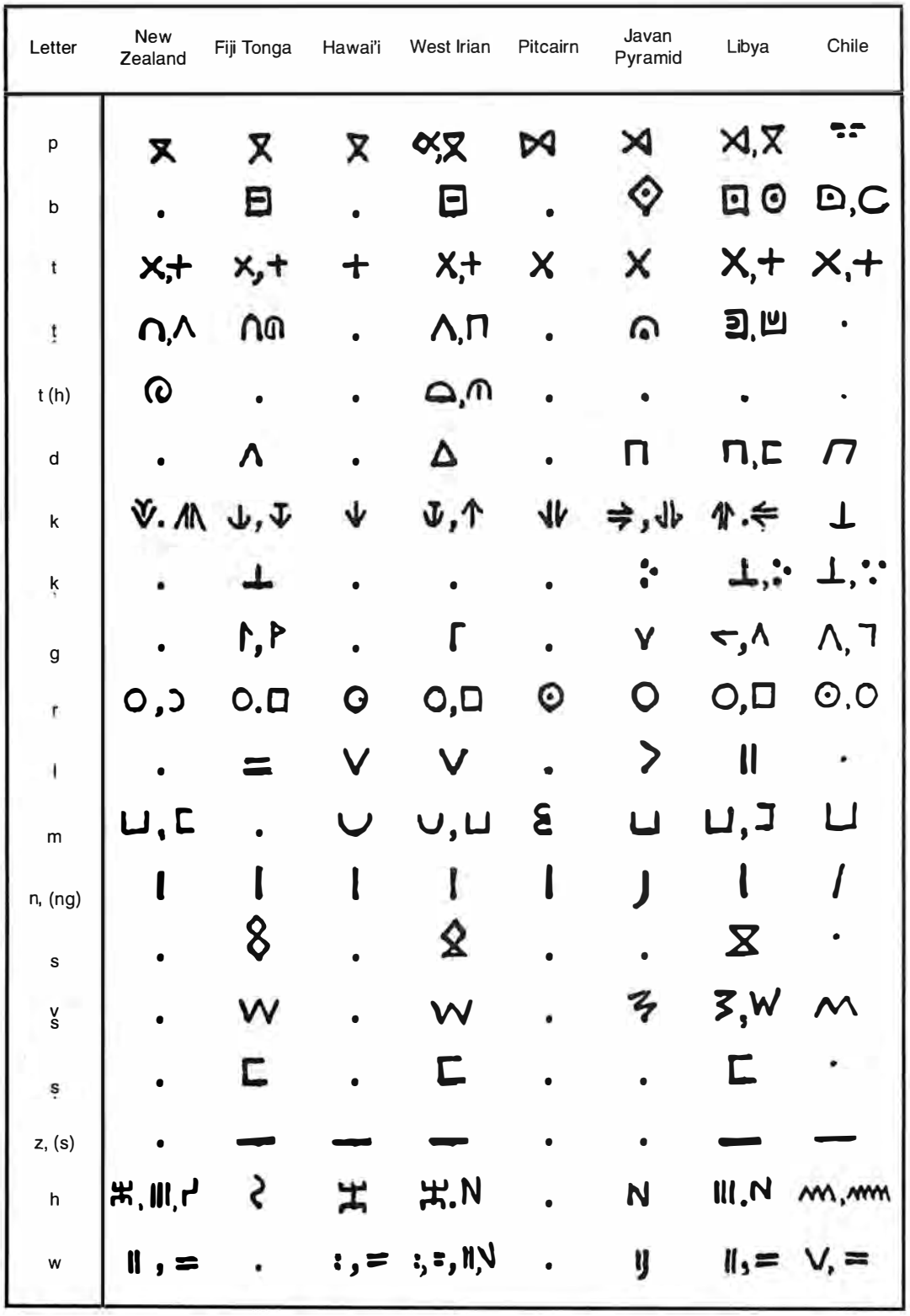
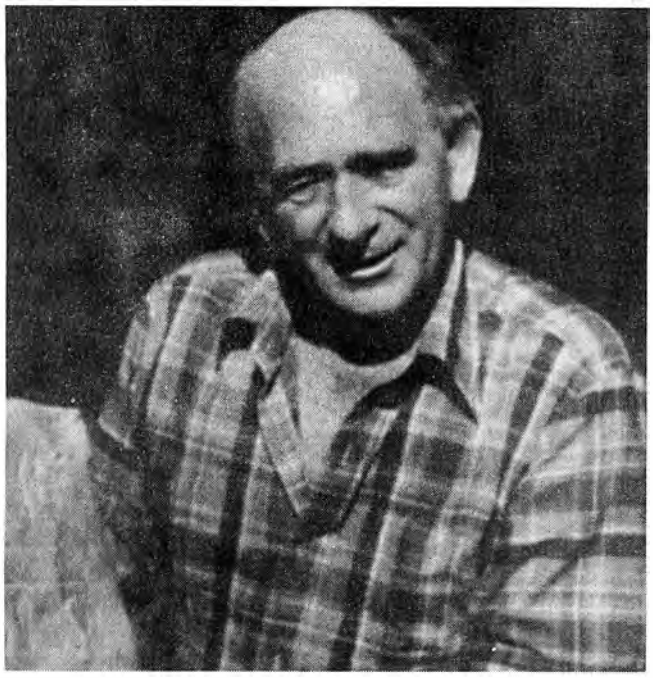


Figure 3
MAORI/NUMIDIAN ALPHABETS OF LIBYA, POLYNESIA, AND CHILE
Here, Fell compares the alphabets he compiled from various inscriptions.

Source: Reprinted with permission from the *Epigraphic Society Occasional Publications*, Vol. 2, No. 21



"It was Barry's broad knowledge of old Greek, his knowledge of Maori language, his knowledge that Maori epics should be chanted . . . and his downwind transoceanic dispersal studies all combined, that brought about his specific identification of Greek words in Maori."

modelling based on techniques of his radar years; and experiments with, and mathematical modelling of, spinning disks, weighted at the margins to simulate continental masses, and the induced wobbles that would result.

Barry concluded that the idea of "sea level" (gravitational and centrifugal isostacy) being a smooth spheroid was unlikely. He postulated that the sea level of the Earth would have to be regionally raised or depressed to accommodate differences in densities of continents and rock types. He also postulated that the existence of a Super Continent (Gondwana) would require an eccentric rotational axis of such magnitude that there would be a conflict between the centrifugal effects and gravity. This would stress the crust to quickly break up the continental mass, if it were floating on magma. Only a solid core could allow such a situation to exist.

He extrapolated this to the Moon, predicting similar regional deflections in the gravitational isostatic sphere. He postulated that it was no accident that the Moon's predominantly oceanic hemisphere ended up facing the Earth, that is, the Moon's mountainous hemisphere ended up centrifugally pulling away from the Earth.

This was in 1968. When Barry tried to publish these works, he hit a brick wall. Geological referees were so offended that his studies impugned their favorite scenario of the day, that all recommended rejection, and no journal would accept his papers for publication.

Time has partially vindicated Barry. In 1969, the Apollo project showed the Moon to have a solid core. As for "sea levels," the U.S. Navy in 1985 determined the actual levels. This was because the accuracy of ICBMs (which, lacking an active deceleration mechanism, typically approach targets at very shallow angles), is very dependent on accurate information of the elevations and the direction of gravitational pull, at both launch and target sites. After some misses with submarine-launched missiles, the U.S. Navy measured sea level globally to within inches, using a radar satellite, and found regional fluctuations over the oceans of several hundred feet. This information remained classified until 1995, a year after Barry's death.

Finding publication impossible because of intellectual censorship, Barry abandoned this line of research, but this failure, and his preceding fossil distribution studies, brought Barry to anthropology and, ultimately, to epigraphy.

POLYNESIAN STUDIES

Barry hypothesized that human beings in small boats, if accidentally unable to return to their home ports because they were blown out to sea by a storm, or by loss of sail or paddle, would drift in the same manner as pelagic or rafting marine organisms. Such incidents of becoming adrift would result in downwind dispersal, the manifestation of which would be a transfer of genes and cultural elements. Of the latter, Barry thought the occurrence of words could be measured objectively. Where two or more cultures exist, and accidents and circumstances result in migration predominantly in one direction, the "receiving" culture will contain proportionately more vocabulary of the "donor" culture. This would be affected by a number of other factors, such as the survivability of the arrivals, their cultural attitudes, the ratio of migration relative to resident population in the recipient area, and so on.

Only in the Pacific Islands were there the conditions to test such a theory. Barry's work on ocean-crossing drifting animals provided the techniques and mathematics to conduct such a study, and his personal familiarity with specific cultures, Maori language, and languages in general were fundamental assets. Barry returned to the accumulation of word lists and Jefferson list roots for as many islands as he could, a project he had begun in 1964.

In truth, the transoceanic migration was only part of the reason for this study; it was the "biological," or ostensible justification. Barry had long harbored a suspicion that the Maori had a writing system at some time, as there were inscriptions in all areas of the Pacific. One of Barry's New Zealand professors had commented to him about odd, word similarities between Maori and classical Mediterranean languages. For Barry, this effort was a refresher course of his life-long Polynesian contact. For the first time, it took him into a systematic investigation of the literature on Pacific Island languages, pictographs, and inscriptions, outside of New Zealand. The libraries of Harvard proved to be a gold mine.

As part of this process, Barry would recite each Polynesian chant new to him, looking for phrases. Recalling the teachings of the Maori mentors of his teenage years, 35 years earlier, he knew that there was significance in the chanting of the epics, beyond just the words. Barry's love of oratorios and Gregorian chants made chanting a natural activity for him, but he always did this in private. Harvard's academic flexibility enabled Barry to work at home, where lack of interruptions and his workaholic habits enabled him to carry a prodi-

gious work load. Boston's torrid summers were unbearable for him, and the only place he could remain at work was in the cool stone cellar of his old New England house, which also provided the requisite privacy.

Eureka!

It was while thus engaged that Barry realized an astonishing perception: Having chanted a line, he realized that he had just spoken nearly a sentence of old Greek! (Jumping ahead a bit, this Greek content is no longer surprising, but at that time, 1970, the possibility of a Greek component to Polynesian language was unthinkable.)

A short digression on Polynesia. Polynesia was "discovered" by modern Europeans in the 17th and 18th centuries. First contact was by a Spanish expedition out of Peru, under Mendana, in 1595. This expedition remarked on the presence of domesticated chickens and pigs, and the light skin of some of the inhabitants. The Spanish crew noted that the light skin and beauty of some of the women matched or exceeded that of their own high-born women, and named them the "Islands of the Marquesas."

Random and infrequent encounters followed, until James Cook more or less filled in the blanks, 1770-1779, with the last major encounter being Hawai'i in 1778. Polynesians have been a puzzle ever since. Thor Heyerdahl (1953) presented a summary of the huge range of opinions, the most common being that Polynesians are principally Caucasian, with a level of other races mixed in that varied substantially between the islands. As with the Marquesas, the first modern Europeans in Tahiti also noted the exceptionally light skin ("almost white") of some of the inhabitants.

Ethnically, Polynesia was of a single culture and language, but with local variations in dialects and beliefs. This variation in some aspects was erratic and showed no gradients with distance. In diction (consonant usage) and syntax, there was a northern, more evolved, pattern and a conservative southern pattern, consistent with Grimm's Law.

The mythology of the Polynesians varies among the islands, but generally has them descended from mythical gods, arriving in huge, ocean-crossing canoes, and in some instances pulling islands up from the sea. Widely prevailing themes include Ra as their Sun god, Maui as a great historical figure, and migration by large canoes. The term "Maori" (or Mauri) is the name the Polynesians call themselves in the linguistically conservative southern area.

No close or historical connection could be shown to any land or culture outside Polynesia. Certain linguistic similarities had resulted in the Polynesian language being grouped with Malayan. The Polynesians consider their culture to be endemic in origin, with no introduced component within their traditional past. The relatively low level of local differentiation, as compared to elsewhere, is taken by many as evidence of comparative youth. Barry believed that it was more likely to be the constant contact by sea voyaging, intermarriage, and the rigidity involved in preserving oral traditions that maintained the cultural uniformity.

It was Barry's broad and intimate knowledge of old Greek, his knowledge of Maori language, his knowledge that Maori epics should be chanted, his love of cantatas and Gregorian chanting that inclined him to chant, and his downwind transoceanic dispersal studies all combined, that brought about his specific identification of Greek words in Maori. The absence of any of these factors would have prevented the accidental discovery. Barry's initial reaction was utter disbelief. Upon backtracking and looking specifically for Greek words, he began to find more of them. This has to be done phonetically, as Greek uses a different alphabet from Maori; the words cannot be recognized by spelling. They could have been accidental homophones, but in this case they also had similar meanings, which meant the word match could not be accidental.

There was indeed a Greek presence. Barry dared not tell anyone except some trusted colleagues and family members, all of whom were sworn to secrecy.

A Short Briefing on Languages

We should take a moment at this point for a short briefing on languages and writing. All natural languages are like living things. The form taken at any instant in time is the latest version, at that time, of a continuous lineage, which goes back into prehistoric times. Languages are constantly evolving. Through the ancestral lineage, many seemingly diverse languages have common sources, and through this, word roots, vocabulary, syntax, and grammatical features are shared to various degrees. These qualities make it possible for linguists to group and classify languages, and provide the resources whereby lost languages can be rediscovered and reconstructed.

Our knowledge of ancient languages comes from the time that they began to be recorded by writing. Ancient writings that survive to modern times are renditions on materials that cannot decompose or oxidize, and which are resistant to mechanical erosion. With few exceptions, this is restricted to engravings on stone, masonry, or gold. Under extraordinary conditions some organic media (such as paper) may endure. Any ancient language whose speakers lacked a method of writing that could survive to recent times, vanishes off the Earth when the language ceases to be spoken. If an ancient language had a method of writing that has survived to the present, then knowledge of its existence still remains, although it may no longer be spoken as a people's language (for example, Latin, Coptic, old English, and so on).

Writing systems (or "scripts" in technical jargon) take a variety of forms. The writing system most familiar to the readers of this article will be a phonetic type, termed alphabetical. Phonetic scripts are intended to reproduce spoken sounds, and are universal, in that they can be used to record any spoken language. There are two types of phonetic scripts: alphabetic and syllabic.

In alphabetic script, vowel letters are used to represent sounds of different tones and consonant letters indicate muscular modifiers. Vowels and consonants are written separately. These are strung together in sequence with spaces between words to reproduce speech. Typically, about 20 consonants and up to a dozen or more tones are needed. In English, our vowel letters carry more than one tone such as the "a" in far, fat, and fate. The required vowel pronunciation is not written, but is inferred by the reader.

Most languages written in alphabetic script will have 20 to 30 letters. This can be complicated by the use of letter alter-

natives, such as hard *C* and *K* or *f* and *ph.* Certain alphabets use upper and lower case letters. When dealing with unknown scripts, this sort of thing introduces complications. Some alphabetic scripts omit the vowels, especially when the vowel changes according to grammatical circumstance. Some scripts include a common symbol for all vowels, with qualifying marks to indicate which vowel. Another practice is to apply such vowel qualifiers directly to the consonants, to show the vowel that follows.

Syllabic writing uses letters to represent a consonant in combination with a vowel. There is no separate rendition of the vowel. Each consonant comes in as many forms as there are associated vowels. For example, there would be a separate letter each for ba, be, bi, bo, and bu; as well as da, de, di, do, and du and so on. Each letter represents a syllable. Typically, 60 to 100 letters are required for a syllabic script.

Ideographic scripts use a different symbol (called a character) for each word. The number of different symbols is enormous, 5,000 being a basic vocabulary. Character scripts do not reproduce the sound of the language; a character script represents a statement, without regard to pronunciation, and can be used in common by several languages. In contrast, when a phonetic script is used, a common message has to be written differently for each language. We in the West communicate with characters when we use universal signs for money or traffic controls. Symbols such as !, ?, and &, as well as numerals 1, 2, 3, and so on, are characters. Often, the term logographic is used in place of ideographic.

Other types of writing include:

- *Pictographs,* which are drawings conveying information. In modern society, we use pictographs (such as washroom signs), object profiles (such as aircraft to indicate an airport), cartoon images, and maps.
- *Hieroglyphs,* which use pictures as letters for phonetic or syllabic scripts. These pictures can be abstracted or stylized, and they can be mixed with pictographs.
- *Symbolic script,* where an image conveys a message not directly obvious (that is, metaphoric) such as the use of rabbit or tortoise profiles to represent fast and slow.
- *Key-word scripting,* where the message is recorded by the use of significant words or symbols, with the remaining text omitted. This is usually done to provide a lasting record that is either shortened or intended to conceal the meaning. Modern functional equivalents would include telegraphic writing, abbreviations, acronyms (USA, KGB), and use of code words for statements.

There are also derived or secondary scripts, which substitute for an original script, instead of writing spoken language directly. Examples of these are Morse code, semaphore, hand sign language, braille, encryption, and various digital renditions of ASCII code. The only one that would concern an epigrapher is hand signs, because certain ancient scripts mimic hand signs.

We, in modern times, are accustomed to mechanically reproduced script, all very neat, uniform, and consistent. We are also accustomed to a widespread and reasonable level of literacy on the part of writers. Neither circumstance existed in ancient times. Much ancient writing was scrawled, and the proper lettering and grammar were not assured. Many old inscriptions were stylized and individualized, like the "tags" of present-day graffiti vandals.

In ancient times, there was no fixed convention as to writing format. All patterns existed: left to right, right to left, up and down, around in a circle or spiral, alternating back and forth, and mirror image symmetry (starting at extremities and meeting in the middle). Some stylists like to form and arrange the letters to re-create the shape of the subject of the inscription, making it a pictograph and a text statement in one. This type of inscription is called a rebus.

Today, we are accustomed to the ubiquitous usage of Roman alphabet with Arabic numerals, which has become a global standard. The majority of the world's languages are now written this way, as many have been for 2,000 years. Prior to the invention of fax machines, languages using a character script had to use alphabetic transcriptions for transmission by telex or Morse code, or if encryption was required.

In ancient times, there was no such standardization and scripts of the time varied with geography and between individual engravers. Not only could a script be used to write several languages (as Roman script is used today), but it was equally prevalent that any language would be written in different scripts, sometimes mixed together.

Epigraphy

Epigraphy is the process of reconstructing ancient languages which now exist only in random, relic inscriptions.

Language is very significant as a measure of cross-cultural contacts. Technologies, religious concepts, life-styles, and community infrastructures can (and do) arise by independent invention, and can evolve in parallel within unconnected cultures. This can result in many similarities. Such similarities between cultures alone cannot prove irrefutably that there has been contact, although it creates a probability of it. Where cultural contact does occur, it can occur to different degrees. There can be an exchange of material objects only (such as trade goods); or there can be concept/idea transference. This latter condition is where an idea or theory is transmitted, but the recipient culture then develops and implements the idea/application in material form independently. Only in the circumstance of person-to-person contact is there transference of language elements.

Parallel and independent development of new and identical words does not happen with languages (with the sole exception of words that mimic sounds, such as buzz, hiss, bang, ding-dong, and so on). The parallel development of identical alphabetical elements in unrelated and unconnected languages is unknown. It is theoretically possible, but statistically such an occurrence is astronomically remote. There have been dozens of phonetic scripts used, and the number of different letters used is well over 1,000. The probability of just one being used for the same phonetic value in two unrelated and unconnected societies is less than 1 in 1,000. The chance of 5 letters being used for the same phonetic values in two independent cultures by random chance is less than a billion to 1. The probabilities of unrelated cultures developing identical words for the same meaning by random chance are even more remote.

Elements of language, such as word roots, syntax, and grammar, as well as letters, behave very much like genes. Every living organism carries in its DNA various genes from

all of the preceding generations of its lineage. Any inflow of genes from an outside immigrant to its ancestral population is carried in its DNA. The probability of unrelated individuals of the same species having identical genomes by random chance is infinitesimally remote. In similar fashion, languages do not spontaneously arise anew; they descend and evolve from preexisting forms. Letters and words are the "genes" of language. Languages and scripts are the "DNA" of cultural lineages and cross-cultural contacts. The vocabulary of every language, carries a kernel of the word roots of every other language with which it has had sufficient contact to acquire loan words. Quite simply, the presence of a group of word roots or letters from one language, in another, simply does not happen by random chance.

We need only to look at our modern languages to see how things work. Two societies in contact and speaking the same language, almost invariably develop different words for the same item when acting independently. Just look at British and American English. We have torch/flashlight, bonnet/hood, pavement/sidewalk, and so on. Instances of developing the same new name independently for the same thing, is the exception, rather than the rule. Between cultures speaking different languages, we do not find any independent development of identical words; certainly, I have found no instance of this.

On the other hand, borrowing or loaning (theft, really) is rampant. Our modern languages are full of cross-cultural language transfers. Autobahn is embedded in English, and French has acquired le weekend and le hamburger. Simply put, (1) independent (isolated) invention of identical words for the same thing within societies speaking the same language is rare, and (2) it is virtually nonexistent between isolated societies speaking different languages. However, (3) acquisition of identical words by transference between societies in contact is routine, whether they speak the same language or different languages. We may safely assume that these dynamics of languages today, occurred equally in the past.

A sharing between cultures of even a miniscule percentage of language components (usually words) mathematically requires a degree of contact. In every case, where a significant contact has occurred, there is left embedded in the languages, a group of loan words that record the contact. Cross-cultural contacts can be small—a single person, expedition, or ship can transfer a religion, a technology, or a disease. The qualitative and quantitative measure of an impact depends on many factors, but a language must either bring a distinct advantage, or the contact must be significant, to transfer a measurable vocabulary.

In Barry's Polynesian studies the blocks of shared word roots were not small: they were massive.

The conservative nature of these root words is sometimes remarkable. We can see this in our modern languages, which are full of word roots from ancient Greek and Latin. Etymologists have become very sophisticated about identifying these "kernels," and the historical "path" of a language can be traced through the various linguistic elements it has acquired over time. The etymologists go to work once an epigrapher has "cracked" the script and language.

The job of the epigrapher is to take unidentified ancient inscriptions and discover the content. What is the script? Is it known, or is it a new form of a known script, or is it a previously unknown script? Is the writing system alphabetic, syllabic, ideographic, hieroglyphic, or symbolic, and so on? What are the possible languages or language groups? What are the clues to the phonetic values?

Having qualified the script and its probable phonetic pronunciation, the next step is to identify the actual language or language group. Barry found that different languages, even closely related ones, had unique and quite divergent frequencies of usage for key letters. An analysis of consonant frequency provided a "signature" that would identify the language. Once identified, the actual words, then the meanings, and then the grammar are determined. The process is partly like code-breaking as practiced by cryptanalysts, and partly like the work of forensic geneticists, who are trying to reconstruct the genome of a deceased person working backwards from surviving relatives.

So-called "dead" and "lost" languages can be read and rebuilt using word roots and the vocabularies of known related or descendant languages. The consistency of word roots and consonant mutations enable the use of known languages to "reverse engineer" a lost language. For example, Phoenician can be read approximately from Arabic and Hebrew. The process would be akin to reconstituting Latin, using dictionaries of Spanish, Italian, French, Portuguese, and so on. The process is not as precise as a direct translation of known languages, but a translation to the level of Roget numbers is possible. The grammar and syntax are derived in the process along with the vocabulary.

Despite the incredible complexity of this work, epigraphers have developed a methodical process of decipherment, which is part detective work, part guess, and a lot of tedious trial-and-error testing. Amazing results have been achieved where a full decipherment has resulted from inscriptions where, both the script, and the language, were originally unknown. Occasionally, epigraphers get a lucky break, such as when bilingual inscriptions saying the same thing are found.

In recent times, Barry was the master epigrapher. He cracked a number of scripts and languages, and of these, the toughest was the Polynesian-Egyptian complex. Famous epigraphers of the past have included Jean François Champollion, H.C. Rawlinson, and Michael Ventris. Like Barry, none of these people was an archaeologist.

In the world of diffusionist thinking, Barry was a latecomer. Many bright and courageous researchers had published evidence of ancient transoceanic contacts. When this involved the Americas, it was considered heresy in the Church of Archaeology. Barry Fell's significance was that his work involved languages, the DNA of diffusionist evidence.

CRACKING THE POLYNESIAN LANGUAGE

At the start of this Polynesian study, Barry began with a spoken language of no known close affinity. There were a number of rock inscriptions scattered all over the Pacific with no apparent common lettering. There were some miscellaneous modern signatures of Maori chieftains on treaties, and the Easter Island Rongorongo tablets with a mysterious script which did not fit any phonetic or ideographic pattern.

The apparent presence of Greek roots in Polynesian language broadened Barry's perspective in these studies. It

Punic (Carthaginian) and Numidian scripts

Latin and Numidian scripts

Figure 4
BILINGUAL GRAVE MARKER STONES FROM TUNISIA

The Numidian script is written Mauri (or Ancient Maori). The Punic script type dates to ca. 200 B.C., and is read from right to left. The Numidian is the earliest type, lacking any vowel indicators. The Mauri on both is read upwards, starting at lower left. On each gravestone the paired texts read approximately the same. The Numidian texts were read for the first time using modern Maori dictionaries from New Zealand, after consonants were adjusted for mutations, in accordance with Grimm's Law.

Source: *Epigraphic Society Occasional Publications*, Vol. 1, Nos. 9 and 11 (1974)

heightened his intensity and alerted him to start looking out for connections well outside the Pacific area. He knew now to look at any potential relationship, no matter how odd it might appear in the light of the ideas of the day; nothing should be rejected out of hand. These initial studies occupied three years, 1970 to 1972.

By 1973, Barry brought forth his initial solution. By following the methods of Champollion (Egyptian hieroglyphs), Rawlinson (cuneiform), and Ventris (Minoan linear B), Barry was able to build on some key inscriptions. The key to the solution came from Java. Two steles bearing identical inscriptions were reported in north-central Java (Cheribon) in 1844, but these had not been deciphered and read. Barry noticed in these inscriptions the presence of punctuation resembling vowel sound pointing, in the manner employed in some Semitic scripts, and a similar script with vowel pointing had also been reported (in use) from Sulawesi in 1750. The attempts to match the script with inscriptions in Kawi (a derivative of Sanskrit in Java) failed to produce a solution.

Barry attempted to match the inscription to a Semitic script (Phoenician)—a seemingly absurd and reckless hypothesis at the time—and produced a match! When the appropriate phonetic values were applied, the language turned out to be late Ptolemaic Egyptian! When the words were translated, it produced an historical text consistent with other Javan steles in Kawi of the fourth century. Thus we have an Egyptian presence and Phoenician influence in Java in the 4th century A.D.

Now alert for a Greek presence, Barry found two steles in Ptolemaic Greek, both dated to 697 of the Seleucid era (385 A.D.). They recorded the invasion of Java by a maharajah termed "Euoplis Theoides" (which means well-armed, godlike). This phrase translates into Sanskrit as Narayan Devasa, a name found on many of the Kawi steles. Now we have a coeval Greek presence.

A fourth undeciphered inscription on a stele from a complex of ruins in eastern Java (Suku) provided a different perspective. It was discovered in 1815 and had defied all translation. Barry's unpublished notes indicated a private hunch that the language on the inscription might be Polynesian, based upon a few letters that resembled letters in old Thai, Malay, and Indonesian scripts, which phonetically produced some Polynesian words within the inscription. Contradicting this were the number of letters, which quite exceeded the number needed for the Polynesian language, and the presence of similarly formed Sanskrit words, in particular the "Maharajah of Ta-Irihia." (Ta-Irihia is Sanskrit for Land of southern India).

Meanwhile, an ongoing comparison of word lists that he had started by matching Greek to Maori (and which was yielding meager returns) was switched to Ptolemaic Egyptian to Maori, after the discovery of Ptolemaic Egyptian on the Cheribon steles. This immediately resulted in a far greater number of matches, to the point that it became evident that the Greek presence came only from loan words in the Egyptian. This led Barry to suspect that the Suku inscription was Egyptian, rather than Polynesian. Upon checking, the scripts were quickly matched and the Suku inscription proved to be a modified Egyptian hieroglyphic script, combined with a Sanskrit vowel notation system. The language was late Ptolemaic Egyptian. But the phonetic rendition, when transcribed into Roman alphabet, and then adjusted for phonetic mutations, yielded words which read as Maori and, on translation, produced the same statement that the Egyptian translation did.

(Jumping ahead a bit, the surplus of letters, compared to Polynesian, in the Suku inscription is because the Egyptian contains more letters. The evolution of Polynesian from Egyptian had involved a simplification by combination of consonants. When written, Polynesian requires significantly fewer letters.) The Suku stele was dated, using Attic Greek decimal numeration. The year appeared contextually to match the Seleucid calender used by Greek princes in India.

The Javan inscriptions, in Greek, Sanskrit/Kawi, Egyptian/(Phoenician script) all told the same story. In a year correlated to both an Indian (Saka year 306) and a Greek (Seleucid year 696) calendar system (384 A.D. in our calendar), an invasion of Java by Maharajah Narayan Devasa from southern India occurred. It apparently resulted in the almost total destruction of the existing towns; the residents were driven out and ultimately departed in ships. The Suku stele is written from the Egyptian (or Maori) point of view; it reports a terrible invasion and calls for the patriots to repel the invader. The Kawi language steles elsewhere, and the Cheribon steles

of Egyptian language/Phoenician-script report the same event from the conqueror's view. They record the triumphant conquest, and the surrender, punishment, and subsequent flight by ship of the defeated.

It appears, at this point, that Java had become a traders' crossroads during the first millennium before Christ. Traders established there apparently included Phoenicians, Greeks, Sanskrit-using Indians (which implies Hindu), and Egyptians, the latter being the first and most numerous. Presumably, each would include associate ethnics, such as Libyan-Numidians, Nubians, Hebrews, Arabs, and, probably, Chinese—all in addition to the rural native populace. As noted below, we can now assume that Egyptian knowledge of the Indian Ocean and western Indonesia was detailed and of very long duration, well exceeding 1,200 years. Alexander the Great (who had covered half the distance on land), had ordered a city built there, which was retained by medieval scribes copying Ptolemaic maps for centuries after Maharajah Narayan Devasa had destroyed the colonies and dispatched their inhabitants "into the islands of the Great South Sea."

Barry concluded, at this point, that the extant Polynesian dialects were in all probability lineal descendants of ancient Egyptian, and represented the only living branch of the Egyptian language family outside of church Coptic—but this proved to be only partially true.

THE NORTH AFRICA LINK

Barry's work on Polynesian, from this point, was being done with the hypothesis that Ptolemaic-era Egyptian was also ancestral Maori. Within Polynesia itself, there was scant material in the way of inscriptions to support this. The predominantly occurring script in the ancient Pacific (exclusive of the Easter Island tablets) was a square letter script that Barry was able to identify as the same syllabic script found otherwise on the south shore of the Mediterranean, between Morocco and Egypt. It has been known as Numidian script, but the language it expressed was unknown, although suspected to be Berber.

In fact, Egyptian-type hieroglyphs had been found only on a Pitcairn Island inscription, and only as part of the text, the remainder being the square letter syllabic script with Sanskrit vowel points. The inscription reported a shipwreck, and identified the writers as the "people of Manu," known to us, via the Romans, as Cyrenaicans. Their national symbol was a bird: the Maori word for bird is "manu."

For a while, Barry had to study this Numidian script in its place of (presumed) origin. Bilingual inscriptions with Latin or Carthaginian had enabled some consonantal equivalents to be determined 50 to 100 years earlier, but the language written evaded identification. It had been in use from 300 B.C. to about 500 A.D., but was very infrequently used after 100 A.D. More than 1,000 inscriptions in this script existed, most from the Tunisian area. Using the bilingual inscriptions, Barry took the (consonantal) text produced phonetically from the Numidian script, applied the appropriate consonantal mutations, and then sought the best phonetic match in a Maori dictionary. The resultant text in English closely approximated the Latin or Punic text translated into English. (The "words" involved were word roots rather than complete words, as we would expect from the precise translations possible between modern languages.)

Thus, Barry had his answer: the Mauri of Numidia were linguistically related to the ancient Maori of Polynesia. The next step was to match the Numidian script to the Pacific inscriptions, and here the method also worked. The Pacific inscriptions were rendered phonetically, based on Numidian consonant values, and the language produced was Maori.

This determination opened floodgates in both the Pacific and the Mediterranean. North Africa provided the alphabet, and Polynesia provided the vocabulary. However, it proved to be more complicated. In time, it was determined that several other languages were also written in this script, including Berber, Arabic, Phoenician, and Egyptian. Additionally, Barry found that the Maurian language (the term he established for the language written in the Numidian script and equivalent to ancient Maori), also appeared variously in inscriptions of seven different scripts.

For the North African archaeologists, the discovery was of monumental significance. The ability at last to read the Numidian scripts revealed historical and cultural information of revolutionary magnitude. North American archaeologists utterly detest Barry for his works, but in the Arab world he is a hero.

A Hittite and Etruscan Link

Looking for script and vocabulary (word roots) origins, Barry's further studies indicated that this square script probably had an Anatolian origin and appeared to have descended through Cypriot Minoan cultures. The language originally associated with this script also appeared, through root word analysis, to have an Anatolian origin, related to Hittite. Barry's studies ranged to Minoan Linear A, Cypriot Linear C, and, ultimately, to Hittite, with diversions to Etruscan and the enigmatic Phaistos Disc. It turns out that all were related, and Barry's works here created a few tidal waves in Mediterranean prehistory. But that is a story for another day.

"North American archaeologists utterly detest Barry for his works, but in the Arab world he is a hero."

The south or African coast of the Mediterranean region has a long, mysterious, turbulent, and multi-cultural ancient history. The North African shore peoples were a melange of many cultures. The region was subject to continuous and multi-sourced immigration (infiltration might be a better description), and the establishment of city-states of various ethnicities. For most of the 1st millennium B.C., it existed as a series of tribes and alliances, but over time, a partial melting-pot effect took place. There was a seafaring heritage, being part of the Minoan "Sea Peoples," and they had their own pharaohs in parallel with Egypt. At various times, they conquered, or were in turn conquered by, Egypt. Several writing systems existed, but the most widely occurring, often on gravestones, is the square letter Numidian type, and from this it is concluded that Maurian was the most widely occurring language. The full vocabulary however, like the population, was multi-cultural.

Even here, there is a problem with terminology. A lot of our knowledge of the history of this area comes from accounts by

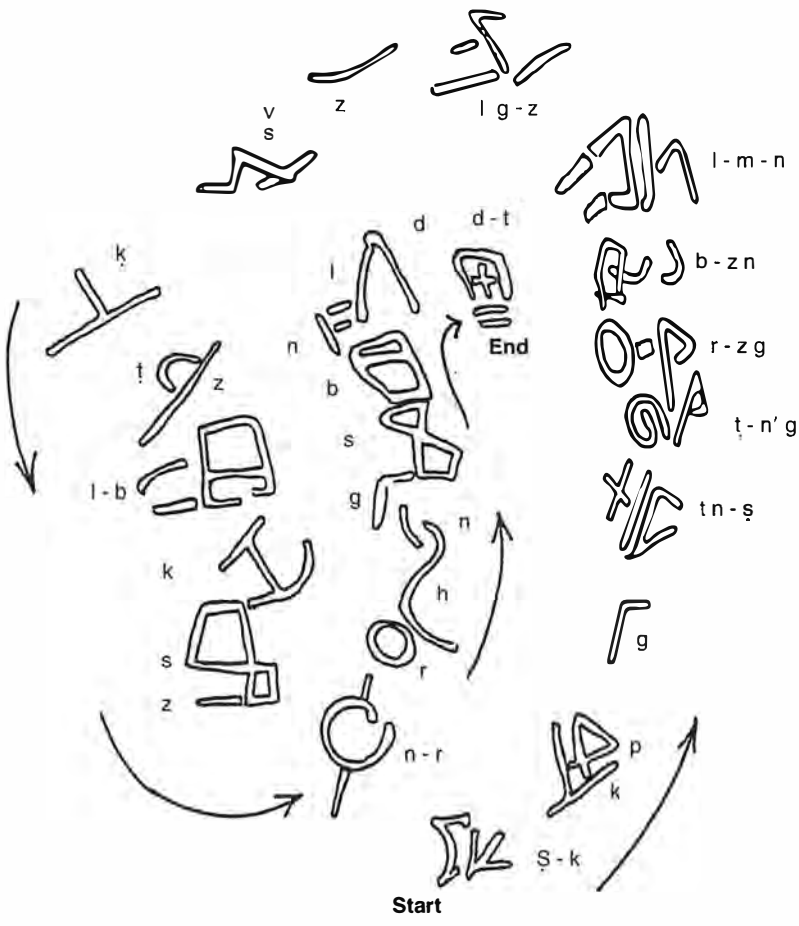
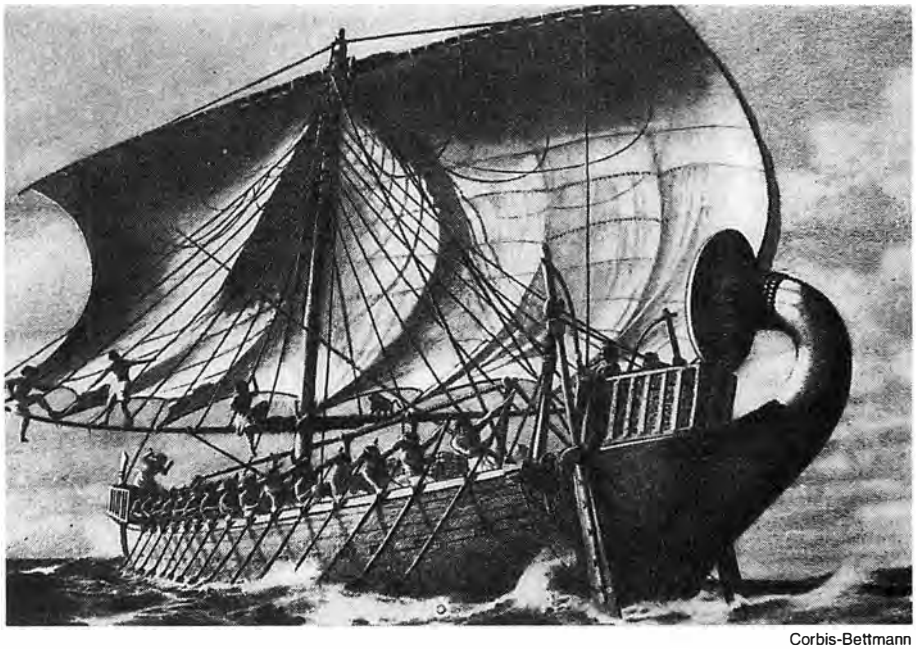


Figure 5
INSCRIPTION IN ANCIENT MAORI FROM FIJI

The Numidian script follows the early Mediterranean form (ca. 250 B.C.), and lacks vowel indicators and the Semitic and Sanskrit influences of later versions. The text follows a spiral format. In telegraphic form, it reports of an unsuccessful attempt to settle in Fiji, in which the settlers were repelled by "Nubians" (that is, Melanesians), and of their retreat to Tonga with no provisions.

The engraving was left to provide notice to other Maori ships, and indicates an active colonization by Maoris in the Pacific at the time.

Source: *Epigraphic Society Occasional Publications*, Vol. 1, No. 13 (1974)



Corbis-Bettmann

The Egyptians had a long history of trading and ocean travel, dating back to 3000 B.C. Here, an ocean-going Egyptian ship around 1500 B.C., as drawn from a relief in the temple of El Bachri.

Greeks, and later Romans. There has been a proliferation of names based on geography and ethnicity, and these have been used interchangeably and imprecisely. Thus, we have Moors, Numidians, Carthaginians, Mauritanians, Mauri, and Libyans, and in the eastern parts, Cyrenaicians, Adrimachidians, Libyans, and west Egyptians. The term for themselves by the "square letter syllabic writing peoples" is "Mauri." The languages include Greek, Latin, Egyptian, Maurian, Arabic, Berber, Carthaginian (Punic Phoenecian), and we may expect others. The mix also changed over time.

The core area of concern to Barry's Polynesian studies, (which was the central and eastern parts) has historically been known most widely as Libya, so we will somewhat arbitrarily refer to these peoples, henceforth in this article, as Libyo-Mauri and their language as

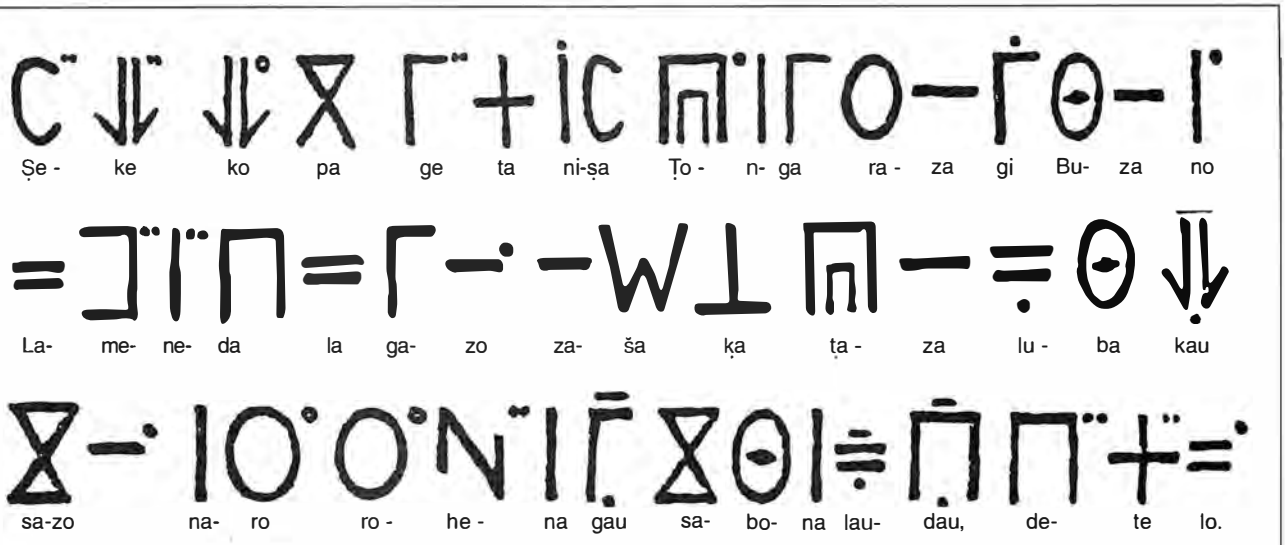


Figure 6
CONVERSION OF ANCIENT MAORI SCRIPT TO STANDARD NUMIDIAN

The script in Figure 5 is converted here to standard Numidian letters, with phonetic equivalences in Roman script. The vowels inserted by Fell are those of modern Maori. The vowels of the vowel-less Numidian/Ancient Maori are actually unknown. As with Hebrew, however, a full translation from vowel-less script represents no difficulty.

Source: *Epigraphic Society Occasional Publications*, Vol 1, No. 13 (1974)

Maurian. As the term "Numidian" for the script is entrenched, we will retain it for the Mediterranean context. For the form it takes in the Pacific, which includes Sanskrit elements, we can say Maurian or ancient Maori. This language was also found written in other contemporary scripts, and is now written in Roman script.

A Dialect of Egyptian

The eastern end of the Libyo-Mauri homeland, adjoining Egypt, appears to be the specific origin of the peoples that proved to be the ancestral Polynesians. This area was heavily influenced by its long association with Egypt, and had absorbed a large Egyptian vocabulary. For all practical purposes, the Maurian language of eastern Libya had become so "Egyptianized" that it could be considered a dialect of Egyptian; yet, it retained its very old and now very small core of Anatolian root words and its Minoan-derived Numidian script.

At the word-root level, Maurian, Ptolemaic Egyptian, and ancient Maori had essentially equivalent vocabularies. Mediterranean texts in the Maurian language could be translated using middle Egyptian or Maori dictionaries. In the case of Maori, this can not be done directly. As linguistic mutations had occurred, these had to be first adjusted for. Corresponding meanings to the level of Roget numbers could then be obtained.

Sparta had established a (Doric) Greek city state at Cyrene, which became a center of learning and culture, providing a steady supply of trained technologists and teachers to Egypt. Cyrene would have been the primary source of Greek loan words in the local (Maurian) language. This area supplied the skilled mariners for the Egyptian fleets (Mediterranean and Red Sea-Indian Ocean) in the last centuries B.C. These mariners, with their hybrid language and Indian cultural elements acquired along the way, had to be the ancestral Polynesians. Other crew on the Egyptian ships would have included peoples from all around the eastern Mediterranean.

The Anatolian, to Cypriot/Minoan, to Libyo-Mauri, to Polynesian evolution was hypothesized by Barry in 1973. It was confirmed by 1978, after etymological word root analyses by Rauol Lochore, who confirmed the core vocabulary relationship to an Anatolian language (Uru), and Linus Brunner, who confirmed the Libyo-Mauri-Egyptian-Greek and Semitic roots in Polynesian.

The Egyptians had a long history of travelling and trading over the oceans. By 3000 B.C. they had large boats, about 45 meters long, for transportation on the Nile. They had mined gold placer-style from the earliest of times, but by 2686 B.C., they had developed hard-rock mining methods in southeastern Egypt. From about 2500 B.C. on, there exist accounts of oceanic travels for mining purposes. The first records (5th Dynasty) are of visits to the Zambesi River region of southern Africa for gold; "Zam-besi" is Egyptian for "River of Gold." By 2200 B.C. (11th Dynasty), these expeditions were also reaching India and beyond, with a regular seasonal shipping cycle and the ubiquitous taxation officials.

Again, around 1520 B.C. (18th Dynasty), further accounts of visits to the Indies are noted, with wording that indicated the possibility of a circumnavigation of Africa. The Ramses III era (1198-1166 B.C., 20th Dynasty) has further accounts of expeditions to Africa, with manpower in the 10,000 range. These extraterritorial episodes occurred during periods of prosperous and stable economies, and strong and expansionist rulers.

Egyptian ships are known to have been up to 67 m (200 feet) long. By contrast, the hull of Francis Drake's *Golden Hinde* was 22 m long, and its weight just over 100 tons. Columbus's *Santa Maria* was even smaller. Egyptian records of oceanic voyaging continue through 800 B.C., but it appears that it continued further, to the Ptolemaic era. The African mines were apparently abandoned around 800 B.C. In 1893 A.D., 2,700 years later, mining engineers reported from south and central East Africa that surface lodes of gold, copper, and tin had been mined to exhaustion. Likewise, mining engineers reported in 1896, that gold lodes on western Sumatra had been mined and tailings dumps existed, indicating ore processing. These mines were later dated to 1200-500 B.C., a time when only the Egyptians were known to mine gold from hard-rock.

Egypt was overrun by Alexander the Great, and the Ptolemaic Dynasty emplaced shortly after this period, but the knowledge of the East Indies and its geology would have remained. Alexander apparently ordered a city to be built on Java (Epargyrometropolis). The Maui Expedition to circumnavigate the world in 234-231 B.C., headed eastward, the direction long familiar to the Egyptians. One only has to see the maps of Claudius Ptolemy (90-169 A.D.) to realize that the Egyptians of the Ptolemaic era had a full knowledge of the Indian Ocean, all the way to Indo-China, and we may comfortably surmise that Egyptians had had this knowledge for more than 2,000 years.

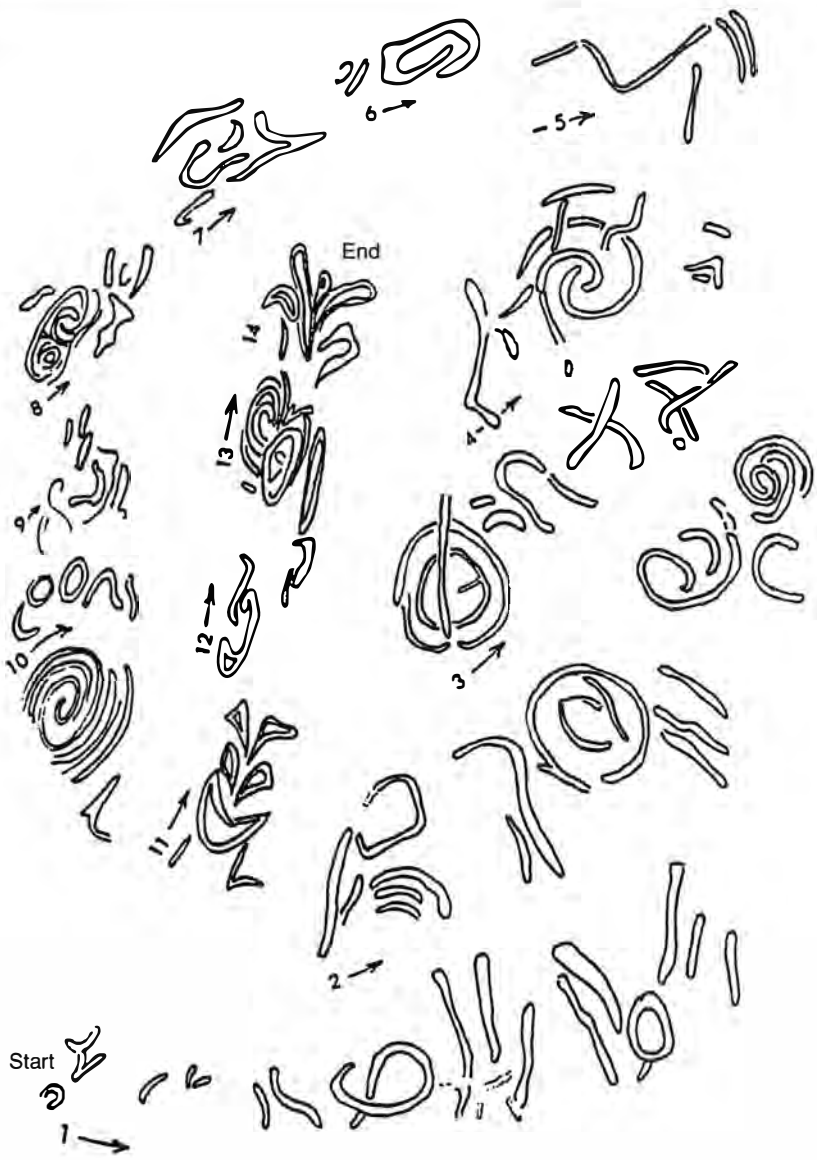


Figure 7
INSCRIPTION ON A BOUNDARY STONE IN TARANAKI, NEW ZEALAND
One side of a two-sided inscription in Maori on a boundary stone in Taranaki, New Zealand. This is the last known use of Numidian script, dated to ca. 1450 A.D. by context, and by named chiefs who were still known from the detailed family lineages maintained in epic oral recitations of existing tribes. The format is a counterclockwise spiral. The script is the modern type and includes vowel pointing.

Source: *Epigraphic Society Occasional Publications*, Vol. 1, No. 16 (1974)

Historical Implications

The historical implications of Barry's epigraphy greatly revised the existing ideas of ancient voyaging and the relationships between cultures. This paper is centered on Barry, but he was only one of a large number of persons, including some distinguished academics. These people had noticed circumstances that gave them cause to question the emphasis on isolationism in current studies of history, archaeology, and anthropology. Many of these people had accumulated collections of data and artifacts, and some had written books (notably Harold Gladwin, 1945; and Cyrus Gordon, 1971) on the probability of early transoceanic voyaging.

Today, practicing archaeologists and historians still ignore, deny, or declare fraudulent anything that contradicts the fixed ideas of the day. Thus, a mass of information exists, but goes (and went) unacknowledged, and is not formally organized. These archives existed privately; and over time, an informal network of contacts had developed among the discoverers and keepers of this information. It was inevitable that Barry would run into this group, and they made their private records avail-

Figure 8
CONVERSION OF NEW ZEALAND ANCIENT MAORI SCRIPT TO STANDARD NUMIDIAN
The script in Figure 7 is converted here to standard Numidian letters, with phonetic equivalence in Roman script. The dialect is Hawaikian. The numbers refer to those in Figure 7.

Source: *Epigraphic Society Occasional Publications*, Vol. 1, No. 16 (1974)

able to Barry. This resulted in an avalanche of data which had very significant American consequences. But that comes later.

For his Polynesian studies, two persons were pivotal. Ruth Hanner of Kauai, Hawai'i, turned over her library of Pacific inscriptions, and geographer George Carter provided a key inscription from Chile, among others. Carter, then a Professor of Geography at Texas A&M, had studied the prehistoric distribution of domesticated animals and plants, and had come to the conclusion that prehistoric ocean crossing was a necessity to account for the facts.

Hanner and Carter provided the epigraphic records which together showed that in 234-231 B.C., an officially organized and commissioned voyage of exploration had been sent from Egypt, eastward through the Indian Ocean, apparently with the purpose of circumnavigating the globe, and to find new gold sources en route. Six ships were used. The chief/captain/admiral was Rata, and the pilot/navigator/astronomer/science officer/official record keeper was named Maui. We know this from detailed records left in a cave on an island just west of Irian Jaya (West New Guinea). These records were dated by the recording of an eclipse, and reference to the reign of the Egyptian pharaoh who had ordered the voyage (Ptolemy III). Part of the justification of the voyage came from Eratosthenes' calculation of the meridianal diameter of the planet.[1]

The two millennia of travels by the Egyptians into the Southern Hemisphere would have indicated to them the spherical nature of the planet, and Eratosthenes' calculation gave a measure of the size of the sphere. The script used in these Irian Jaya records was the Numidian square lettering, found elsewhere in the Pacific. The language was also Mau-

rian, and was arranged in rebuses. Some Egyptian hieroglyphs were used to label a star map. An image of a navigational device called a torquetum was included.[2]

Not surprisingly, the expedition ran into South America, and apparently explored up and down the coast. A party must also have gone inland to look for a passage, for an inscription in Numidian script/Maurian language was left in a cave near Santiago, which indicated that this was the southernmost point of the exploration. It proclaimed the 6,000 (units of distance) of mountains and coast for the King, and gave the date as the fifth day (of a month equivalent to our August) in the 16th year of the reign—which would make it 231 B.C. There is no record of the expedition returning to Egypt.

The inscription reporting a shipwreck on Pitcairn Island, mentioned earlier, is linguistically coeval and materially and subjectively consistent with the Maui expedition. The Maui expedition is the earliest record of Libyo-Mauri (or Maoris) in Polynesia. The huge exodus from Java in 384 A.D., was to come 661 years later. By 1976, Barry learned of the existence of golden plates found in Cuenca, Peru. Although in classic Egyptian hieroglyphic format, they had cartouches identifying Libyan Pharaohs of the second century B.C. How these ended up in Peru is without explanation; no equivalent artifact has been found in Libya.

There now exists a continuum of Libyo-Mauri (ancient Maori) script from the Canaries and Morocco, to Chile, spanning from circa 300 B.C. to 500 A.D. in the Mediterranean, and from 232 B.C. to about 1450 A.D. in Polynesia. It would appear that there would have been a well-established Libyo-Mauri presence in the western Pacific before 232 B.C. The Egyptians had been around the eastern Indian Ocean for perhaps 2,000 years, and during the latter part of this time, the Libyo-Mauris would have been an integral part of the Egyptian manpower.

In addition to the diverse Mediterranean elements in the culture of the Libyo-Mauri people, there were ongoing contacts with the Indians, who, certainly after 200 A.D., would have been participants in the mining and trade in Indonesia. After 384 A.D., Indians took control of the entire area. Except for the adoption of the Muslim religion, urban western Indonesia is culturally Hindi (as is also the Khmer civilization of Angkor Wat). Indian scholars have noted elements of the Hindu culture in Polynesia.

A large part of Barry's epigraphy involved discovering the grammar; discerning regional consonantal usage, alternative letter forms, syntax, and numeral systems; and compiling dictionaries of vocabulary, word etymology, and so on. Although the historical implications of epigraphy are exciting and sometimes astonishing, the reality is that most of the work and publication is drudgery and esoteric.

The year 1974 was key in Barry's epigraphic work. His entry into the diffusionist information network precipitated an avalanche of inscriptions, mostly from America, which diverted him from Polynesian studies for most of the next 15 years—but this is for the next part of this biography. The other event was the founding of the Epigraphic Society.

Intellectual Censorship

In 1974, when Barry wrote his first paper on the origin of Maori for formal publication, he ran into an old acquaintance—intellectual censorship. The anthropologists of Polynesia (almost all white academicians) had built their careers studying what appeared to be a unique but globally insignificant group of insular warrior societies, with no demonstrable outside close affinity, no writing system, and no science or intellectual history. Great sailors, yes, but basically a bunch of naked, albeit noble, savages. The language had been lumped vaguely with Malayan. Coming from the other direction was Thor Heyerdahl, who was trying to make a case for Polynesians being the descendants of South American indigenous peoples, taking to the sea like proverbial lemmings on rafts, in a one-way trip into the great unknown.

Suddenly, into this long-standing, comfortably stable scenario pops up Barry Fell, ostensibly a marine biologist of the Atlantic with the thesis, backed by inscriptions and linguistic co-relations, that the "natives" are nothing less than the descendants of the earliest and arguably greatest of ancient cultures. With a 5,000 year history, and engineering, scientific, and navigational achievements that were not surpassed by any civilization until only 500 years ago, these "natives" had a cultural pedigree and heritage second to none. Their ancestors were mapping the oceans blue, while the professors' ancestors hunted from caves with spears.

Whereas the Maoris had no problem with this possibility, the anthropologists were choked speechless on it. Response was total rejection, and no journal of Polynesian studies would accept Barry's papers for publication. This never changed. After fuming a bit, Barry followed his wife Rene's advice that he solve this problem as he would have done in the Army, and the time when he could not find a cello: namely, innovate.

Thus was born the Polynesian Epigraphic Society. Time and events quickly overtook the scope of the society, when it became apparent within a year that unrecognized ancient inscriptions existed on a global scale. The society became the Epigraphic Society and in this venue Barry published all of his epigraphic studies, along with all those of others who had been censored out of the conventional journals.

In the matter of Polynesian epigraphic work there remained only the Rapa Nui Rongorongos (Easter Island tablets). Starting in 1988, Barry published his conclusions concerning these, a large part of which he had figured out by 1975.

RAPA NUI RONGORONGOS: THE EASTER ISLAND TABLETS

After 1973, all of Barry's research involved epigraphy. Having tenure at Harvard, he had this option. Barry also carried a heavy teaching load, which became a victim of its own success. Harvard had decided, around 1970, to offer less technical science courses, especially for non-science majors. Barry taught an environmental biology course in this program, based on climactically defined ecosystems. The first enrollment was 30 students, and this increased geometrically each year following; more than 800 students enrolled in its fifth year. Before the sixth year began, the university administration cancelled the course, as its popularity was stripping students away from other courses. Also, because departmental teaching budgets were funded on a per capita enrollment basis, this course was financially draining other departments.

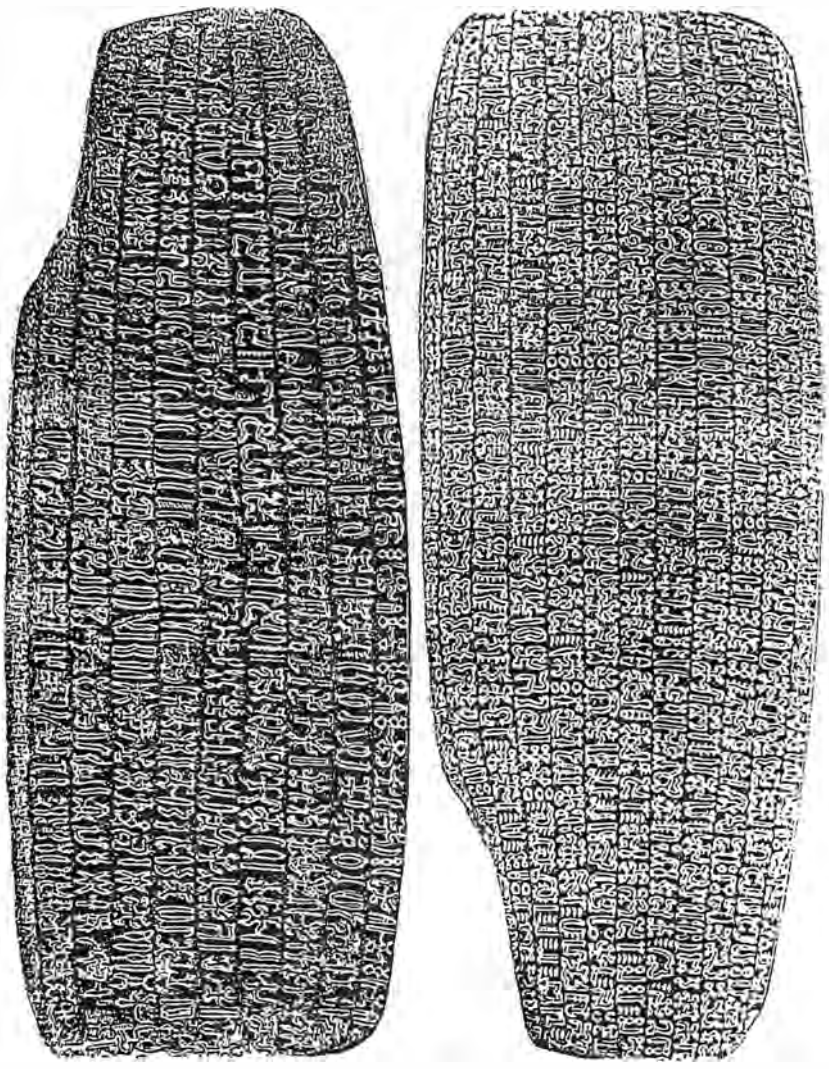


Figure 9
EASTER ISLAND TABLET—RAPA NUI RONGORONGO
This Easter Island Tablet, or Rapa Nui Rongorongo, is named Aruku. Its ideographic script is written in lines that follow a zigzag pattern (inverse boustrophedon). The script is always read from left to right starting at the bottom, and the tablet has to be rotated 180 degrees to read adjacent lines. Each side has been written by a different person.

Barry had the support of his peers at MCZ who knew the scientific (mathematical and biological) basis of his methods. His North American studies were denounced by archaeologists, and some of the most intense ridicule came from an adjacent building at Harvard. MCZ curators were no strangers to controversy. Entomologist E.O. Wilson was taking serious *ad hominem* attacks for sociobiological discoveries arising from his studies of ant behavior.

By 1977, Harvard and Barry had agreed on a formula for early retirement, and his faculty appointment ended. In 1981, Barry re-located to San Diego. Here he found preserved and magnificently restored a tall ship called the "Star of India." This very ship, under a former name, had transported his mother to New Zealand, 70 years earlier.

Return to Polynesia

In 1988, Barry was able to return to the Polynesian works. The Rapa Nui Rongorongos (Easter Island tablets) are wooden boards bearing an unknown script. The existence of these tablets became known to Europeans in 1864, when a missionary sent four of them to Bishop Jaussen in Tahiti. They are now located in museums in North and South America, Hawai'i, and Europe, and the writings were collected into a book by Thomas Barthel in 1958. The tablets have hundreds of letters and characters, and many appear to be variants of each other. The number of these would seem to point to an ideographic script.

Easter Island was culturally devastated in 1862. The entire adult male population, which included all the elders and *tahungas* who could read the tablets, was removed from the island for slave labor in guano pits by business interests in Peru and Chile. Of a total population of about 3,000, more than 1,000 were removed. Within a year, 900 of the slave laborers had died. Protests from Europe compelled the return of the survivors, but these few were reduced in number by measles, to only 15 on the return voyage. The remaining island population was then almost wiped out by disease, hitting a low of 111, of whom only 26 were female. The population has since recovered, but the surviving language contains only 2,100 Polynesian words. The common language is now Spanish.

There existed certain clues:

(1) A chieftain named Metero from Rapa Nui was living in Tahiti, and had thereby escaped the enslavement. When four of the tablets reached Tahiti in 1864, Metero told Bishop Jaussen that he could read them. The content, or what was purported to have been written, was dictated to Bishop Jaussen, who recorded Metero's words. The recital appeared to come from memory, rather than being based on the characters. Metero provided a phrase for each character. The same character in different places represented a different phrase.

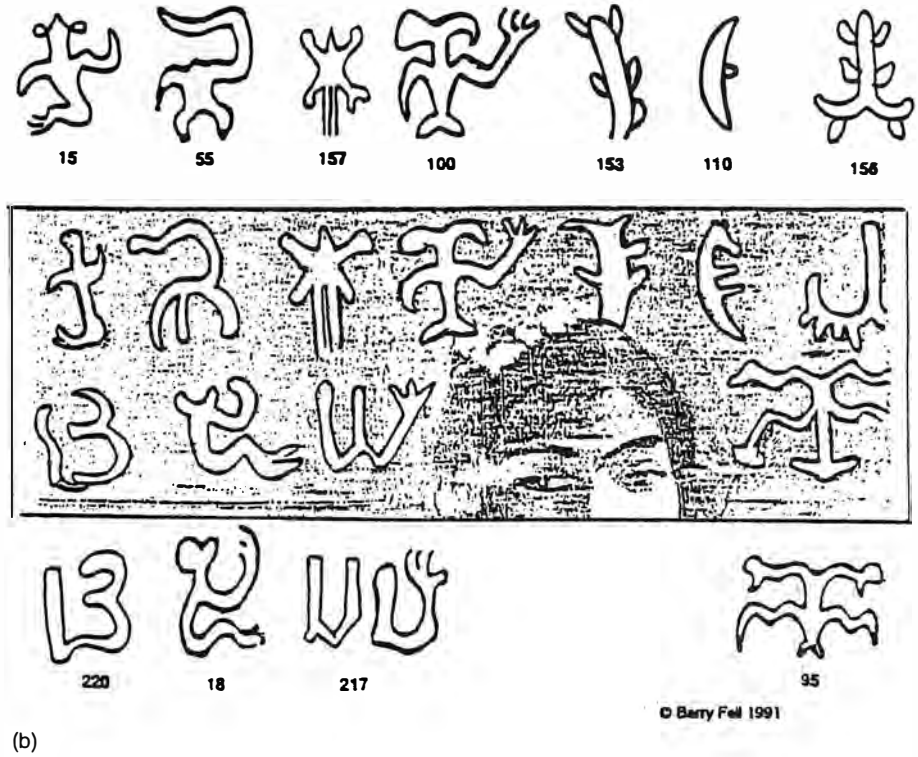
The oddest thing was that when read in sequence, it was utter nonsense. Ideas did not follow, statements were absurd, and the grammar was incorrect. Little credence had been given to Metero's reading, but fortunately the good Bishop recorded it all verbatim.

(a)

Figure 10
RONGORONGO SCRIPT IN 1893 GAUGUIN PAINTING

(a) Part of painting by Paul Gauguin of his Tahitian wife, Tehamana (1893), titled (in English) "The many ancestors of Tehamana." The two lines of ideograms behind Tehamana are in Rongorongo script. Translated in the same manner as the Easter Island inscriptions, the text does, indeed, tell of her ancestors. This painting proved recent knowledge of, and use of, the Rongorongo script outside of Easter Island, and confirmed the translation method worked out by Barry Fell.

(b) Easter Island ideograms matched to Gauguin's painting (center panel). The numbers give the identification serial number of each ideograph based on Metero's vocalizations for Bishop Jausson.



(b)

Source: *Epigraphic Society Occasional Publications*, Vol. 19, p. 279 (1990)

(2) Another islander with knowledge as to the content of one of the tablets left a written record, which was retained by his descendants. When revealed decades later, this corroborated Metero's rendering.

(3) Barry noticed peculiar similarities between 14 (of the 300 or so) "letters," and a Micronesian syllabic script. Each "letter" functioned as a hieroglyph. The phonetic value in both locations was the same, despite the vocabularies being different. The phonetic value corresponded to the Polynesian pronunciations of the pictogram, which pointed to a Polynesian origin. From this, Barry deduced that there had to have been a genuine, underlying writing system, and that it had existed beyond Easter Island.

(4) In 1840, 574 New Zealand chiefs signed the Treaty of Waitangi; another 52 chiefs had signed a prior document. Some of the chiefs signed using an image of an object, which, when named, sounded very similar to the name of the signatory.

(5) Barry's personal acquaintance with Maoris had showed him the extreme dedication that they apply to meticulously learning, verbatim, the chants that recorded the family histories for centuries. From this, Barry concluded that it was very likely that the renderings by Metero of the tablets' wording were accurate.

(6) Many Maori chants and poems in New Zealand also appeared to speak nonsense in the same way. Even the Maoris themselves were puzzled by this, but they always learned the rhymes exactly as they received them, and passed them on faithfully, verbatim. Nonsense rhyming is, in fact, widespread in Polynesia.

(7) Chanting is very important in the perpetuation of Maori lore among elders, priests, and *tohungas.* (*Tohunga* in New Zealand is *tahunga* in Rapa Nui, and *kahuna* in Hawai'i.)

(8) The script might be symbolic or partially symbolic, in which event it would have a hidden meaning, or at least a not-obvious meaning.

Barry's Solution

Metero had provided a phrase for each symbol. Upon matching the Metero text to the written symbols, it appeared that in places there was a core match, but the accompanying words of the phrase varied with each usage. This would point to a key-word writing system, where each symbol was a guide or memory aid, with the speaker filling in the rest from memory. But it was not that simple, because the core match also could vary. For a particular symbol, there could be (a) *isophones:* words of the same sound but having different meaning, such as in English, "to, too, two"; (b) *homophones:* words of similar sound but having different meaning, such as the English "hit, hut, hat, had, hag"; and (c) *heterophones:* different pronunciations using same symbol.

Barry applied a variant of the practice of the Maori signatories, where similar sounding words (homophones) depicting objects that can be drawn are substituted for words that cannot be drawn, or are difficult to render as a drawing. He began by substituting homophones. In the nonsensical chants of New Zealand, the substitutions produced a variety of possibilities, depending on what was substituted; but in every case, one of the solutions produced a chant that rhymed and scanned properly, and the text became sensible and logical.

Barry found that he could transform a variety of Maori chants from nonsense to logic by the substitution of appropriate homophones, and the use of alternate meanings where the same word had more than one meaning. Many of the chants related to changing one's (mis)fortune. It appeared to Barry that a spell, charm, or prayer had to have its intended meaning concealed in order to have, or retain, its intended purpose.

But a problem developed. The existing Maori dictionaries were inadequate. There were words missing, and more than a few chants went unsolved—that is, until Barry switched to using a Tuamotu dictionary. But more of this later.

Having solved the question of the nonsense chants in New Zealand by homophone substitutions, Barry applied this procedure to Metero's recitation of the tablets' text. Character by character, Barry made homophone substitutions (usually only one or two were required), and the result was . . . sense. The first tablet (named Aruku) that he reported upon after applying this procedure, yielded a history of the island. It told of the sighting of the island by Hiti-ai-Rangi and the subsequent landing and settlement. The next tablet examined was called Tahua. Part of Tahua carried large numbers of the character that Metero had identified as meaning domesticated chicken (sounded as *moa*). It had long been assumed that the tablet contained a dissertation on poultry, perhaps in a religious context. Barry quickly determined that the applicable homophone was *moai,* which happens to be the endemic common name of the giant statues.

Translation proved to be an account of the production and subsequent destruction of the giant statues. This would also date the time of manufacture of Tahua to the post-destruction period. However, the very complex nature of the script, and its connection to some chants of great age, would tend to indicate a long development period (and once developed it would have been duplicated and perpetuated with great fidelity). Tahua also yielded epic chants that told the legendary exploits of Maui: capturing the Sun god, stealing fire from the fire goddess, and fishing up an island, all prominent events in Polynesian mythology. The Mamari tablet proved to be a book of medicinal spells and incantations for *tahungas.*

So, it turns out that the Rongorongo text is in a key-word ideographic script. It produces a basic set of words, providing an ostensible or fronting text, which then has to be further manipulated to reveal the real and hidden meaning. This manipulation takes place in the mind of the chanter, and its expression is revealed only in the vocalization. Like Chinese, it is not just what you say, but how you say it that counts. Thus, the importance of chanting in Polynesian culture.

This writing system is endemic to Polynesia. This, and the Numidian (or ancient Maori) script, gives Polynesia two old writing systems. Barry then produced a revised list (or "vocabulary") of ideograms, with assigned common words, to be used directly, or as isophones or in homophone substitution. Wherever nonsense rhyming occurs, we can now anticipate a hidden meaning.

The vocal text produced by homophone substitution (and isophones, where appropriate) agreed so closely with the endemic culture and beliefs of the Easter Islanders, that Barry's "procedure" was accepted by them as correct. Barry received strong support from Maori and other Polynesian sources.

A confirmation came from a surprising source. The painter Gauguin had settled in Tahiti, learned Maori, married Tehamana (a young *vahine* of high birth and education), and immersed himself in the culture. He mentions in his autobiography *No'a No'a,* that his wife revealed many discrete details of her culture to him. In 1893, he painted Tehamana and wrote in Maori using Roman alphabet "Merah metua no Tehamana" (the many ancestors of Tehamana). As only Tehamana is in the picture, it was assumed that Gauguin chose the title arbitrarily, or to emphasize her noble lineage.

Behind Tehamana are two rows of an ideographic, script, which apparently had been declared by some authority to be not related to any known language. The characters, in fact, matched the Rapa Nui script, and when treated to homophone substitutions yielded words that read, "the many ancestors of Tehamana, powerful men of property, drummers, men of importance, warriors bold, as well as others since forgotten."

The painting was what all epigraphers fantasize about—bilingual! It showed that the use of this ideographic script went well outside Rapa Nui, and was still in use within the last 100 years. There is a New Zealand cave painting containing elements of it, and a form of syllabic usage was noted in Micronesia. All these point to a long period of usage. More ideograms were found (by George Carter) on a crucifix impression carved in wood by Gauguin. By homophone substitution, the text reads as three religious sentences appropriate to a Christian crucifix.

To a European or Westerner, the hidden meanings and verbal manipulations must seem illogical and an epigraphic contrivance. To comprehend it, one must understand an aspect of Polynesian culture called *Te Reo Kihikihi* in New Zealand which means language unintelligible to the uninformed, or *Kaona* in Hawai'ian, which means hidden or double meanings. From Hawai'ian sources, we have learned that Polynesians believed that objects had influence or power (*mana*) and that knowledge was one of the greatest powers. The more knowledge was restricted, the more power could be concentrated and monopolized by the "informed." Trade skills were protected by guild secrecy. The priesthood diligently guarded its secrets. Written words were deemed to have enormous power, because they could carry information in distance and time far beyond any spoken word. (In our century, technology has countered and reversed this, so that this concept is not obvious to us.)

Entitlement to knowledge and power (the two being treated as manifestations of the same thing) was regarded as sacred, and therefore knowledge of writing was restricted only to those "worthy" of it. When Europeans appeared, it was obvious that they had great power, which in Hawai'i was attributed to widespread literacy among Europeans. Around 1820, the Hawai'ian kings saw literacy as a necessity to "catch up," and they instituted schooling on a large-scale. By 1840, Hawai'i had one of the highest literacy rates in the world.

Much of the old culture was lost, because knowledge had been restricted to so few, who could be suddenly snuffed out by disease or cultural depredations. In addition, the "informed ones" were rivals of, and had animosity towards, the European missionaries, and were disinclined to share their secrets with these spiritual invaders, who, ironically, were the ones best equipped to record and thereby preserve the secrets.

Mel Kermanham

Barry Fell and his wife, Rene, in 1994.

REDISCOVERING THE POLYNESIAN HERITAGE

A life-long hope of Barry Fell was that the origin of the Polynesians and their language would be found, and that it would be determined whether or not there was a writing system (which he had considered to be a possibility for a long time). In these matters, he ended up seeing results and having a role in the process beyond all expectations.

The source was determined. The historical range proved to be much greater, spanning the Pacific from Java, to Peru and Chile. Barry was able to recognize that pictographs in Hawai'i were actually rebuses, containing statements that provided the cultural context of their locations. These were then used in lawsuits to prevent disturbance of the sites by highway construction. Many Polynesians were astonished and thrilled to learn that the mythological character Maui had been derived from a real person, and that there existed writings by the hand of Maui himself. The Polynesians were considered to be a cultural group that had not passed the Stone Age. Barry showed they had regressed from the Bronze Age (and possibly Iron Age) for lack of metal. For 1,000 years they were the world's greatest mariners. This was not just from being clever; it also derived from the science of Eratosthenes and Egyptian engineering.

Barry's research filled a huge blank in history, and provides the means for others to continue. His comments in his Rapa Nui papers showed clearly that he expected the job to be finished by others. Those continuing the Rapa Nui tablets will have a tough job. Barry's results were with units for which Metero had provided the fronting text. Other tablets will

need to have the fronting text determined, as well as the hidden text.

His works also revealed the blanks in the known vocabulary. Barry preferred to use the New Zealand Maori dictionary in the Libyo-Mauri studies, because the New Zealand dialect is the most conservative; that is, the closest to the ancestral form. The Easter Island dialect is very close to the New Zealand one, but barely 2,100 words remained. Despite the 23,000 words of the New Zealand vocabulary, it became apparent that there was still a block of words missing.

There are 9,000 words known from Tahiti and 26,000 from Hawai'i, but these dialects differ significantly from those of New Zealand and Easter Island. A solution came from the Tuamotu Islands. Despite its proximity to Tahiti, the Tuamotu dialect, like Easter Island's, is very close to that of New Zealand. Through an accident of fate (too many islands and not enough missionaries), many islands of the Tuamotu Group escaped "civilization," and retained their original culture and vocabulary long enough for some non-missionaries to record it.

The Tuamotu dictionary of 1944 contains 32,000 words. The 9,000 extra words showed what was missing from the New Zealand Maori dictionary. These were: (a) those deliberately omitted by missionaries because they related in some way to sensuality, passion, naughty body parts, or to non-Christian religious beliefs or practices; (b) those words that were never recorded because of esoteric and infrequent use, and were simply overlooked; and (c) the words deliberately withheld by Maoris, because of use in matters that the Maoris chose not to divulge, and which later became forgotten.

By using the Tuamotu dictionary, a large part of the missing words can be reclaimed for New Zealand and Easter Island and, by appropriate transliteration, also for other islands.

Having established the Libyo-Mauri/Egyptian (ancient Maori), to Maori, to Hawai'ian dialect evolutionary lineage, a study of the changes in consonantal usage became possible. It turns out that it complies with Grimm's Law. Jakob Grimm (the elder of the brothers) had systematically documented the very consistent changes in usage (mutations) of speech found almost universally in Indo-European languages. Barry found at least 11 classes of these transforms; and the Egyptian component had started to go through the changes even as it was being absorbed by Libyo-Mauri. There now is a possibility of extrapolating (or interpolating) missing vocabulary by applying the appropriate transforms.

Further, the Pacific inscriptions that include vowel notations, and the Maori language itself can serve as a guide to the pronunciation of the vowel-less Mediterranean scripts from which they are descended.

Reaction to the Libyan/Egyptian origin of Polynesians was muted, but accepted as linguistically correct, among persons experienced in epigraphy. The sheer magnitude of the change in accepted beliefs this required was perhaps a little overwhelming. The white anthropologists vehemently denied the possibility, provided no contradictory evidence, and then fell utterly silent; they pretended thereafter that Barry Fell did not exist. In the matter of the Rapa Nui Rongorongo decipherments and translations, the white anthropologists have not made a peep, maintaining a stony silence.

In contrast, the Maoris and other Polynesians have endorsed the findings with enthusiasm and encouragement. The only resistance came from some of the Rapa Nui elders, ironically not for being wrong, but for being right! They felt that sacred secrets should remain secret, and not be revealed. In 1994, the Rapa Nui elders voted Barry honorary membership in their society. He was after all now "one of those who knew the secrets."

* * *

Barry Fell died suddenly from cardiac arrhythmia in 1994.

Julian Fell is a zoologist with a speciality in systematics, evolution, and ecology. He has had a lifelong involvement with museums, in a range of roles from technician to administrator. He has also worked as a technologist in several fields, including mining. Although not an epigrapher himself, he has enjoyed a unique front-row seat during the epigraphic "explosion" of the last three decades.

Notes

1. The story of the 3rd century B.C. Egyptian voyage, and the role of Eratosthenes can be found in Lyndon H. LaRouche, Jr., "On Eratosthenes, Maui's Voyage of Discovery, and Reviving the Principle of Discovery Today," *21st Century*, Spring 1999, p. 24; Marjorie Mazel Hecht, "Eratosthenes' Instruments Guided Maui's 3rd Century B.C. Voyage," *21st Century*, Spring 1999, p. 74; "The Decipherment and Discovery of a Voyage to America in 232 B.C.," *21st Century*, Winter 1998-1999, p. 62; and Karl Stolp, "Indian Inscriptions from the Cordilleras in Chile," *21st Century*, Winter 1998-1999, p. 66. Other articles on the Egyptian voyage appeared in *Executive Intelligence Review*, Nov. 20, 1998.

   Fell's original writings on the voyage are published in various early issues of the Epigraphic Society, Donal B. Buchanan Secretary, 97 Village Post Road, Danvers, Mass. 01923, or e-mail donalb@aol.com.
2. For more on Maui's torquetum, see Sentiel Rommel, "Maui's Tanawa: A Torquetum of 232 B.C.," *21st Century*, Spring 1999, p. 75.

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The Global Warming

by Zbigniew Jaworowski, M.D., Ph.D., D.Sc.

Despite billions of dollars and millions of propaganda headlines, the global warming prophesied by the climate modelling industry is not scientifically real.

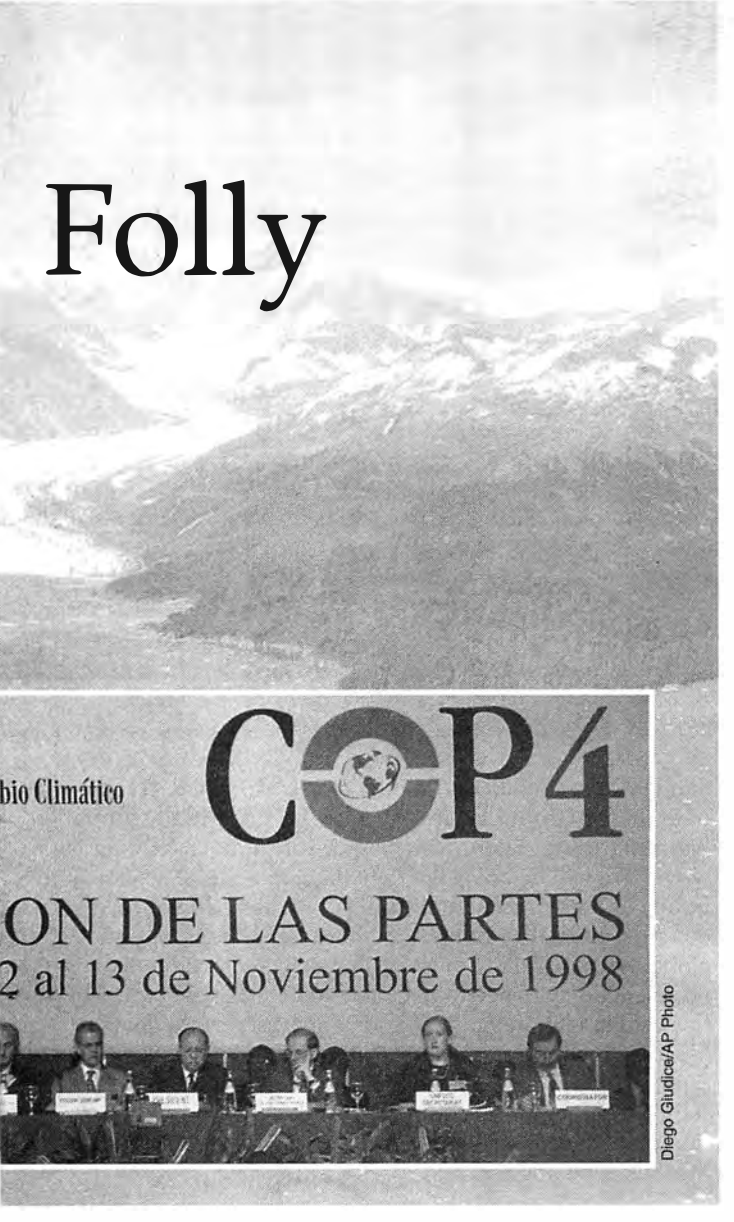
The amount spent on climate studies worldwide has now reached the astonishingly high level of about $5 billion per year.[1] In the United States alone, more than $2 billion is spent annually for climate studies, not including the costs of satellites, ships, and laboratory construction.[2] Climatologists have obtained this immense amount of funding by creating the vision of a man-made planetary climate catastrophe.

In the 1970s and the 1980s, computer models of climate prophesied a doubling of the carbon dioxide (CO_2) content in the atmosphere during the next 60 years. The greenhouse effect of this CO_2 increase, together with that of other greenhouse gases released by human beings into the atmosphere—CH_4, N_2O, CFC-11 (freon), and CFC-12—was supposed to increase the average global surface air temperature by 5°C. In polar regions, the increase was projected to be 10°C.[3-5] Later, in the 1990s, climatologists truncated the computer model estimates of the man-made increase of global temperature by the year 2100, first to 3.3°C, [6] and then to 2.0°C.[7]

Climate warming caused by man-made greenhouse gases, is usually presented as a gloomy catastrophe that will induce the mass extinction of animals and plants, epidemics of contagious and parasitic diseases, droughts and floods, and even invasions of mutated insects resistant to insecticides. Melting glaciers are predicted to raise sea level by 3.67 meters, flooding islands, densely inhabited coastal areas, and great metropolises.[6, 8] There will be mass migrations and a host of other social and environmental effects—always detrimental, never beneficial.

According to one American climatologist, the "scare-them-to-death" approach seems to be the best way to get money for climate studies. Dr. Stephen Schneider, a leading prophet of man-made climate warming, stated this bluntly:

Folly



National Snow and Ice Data Center

The climate modellers claim a global warming consensus, as Mother Nature moves toward a new Ice Age. Here, delegates from 180 countries gather at the Fourth Framework Convention on Climate Change in Buenos Aires last year. In the background is Alaska's College Fjord Glacier.

> To capture the public imagination . . . we have to . . . make simplified dramatic statements, and little mention of any doubts one might have. . . . Each of us has to decide the right balance between being effective and being honest.[9]

Great international organizations, such as the World Meteorological Organization (WMO), the United Nations Environmental Program (UNEP), the Intergovernmental Panel on Climate Change (IPCC), and others, direct the immense stream of money for climate studies. The sources of these funds are the governments of many countries, the European Union, and the World Bank. The IPCC, founded in 1988, became a leading scientific adviser to the governments that are part of the United Nations Framework Convention on Climate Change, adopted in 1992 in Rio de Janeiro, and known for short as "The Climate Treaty."

The IPCC reports, which have become bibles for bureaucrats and environmentalist fanatics, accuse modern civilization of being responsible for global warming, and repeatedly state that they reflect a true "consensus" of the scientific community. This statement about consensus is totally false: The assessments, conclusions, and even the working method of the IPCC are criticized by numerous scientists today. A more accurate description of the current situation would not be consensus, but rather *controversy.* Science does not progress via a process of consensus, or voting. There was no "consensus" for Copernicus's idea, in his time, that the Earth orbited the Sun. Consensus is not needed in science; it is for politicians.

"Consensus is not needed in science; it is for politicians."

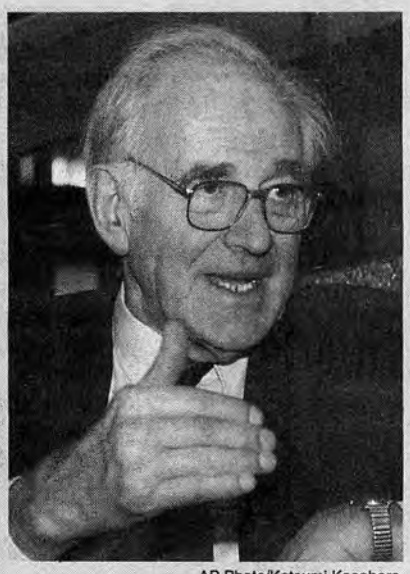
Opinions critical of the IPCC reports have been expressed by many prominent, competent scientists. For example, Dr. Frederick Seitz, a past president of the U.S. National Academy of Sciences and the American Physical Society, President Emeritus of Rockefeller University, former Chairman of the Defense Science Board, and former Science Adviser to NATO, stated: "I have never witnessed a more disturbing corruption of the peer-review process than the events that led to this IPCC report."[10] Dr. Keith Shine, one of the leading authors of the IPCC reports, described the editing process of the IPCC reports as follows:

> We produce a draft, and then the policymakers go through it line by line and change the way it's presented . . . . They don't change the data, but the way it's presented. It is peculiar that they have the final say in what goes into a scientists' report.[11]

About half of the scientists who took part in preparing the IPCC report of 1996 do not agree with its conclusions[12]—hardly a consensus. Even the leading establishment science journals, *Science* and *Nature,* have exposed the IPCC's lack of consensus and its wrong methodology. *Nature* devoted two editorials to the subject,[13, 14] and an editorial in *Science* stated that: "[I]f one examines some of the scientific articles on the subject [climate warming modelling], one finds virtually unanimous agreement that the models are deficient."[15] The incompatibility of IPCC procedures with the usual standards of scientific research led *Science* to write that "IPCC's reputation for procedural correctness and consensus-building around scientific accuracy will be permanently compromised."[16]

An independent organization, The European Science and Environmental Forum (ESEF), recently published two monographs, in which a few dozens of scientists (including Sir Fred Hoyle) present studies contradicting the conclusions of IPCC.[17-18] One hundred or so scientists signed the 1996 Leipzig Declaration, protesting the alleged IPCC consensus and the implementation of the Rio de Janeiro treaty. The Leipzig Declaration termed the provisions of this treaty "drastic policies—lacking credible support from the underlying science—. . . ill-advised, wrought with economic danger, and likely to be counter-productive." In 1998, 17,000 scientists signed what is known as the Oregon Petition, protesting

What the Global Warmers Are Saying



AP Photo/Katsumi Kasahara

Bert Bolin: "In the current post-Kyoto international political climate, scientific statements about the behavior of the terrestrial carbon cycle must be made with care. . . ."

Stuart Lewis/EIRNS

Timothy Wirth: "We've got to ride the global warming issue. Even if the theory of global warming is wrong, we will be doing the right thing. . . ."

against the 1997 Kyoto agreements.[19] These agreements demanded, among other things, a decrease of energy production in the United States by 35 percent in one decade.

Just how sensitive the leaders of the IPCC and related organizations are to the threat of losing credibility (and funding) can be seen in a recent paper by the former chairman of the openly political IPCC body, Bert Bolin, and four leading officers of Global Change and Terrestrial Ecosystems (GCTE) and the International Geosphere-Biosphere Programme (IGBP). Bolin et al., writing in *Science,* Sept. 17, 1999, comment on the study by DeLucia et al. (*Science,* May 14, p. 1177), which projected that in the year 2050, the world's forests would absorb 50 percent of man-made CO_2—that is, that there is no imminent global warming. Bolin et al. state,

> In the current post-Kyoto international political climate, scientific statements about the behavior of the terrestrial carbon cycle must be made with care. . . .

This is an open attempt to include political criteria in forming scientific statements, and to limit the freedom of science. Such statements evoke the unholy ghost of the politically minded Soviet academician Trofim Lysenko.

Both the idea of man-made global warming, and a pressure to limit fossil fuel burning, were politicized long ago.[20] Climate warming became a convenient justification for the now popular neo-Malthusian propositions of limiting the population increase in Third World countries, and the excessive taxing of fossil fuels. The so-called BTU tax would be levied at $500 per ton of carbon,[21] causing an eight-fold increase of the price of bituminous coal and a drastic reduction of global economic activity. The nuclear industry applauds this, believing naively that somehow, the global warming scare will make public opinion more favorable for nuclear energy.

Maurice Strong, Secretary General of the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro, in June 1992, set the stage for the political fight: "We may get to the point where the only way of saving the world will be for industrial civilization to collapse."[12] Strong was seconded by Timothy Wirth, U.S. Undersecretary of State for Global Issues: "We've got to ride the global warming issue. Even if the theory of global warming is wrong, we will be doing the right thing in terms of economic policy and environmental policy." Richard Benedick, another representative of the U.S. State Department, stated: "A global warming treaty must be implemented even if there is no scientific evidence to back the greenhouse effect." Maurice Strong elaborated on his idea of "sustainable development," which, he said, can be implemented by "deliberate quest of poverty . . . reduced resource consumption . . . and set levels of mortality control." This death sentence echoes the 18th century recommendations of Parson Thomas Malthus, who advised:

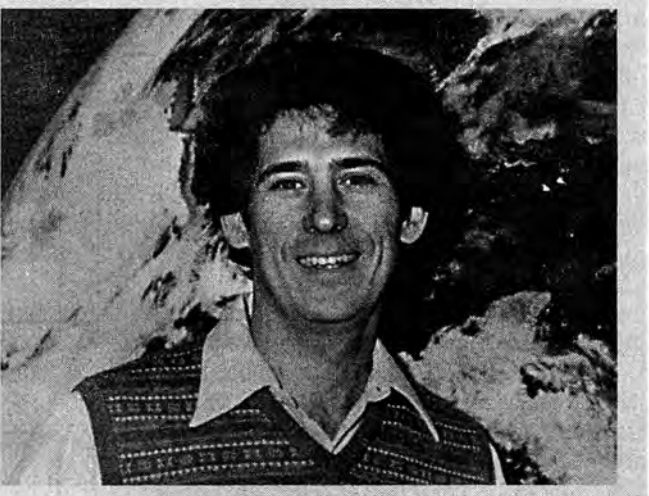
> All the children born, beyond what would be required to keep up the population to this level, must necessarily perish, unless room be made for them by the death of grown persons. . . . [T]herefore we should facilitate, instead of foolishly and vainly endeavoring to impede, the operations of nature, in producing this mortality.[22]

The Benefits and Costs of Catastrophism

Exhortations by climatologists on catastrophic themes are beloved by ministries of environmental protection, because it justifies their very existence. Such exhortations are beloved also by ministers of finance, eager to increase the budgets of their governments by imposing new taxes. Thus, the interest of climatologists in hunting for research grants is concurrent with the interest of governments. In fact, governments may gain about 500 times more than the climatologists: Taxing all industrial emission of CO_2 into the atmosphere (5 gigatons of carbon per year) could reach $2.5 trillion per year. However, losses in the world's economy caused by the BTU tax would be orders of magnitude greater, and could ruin global industry and induce mass impoverishment—just as actually proposed by Maurice Strong in Rio de Janeiro. According to Sir Fred Hoyle, this could have the eventual effect of returning us all to the Dark Ages.[23]

Stuart Lewis/EIRNS

Maurice Strong: "We may get to the point where the only way of saving the world will be for industrial civilization to collapse."



Stephen Schneider: "Each of us has to decide the right balance between being effective and being honest."

Merely 20 years ago, in the 1970s, climate warming was called "amelioration," that is, a bettering of the climate, and the warm periods in the past epochs were known as "climactic optimums." Dr. Stephen Schneider, the leading prophet of greenhouse warming catastrophe cited above, in the 1970s was warning that industrial dust emissions would induce a drastic climactic *cooling*—a cooling that soon after the year 2000 would bring a new Ice Age.[24] At that time, cooling was a better provider of funding for the attack on industry and population than warming!

The Scientific Foundation for Climate Theories

Global warming that is allegedly caused by man-made emission of CO_2 and other greenhouse gases, is a hypothesis based on computer modelling and theoretical arguments. The most *important* foundation for this hypothesis is the analysis of greenhouse gases in ice cores from Greenland and Antarctica. From these results, glaciologists have inferred that the CO_2 content in the pre-industrial atmosphere was 26 percent lower than it is now. In several papers published during the last decade, however, it has been demonstrated that the ice core studies are tainted by the manipulation of data, the illegitimate rejection of inconvenient results, and one-sided interpretations—all of which disqualify these studies as a reliable source of information on atmospheric changes during past ages.

The low concentrations of CO_2 and other greenhouse gases found in air inclusions in the ice, are artifacts resulting from a variety of more than 20 chemical and physical processes that either occur in the polar ice sheets or result from coring the ice; they are not the real concentrations in the pre-industrial atmosphere. Most of these processes tend to *decrease* the concentration of CO_2 in the gas inclusions. These factors were all but ignored by glaciologists in their unilateral interpretations of their analytical results.[25-33]

On the other hand, a meticulous analysis of the abundant 19th century measurements of CO_2 in air, show that its average atmospheric concentration before 1900 was 335 parts per million by volume (ppmv)[34]—that is, similar to the CO_2 concentration in 1978.

Recently, it was found that there is an inverse relationship between atmospheric CO_2 concentration and stomatal frequency in tree leaves, and that this phenomenon provides an accurate method for detecting and quantifying century-scale CO_2 fluctuations. Birch leaves recovered from Holocene-era lake deposits in Denmark by a team of Dutch scientists, for example, demonstrate that 9,600 years before the present (YBP), the atmospheric concentration of CO_2 was 348 ppmv—the same as the CO_2 concentration in 1987. From 9,600 YBP until about 9,400 YBP, the CO_2 levels remained between 333 and 347 ppmv. So, in contrast to the much touted ice core estimates, the stomatal frequency signal shows that early Holocene CO_2 concentrations were similar to those at the end of 20th century.

The authors of the Dutch study stated: "Our results contradict the concept of relatively stabilized Holocene CO_2 concentrations of 270 to 280 ppmv until the industrial revolution."[35] The tree leaf studies corroborate the criticism of ice core studies and destroy the very foundation of the global warming hypothesis.

Temperature Changes: The Long Cycles

The CO_2 content in the atmosphere and atmospheric temperature have never been stable; they have fluctuated since the dawn of time. Geological evidence shows that the atmospheric concentration of CO_2, which is now about 350 ppmv, was about 5,600 ppmv in the late Ordovician, 440 million years ago;[36] 340 million years ago, in the Carboniferous period, it was 4,000 ppmv; and about 90 million years ago, in the Cretaceous period, it was about 2,600 ppmv. These extremely high concentrations were obviously not associated with a "runaway greenhouse effect," the mantra of the global warming propagandists.

For the past 100 million years, the average surface temperature of the Earth and the atmospheric CO_2 level have been decreasing systematically.[37] About 50 million years ago, the CO_2 concentration (2,000 ppmv) was almost six-fold higher than now, but air temperature was higher by only 1.5°C. In the Ordovician, when the CO_2 content in air was 16 times

higher than it is now, the air temperature in the tropics was not increased, and in the high latitudes, there was the glaciation of Gondwanaland.[36]

The reason for the lack of relationship between the temperature changes and CO_2 concentration in past epochs is that it is not CO_2, but water, H_2O, that is the main greenhouse gas. It is also the case that increasing CO_2 concentration above a certain, rather low level cannot increase the air temperature (see below). It was not CO_2 that determined the permanent oscillations of Earth's climate in the past, but rather changes of the solar constant; these are in step with climactic oscillations with a periodicity of about 2,500 years. This is suggested *inter alia* by glacial deposits on the bottom of the North Atlantic, salt deposits in the glaciers and in the oceanic sediments, and the carbon-13 content of tree rings.[38]

In the longer time scale, the duration of alternating and asymmetric cycles of long glaciations, and much shorter warm interglacial periods, was from 20,000 to 400,000 years.[39] Since about 2 million years ago, one cycle has typically lasted about 100,000 years, with glacial cycles that were about 90,000 years long, and warm periods that were about 10,000 years long.[6, 40, 41] During the last 850,000 years, there have been seven or eight such cycles (Figure 1). The temperature difference between the warm and cool phases is 3°C to 7°C.[42]

The present warm period started about 10,500 years ago,[6] and thus one may expect the coming of the new Ice Age soon, perhaps in the next hundred or thousand years. After a Climactic Optimum around 800 YBP, there was a Little Ice Age between 1550 and 1700, when the average surface temperature of the globe was about 1°C lower than it is now (Figures 1 and 2). After 1750, the climate began to warm again, but we still have not reached the warmth of the 12th century (Figure 2). An acceleration of warming occurred around 1938, and then for 40 years, until 1976, the globe was cooling. Between 1976 and 1984, there was a rapid increase of the global surface temperature. The 40-year-long period of cooling of the global atmosphere between 1938 and 1976 occurred when about 75 percent of the total mass of man-made CO_2 was released into the atmosphere (Figure 3). It is obvious that all these changes were not dependent on the anthropogenic emission of CO_2.

At the regional European scale, the measurements from nine representative stations do not show warming between 1780 and 1989. Except for the years near 1940, the climate of Europe has been cooling during the past 200 years (Figure 4). For example, between 1780 and 1980, the summer temperature in Warsaw decreased by 0.39°C; in Vienna, by 0.91°C; in Prague and Budapest, by 0.53°C. In Warsaw, the warmest two-decade periods were the years 1899-1919 and 1934-1954; in Vienna, 1788-1817, 1943-1963, and 1970-1990; in Prague, 1797-1817 and 1943-1963; in Budapest, 1788-1808, 1934-1954, and 1971-1991. The greatest deviation of average temperature, in the region of +0.82°C, was observed in Prague in the years 1797-1817.[43]

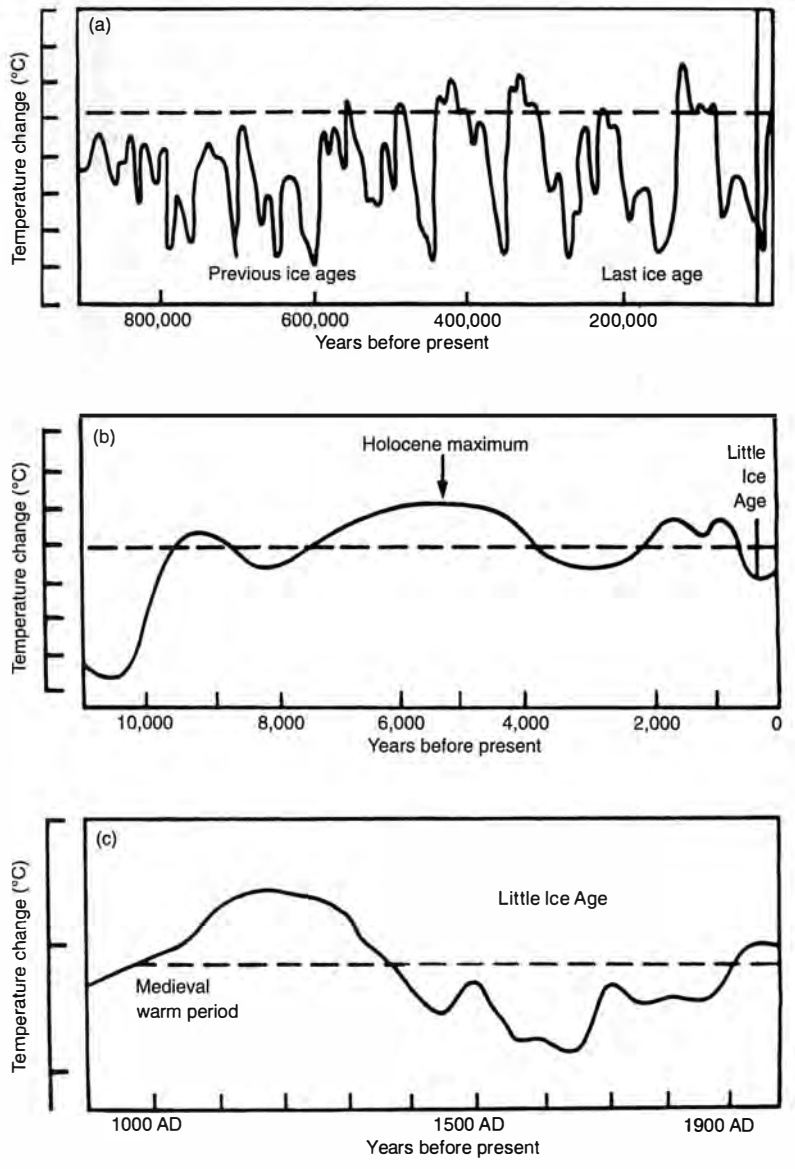


Figure 1
TEMPERATURE VARIATIONS AT EARTH'S SURFACE

The three curves show temperature variations at the Earth's surface during the last million years (a), the last 10,000 years (b), and the last thousand years (c). The dotted line represents temperature at the beginning of the 20th century.

Source: Intergovernmental Panel on Climate Change (IPCC), 1990. (Note 6)

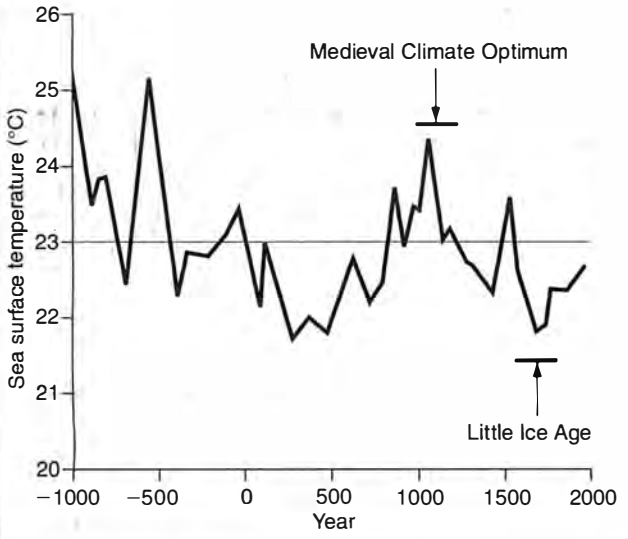


Figure 2
SURFACE TEMPERATURES IN THE SARGASSO SEA

Surface temperatures of the Sargasso Sea—east of the West Indies—have been determined for a period of about 3,000 years by analyzing oxygen isotope ratios of fossil organisms in bottom sediments. The data run to 1975.

During the warming period—about 500 B.C.—Mediterranean countries, the Indian subcontinent, and China enjoyed an unprecedented heyday. A cooling period about 500 A.D. was associated with a decline in the European economy and civilization, from which Europe recovered in a new climactic warming about the year 1000 A.D. Since the end of the Little Ice Age, temperature has not yet come back up to the Medieval Optimum.

Source: Adapted from L.D. Keigwin, 1996. *Science*, Vol. 274, pp. 544-545

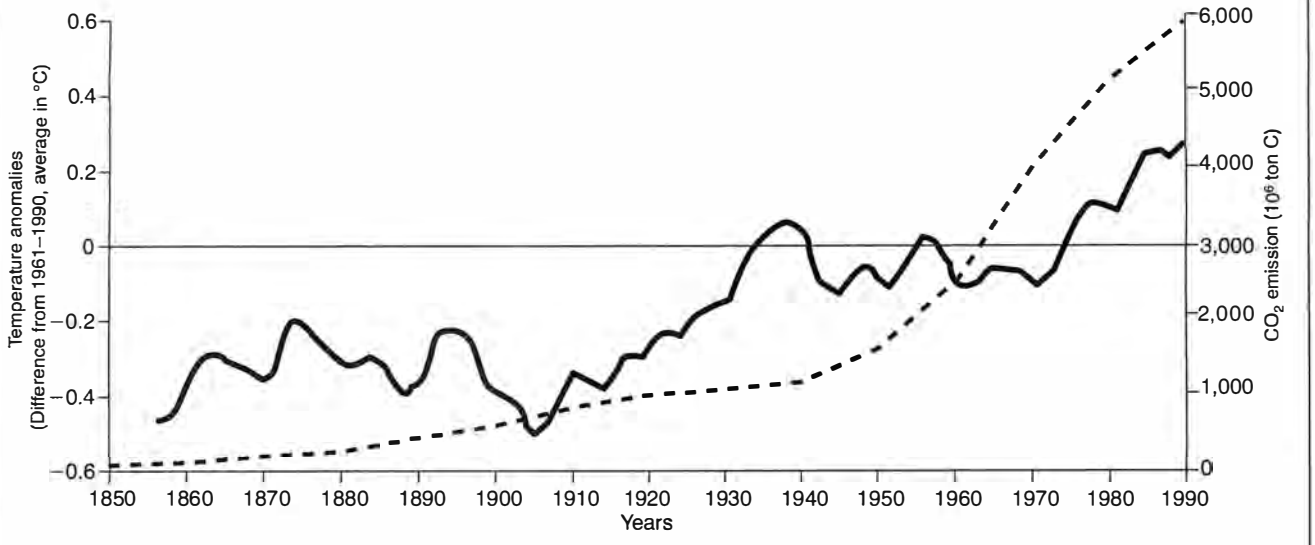


Figure 3
ANNUAL EMISSIONS OF MAN-MADE CO_2 AND TEMPERATURE CHANGES

The 40-year-long period of cooling of the global atmosphere between 1938 and 1976 occurred when about 75 percent of the total mass of man-made CO_2 was released into the atmosphere. Annual emissions of anthropogenic CO_2 (light line) are plotted against temperature changes near the Earth's surface (heavy line).

Sources: Notes 96, 97, and 98

In the United States, average annual temperatures do not show great changes between 1895 and 1997: The centennial trend was only +0.022°C per decade, and for the period 1940-1997, +0.008°C per decade.[44] All these regional fluctuations cannot be related to man-made emissions of greenhouse gases.

Satellite measurements of the temperature of the lower troposphere provide us with evidence against the theory of man-made global warming. Between 1979 and 1997, these measurements (270,000 readings per day over 95 percent of the Earth's surface) revealed a slight cooling trend of −0.04°C per decade (Figure 5). In the same time period, ground-level measurements over land and sea were showing a warming of +0.15°C per decade, and computer models projected a warming of +0.18°C per decade.[46] Satellite measurements up to 1998 are given in Figure 6. The difference between satellite and balloon measurements on the one hand, and ground-level measurements on the other, is usually explained as the result of ground-level measurements being influenced by local heating of the atmosphere by cities, and changes in methods in sea-surface measurements.

Ground-level data for the period 1940-1996 from 107

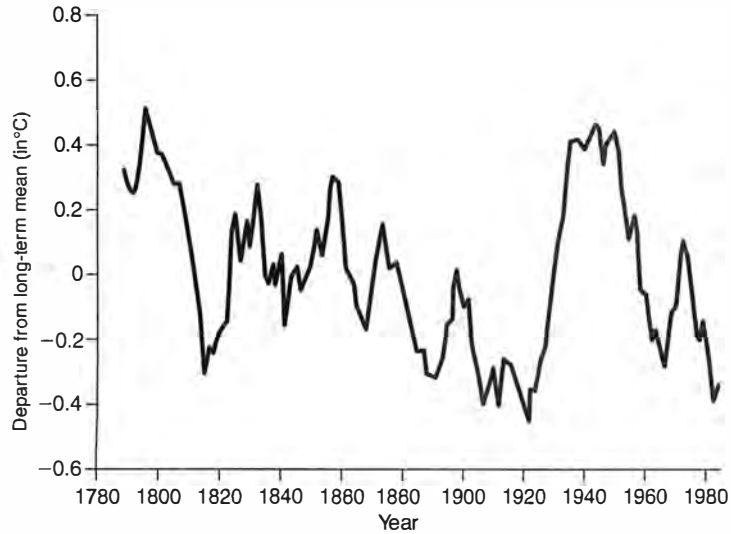


Figure 4
EUROPEAN SUMMER TEMPERATURES (1780-1989)

Except for the years near 1940, the climate of Europe has been cooling during the past 200 years. Shown here are trends of European summer temperatures, 1780-1989, in nine representative European meteorological stations: Budapest, Central England, De Bilt, Edinburgh, Hohenpeissenberg, St. Petersburg, Trondheim, Uppsala, and Warsaw.

Source: G.-R. Weber, 1996 (See Note 43.)

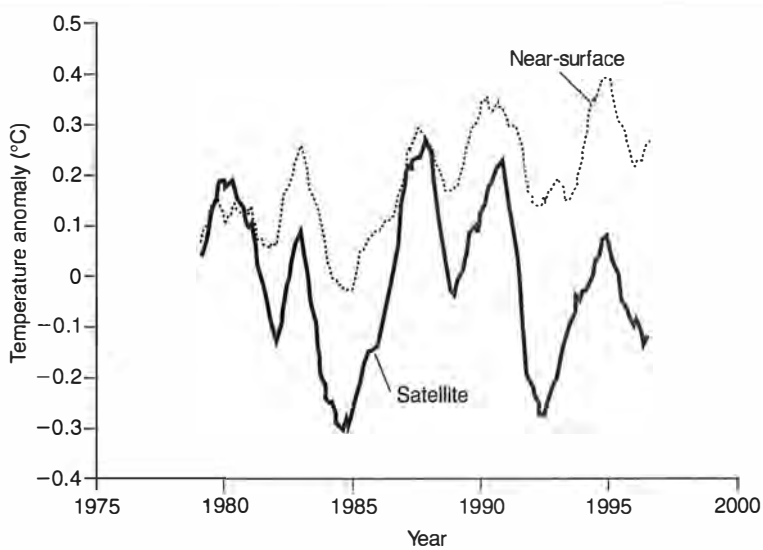


Figure 5
CHANGES OF AVERAGE GLOBAL TEMPERATURE OF EARTH'S ATMOSPHERE

Satellite measurements of the temperature of the lower troposphere between 1979 and 1997 (30,000 readings per day over 95 percent of the Earth's surface), reveal a slight cooling trend of −0.04°C per decade. Changes of average global temperature of Earth's atmosphere are shown here from the satellite measurements in the lower troposphere (solid line), and near-surface measurements over land and sea (dotted line).

Source: Adapted from A.H. Gordon, 1998 (See Note 99.)

stations in California show that temperature increases with increases in population density in areas where these stations are located. In a rural Californian station, Fast Park, which is not near "urban heat islands," a negative temperature trend was registered during the same 1940-1996 period.[47]

The Influence of the Sun

Recent studies by several groups of oceanographers, meteorologists, and astrophysicists show excellent agreement between the fluctuations of sea-surface temperature and the activity of the Sun. During the past 50 years, tropical and subtropical parts of three oceans have been cooling and warming by about 0.1°C, exactly in step with the 11-year solar cycle. This is astonishing, because differences in solar brightness reach only 0.1 percent, not enough to cause the observed temperature changes. It seems that the solar signal triggers a climate effect by some amplifying mechanism. During the Little Ice Age, 300 years ago, solar radiation was only 0.25 percent lower than it is now.[48] Since 1750, air temperature over the Northern Hemisphere has been changing almost exactly in the rhythm of magnetic solar cycles, but not in the rhythm of greenhouse gas changes: When the Sun was more active, the Earth's troposphere was warmer (Figure 7).[47, 49, 51]

The mechanism that amplifies the solar signal is probably a phenomenon like El Niño/Southern Oscillation (ENSO), that is, thermal anomalies of the east equatorial Pacific waters: El Niño, warming, and La Niña, cooling. ENSO anomalies occur as irregular 2- to 7-year cycles, associated with large-scale changes of atmospheric pressure in the tropics, between the southeastern and western Pacific. ENSO influences the climate of the whole planet.[52] Satellite measurements suggest that during the observation period of the last 20 years, El Niño of 1998 caused the strongest ther-

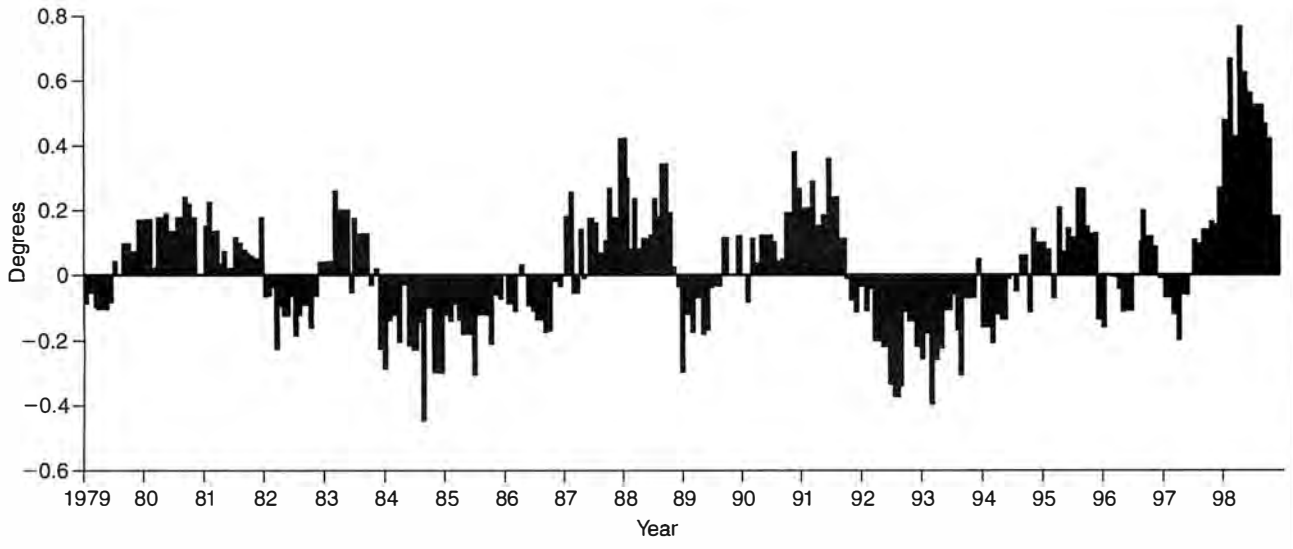


Figure 6
SATELLITE TEMPERATURE MEASUREMENTS IN THE LOWER TROPOSPHERE
Satellite measurements of temperature (deviations from the average) in the lower troposphere, 1979-1998.

Source: J. Christy, R. Spencer, and W.D. Braswell, 1999 (See Note 46.)

mal anomaly in the Earth's atmosphere. In April and May 1998, the deviation of the global temperature from the 1982-1991 average reached +0.7°C.

During the past 20 years, El Niño has occurred several times, but in 1997-1998, it developed without simultaneous volcanic eruption. Twice earlier, El Niño was associated with large volcanic eruptions, which injected enormous amounts of dust into the stratosphere: El Chichon in 1982, and Mt. Pinatubo in 1991. These eruptions caused a cooling of the global atmosphere, which masked El Niño's thermal effects (Figure 6).

It seems that ENSO is probably the strongest factor of natural variability of the global climactic system.[53] Negative and positive anomalies of the global temperature associated with ENSO have been observed since 1958,[54] and some were even observed as far back as 1610.[52]

Numerous observations suggest that the ENSO phenomenon depends on the activity of Sun: Great solar explosions cause dramatic increases of the solar wind, and decrease the intensity of cosmic radiation reaching the Earth's atmosphere. Because cosmic rays provide condensation centers for clouds, great solar explosions probably enable the formation of El Niño, through a short-term, 2- to 3-percent decrease of the global cloud coverage.[52, 55, 56]

Computer Models Are Only Opinions

Computer models of climate are nothing more than the formalized opinions of their creators, on the working of the global climate system.[57] If these models were capable of correctly projecting

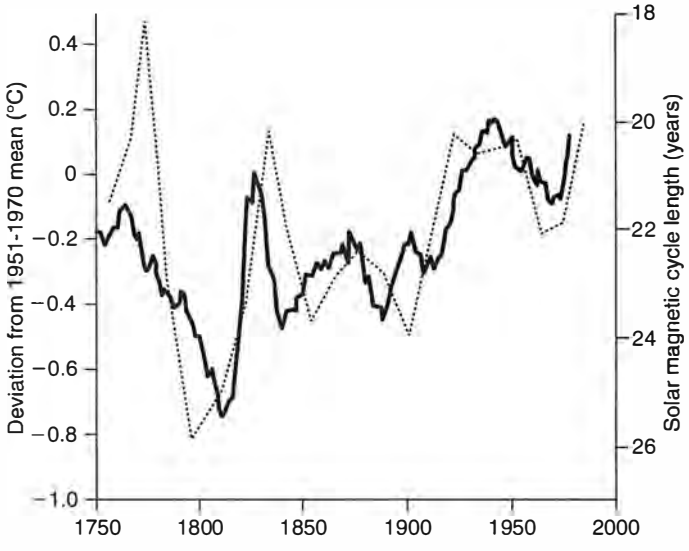


Figure 7
SOLAR MAGNETIC CYCLE LENGTH AND NORTHERN HEMISPHERE TEMPERATURES
The shorter the magnetic cycle, the more active, and hence brighter, the Sun. During the past several hundred years, terrestrial temperature has fluctuated in step with solar brightness, as would be expected. Moving 11-year average of terrestrial Northern Hemisphere temperatures, as deviations from the 1951-1970 mean, are shown by the heavy line. The length of the solar magnetic cycle is shown by the thin line.

Source: A.B. Robinson, S.L. Baliunas, W. Soon, and Z.W. Robinson, 1998 (See Note 47.)

climactic changes, they should be able to pass the test of accurately reconstructing past climates, or at least reconstructing the present climate.

"Computer models of climate are nothing more than the formalized opinions of their creators, on the working of the global climate system."

Usually, for projections of the human impact on climate, one of the many versions of the General Circulation Model (GCM) is used. Testing of the various versions has demonstrated that the models are unable even to correctly reconstruct the present climate. All GCM models had a 100 percent error for atmospheric precipitation predictions, and a 2°C error for global temperature estimates. For the Arctic region, this error reached 10°C, and for Antarctica, 20°C.[58] When 14 GCM models were fed with identical climate input parameters in a test, they produced 14 different answers, ranging from cooling to warming of the global climate.[59] A similar test run for 17 GCM models produced similar results.[60] This explains why the IPCC projection of temperature changes, based on GCM modelling, is in complete disagreement with the real temperature measured by satellites (Figure 8).

The computer models project the greatest warming of the Northern Hemispheric atmosphere in the Arctic, by as much as 8°C to 10°C.[35] These projections, however, have not been confirmed by the *in situ* measurements. At Spitsbergen, where the Norwegian Meteorological Institute has carried out observations since 1912, temperature does not show a positive trend.[61] A lack of warming was also found in five other Arctic regions,[62] on the Scandinavian Peninsula, in Denmark, and in Greenland.[63, 64]

A long series of measurements from 10 meteorological stations, forming an arc around the Arctic, demonstrates that there has been not warming, but rather cooling of the region.[65] Analysis of the data from these stations, covering a Canadian sector of Arctic, Greenland, Iceland, and Eurasia, shows that a strong warming occurred in the Arctic around 1920. Between 1912 and 1920, in Spitsbergen and West Greenland, the air temperature increased by 3.5°C to 5°C. After 1950, the Canadian stations Resolute and Alert observed a cooling trend. In this period, the temperature in Western Greenland decreased by 1.5°C. A negative trend was observed also in the Russian Arctic, with the greatest, short-term temperature decreases of 4°C to 5°C in Franz Josef Land.

Nine Danish meteorological stations in Greenland observed similar long-term changes, with cooling of this region between 1940 and 1985.[65, 66] During the decade 1955-1964, in a sector of the Arctic between Greenland, Norway, Spitsbergen, and Novaya Zemlya, the temperature of surface seawater decreased by 0.1°C to 0.6°C in winter, and 0.1°C to 0.25°C in summer. Between 1945 and 1975, a decrease of seawater temperature of 1°C was also observed around the Faeroe Islands, and the average temperature of the Atlantic north of 35°N decreased by 0.5°C, between 1940 and 1987.[64] A review of temperature measurements from the Greenland Ice Sheet shows a decrease of air temperature during the past 30 years, and a 15 percent decrease of precipitation; both these effects are just the opposite of what computer models project.[67]

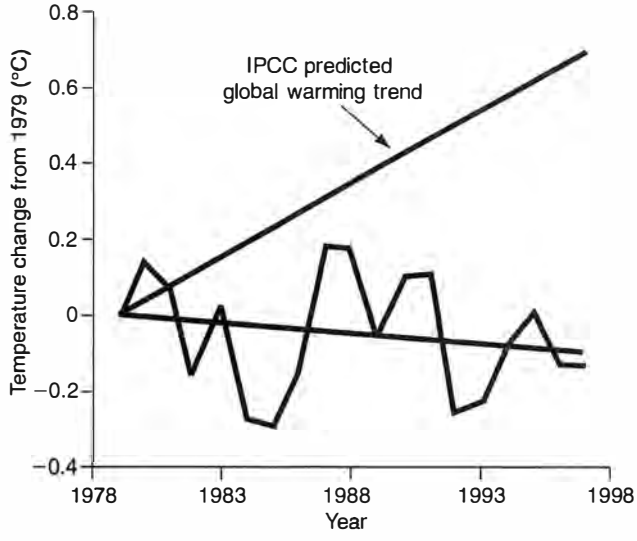


Figure 8
DIVERGENCE OF TEMPERATURE TREND IN LOWER TROPOSPHERE FROM IPCC GLOBAL WARMING FORECAST

The trend of annual temperature changes in the lower troposphere, as measured by satellites between latitudes 83°N and 83°S, diverges from the corresponding trend line predicted by the IPCC computer climate models.

Source: A.B. Robinson, S.L. Baliunas, W. Soon, and Z.W. Robinson, 1998 (See Note 47.)

Farther south, dendrological measurements indicate a systematic summer cooling of 3°C in the Northern Quebec region, between 1800 and 1950.[68] On the southern side of the globe, at the Antarctic Peninsula, the climate has cooled gradually by 2°C since 1850.[69] In comparison with the 19th century, the air temperature at Ronne Shelf decreased by about 0.7°C, and by about 4°C in the 1980s.[70] On the global scale, temperature measurements show a lack of systematic increase of air temperature after the optimum around the 1940s; instead, there is a cooling trend during the next three decades.[57, 71] Since the 1940s, the greatest cooling of climate has been observed at the high northern latitudes,[72]—that is, exactly where the man-made global warming hypothesis projects the highest temperature increase.

"Since the 1940s, the greatest cooling has been observed at the high northern latitudes—exactly where the global warming hypothesis projects the highest temperature increase."

The Growing Glaciers

Satellite radar altimeter measurements carried out by NASA suggest that between 1978 and 1985, the polar ice caps were

growing at a rate corresponding to a decrease of the ocean level of 0.20 to 0.45 mm per year, mainly as a result of the accumulation of ice in Greenland.[73, 74] During these eight years, the thickness of the Greenland ice cap increased by about 1.5 meters, which corresponds to a rate of 0.23 cm per year. The precision of these measurements was questioned on the basis of secret military data.[75] However, the original results of Zwally et al. were confirmed by later measurements during the Geosat Exact Repeat Mission,[76] and by results of laser measurements.[77]

The measurements in central Greenland carried out on the ground by the Expedition Glaciologique Internationale au Groenland (EGIG) and by other groups in southern Greenland, show an average increase of ice of 3 cm to 9 cm per year.[74] Since 1968, the fronts of six out of nine small glaciers studied in western Greenland have started to advance.[66] EGIG measurements have shown that between 1959 and 1968, the surface of the central Greenland ice cap increased in height by 1 meter. Around 1950, most of the ice cap rim in southern and western Greenland was retreating and decreasing in thickness. But since about 1985, numerous of the formerly retreating parts have started to advance. At the beginning of the 1990s, the area of progression widened from the highlands of Greenland, to the lowlands.[78] Recent studies suggest, as one paper states, that "There is no compelling indication of increasingly negative balance conditions which might, a priori, be expected from anthropogenically induced global warming."[79]

Of the 18 glaciers studied in the Arctic, 15 (77 percent) now have a positive mass balance slope coefficient. Some of the glaciers show a trend toward a less negative mass balance, and some others show a significant positive trend. Most of the Scandinavian glaciers reached their historical maximum in the 18th century, during the Little Ice Age. After intensive melting in the first part of the 20th century, 17 Scandinavian glaciers dramatically decreased the rate of retreat and entered a new phase of increasing their mass.[80, 81] Similar changes were found later in Scandinavia and Spitsbergen.[82]

In Antarctica, ice is now growing up so quickly that by about 2050, it will have lowered the sea level by 30 cm.[83] Measurements of ice accumulation indicate that in a large part of Antarctica, the increase of the ice cap now corresponds to 5 to 25 percent of global atmospheric precipitation, and to a lowering of ocean level of 1.0 mm to 1.2 mm per year.[84] Such behavior of the cryosphere does not support claims that the climate is warming, and that the catastrophic visions of a man-made sea level rise will be fulfilled.

The Greenhouse Effect

Only about half of the incoming solar energy is absorbed by the Earth's atmosphere. The rest is scattered back and to some extent absorbed by the atmosphere, or reflected by the ground. The Earth itself radiates at infrared wavelengths, much longer wavelengths than the solar radiation. The Earth infrared radiation, unlike the solar radiation, is strongly absorbed in the atmosphere. The absorption is mainly caused by water vapor and clouds, but also by some trace gases. Only a very small part of the radiation emitted by the ground escapes directly to space. In this way, the atmosphere is heated, and returns radiative energy to the Earth's surface, where it is again absorbed and re-radiated. Thus, a remarkable exchange of thermal energy takes place between the ground and the lower atmosphere. This process, called the greenhouse effect, is responsible for the relatively high mean surface temperature on Earth.

Without the greenhouse effect, the average temperature near the Earth's surface would be −18°C, and not +15°C, as it is now. The difference of 33°C is the result of absorption of infrared radiation by the atmospheric greenhouse gases. The most important greenhouse gas is water vapor, which is responsible for about 96 to 99 percent of the greenhouse effect. A reader of the IPCC 1990 report (the bible of the man-made global warming adherents) might incorrectly believe that CO_2 causes 25 percent of the entire greenhouse effect.

What is striking in this IPCC report, is that water was not even mentioned in any of its eight tables comparing the greenhouse effect of different atmospheric components! If the corresponding values for water had been presented in these tables, the unimportance of the contribution from CO_2 produced by man, in the thermal balance of the atmosphere, would have been very clear. If CO_2 were the only greenhouse gas in the atmosphere, it would contribute about 22 percent of the present greenhouse effect. However, the real greenhouse effect of CO_2 is much less, because of the overlapping of strong 15 μm absorption lines, and the rotational band of H_2O in the 12 μm to 18 μm spectral region.

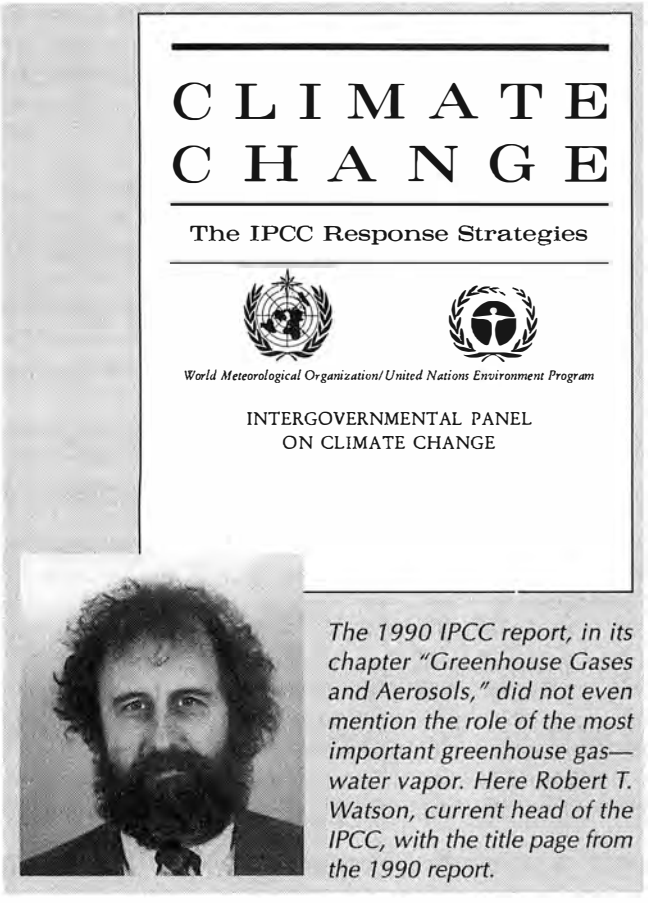
Detailed analysis performed for the summer atmosphere in the middle latitudes indicates that, to the total greenhouse ef-

RESERVOIRS OF CARBON AND CO_2 FLUXES INTO THE ATMOSPHERE

Human industrial and agricultural activity adds about 6 gigatons (Gt) of carbon per year to the total CO_2 flux into the global atmosphere of 169 Gt of carbon per year. This is similar to the amplitude of the annual fluctuations of the total mass of atmospheric CO_2 (5.4 megatons carbon per year). The table shows current reservoirs of carbon at the Earth's surface, and annual fluxes of CO_2 (expressed as carbon equivalents in gigatons = 10^{15} t) into the atmosphere.

Current reservoirs of carbon	(gigatons)
Sediments	60,000,000
Marine dissolved organics	1,000
Marine dissolved inorganics	38,000
Fossil fuels (exploitable)	7,200
Atmosphere	727
Soil	1,300
Terrestrial biomass	834
Marine biomass	42
Natural annual fluxes into atmosphere	
Ocean	106
Land	63
Total	**169**
Man-made annual fluxes into atmosphere	
Fossil fuels and land use	6

Source: Adapted from Z. Jaworowski, T.V. Segalstad, and V. Hisdal, 1992 (See Note 27.)



The 1990 IPCC report, in its chapter "Greenhouse Gases and Aerosols," did not even mention the role of the most important greenhouse gas—water vapor. Here Robert T. Watson, current head of the IPCC, with the title page from the 1990 report.

fect of 342 watts/m^2, water vapor (continuum and discrete absorption lines) contributes 330 W/m^2—that is, 96.5 percent—and CO_2 contributes 12 W/m^2—that is, 3 percent.[85, 86] Other studies, taking into account water vapor, liquid water, and convection heat transport, estimate the CO_2 contribution as 1 to 5 percent of the total greenhouse effect.[87, 89] The remaining greenhouse gases are of marginal importance.

It is the existence of oceans, which emit water vapor, and not the presence of CO_2, that we can thank for a temperature well above 0°C at Earth's surface, that is stable in a range of only a few degrees, which has enabled the existence of life. To the total CO_2 flux into the global atmosphere of 169 gigatons (Gt) of carbon per year, human industrial and agricultural activity adds about 6 Gt C per year (see table, p. 19). This is similar to the amplitude of the annual fluctuations of the total mass of atmospheric CO_2 (5.4 megatons C/year).

Isotopic mass balance calculations for carbon-12 and carbon-13 of atmospheric CO_2 demonstrate that in 1988, the mass of CO_2 from fossil fuel burning, which accumulated in the atmosphere between 1860 and 1988, was about 30 Gt C—that is, about 5 percent of the total atmospheric CO_2 mass.[31, 90, 91] Similar results were found with non-isotopic CO_2 mass balance estimates.[92] Hence, man's addition to the total natural greenhouse effect may be about 0.05 to 0.25 percent.

But even this tiny addition is doubtful. According to recent studies, all of the infrared radiation that could escape the Earth's atmosphere (outside the spectroscopic "window" in the range 7.5–14μm) is already almost completely absorbed. Any increase of CO_2 concentration in the air above its current level cannot contribute significantly to a higher retention of heat by the lower atmosphere.[89, 93]

The Known Consequences of Global Warming Hysteria

The man-made global warming hypothesis is far from being confirmed by observations, many of which suggest that it is false. Environmental daydreamers try to make it seem axiomatic that imaginary dangers of this warming should be remedied without waiting for proof. In fact, they ask that the scientific uncertainty should become a basis for worldwide regulation, which may enormously burden the people of the world, especially in developing countries.

F.B. Cross, professor of business regulation at the University of Texas, warned that "the precautionary principle is deeply perverse in its implications for the environment and human welfare."[94] To fulfill their dreams, however, environmentalists are ready to pay any costs: to impoverish entire nations and thus endanger the environment; to destroy the industry created by the toil and sweat of their forefathers: and to strangle our civilization. It is astonishing how easily and credulously a large part of society, exposed to concentrated media manipulation, has accepted the global warming mythology. One can understand the psychological and social reasons for this acceptance. However, the actions of the United Nations Organization and many governments, leading the Earth's community into an economic and civilizational disaster, on the ground of a wanton specter, do not seem responsible.

Is it perhaps too much to ask politicians to act reasonably, instead of for selfish, short-term interests?

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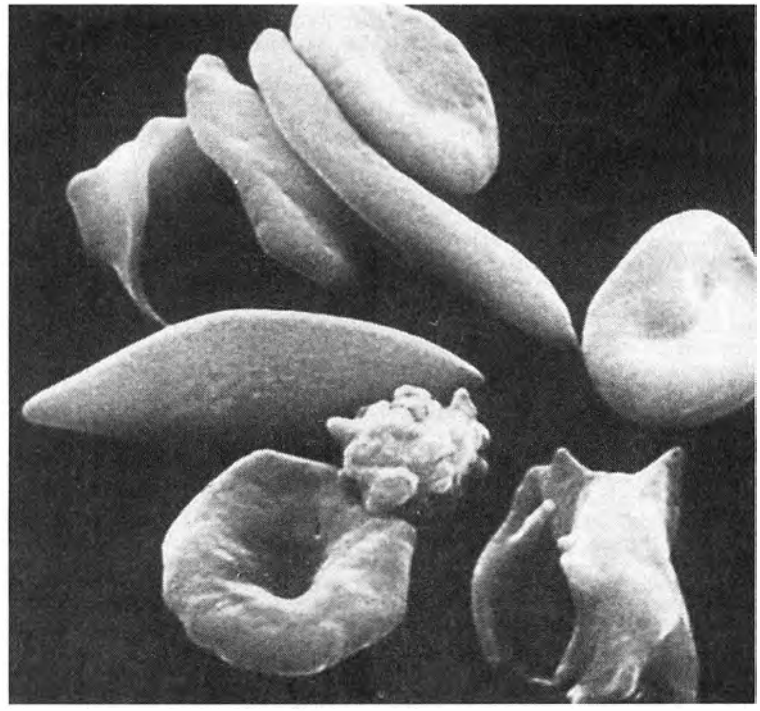
Budget Cuts and Bad Policy Threaten Sickle Cell Treatments

by Cloret Richardson

An estimated 84,000 to 90,000 African-Americans, and 1 in 350 African-American newborns, stand to benefit from research and development into so-called "orphan drug products," such as arginine butyrate, to treat sickle cell disease. In addition, those with beta thalassemia (major), another killer blood disease—against which 1 in 800 and 1 in 2,500 Americans of Greek or Italian ancestry battle to live—would also benefit. Such work could extend the lives of millions throughout the world who suffer from these diseases.



Educational Media/BUMC

Sickled red blood cells exhibit the elongated, crescent shape.

The orphan drug arginine butyrate, a simple fatty acid, continues, in clinical trials over more than a decade, to demonstrate its efficacy and pharmacologic benefits in treating sickle cell disease and beta thalassemia major. Yet funding lags in the effort to perfect the use of an oral-derivative of this orphan drug, which offers safe treatment for these two deadly blood diseases. The problems of development associated with this drug, which have personally affected this author, simply highlight a broader problem with the policies guiding our nation's medical research and development programs.

"Orphan drug products" are defined by law as "drugs of limited commercial value," or upon which "fewer than 200,000 people depend for treatment." For this reason, drug companies often have deemed it "not profitable" to pursue research and development into treatments in such areas. To its credit, the Reagan White House's creation of the Office of Orphan Products (1982), and the subsequent enactment of the Orphan Drug Act of 1983, showed at least an attempt to muster a human response to the above-cited dilemma. However, these efforts have proven to be little more than band-aid measures. The continuation of the free-market ideology, pronounced among members of the present U.S. Congress, has meant cuts in crucial areas of medical research, on the premise that accounting measures of "profitability," can substitute for the founding fathers' commitment to promote "the general welfare," in guiding our national health care programs.

Lifesaving Drug Denied Funding

Born with sickle cell thalassemia, I have been interested in the progress of arginine butyrate to treat sickle cell syndrome and beta thalassemia since the early 1990s. However, in 1997, I was given a more urgent reason to pay attention to the progress of the phase I-II clinical trials of the drug: I became violently ill and, with the exception of a few days here-and-there, spent a great deal of time in the hospital.

It began with a series of progressively worsening painful vaso-occlusive crises, and a recurring drop in my blood count despite regular blood transfusions. Then, I acquired two antibodies, which made more dangerous any further use of blood transfusions to temporarily correct my condition.

After surgery to remove a blood-engorged spleen, which was found to be unrelenting in its quest to deprive me of as much blood as possible, I landed back in the hospital the very next month. This time, I spent several days in the intensive care unit, receiving treatment to avert an even more dangerous complication—irreversible damage to my heart and lungs as a result of acute chest syndrome, another symptom of sickle cell disease. In total, I had now spent the greater portion of four months, consecutively, in the hospital fighting to recover.

What Are Sickle Cell and Beta Thalassemia Syndromes?

Both sickle cell syndrome and thalassemia syndrome refer to several different groups of genetic disorders affecting the hemoglobin—a substance in red blood cells which transports oxygen throughout the body.

The red blood cells of those with sickle cell disease change from their usual donut-like, balloon form to elongated curves, like a crescent moon or sickle shape. These rigid, sticky blood cells clog the blood stream, cutting off the flow of blood to the body's vital organs,

Symptoms of sickle cell disease can mimic other disorders: leg and foot ulcers, inflammation of joints, scarring of the retinal tissue, heart murmurs, and other heart problems. The deprivation of oxygenated blood can cause chronic fatigue, chronic infections, stroke, life-threatening damage to vital organs, tissue necrosis, and acute episodes of excruciating pain in the limbs, abdomen, and lungs.

One life-threatening symptom called acute chest syndrome imitates a medical picture of pneumonia. This symptom is the second most common reason for the hospitalization of sickle cell patients. It involves both pulmonary infection and vaso-occlusive infarction, and is one of the leading causes of death in sickle cell patients. Even under conditions of appropriate hospital treatment, complications caused by the sickling of blood cells can be far-reaching and deadly.

For example, at Boston's Mass-General Hospital, a 22-year old African man with a history of sickle cell anemia, and numerous sickling crises, was placed on a ventilator to alleviate respiratory distress caused by sickling of the blood in his lungs. On the second hospital day, he suffered cardiac arrest. All attempts to resuscitate him were unsuccessful. An autopsy showed that liberated fat from the dead bone tissue of his hip (too frequently deprived of blood, that is, necrosis of the bone) had travelled to his lungs and, in combination with the sickled cells, had caused lung failure.

Until recently, children born with thalassemia (major) rarely survived their first decade of life. Onset of the disease usually occurs in the first few months of life. The early signs are paleness, irritability, fatigue, fever, feeding problems, diarrhea, gastrointestinal complications, and, most notably, failure to thrive.

Treatable symptoms, although they become progressively more severe, include enlarging spleen, severe anemia, jaundice, leg ulcers, easily fracturing bones, and enlargement of the heart.

Damage to the spleen, liver, and heart occur as a result of the accumulation of iron and waste products from the rapid death of red blood cells which, in this disease, are unusually small and fragile. Healthy red blood cells survive for four months; these breakdown within a few weeks. Consequently, the body churns out massive quantities of these premature cells, only to have them rapidly perish.

The need for more red blood cells causes the bone marrow, where they are produced, to expand dramatically; the surrounding bone becomes extremely thin. Because of this process, thalassemic individuals characteristically have a facial appearance with prominent cheek bones, eyes slanted toward the nose, overgrowth of the upper jaw, and dental malformations of the upper teeth. Most of the life-threatening problems and complications of this disease result from the "iron overload."

—Cloret Richardson

Two months later, I was accepted into the Boston University Medical Center phase I-II trial of arginine butyrate for increasing fetal hemoglobin in beta globin disorders (sickle cell disease or beta thalassemia). Dr. Susan P. Perrine, the investigator-initiator of the drug, was conducting this trial. As the originator of both the intravenous form of the drug, and its oral derivative, she has received international acclaim for the promising results achieved with the drug.

I had taken the drug for only a few weeks when funds for this particular five-year study ran out. These clinical trials studied efficacy and appropriate dosing parameters, in inducing the production of fetal hemoglobin in both sickle cell syndrome and beta thalassemia major. A naturally occurring fatty acid, arginine butyrate, administered intermittently, ameliorates the symptoms and complications, which otherwise occur in both sickle cell disease and beta thalassemia major. An "on again-off again" monthly regime of the drug stimulates the body's own production of a form of hemoglobin, the oxygen-bearing protein present in red blood cells.

Dr. Perrine showed that arginine butyrate "artificially" stimulates the body's ability to produce fetal hemoglobin which then acts "in place of" the unhealthy, defective adult hemoglobin of sickle cell and thalassemia patients. All human beings, before birth, produce fetal hemoglobin. Its production usually tapers off after birth, replaced primarily by its adult form.

Dr. Perrine's hypothesis as to why an increase in the production of fetal hemoglobin might improve the conditions of life for sickle cell and thalassemia patients drew upon discoveries contributed to hematology by her father, Richard Perrine, M.D. (see "The Sickle Cell Debacle: How Research Cuts and the Free Market Virus Kill People," C. Richardson, *21st Century*, Fall 1998, pp.10-13). In her own work with the healthy babies of diabetic mothers, Dr. Susan Perrine found that these babies continue producing fetal hemoglobin long after they are born. Her work with arginine butyrate seeks to address the underlying cause of both sickle cell and beta thalassemia.

'Benign Neglect' of an Orphan Drug

For sure, I was extremely upset that a lack of funding could possibly prevent me and the small, international grouping of other sickle cell and thalessemia patients, in the Boston University Medical Center (BUMC) study, from continuing arginine butyrate therapy. This news

Review of Treatments

Readers of my previous articles have requested that I comment on treatments for sickle cell syndrome which have received recent coverage in the media. Here, I summarize these treatments, based on discussions with the medical staff of the relevant hospitals, pharmaceutical companies, or branch of NIH involved in this work.

DRUGS THAT ACT ON SYMPTOMS

The following drugs are being researched for potential benefits they may have for sickle cell patients undergoing a painful crisis. These products are therefore administered only at the time the patient manifests signs of a painful sickling episode.

Drug name: Cordox, or FDP (Fructose 1-6 diphosphate)

Harvard University's Brigham & Women's Hospital Pain Center in Boston leads an experimental study, on behalf of a private pharmaceutical company, of an orphan product called Fructose 1-6 diphosphate (FDP). Fructose diphosphate occurs as an intermediate sugar molecule resulting from anaerobic generation of energy in cells. FDP is being researched for its ability to stimulate and maintain glycolysis, a metabolic process by means of which cells stay alive.

Within 12 hours of the onset of a sickling-pain crisis, the compound is given intravenously. It is then tested for its safety and efficacy in protecting human tissue from dying as a result of the lack of oxygen when sickled cells block the flow of blood to parts of the body.

It is a blind study, where some number of patients receive the compound, and others receive a placebo (an unmedicated preparation). The compound's effectiveness, researchers say, would be indicated by the need for smaller doses of narcotic pain-relievers, and smaller amounts, over a fewer number of days, during the course of treatment in a hospital.

Drug name: Flocor or purified poloxamer 188

At New England Medical Center in Boston, an end-phase research trial, preparatory to FDA-approval, is under way into another orphan product called Flocor. This lubricant, being researched and developed for a private pharmaceutical company, potentially may produce effects similar to those of the fructose-compound, FDP. However, Flocor is not metabolized; it acts externally on the blood cells.

After being injected into the bloodstream, this lubricant, which lowers the surface tension of the blood, passes through the body in 4 to 6 hours. It promises to minimize or prevent tissue damage by "loosening" the binding tendency characteristic of the sticky sickled cells, which clump together and block the flow of blood throughout the body.

Drug name: Nitric oxide

Clinical trials at NIH's Warren Grant Magnuson Clinical Center, at Boston University Medical Center, and at Harvard University's Brigham & Women's Hospital, will study the physiological effects of inhaling nitric oxide, a gas. The study investigates how the gas is metabolized in the body and how it interacts with the blood's oxygen-carrying substance, hemoglobin, in patients with sickle cell, and in healthy individuals.

Nitric oxide is known to cause blood vessels to dilate, and therefore may be suited for use in relieving the clumps of sickled-cells which block pulmonary blood vessels in acute chest syndrome, a pneumonia-like illness affecting sickle cell patients. It has also been suggested that this gas may have a beneficial effect on sickle hemoglobin itself.

DRUGS THAT ACT ON THE DISEASE

Until recently, most treatments for sickle cell syndrome have focussed upon responding to symptoms of the disease. The following drugs are being researched for their potential to act on the disease itself.

Drug name: Hydroxyurea, Droxia, or Hydrea

In its role as a treatment for sickle cell syndrome, Hydroxyurea became an FDA-approved orphan drug for commercial sale in March 1998, for patients over 18 years of age. However, the drug has been approved for sale for the past 30 years in treating certain malignancies.

Research during the recent decade has shown that the drug affects the blood cells of sickle cell patients by way of stimulating the production of a hemoglobin type called fetal hemoglobin. Related research in this field

was the more disheartening, given additional promising results discussed in an unpublished manuscript of February 1998 (privately made available to me), on the effective use of "pulse butyrate therapy" in sickle cell patients.

That report documented that an arginine butyrate pulse regime caused nearly a two-fold increase in production of fetal hemoglobin, in 9 out of 11 sickle cell patients. It was discovered that the presence of a more than 2 percent baseline fetal hemoglobin in sickle cell patients, might signal a predisposition to respond to this pulse regime, because the two unresponsive patients had baseline fetal hemoglobin levels of less than 2 percent. A published account of this multi-medical-school trial is now accessible to the public in a March 15, 1999, article in *Blood* magazine ("Focus on Hematology-Sustained Induction of Fetal Hemoglobin by Pulse Butyrate Therapy in Sickle Cell Disease," by G.F. Atweh et al., Vol. 93, No. 6, p. 1790).

In the BUMC trial, those patients with sickle cell-thalassemia each had, as I do, serious medical reasons preventing them from receiving blood transfusions. Many of them also could not tolerate the "conventional" daily injections of iron-chelating drugs (to remove the buildup of dangerous levels of iron from the body), or could not tolerate a bone marrow transplant. For them, and for me, receiving this treatment is a matter of life versus death, literally.

That is what sparked my preoccupation with investigations of new treatments for these two hereditary blood diseases. And it is why I support every effort made to break the popular me-

for Sickle Cell Syndrome

demonstrates that high levels of fetal hemoglobin in the blood ameliorate the process of sickling in patients with sickle cell syndrome.

Recent clinical studies suggest that higher levels of fetal hemoglobin also are achievable with a therapy that combines the use of Hydroxyurea with intravenous doses of the red-cell growth factor Erythropoietin. Such a therapy is being viewed as an alternative for those sickle cell patients who either respond poorly, or are unresponsive, to the use of Hydroxyurea alone.

Hydroxyurea appears to be toxic to certain blood cells. However, this suppression of certain blood cells, researchers think, may account for the drug's ability to hinder "red-cell clumping" when sticky clumps of sickled cells form and block the flow of blood. This process has been noted to occur even before the drug induces the body to produce any significant increase in fetal hemoglobin.

Other anecdotal findings suggest that the drug may exacerbate the intractability of painful leg and foot ulcers, which commonly plague sickle cell patients. However, the pill/capsule form of the drug makes it very convenient for patients to comply with dosing schedules.

Currently, clinical studies are under way at NIH's Warren Grant Magnunson Clinical Center into the "Effect of Hydroxyurea on Fetal Hemoglobin Synthesis in Patients with Sickle Cell Anemia." The study is sponsored by the National Heart, Lung and Blood Institute.

Drug name: Butyrate compounds: arginine butyrate, oral sodium phenylbutyrate, and oral isobutyramide

The use of butyrate compounds either alone, as in "pulse therapy of arginine butyrate" (discussed earlier), or in combination with doses of Hydroxyurea or Erythropoietin, are currently emerging as the most promising, and safe, means to treat both sickle cell syndrome and beta thalassemia major.

In January 1999, Dr. Susan Perrine of Boston University Medical Center received an NIH grant to study the use of arginine butyrate infusions alone, or in combination with the use of erythropoietin, in elevating fetal hemoglobin in beta thalassemia patients. This is one of eight grants sharing a total of $3 million, advanced collectively by the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) and the National Heart, Lung and Blood Institute (NHLBI). Each of the grants researches aspects related to thalassemia, or the blood disease called Cooley's anemia.

Research into pulse therapy of arginine butyrate, discussed above, was conducted at New York's Mt. Sinai School of Medicine, Boston University School of Medicine, Johns Hopkins University School of Medicine, the University of Washington School of Medicine, and the New England Research Institute in Massachusetts.

The Limits of This Therapy

Arginine butyrate presents an important challenge to the average patient's ability to comply with the needed doses. The drug can be administered only intravenously, and done via an implanted venous access portacath device. This serious obstacle limits patient access to the benefits of the drug's pulse therapy for many reasons:

- Many patients have physical conditions which contraindicate implanting vascular devices, or lack the insurance to cover an operation to implant the device.
- The patient and his family must demonstrate the willingness and ability to master some basic medical techniques to administer the drug in a home setting.
- Administering the drug in an outpatient clinical setting, over a long time period, is inconvenient and may be costly. A typical treatment might require daily 4-10 hour infusions of the drug, 4 to 6 days a week, at least twice a month, on a yearly basis.

These reasons underscore the immediate necessity of developing oral derivatives of the drug, such as sodium phenylbutyrate and isobutyramide. Previous research trials with these oral forms of butyrate-derived drugs have induced fetal hemoglobin production in adult patients with sickle cell syndrome and in those with severe beta thalassemia, as well.

At the time this article was researched, information regarding the number of research trials, or existence of trials investigating sodium phenylbutyrate and isobutyramide (developed by Dr. Susan Perrine), was not available.

—Cloret Richardson

dia's "silence" about the success of the arginine butyrate trials, while at the same time promoting discussions about sickle cell disease and some of the palliative treatments becoming available.

At the beginning of my search for answers concerning the predicament of the butyrate trials, I learned that Susan Perrine, M.D., the investigator-initiator of both orphan products (intravenous arginine butyrate and its oral derivative, isobutyramide), no longer maintained control over production of the two drugs, which initially she had liberally produced in her medical school laboratory. "Exclusive worldwide rights from Children's Hospital Oakland to develop, manufacture, and market" the two orphan, butyrate-based drugs now resided with a pharmaceutical company based in Cambridge, Massachusetts.

In discussion with this author, the company revealed that it had ended its work with arginine butyrate (the intravenous drug) in 1995, and had announced in 1997 that it would also discontinue its work with the butyrate-based oral derivative. The company's press releases show that, in spite of laws governing the activity of orphan drug sponsors under the Federal Food, Drug, and Cosmetic Act, the pharmaceutical company had indeed abandoned both orphan drugs.

Budget Cuts and the HMO Factor

It is to be feared that the highly penetrating influence of health maintenance organizations (HMOs) on healthcare, coupled with federal budget cuts, will take an even deadlier toll on the life of teaching hospitals. Teaching hospitals function as the support mechanism for medical schools, where the nation's

clinical research is largely conducted.

In Massachusetts, under the Balanced Budget Amendment, $1.7 billion has been cut from Medicare payments to that state's hospitals, over five years. On top of this, the federal government has refused to maintain $1.5 billion out of the overall research funding the New England region has relied upon.

Reportedly, 10 percent of the so-called clinical revenues. which the faculties of medical schools generate in caring for the sick, goes to fund research. Any contraction in the so-called "clinical revenues," translates into a diminished percentage of funds allocatable to medical research. This is where the virus of HMO and managed-care plans really begins to "kick-in." These plans select hospitals and doctors based upon a "price-is-right" criterion, where emphasis is placed upon a list of negotiated discounted fees—not the quality of care to be provided, nor the medical needs of the patient.

The form of Senate appropriations bill S1650 also militates against any improvement in patient-oriented research conducted at medical schools. Although the bill repairs previous cuts in NASA and the National Science Foundation budgets, $20 million was "siphoned" from an already anemic National Institutes of Health (NIH) budget to do so. The appropriations for NIH from 1997 to 1999 was one-thirteenth of the $550 billion spent on legalized gambling in the United States in the year 1995 alone!

A 1997 study published in the *Journal of the American Medical Association* utilizes NIH data to show that, from 1986 to 1995, there was a decrease in the share of NIH dollars received by medical schools located in areas highly penetrated by HMOs. ("Relationship between NIH Research Awards to U.S. Medical Schools and Managed Care-Market Penetration," by E. Moy et al., July 16, 1997, Vol. 278, No. 3, p. 217). At the same time, there was an increase in the share of NIH awards, in dollar amounts, for schools in areas where HMO penetration was lower.

The study also states that after 1990, medical schools in the high HMO penetration areas, suffered a decrease in the overall number of NIH awards they received, as compared with a steady increase in the number of NIH grants to schools located in areas of lower HMO penetration.

(Approximately 50 percent of all NIH research grants are awarded to medical schools, and close to 80 percent of federally backed health-related research is distributed by NIH, according to its budget reports.)

The report's toleration of the HMO "profits before people" ideology is striking. For example, it insistently refers to the healthcare system as a *"market"* of sales-related activity, rather than an integral segment of the nation's vitally necessary infrastructure. Yet the "anecdotal evidence," it cites, "suggests the loss of institutional support to start new investigators or to assist" ongoing research between grants, such as in the case of the Boston University Medical Center's arginine butyrate trials to raise fetal hemoglobin in patients with sickle cell syndrome.

Additionally, the study notes that researchers are exiting those locales with high HMO penetration, and that they are attempting to relocate in areas where there are fewer HMOs.

Foreseeing a potential to cause greater damage, the report recapitulates charges made in other case studies stating that, "teaching hospitals are moving to de-emphasize teaching and research [work] and that their faculty members face increasing pressure" to work more at bringing in money through the care of patients, at the expense of doing research. Such tensions make clinician-scientists such as Dr. Perrine, who care for patients as well as conduct research, particularly vulnerable.

Educational Media/BUMC

Susan P. Perrine, M.D., who discovered that treatment of sickle cell patients with the simple fatty acid, arginine butyrate, can stimulate the body's own production of fetal hemoglobin, and thus ameliorate symptoms of the disease.

More Breakthroughs Needed

The treatment of children with sickle cell disease and thalassemia disease differs in many respects from the type of treatment adults with these two diseases must receive. Bone marrow transplantation with umbilical cord blood is a medically viable cure for children with these lethal blood diseases. Cord blood, the blood remaining in the um-

Cloret Richardson

A sickle cell patient in the Boston University Medical Center hospital receiving an infusion of the "orphan drug," arginine butyrate in the General Clinical Research Center at the University's School of Medicine. The drug is being used to treat his refractory leg ulcers., a common symptom of sickle cell syndrome.

Cloret Richardson

The Boston University Medical Center, where federal funding recently ran out for Dr. Susan Perrine's study of arginine butyrate treatment to increase the level of fetal hemoglobin in sickle cell patients.

bilical cord and placenta after the birth of an infant, is a rich source of the type of blood cells found in bone marrow, and hence can be effectively used in bone marrow transplantation. The use of cord blood overcomes two serious problems with the procedure: the need for a perfect blood match, and the potential for the recipient to reject the grafted cells—what is called graft-versus-host disease.

One successful cord blood transplantation received coverage in a 1995 *New England Journal of Medicine* article (Feb. 9, 1995, Vol. 332, No. 6, p. 367). This bone marrow operation grafted umbilical cord blood from a newborn brother without thalassemia, to his two-and-a half-year-old sister, who suffered from beta thalassemia major. Retested and processed at the boy's birth, the cord blood was then transfused into his sister. In this case, the blood type of both recipient and donor was identical. Eventually, the sister recovered without any manifestations of graft-versus-host disease, commonly associated with bone marrow transplantation.

Gauging by the increase in news reports on the topic, the number of bone marrow transplants being performed is on the rise. In the past, this procedure was treated as a last-ditch option in efforts to cure sickle cell or severe cases of thalassemia; and then it was mainly performed on young children. The costliness of the procedure has prevented its use more widely to save lives. Given the success of transplantations using cord blood, both practices need to be reassessed.

The Role of Poverty

That these diseases occur widely among the poor, and prevail throughout the least-developed nations of the so-called Third World, suggests that ancestry plays a lesser role than is usually asserted in textbook expositions, in determining exactly whose progeny are threatened by these diseases. Closer investigation should be made into physical economist Lyndon H. LaRouche's hypothesis that certain types of anemias are borne out of generations of impoverishment and malnutrition. Also, the role played by economic factors, such as collapsing living standards, should be examined, in the incidence of severe forms of both sickle cell and beta thalassemia syndromes. Another factor to be more closely examined is new clinical findings that show increasing numbers of individuals with sickle cell trait, and "carriers" of beta thalassemia trait, becoming symptomatic.

Cloret Richardson is a longtime activist with the LaRouche political movement.

FLYING ARROWS AND FIRE-BREATHING DRAGONS

A History of Rocketry in China From the 13th Century

by Marsha Freeman

Few inventions have had a greater impact on both exploration and warfare than the rocket. It is generally recognized that the first rocket devices were developed in China, during the centuries described in the West as the Middle Ages. In a paper presented at the 50th Congress of the International Astronautical Federation, held in Amsterdam in October 1999, Dr. Lai Chen Chien, from the Institute of Physics of the Academia Sinica in Taiwan, added new detail to the fascinating history of rockets in China.[1]

It is not surprising that rocketry first developed in China, because that is where there was the first reported use of gunpowder. Dr. Chien explained that in ancient China, the word "rocket" described an arrow with flammable material attached to it. The first objects that were called "rockets," however, were not self-propelled devices, using the reaction principle, but simply arrows shot from bows, in which the iron head was replaced by flammable materials, such as gunpowder. The arrangements of these "flaming arrows" would vary, and could be grouped together to increase the effect.

Gunpowder was an important enabling technology for rockets because it does not simply burn; in the right concentration, it explodes. The ingredient that creates this effect is saltpeter, or potassium nitrate (KNO_3). When the saltpeter is ignited, oxygen is released, feeding, and increasing the burn rate of the combustion. Indications are that the Chinese had discovered the advantage of adding saltpeter to charcoal, for the formation of what became called gunpowder, some time in the 12th century.

Dr. Chien reported in his presentation that the Hsung Dynasty, under threat of losing control of the central government of China, used gunpowder weapons in the form of flaming arrows shot from bows, between 1125-1127, to try to fend off an invading tribe. Although the range of the gunpowder arrows was more than 300 yards, the Hsung Dynasty was defeated.

During the next 100 years, technology development continued in the use of gunpowder, and during the early 13th century, nozzles for rocket propulsion were devised. The basic concept, Dr. Chien reported, was to strap a small rocket on to the body of an arrow, replacing the bow, and propelling the arrow forward, increasing its range. An early arrow rocket is shown in Figure 1.

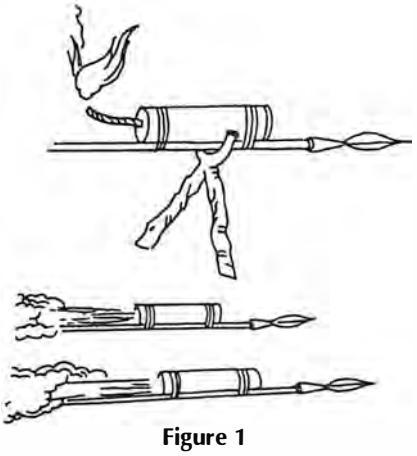


Figure 1
FLYING ROCKET ARROW

Science writer Will Ley recounts in his book *Rockets, Missiles, and Space Travel,* published in 1944, that the oldest Chinese source which records the use of rockets (although not the invention itself), is known as the *T-hung-lian-kang-mu,* which sets the date at 1232. The occasion was a siege of the city of Kai-fung-fu (Pien-king) by the Mongols.

In defending themselves, the Chinese used two new weapons, one of which was an arrow of flying fire. Attached to the body of the arrow was a paper container of gunpowder. When ignited, this spewed combustion products out its rear, propelling the arrow forward. The shape of the arrow was maintained to provide stability during flight. Dr. Chien reported that the range of these early rocket arrows was between 200 and 500 yards.

Other configurations using the single-tube rocket design were employed, in addition to the flying arrow. The "soaring flame bird" was one, made of thin pieces of bamboo fabricated in the shape of a bird (Figure 2). In addition to having the rocket to give it flight, the bird's abdomen was filled with poison and gunpowder. In one battle, Dr. Chien reported, an army of 64 soldiers assailed a town at night, sending hundreds of flame birds into the sky. As they made impact and exploded, the enemy was killed by the poison gas.

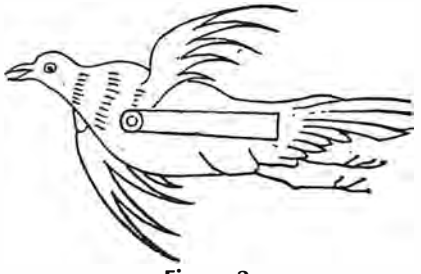


Figure 2
SOARING FLAME BIRD

Increased Range and Firepower

The next great leap in rocket technology came during the first century of the Ming Dynasty, beginning in 1368. This period also saw the design and construction of fleets of great ships, which sailed the east coast of Africa. Two sig-

nificant improvements made in rocketry in this period were multi-tube rockets and multi-stage rockets.

Multi-tube rockets are the forerunners of today's clusters of boosters that are very common in the Soviet/Russian design, where the base of a large rocket is surrounded with a circle of smaller rockets.

The Chinese developed a range of multi-tube rocket configurations, which were designed in different styles, for different purposes:

• The "seven arrows pipe" was developed to combine increased firepower with mobility. Seven pieces of bamboo, 3 feet in length, were bound together, and each pipe was filled with an arrow, carrying 6 inches of gunpowder and a poison iron head. All of the fuses were tied together, so that the entire combination produced thrust simultaneously. The assemblage could be placed in a leather bag with a strap, to be easily carried by a soldier (Figure 3).

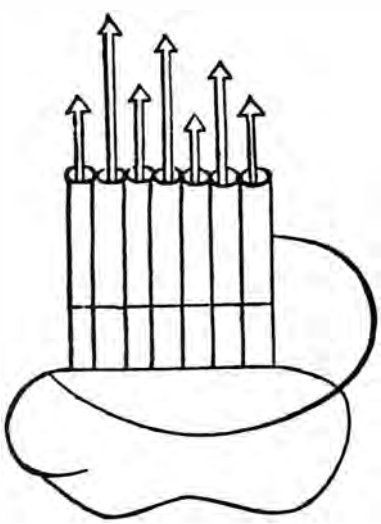


Figure 3
SEVEN ARROWS PIPE

• A similar design, holding 32 arrows, was called the "swarm of bees rocket," and is reported to have been effective in killing soldiers and horses.

• The most ambitious design appears to have been the "Hundred Arrows Chest." Each of 100 tubes was filled with 2 pounds of gunpowder and equipped with a 5-inch dagger at the head of the arrow, for added lethality. To extend the range, the Chinese developed the multi-stage rocket, where rockets ignited sequentially—a technology later employed by the 20th century's space pioneers.

• Perhaps the most frightening incarnation of these early two-stage Chinese rockets was the "fire dragon over water," shown in Figure 4. Its purpose was to attack and destroy ships.

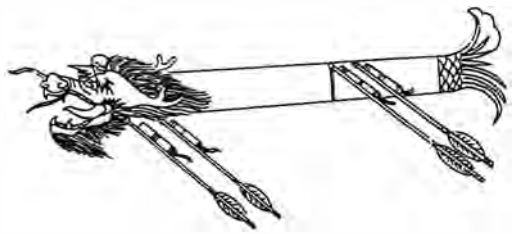


Figure 4
FIRE DRAGON OVER WATER

The body of the dragon was a 5-foot piece of bamboo, hinged on a dragon head and tail. Under the belly of the body, were four propulsive rockets, two at each end. These four underbelly rockets were ignited simultaneously to propel the weapon.

The dragon would fly above the water's surface by 3 to 4 feet, for a range of more than 2 miles. When the four propulsion rockets reached burn-out, they would ignite the gunpowder rockets in the abdomen, ejecting them from the mouth of the dragon—undoubtedly a frightening sight for the intended victims.

• The "burning crow" two-stage rocket was a refinement of the bird design (Figure 5). One pound of gunpowder was wrapped tightly in paper in the body, equipped with a head, wings, and tail to balance it during flight. Four tube rockets were installed under the wings for propulsion. After a flight of about 1,000 feet, the burning bird would arrive at the target, and hit the ground to burn an enemy camp, or a ship.

Rocketry Declines in Ming Dynasty

Although the Chinese had made great contributions to the development of rocket technology and manufacturing techniques, that development stopped at the middle of the 15th century. Dr. Chien attributed this to a "turning inward" of the the Ming Dynasty, where "the government paid more attention to literature and social sciences, and took no care of science and technology development."

He also stated that, in his view, the lack of support for the study of chemistry and metallurgy, and poor theoretical and experimental skills, contributed to the decline. In addition, the Manchu Dynasty that governed China after the Ming Dynasty, he said, restricted the production of weapons, and research and development in weaponry was forbidden by the government. The manufacture of gunpowder and related products was also prohibited.

The "conceited" Manchu Dynasty, Dr. Chien said, ignored the development of weapons in Europe, and prevented the population from becoming acquainted with Western civilization. Rather than continue the development of rockets, the Manchu Dynasty gradually replaced the ancient rockets with cannons. Indeed, when the British attacked China during the Opium Wars, they encountered the same paper rocket tubes filled with gunpowder that their ancestors had been aware of centuries before.

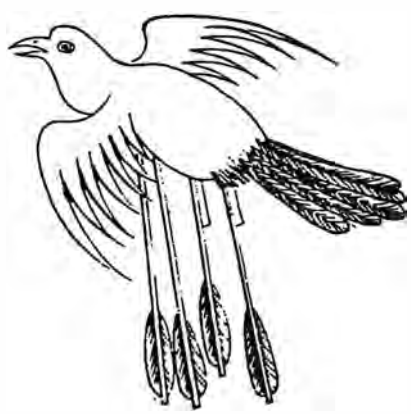


Figure 5
BURNING CROW

But the developments in China had a profound global impact on rocket technology, as news of these new weapons quickly travelled around the world. Willy Ley reports that a mere eight years after the battle at Kai-fung-fu, an Arab scholar compiled a book in which saltpeter is mentioned, and from the Middle East, knowledge of gunpowder and rockets travelled to Europe, where the next major developments in rocketry were made, five centuries after the first rockets were fired in China.

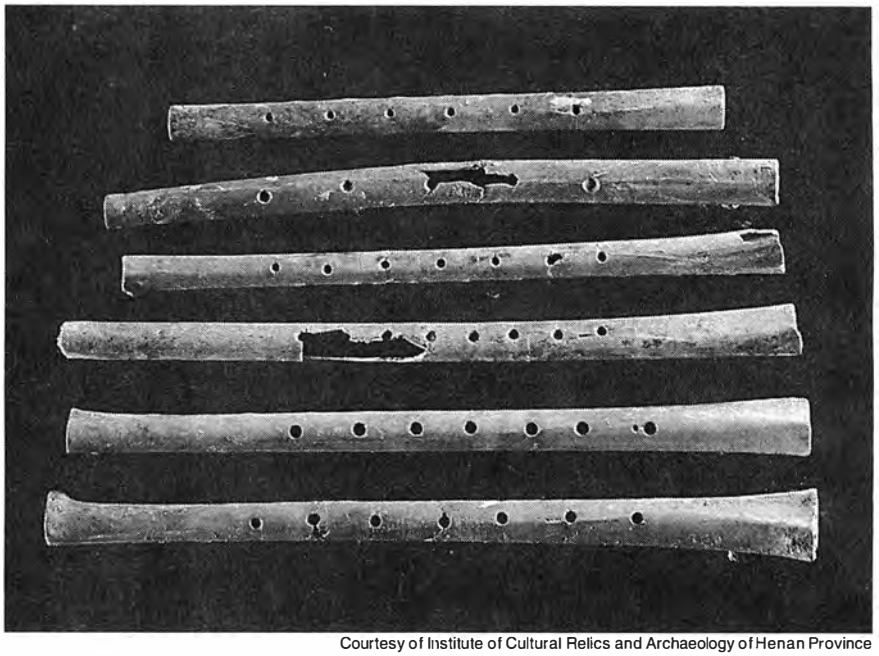
Notes

1. "Multi-Tube and Multi-Stage Rockets in Ancient China," by Lai Chen Chien, Institute of Physics, Academia Sinica, Taiwan, China; and Youn Chiung Liuo, Yu-Jen Su, and Yu-Ting Ke, Institute of Natural Science Education, National Taichung Teachers College, Taiwan, China.

THE CRANES OF JIAHU

7,700-9,000 Year-Old Flutes Found in China

by David Shavin



Courtesy of Institute of Cultural Relics and Archaeology of Henan Province

Six bone flutes, 7,700 to 9,000 years old, from the early Neolithic site of Jiahu, China. The second from bottom flute may be the oldest playable instrument in the world.

Approximately three dozen flutes, made from the wing bones of red-crowned cranes between 7,700 and 9,000 years ago, have been recovered from the early Neolithic site of Jiahu, in Henan Province, China. The excavation and carbon-14 dating were carried out by researchers from the Institute of Cultural Relics and Archaeology of Henan Province, the Archaeometry Laboratory at the University of Science and Technology of China, and the Paleobotany Laboratory of the Academia Sinica in Beijing. Garman Harbottle, a senior chemist emeritus at Brookhaven National Laboratory in New York, an expert in carbon dating, was also a member of the Jiahu research team.

Six largely intact flutes (see photo), approximately 20 to 22 centimeters long, were displayed on the cover of *Nature* magazine Sept. 23, 1999, each with five to eight notes.[1]

One of the three seven-note flutes was recorded and heard for the first time in about eight millennia, by Huang Xiangpeng's team at the Music School of the Art Institute of China. The reader may hear a folk song performed by Taoying Xu on the internet,[2] a haunting experience that may contribute to putting millennial events in perspective.

The seven notes of this particular flute, span one octave and seem to approximate fairly closely the notes A, B, C, D, E, F#, and A, starting from the A two octaves above middle C, and going up. Even here, in this largely whole-tone scale, the half-step between B and C speaks volumes against the persistent cultural relativists, who would isolate the "Western diatonic scale" from other, reified, "ethnic" constructs. As in the case of the flute fragment found in Slovenia, from at least 43,000 years ago, the mind that can carve out a diatonic tuning —with room in the scale constructed to be able to mirror, and so be able to reflect upon, an initial idea with apposite material—is a universal mind.[3]

The Jiahu site was discovered in 1962 by Zhu Zhi (now deceased), the director of the Wuyang County Museum, in 1962, but less than 5 percent of the site has been examined so far. Foundations of homes, cellars, pottery kilns, and separate areas for residences, workshops, and burials, all indicate a fairly well-developed civilization. Where the Jiahu culture came from is not clear, but the geographical area of the site is in the Central Yellow River Valley of China, bounded on north and south by the flood plains of the Sha and Ni rivers, and bounded on the west by Mt. Funiu. It may well be that this area became a "new" inland waterfront area, after the retreat of the Ice Age, and was a prime area for development.

Another example of the development of this culture is that the particular, "A-minor" flute in question, had a tiny, extra, precision-drilled hole, near its lowest note, evidently correcting for the lower A that was heard about half of a half-step too flat for the upper octave A. So, the local machine-tool shop had to develop a super-fine drilling procedure to engineer the proper A-octave relationship back into the flute.

May the cranes of Jiahu be heard for millennia to come!

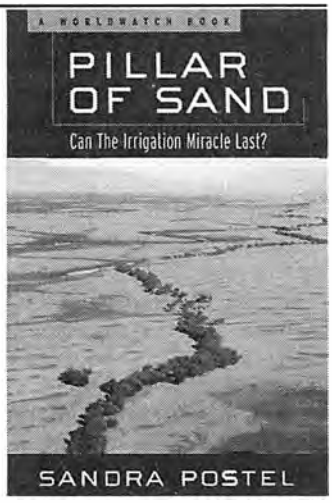
Notes

1. "Oldest Playable Musical Instruments Found at Jiahu Early Neolithic Site in China," by Juzhong Zhang, Garman Harbottle, Changsui Wang, and Zhaochen Kong, *Nature*, Sept. 23, 1999, p. 366.
2. www.nature.com or http://www.bnl.gov/bnlweb/flute, which has a recording and a video of the flute.
3. "Neanderthal Flute in Tune with Classical Diatonic World," by David Shavin, *21st Century*, Winter 1997, p. 6.

WHAT WORLDWATCH DOESN'T TELL YOU

'Natural' Water Resources Are Man-Made

by Marcia Merry Baker



Pillar of Sand:
Can the Irrigation Miracle Last?
Sandra Postel
New York: W.W. Norton & Co., 1999
(A Worldwatch Book)
Paperback, 313 pp., $13.95

Pillar of Sand is a book that you don't need to read—but you want to beware: The book is a product of the international propaganda mill, the Worldwatch Institute, for which the author, Sandra Postel, is now a senior fellow, and was formerly vice president for research, from 1988 to 1994. She now heads the Global Water Policy Project in Amherst, Mass.

Postel reviews locations around the globe where there are water shortages, and then she attributes water resource depletion to *over-use* of technology, in particular, technology for irrigation. Moreover, Postel includes a chapter on the history of irrigated agriculture in ancient settings, concluding, "History tells us that most irrigation-based societies fail."

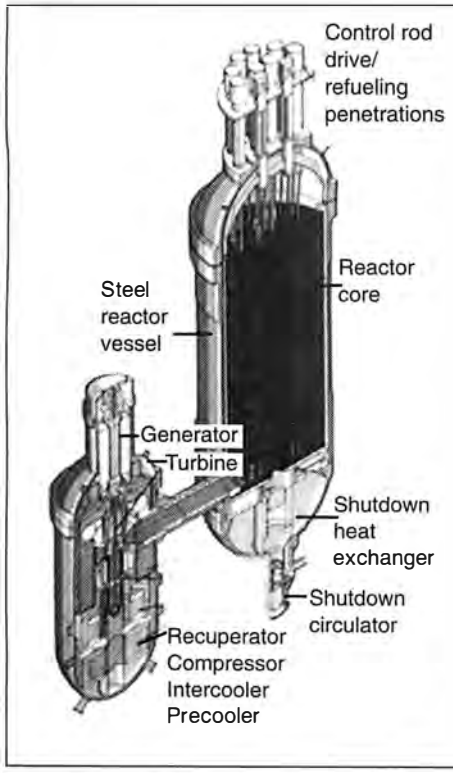
In reality, under the worsening economic conditions in almost all nations over the past 30 years, advanced science and technology have been *held back* in infrastructure, industry, agriculture, medicine, and other areas. National economies are failing because of the *under-use* of technology, interlinked with the spread of "free" (rigged) trade, speculative financial bubbles, and globalism, backed by the very political and financial interests Worldwatch serves—the International Monetary Fund, the World Bank, and related private circles.

There are many examples. In Africa, there has been no modern, high-tech river-basin development, nor nuclear-powered desalination, which would allow fabulous irrigation and agricultural and industrial improvements. In North America, nuclear-powered desalting systems have not been built as originally planned; for example, the abandoned plans for desalting in southern California, and on the Atlantic coast, where saltwater incursions are severe.

Water expert Postel does not criticize such advanced technologies as nuclear-powered desalination techniques, nor electron-beam treatment of wastewater, nor other high-tech water supply systems: She does not even mention them! Nor does she even identify advanced water usage systems in agriculture—hydroponics and aquaculture, for example.

Instead, Postel proposes a list of practices, many of them low-technology, which she refers to as her "Blue Revolution" strategies. For poor countries, this means foot-treadle pumps for lifting groundwater, for low-cost bucket-drip irrigation. For California, this means relining canals, re-cycling farm run-off, and so on.

She also includes a Blue Revolution proposal for "water markets." This exactly complies with the demands of global commodity cartel interests, best known as the "BAC"—British-American-Commonwealth grouping: to monetize and privatize water "rights," along with



GENERAL ATOMICS GT-MHR

The gas-turbine modular helium reactor (GT-MHR) is simple in design and inherently safe. Its compact, direct-cycle system eliminates the need for a steam generator, steam turbine, and various feedwater pumps and condensers. This gives the GT-MHR its high net efficiency of 48 percent, compared to the 33 percent efficiency of conventional power plants.

GT-MHR modules can be combined with a low-temperature multi-effect distillation system, using the reject heat from the power plant to distill seawater efficiently and cheaply.

Source: General Atomics

all other vital economic commodities. Postel writes: "Until fairly recently in the United States, a variety of federal and state laws and regulations inhibited farmers from selling their water. . . . As legislatures and courts gradually sweep away these restrictions, markets are opening up."

Worldwatch's Plan: Cut People

The fundamental premise of Worldwatch, founded in 1974, is that population growth has exceeded science and technology. This is the outlook of Worldwatch's founding sponsors among the international financial and political circles, who want power and control through globalism. The key foundations providing financial backing reads like a "Who's Who" of heirs to the British East India Company, including the Rockefeller Brothers, Pew, MacArthur, and other leading foundations.

Postel, a Pew Fellow, was an adviser to the *Global 2000* anti-population growth program, and is a member of the board of the World Future Society, and consultant to the United Nations Development Programme and World Bank. Her writings on water questions are entirely ideological: She presents a series of assertions and sophistries. For example, she states that the greenhouse effect will raise temperatures, which will affect snowpack, which can cause flooding, which will then cause more "risk" to irrigation systems.

The menace of Worldwatch is that its every dismal utterance is heavily promoted, and accorded credibility. Postel's 1992 book on water, *Last Oasis,* appeared in eight languages, and was used as the basis for a Public Broadcasting System documentary in 1997.

'Listen to Ozymandias'

The joke of the "Pillar of Sand," is that the author herself begins and ends her book with the poem "Ozymandias," by Percy Bysshe Shelley, which she misinterprets entirely. Her very misinterpretation, however, proves Shelley's point!

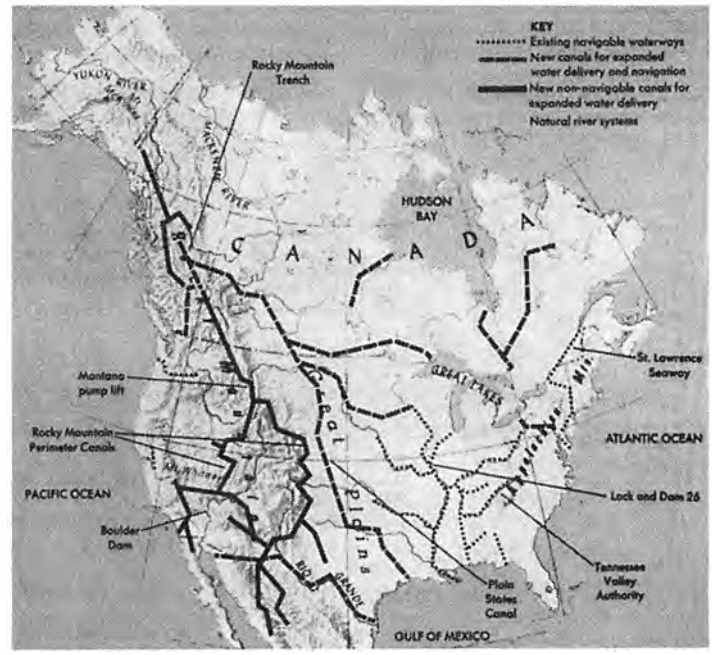
Postel takes "Ozymandias" to mean that big projects in the desert are destined to fail. Societies will fade; only shifting sands remain. In her last chapter, "Listening to Ozymandias," Postel's closing idea is that there should be a "collective pulling back" of people—away from big projects, and development. She wants "*tsimtsum*—a voluntary retraction to create space for other living things" (a term she attributes to a 16th century kabballist). She advises: Use less water, have fewer people, eat less meat, and so on.

The poet Shelley, however, is warning us of the danger of tyrannical blockheads, not "technology" and progress. Only if we allow the arrogance and stupidity of today's arrogant colossi—the IMF, the BAC, the major media, and the mega think-tanks like Worldwatch—to prevail, will it mean sure death. Listen to the poet, and the future is beautiful.

Great Projects

This poetic truth is borne out in the array of technologies and projects that can be used to "make" natural water resources. Let's look at two categories as examples—geographic engineering and advanced energy water production: On every continent there are large-scale

Continued on page 88



THE NAWAPA PLAN FOR BRINGING ADDITIONAL FRESH WATER TO THE UNITED STATES, CANADA, AND MEXICO

If NAWAPA, which was designed as a 20-year construction project, had been initiated when first favored by Congress in the 1960s, the United States would not now, in the 1990s, be experiencing increasingly severe water shortages in its western states.

Source: Fusion Energy Foundation, 1982

Shaman You, Dr. Krupp!

by Richard Sanders

Astronomy and the Archaeology of Power: Skywatchers, Shamans & Kings
E.C. Krupp
New York: John Wiley & Sons, 1999
Paperback, 364 pp., $17.95

Shame on you, Dr. Krupp, and shame on the American people for putting up with his ilk.

The crime of this book is not that the author says a lot of things we disagree with. The crime is that E.C. Krupp is not a "scientist," and, that he is the director of one of the most precious and beautiful instruments of mankind, an astronomical observatory!

A real scientist is a *thinker* who makes hypotheses and then tries to disprove or prove something serious about mankind, nature, and the human mind.

If you are expecting this, or expecting some serious, and fun astronomy, hear Dr. Krupp:

"Marilyn Monroe presides [at a Hollywood shrine] in gold—a spellbinding Venus, a high goddess of Hollywood whose milky, knife-pleated dress blows above her legs the way it did in *The Seven-Year Itch*." (p. 42)

Or this:

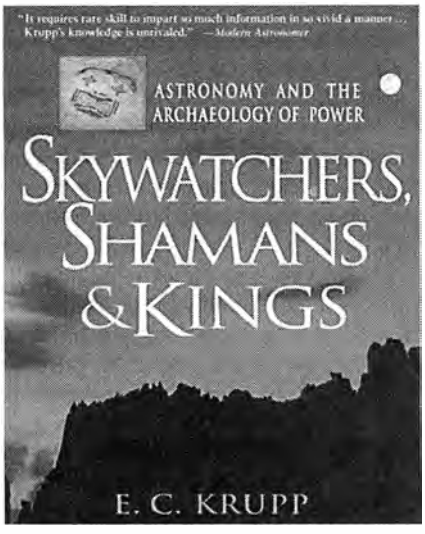
"If suggestive natural clefts in the rocks are genital apertures of Mother Earth, caves must be her womb." (p. 110)

This goes on and on. If you are wondering what all this soft-porn has to do with astronomy, you're not alone. But it does have something to do with Aristotle, the guiding spirit of the entire book, as revealed in the beginning, where Krupp writes:

"Unlike the earth itself, [the sky] cannot be reached on foot. To get there, people had to rely on supernatural power, and that was the business of spiritual specialists." (p. 33)

This is pure Aristotle, who says in *On the Heavens* that there are two different spheres, two different realities: the heavens eternal, infinitely remote from, and unconnected to the sublunary, the Earth, all mutability.

The simple refutation of Aristotle is the following: Where are these ideas



held? Or any ideas? They exist *in the mind of man*, whence, when we have a concept of "sky" or "heavens," we are already *there* so to speak. In the same way as in Zeno's paradox, you cannot go halfway to a goal, and then halfway, and then halfway, *ad infinitum*—without ever reaching the end, because you don't know what "half" is. And if you don't know, if you don't grasp that it is the whole distance which you divided in half, you don't get there.

But once you make the Aristotelian assumption, the rest will follow as night follows day. If you are infinitely remote from heaven, from God, you must be with the devil. And certainly these 317 pages are devilishly bad reading, retailing the opinions of this archaeologist, and that expert, like so many neighborhood gossips piling garbage upon garbage. Appropriately, the book ends with an explicitly Satanic note:

"We however, remain on alert, thanks to the Irish poet William Butler Yeats, for that new rough beast at last slouching toward Bethlehem.[1] But as its ordained hour comes round, we should keep in mind that it could look something like Elvis." (p. 317)

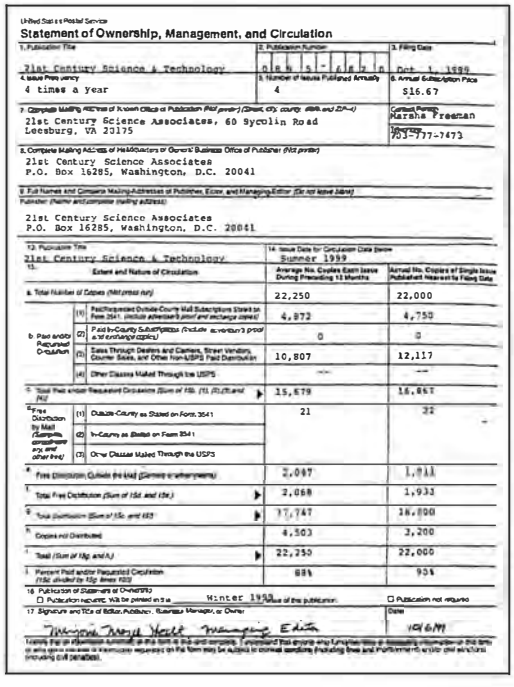
A Clinical Case

Someone might launch a very fruitful study of this book as a clinical case of the effect of counterculture witchcraft on modern science and its practitioners—but the place for that is not here.

We were tempted to throw this trash where it belongs, without any review at all, except that some good might come of it yet. Is America a republic? Can we get this Dr. Krupp fired? He is the director of the multi-million-dollar Griffith Observatory in Los Angeles. It is he who decides which astronomers get access to limited telescope time. Imagine a serious scientist trying to test a crucial hypothesis, asking Dr. Krupp for telescope time? He might be pre-empted by some other "Doctor," more pleasing to Krupp, who is trying to look up Venus's skirt in some other galaxy!

Notes

1. Yeats, who wrote entire books dictated to him by the spirit world while he was in a trance, was a pro-fascist member of the British Intelligence Occult Bureau's "Order of the Golden Dawn." In the poem referenced here, "The Second Coming," Yeats is hailing the birth of the pitiless anti-Christ.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'Natural' Water Resources

Continued from page 86

water development projects unfinished, or never begun.

In North America, there is the NAWAPA, the North American Water and Power Alliance, designed in the 1950s, reviewed by Congress in the 1960s, and then shelved, after the post-industrial shift in the 1970s. NAWAPA would redirect southward, about 15 percent of the MacKenzie River flow that is now going toward the Arctic, and utilize the 500-mile wonder of the British Columbia Rocky Mountain Trench, channelling the water through a network serving the Canadian Prairies, western United States, and, indirectly or directly, Mexico.

The hydraulic designs for the Sierra Madre, developed by Mexico's College of Engineers 30 years ago, are sister projects to NAWAPA, called "Hydraulic Project for the Northwest" (Plhino) and the "Hydraulic Project for the Gulf of the Northeast" (Plhigon). Via NAWAPA, U.S. water supplies would be increased by 20 percent (135 billion gallons a day).

In Africa, the centerpiece project is the 1970s Trans-Aqua plan, to develop the Zaire River Basin, with inland lakes, ports, hydro-power, rail, and highways.

In the Middle East, and other arid regions, nuclear-powered desalinating plants, strategically located on a Mediterranean-Dead Sea ("Med-Dead") canal route, along the Suez, the Gulf of Aqaba, and Red Sea, would transform the region, with power and water supplies. Just 20 of these facilities would equal a "New Jordan River" in volume!

On the vast Eurasian expanse, the priorities include resuming the southward diversion of parts of the run-off now flowing toward the Arctic, to provide fresh input into the Aral Sea Basin. Work on these diversion canals was started 25 years ago, and then suspended.

There are priority projects for China, the Mekong Basin, Australia, and for the Southeast Asian archipelago nations, where nuclear-powered desalination facilities can mitigate the terrible episodes of El Niño drought.

Desalting Seawater

Desalting seawater requires reducing the parts per million (ppm) of dissolved solids (80 percent of which is sodium chloride, or salt) from 35,000 ppm to less than 500 ppm, a reduction of 70 to 1. There are several methods now commonly used: distillation (some form of which is used in more than 90 percent of installed desalination capacity), reverse osmosis membrane (newly improved), electrolysis, and vapor compression. In addition, research into the electromagnetic structure of water promises revolutionary methods of desalting for the future.

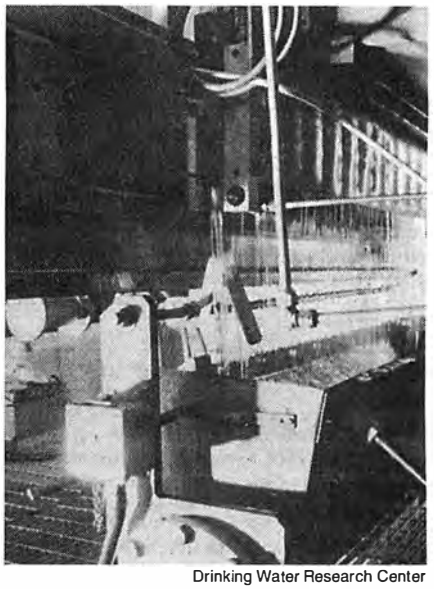
With the many recent advances in materials involved in seawater desalting, the chief cost of making fresh water is the energy involved. Using advanced nuclear generation to provide power inexpensively, greatly reduces the cost of desalination. For example, the gas-turbine modular helium reactor (GT-MHR), proposed by General Atomics, based in San Diego, can be efficiently used for both energy generation and water desalination.

The application of these new technologies would provide relatively low-cost water, along with electricity, and create new "run-off" at strategic coastal sites; in other words, we would create new supplies of water that are equivalent to new man-made rivers and reservoirs.

One proposed installation of the GT-MHR, and a desalination facility (multi-effect distillation) in Southern California, was projected to provide 106 million gallons per day, which is comparable in size to Atlanta, Georgia's municipal water system (104 million gallons per day, serving 700,000 people), and that of many other cities, including San Diego (104 mgd, 723,000 people) and Honolulu (110 mgd, 535,000 people).

Just a brief look at some of the new technologies that could be available makes a sham of Sandra Postel, Worldwatch, and their gloomy prognosis for mankind.

The author is Economics Editor of the weekly Executive Intelligence Review. *Her review of "Mideast 'Mega-projects' to Build Infrastructure and Peace," which centered on economist Lyndon LaRouche's "Oasis Plan" for building nuplexes—nuclear-powered agro-industrial centers—appeared in the Spring 1995 issue of* 21st Century.



Drinking Water Research Center

Another technology not mentioned by Postel: Wastewater can be efficiently treated with electron beams, as in this experimental facility in Miami. The water is "zapped" by high-energy electrons as it passes over the weir in a thin sheet. Treatment cost per 1,000 gallons is about $2.50.

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In This Issue:

A PASSION FOR ANCIENT DISCOVERY: CHAMPOLLION AND FELL

This issue features the story of Jean François Champollion in the 19th century, and of Barry Fell a century later—both remarkable individuals, whose passion and persistence over years opened up the true history of ancient cultures. Champollion, as Muriel Mirak Weissbach relates, deciphered hieroglyphics, and in so doing, buried the myth propagated by the British Empire that Egypt's script was related to the use of magic by the priest caste.

Barry Fell deciphered many previously unknown ancient scripts, in particular Polynesian. In an insightful and detailed memoir, his son Julian presents an inside look at his father's wide-ranging knowledge of marine biology, languages, and a host of other disciplines, and how these combined to make Barry's breakthroughs possible.

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A fresco (ca. 1320-1200 B.C.) from the tomb in Thebes of Nefertari, the queen of Ramesses II, depicted playing senet.

Courtesy of the Epigraphic Society

Howard Barraclough Fell (1917-1994)

J. Gordon Edwards

$5 BILLION A YEAR TO PROVE NOTHING

The climate modeling industry receives more than $5 billion per year for studies to prove that modern civilization is responsible for a coming catastrophe, caused by global warming. Dr. Zbigniew Jaworowski, a multidisciplinary scientist and world expert on radiation effects, reviews all the arguments in the global warming arsenal, and shows that they are without foundation.

A new Ice Age, not global warming, is on Mother Nature's agenda. Here, Mt. FitzRoy in Argentina's Glacier National Park.