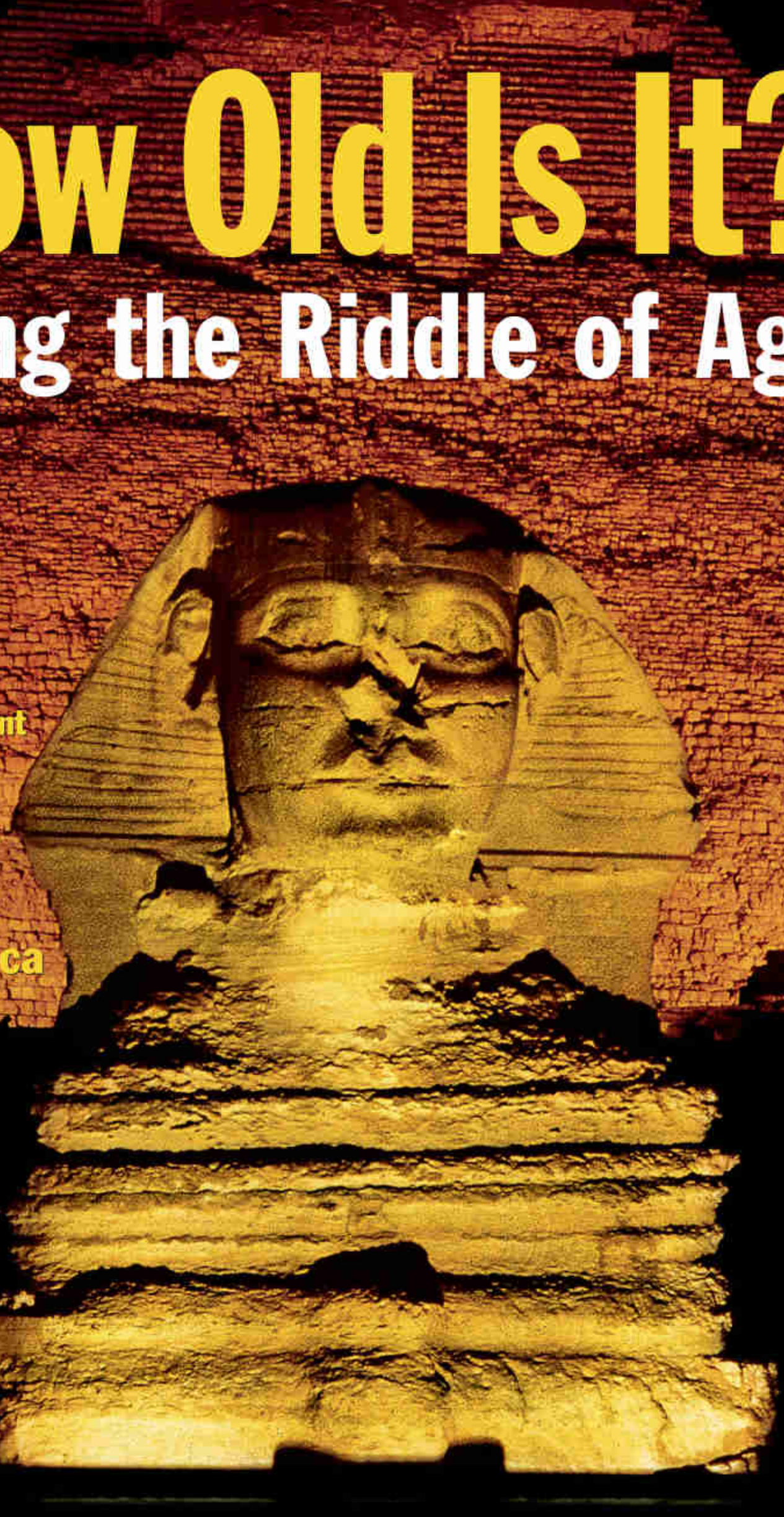
NATIONALGEOGRAPHIC.COM SEPTEMBER 2001

NATIONAL GEOGRAPHIC

How Old Is It?
Solving the Riddle of Ages



Africa Oggi

Produced by National Geographic Maps for National Geographic Magazine

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ALLEN CARROLL, CHIEF CARTOGRAPHER

Washington, D.C., settembre 2001

Image Not Available

Testa di antenato reale, in ottone, regno del Benin, XVI secolo (a sinistra); tessuto in cotone e seta, dettaglio, Nigeria (margine superiore e inferiore)
BRITISH MUSEUM, LONDRA (ENTRAMBE)

Image Not Available

MUSEO NAZIONALE DI ARTE AFRICANA, SMITHSONIAN INSTITUTION, WASHINGTON, D.C.

Cacciatore bianco con i suoi trofei, Stato libero del Congo, 1905 (sopra); guerriero dell'Impero Zulu del XIX secolo, i cui eserciti sfidarono la potenza britannica nell'odierno Sudafrica (a destra)

La carta dell'Africa, com'è oggi, è un'invenzione degli imperi coloniali. All'apparenza lindi e ordinati, i confini sembrano voler nascondere la crisi che lacera il continente. Illustre testimone della colonizzazione un secolo fa, Joseph Conrad definì il diffondersi della cultura europea "una fantastica invasione". Sull'altra sponda, lo scrittore nigeriano Chinua Achebe intitolò il suo celebre romanzo del '58 così: *Things fall apart*, Tutto cade a pezzi (in Italia *Il Crollo*). A distanza di decenni, la ricostruzione dell'Africa non è ancora avvenuta. Mentre gli scontri divampano, e l'Aids uccide milioni di persone, il continente affonda nella miseria. Le ragioni sono diverse: il boom demografico, la corruzione dei governi, la dominazione straniera, le divisioni etniche e religiose. In tutto ciò, l'Africa lotta per riscattarsi. Negli anni '50 il poeta Bernard Dadie sognava un tempo in cui sarebbe emersa vittoriosa: "Insieme, costruiamo la nuova città… Pensate all'Africa che ci attende". Oggi, i figli dei suoi figli affrontano lo stesso compito.

Images Not Available

MICHAEL NICHOLS, NGS

KENNETH GARRETT

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CHRIS JOHNS, NGS

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LOUISE GUBB/SABA

In senso orario, da sinistra in alto:

Tre manufatti (un ciondolo d'oro dei Baule, popolazione della Costa d'Avorio, uno scudo masai dal Kenya e un "bastone del capo" dei Luba, della Repubblica Democratica del Congo) un tempo testimoniavano la ricchezza e il rango dei loro proprietari.

Nella Repubblica Democratica del Congo, ragazze mbuti durante il rito di passaggio all'età adulta.

Nella vicina Repubblica del Congo vengono abbattuti gli alberi più pregiati di una grande foresta.

Pescatori recuperano le reti sul lago Turkana, in Kenya.

Le banconote hanno sostituito "monete" come questo bracciale in lega di rame, usato per il commercio sulle coste dell'Africa occidentale.

Un nomade Afar cuce con foglie di palma i sacchi di sale estratto dal lago Assal, nel Gibuti.

In Tanzania, una famiglia prega sulla tomba del padre, morto di Aids e sepolto nel giardino di casa.

I grattacieli di Città del Capo si ergono di fronte a Table Bay, vicino al punto più meridionale del continente.

Nei combattimenti fra clan dei primi anni '90, furgoni carichi di giovani armati circolavano per le strade di Mogadiscio, in Somalia.

MARY EVANS PICTURE LIBRARY

MUSEO NAZIONALE DI ARTE AFRICANA (IN ALTO, A SINISTRA E A DESTRA)

ROBERT CAPUTO

SA TOURISM

Design: Sally S. Summerall. Ricerca: Patricia A. Healy. Revisione: David B. Miller. Produzione: John S. Ballay, Mary Kate B. Cannistra, Meghan M. Kieffer, Stephen P. Wells. Testi: Karen E. Lange, autrice; Marisa J. Larson, ricercatrice

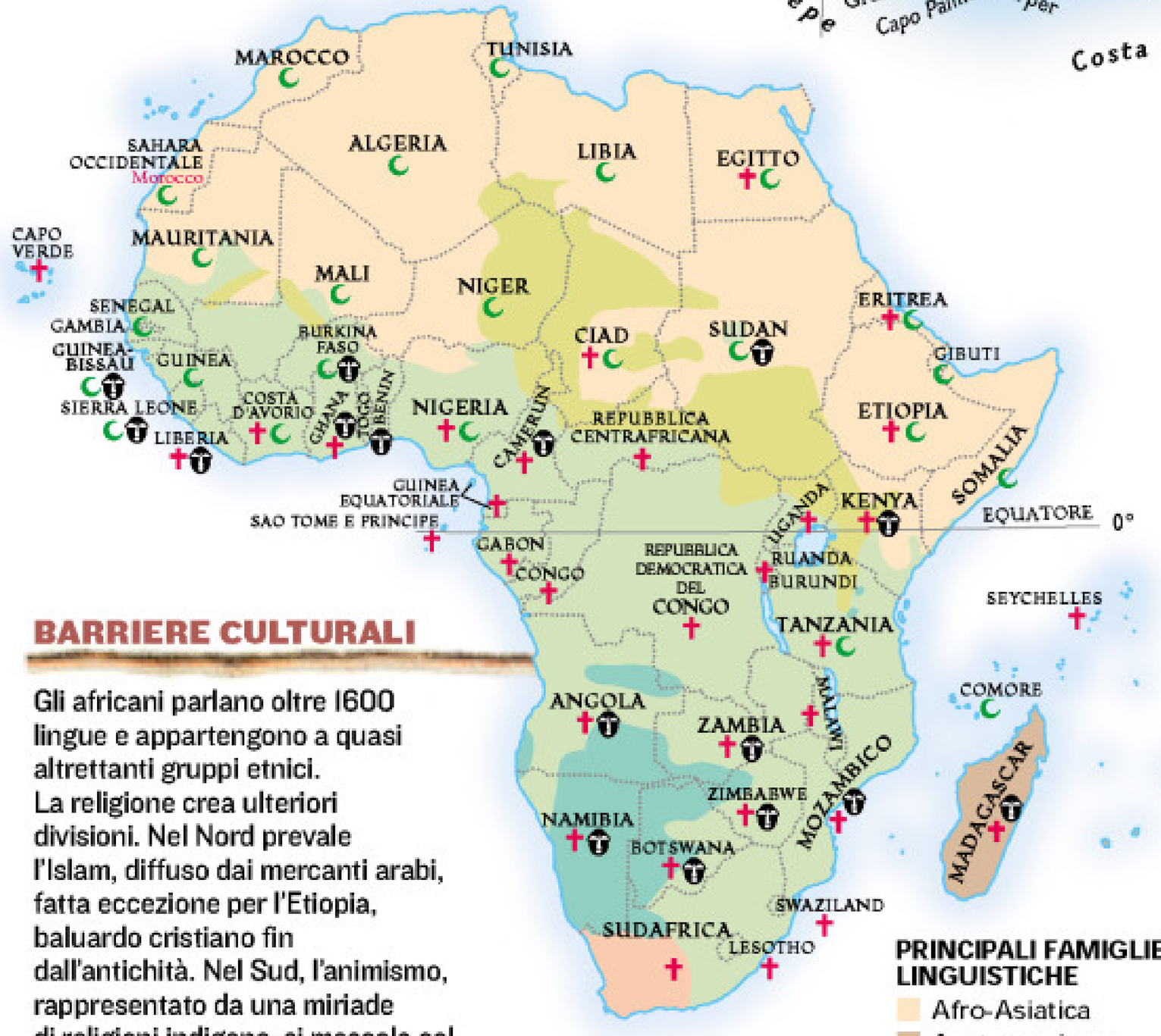
Consulenti: H. J. de Blij, Michigan State University; Jerome E. Dobson, LandScan 2000, Oak Ridge National Laboratory; Carl Haub, Population Reference Bureau; Monty G. Marshall, Center for Systemic Peace, University of Maryland; Karen A. Stanecki, U.S. Bureau of the Census; Gregory Yetman, CIESIN, Columbia University; U.S. Committee for Refugees

EQUIVALENTI GEOGRAFICI

Adrar	montagna	Lac, Lago	lago
Arquipélago	arcipelago	Massif	massiccio
Bahr	fiume	Nosy	isola
Baía, Baie	baia	Oued	fiume, corso d'acqua
Bir	pozzo	Pointe, Ponta, Punta	punta
Cabo, Cap, Capo	capo	Presqu'île	penisola
Emi	montagna, scoglio	Ras, Râs	capo, punta
Erg	dune di sabbia	Sarir	deserto di pietra
Gebel	montagna	Sebkha, Sebkhet	lago salato asciutto
Hadabat	altopiano	Shott	lago salato temporaneo
Hamada	deserto roccioso	Tassili	altopiano
Häyk'	lago	'Urūq	dune
Île-s, Ilha-s	isola-e	Veld	prateria, pianura
Ilhéu-s, Isla-s	isola-e, isolotto-i	Wadi	valle, corso d'acqua
Jabal, Jebel	montagna	Wabē, Webi	torrente

ABBREVIAZIONI

C.	Capo	N.	Nord
I.-Is.	Isola-Isole	O.	Oued
L.	Lago	St.-e.	Saint-e
Mt.-s.	Montagna-Montagne	W.	Wabē

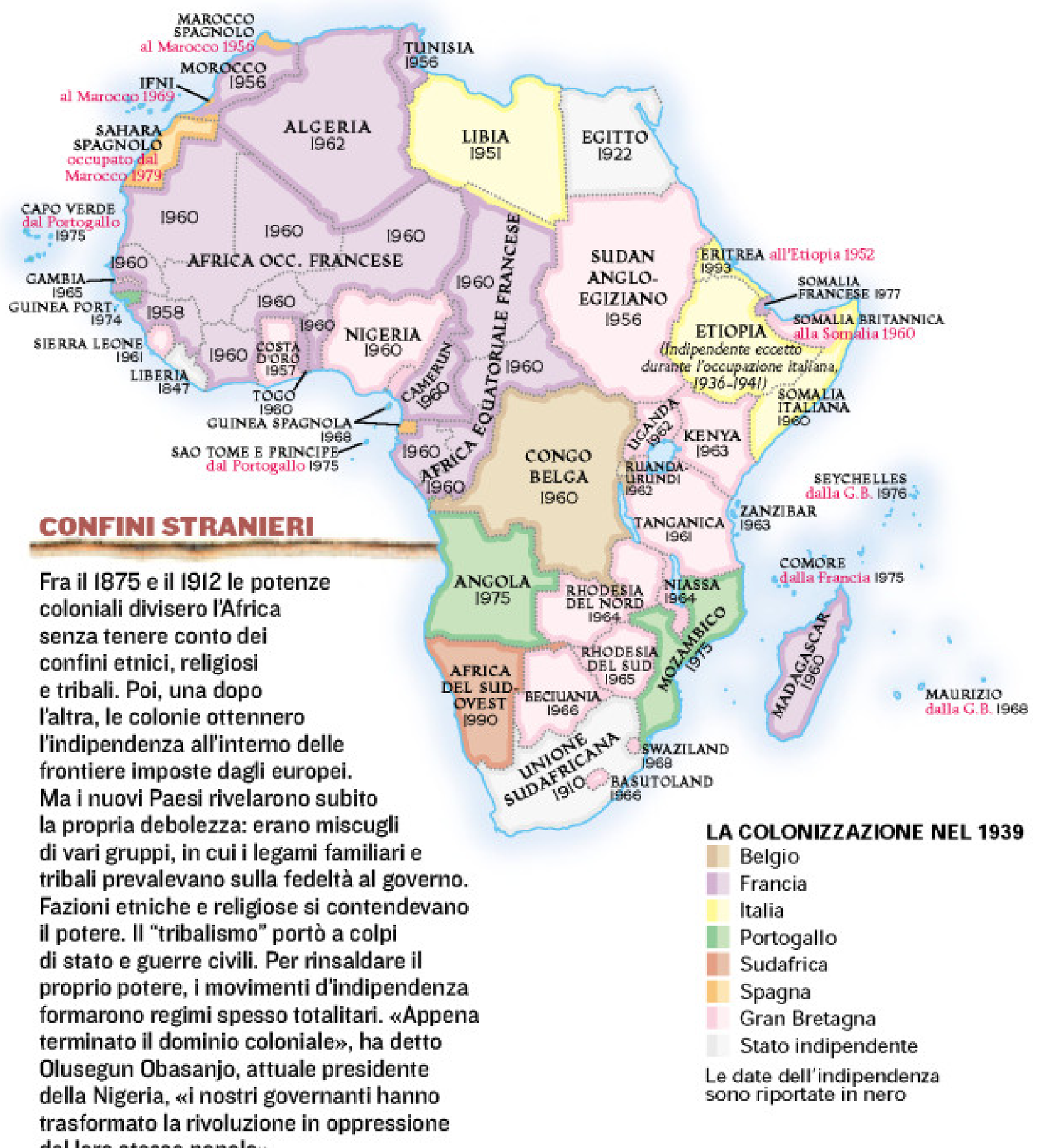


BARRIERE CULTURALI

Gli africani parlano oltre 1600 lingue e appartengono a quasi altrettanti gruppi etnici. La religione crea ulteriori divisioni. Nel Nord prevale l'Islam, diffuso dai mercanti arabi, fatta eccezione per l'Etiopia, baluardo cristiano fin dall'antichità. Nel Sud, l'animismo, rappresentato da una miriade di religioni indigene, si mescola col Cristianesimo introdotto dai missionari europei. Nel periodo pre-coloniale, i diversi gruppi etnici e religiosi a volte entravano in conflitto, ma sapevano anche convivere pacificamente in città-stato, regni e imperi. I conquistatori europei spesso privilegiavano determinati gruppi in base alle differenze culturali e razziali, e mantenevano il controllo su di essi con il metodo del *divide et impera*. Più che nelle guerre del passato, i germi degli attuali odi razziali vanno cercati proprio in queste discriminazioni.

PRINCIPALI FAMIGLIE LINGUISTICHE
- Afro-Asiatica
- Austronesiana
- Indoeuropea
- Khoisan
- Niger-Congo
- Nilotico-Sahariana

PRINCIPALI RELIGIONI
- Cristianesimo
- Islam
- Religioni indigene

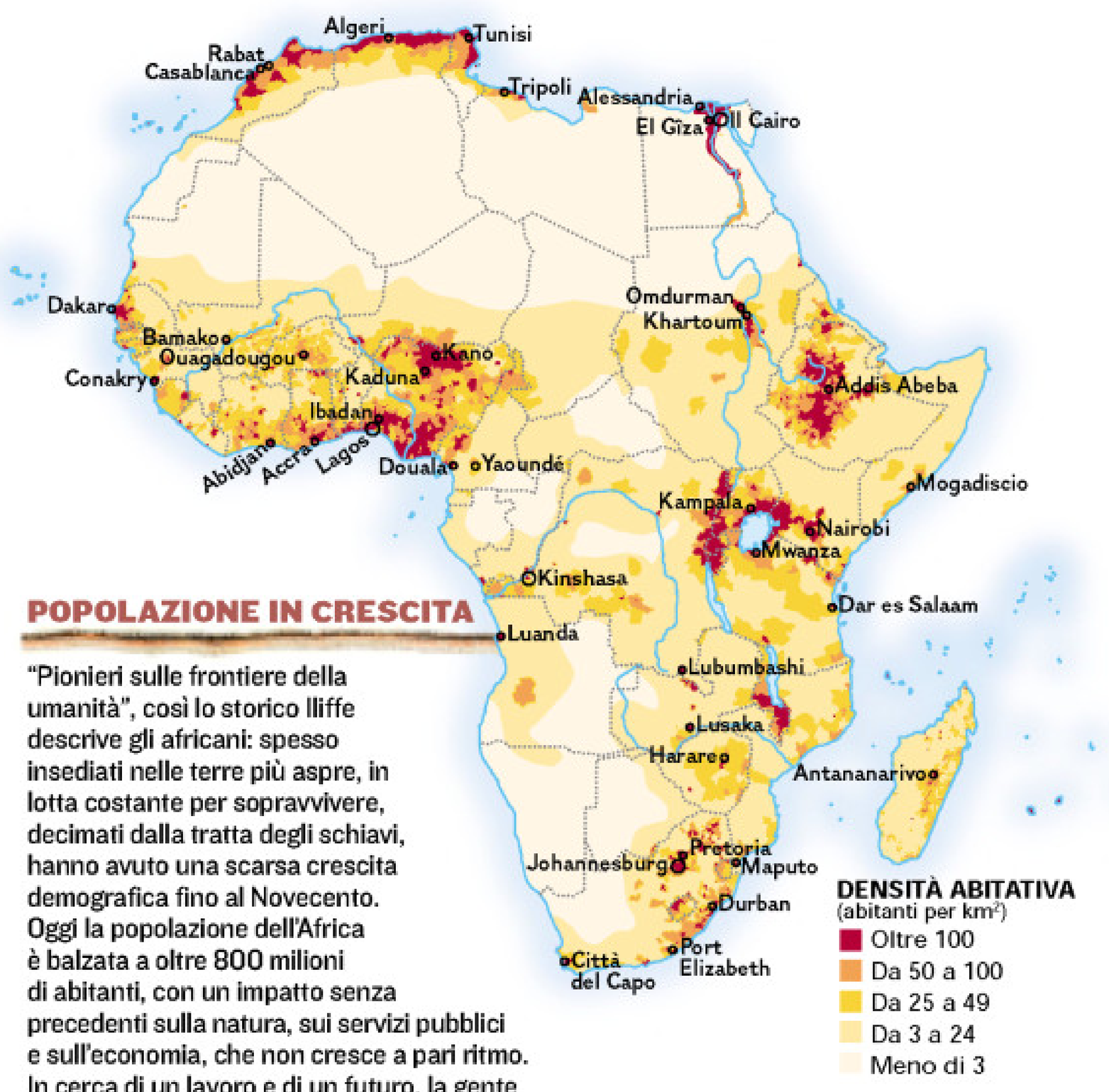


CONFINI STRANIERI

Fra il 1875 e il 1912 le potenze coloniali divisero l'Africa senza tenere conto dei confini etnici, religiosi e tribali. Poi, una dopo l'altra, le colonie ottennero l'indipendenza all'interno delle frontiere imposte dagli europei. Ma i nuovi Paesi rivelarono subito la propria debolezza: erano miscugli di vari gruppi, in cui i legami familiari e tribali prevalevano sulla fedeltà al governo. Fazioni etniche e religiose si contendevano il potere. Il "tribalismo" portò a colpi di stato e guerre civili. Per rinsaldare il proprio potere, i movimenti d'indipendenza formarono regimi spesso totalitari. «Appena terminato il dominio coloniale», ha detto Olusegun Obasanjo, attuale presidente della Nigeria, «i nostri governanti hanno trasformato la rivoluzione in oppressione del loro stesso popolo».

LA COLONIZZAZIONE NEL 1939
- Belgio
- Francia
- Italia
- Portogallo
- Sudafrica
- Spagna
- Gran Bretagna
- Stato indipendente

Le date dell'indipendenza sono riportate in nero

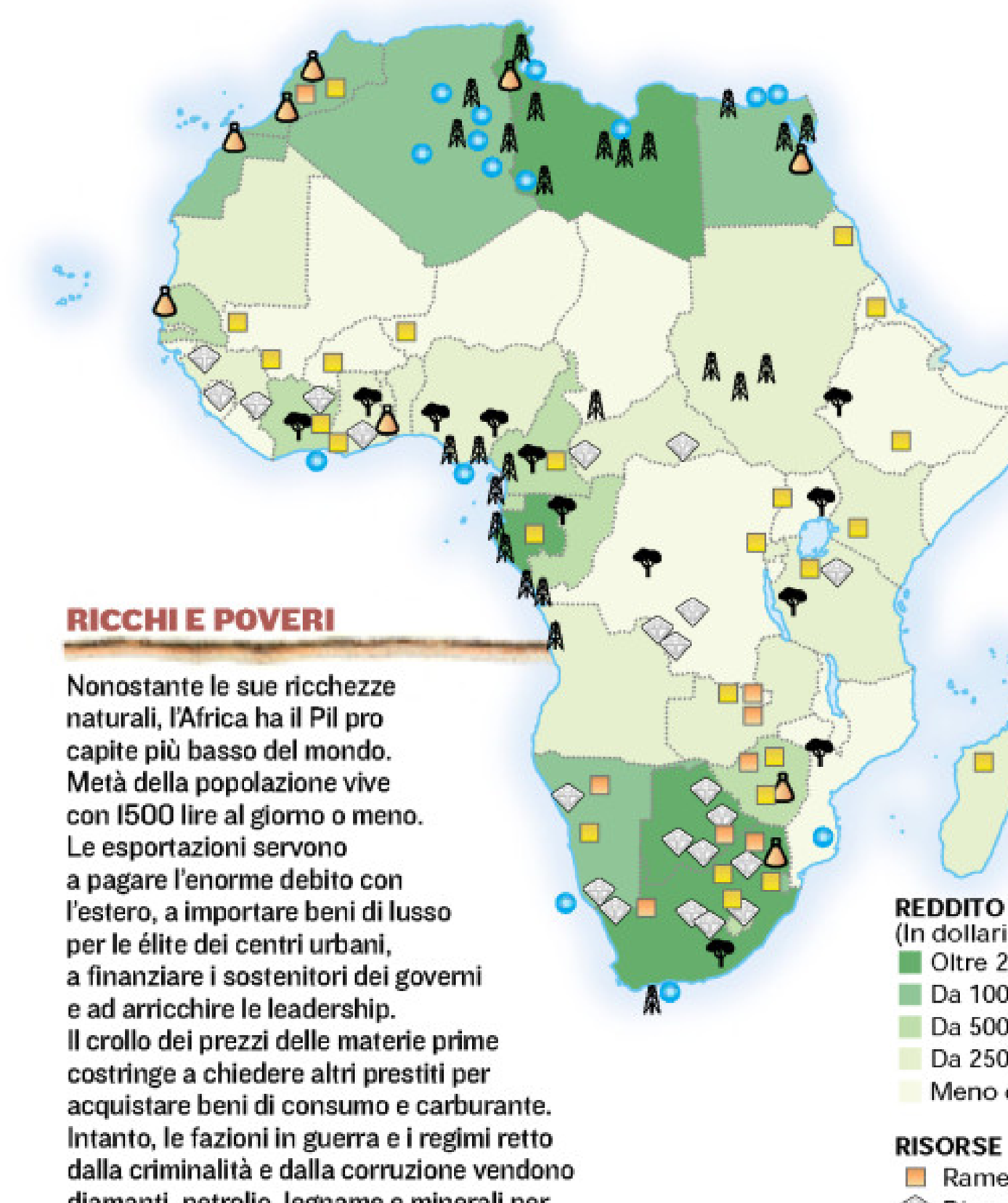


POPOLAZIONE IN CRESCITA

"Pionieri sulle frontiere della umanità", così lo storico Iliffe descrive gli africani: spesso insediati nelle terre più aspre, in lotta costante per sopravvivere, decimati dalla tratta degli schiavi, hanno avuto una scarsa crescita demografica fino al Novecento. Oggi la popolazione dell'Africa è balzata a oltre 800 milioni di abitanti, con un impatto senza precedenti sulla natura, sui servizi pubblici e sull'economia, che non cresce a pari ritmo. In cerca di un lavoro e di un futuro, la gente si affolla nelle città costiere, nelle fasce fertili dell'Africa orientale e centrale, e nella cintura mineraria che si estende dalla Repubblica Democratica del Congo a Johannesburg.

DENSITÀ ABITATIVA (abitanti per km²)
- Oltre 100
- Da 50 a 100
- Da 25 a 49
- Da 3 a 24
- Meno di 3

POPOLAZIONE URBANA
- Oltre 5 milioni
- Da 1 a 5 milioni

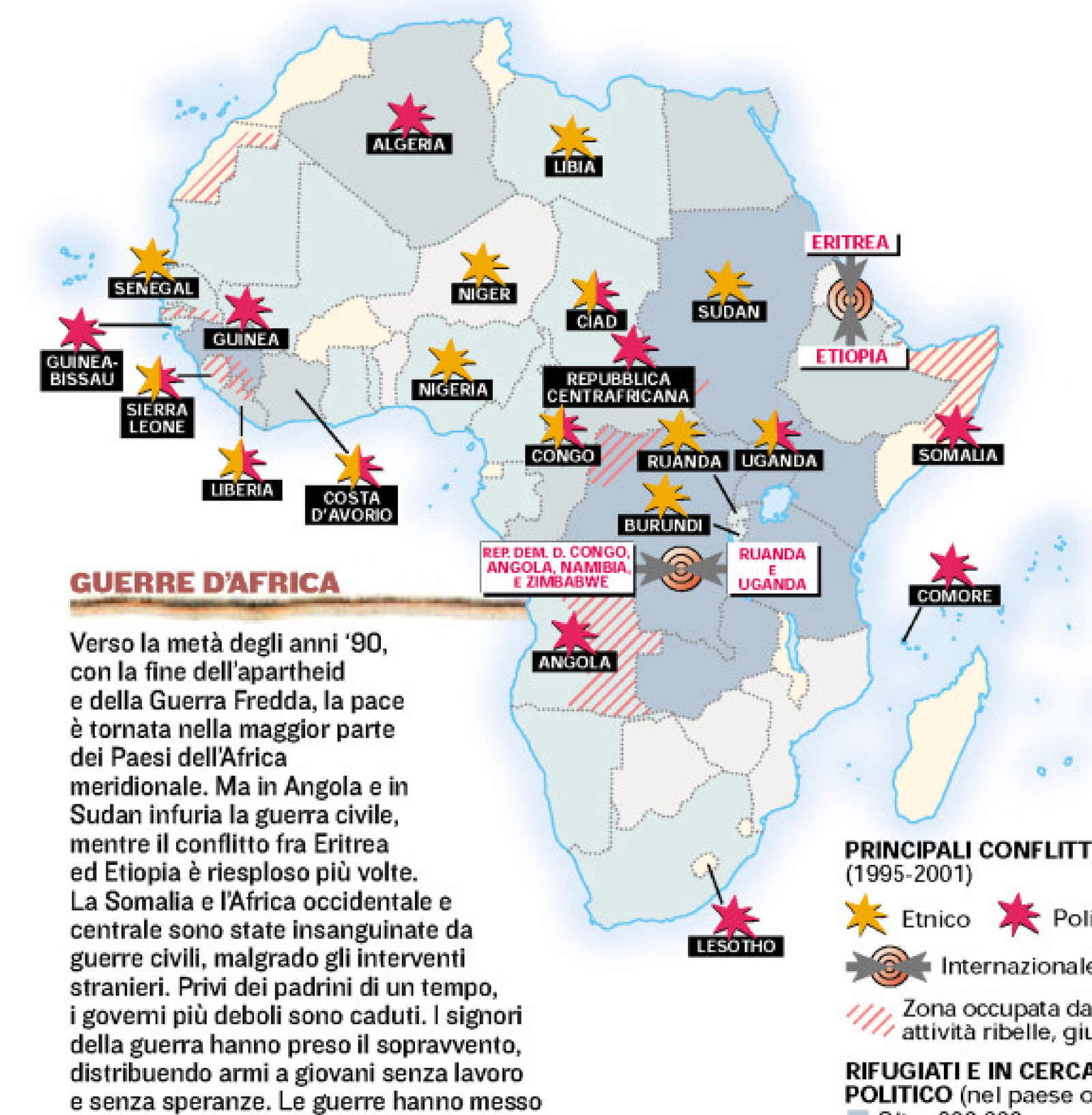


RICCHI E POVERI

Nonostante le sue ricchezze naturali, l'Africa ha il Pil pro capite più basso del mondo. Metà della popolazione vive con 1500 lire al giorno o meno. Le esportazioni servono a pagare l'enorme debito con l'estero, a importare beni di lusso per le élite dei centri urbani, a finanziare i sostenitori dei governi e ad arricchire le leadership. Il crollo dei prezzi delle materie prime costringe a chiedere altri prestiti per acquistare beni di consumo e carburante. Intanto, le fazioni in guerra e i regimi retto dalla criminalità e dalla corruzione vendono diamanti, petrolio, legname e minerali per finanziare gli eserciti e comprare le armi.

REDDITO PRO CAPITE (In dollari Usa)
- Oltre 2000
- Da 1000 a 2000
- Da 500 a 999
- Da 250 a 499
- Meno di 250

RISORSE
- Rame
- Diamanti
- Oro
- Gas naturale
- Petrolio
- Fosfato
- Legname

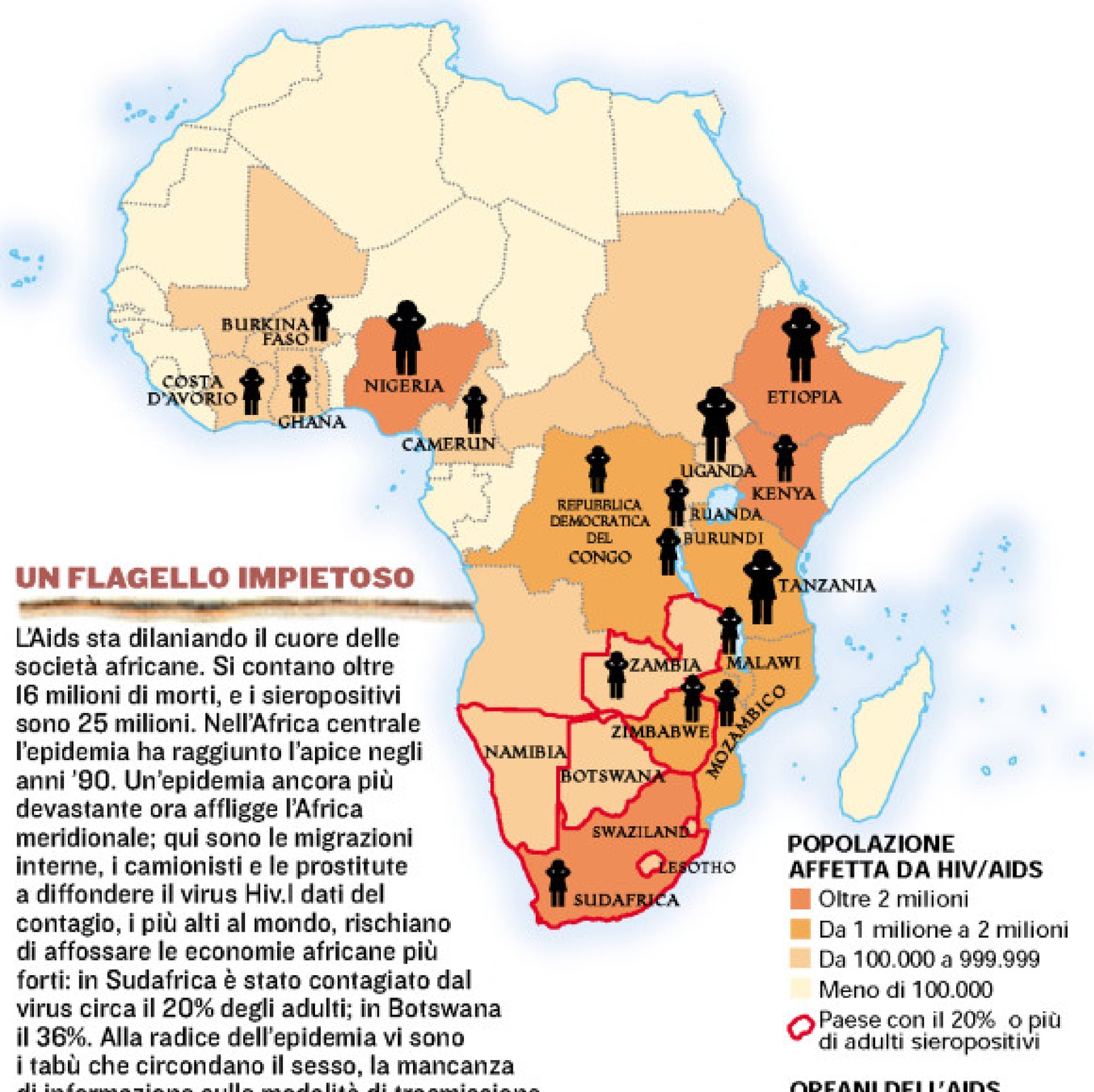


GUERRE D'AFRICA

Verso la metà degli anni '90, con la fine dell'apartheid e della Guerra Fredda, la pace è tornata nella maggior parte dei Paesi dell'Africa meridionale. Ma in Angola e in Sudan infuria la guerra civile, mentre il conflitto fra Eritrea ed Etiopia è riesploso più volte. La Somalia e l'Africa occidentale e centrale sono state insanguinate da guerre civili, malgrado gli interventi stranieri. Privi dei padrini di un tempo, i governi più deboli sono caduti. I signori della guerra hanno preso il sopravvento, distribuendo armi a giovani senza lavoro e senza speranze. Le guerre hanno messo in fuga decine di milioni di profughi. Quasi 14 milioni aspettano di tornare a casa.

PRINCIPALI CONFLITTI ARMATI (1995-2001)
- Etnico
- Politico
- Internazionale
- Zona occupata da ribelli o con attività ribelle, giugno 2001

RIFUGIATI E IN CERCA DI ASILO POLITICO (nel paese ospite)
- Oltre 200.000
- Da 50.000 a 200.000
- Da 5000 a 49.999
- Meno di 5000
- Informazioni non disponibili



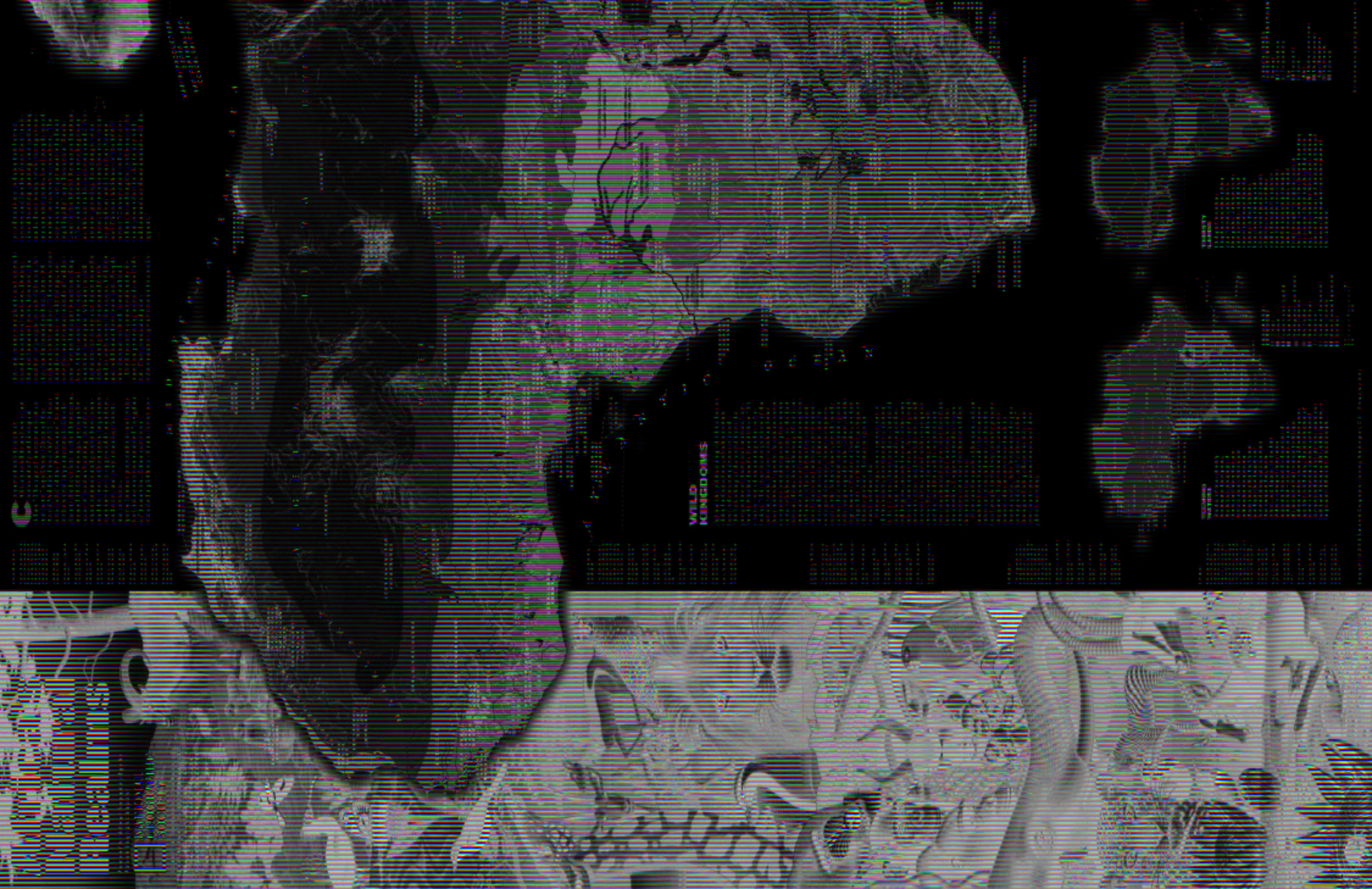
UN FLAGELLO IMPIETOSO

L'Aids sta dilaniando il cuore delle società africane. Si contano oltre 16 milioni di morti, e i sieropositivi sono 25 milioni. Nell'Africa centrale l'epidemia ha raggiunto l'apice negli anni '90. Un'epidemia ancora più devastante ora affligge l'Africa meridionale; qui sono le migrazioni interne, i camionisti e le prostitute a diffondere il virus Hiv. I dati del contagio, i più alti al mondo, rischiano di affossare le economie africane più forti: in Sudafrica è stato contagiato dal virus circa il 20% degli adulti; in Botswana il 36%. Alla radice dell'epidemia vi sono i tabù che circondano il sesso, la mancanza di informazione sulle modalità di trasmissione del virus, la condizione inferiore delle donne e l'alto costo delle terapie mediche.

POPOLAZIONE AFFETTA DA HIV/AIDS
- Oltre 2 milioni
- Da 1 milione a 2 milioni
- Da 100.000 a 999.999
- Meno di 100.000
- Paese con il 20% o più di adulti sieropositivi

ORFANI DELL'AIDS
- Oltre 1 milione
- Da 100.000 a 1 milione

Per informazioni sulle mappe disponibili scrivete a National Geographic Maps, PO Box 4357, Evergreen, CO 80437-4357, USA. Oppure contattateci all'indirizzo nationalgeographic.com.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KINGDOMS

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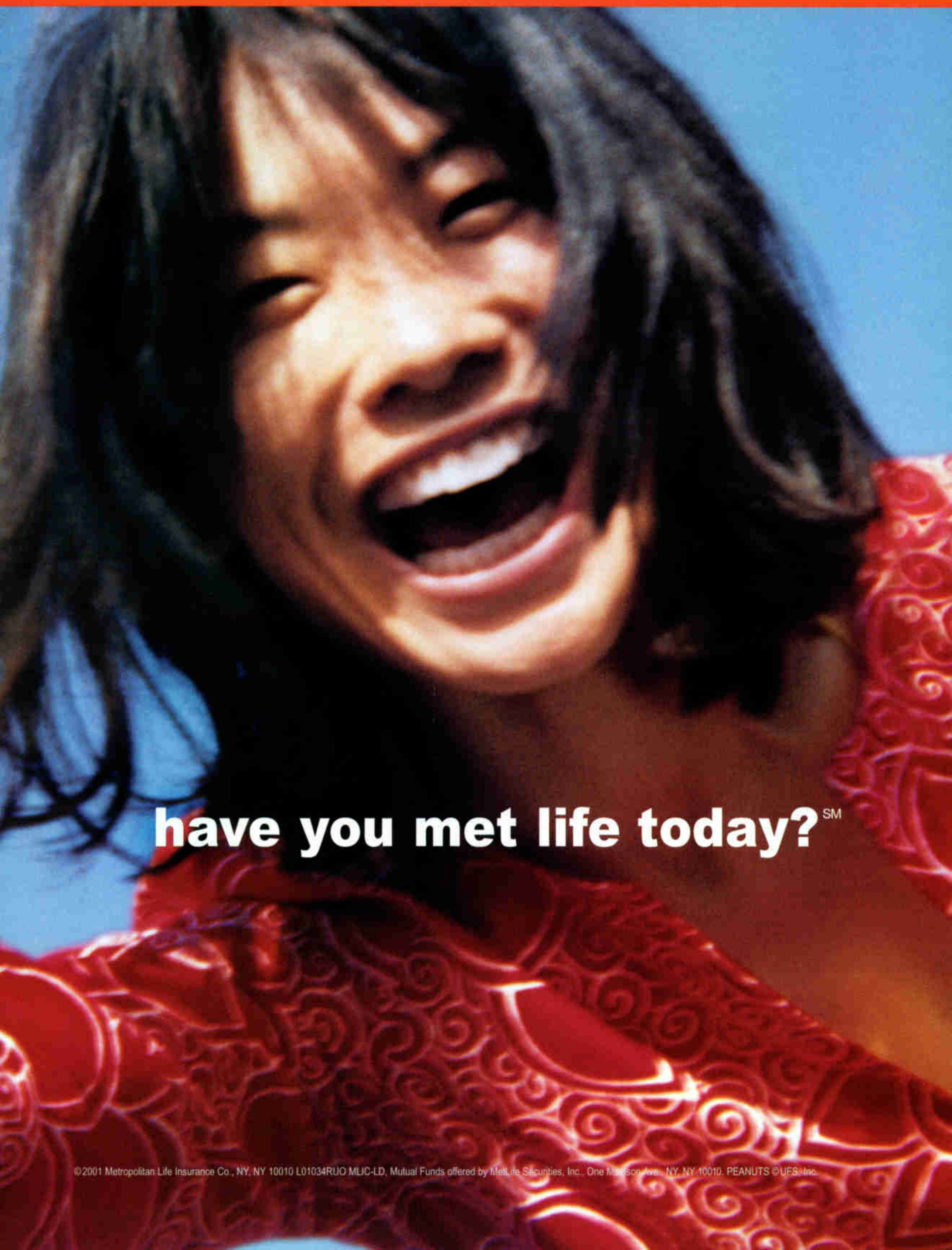

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THE COVER

By matching the ancient positions of stars with a pyramid's alignment, a new theory pinpoints the tomb's construction date at about 2448 B.C.
BY BILL ELLZEY

ON THE NGM WEBSITE

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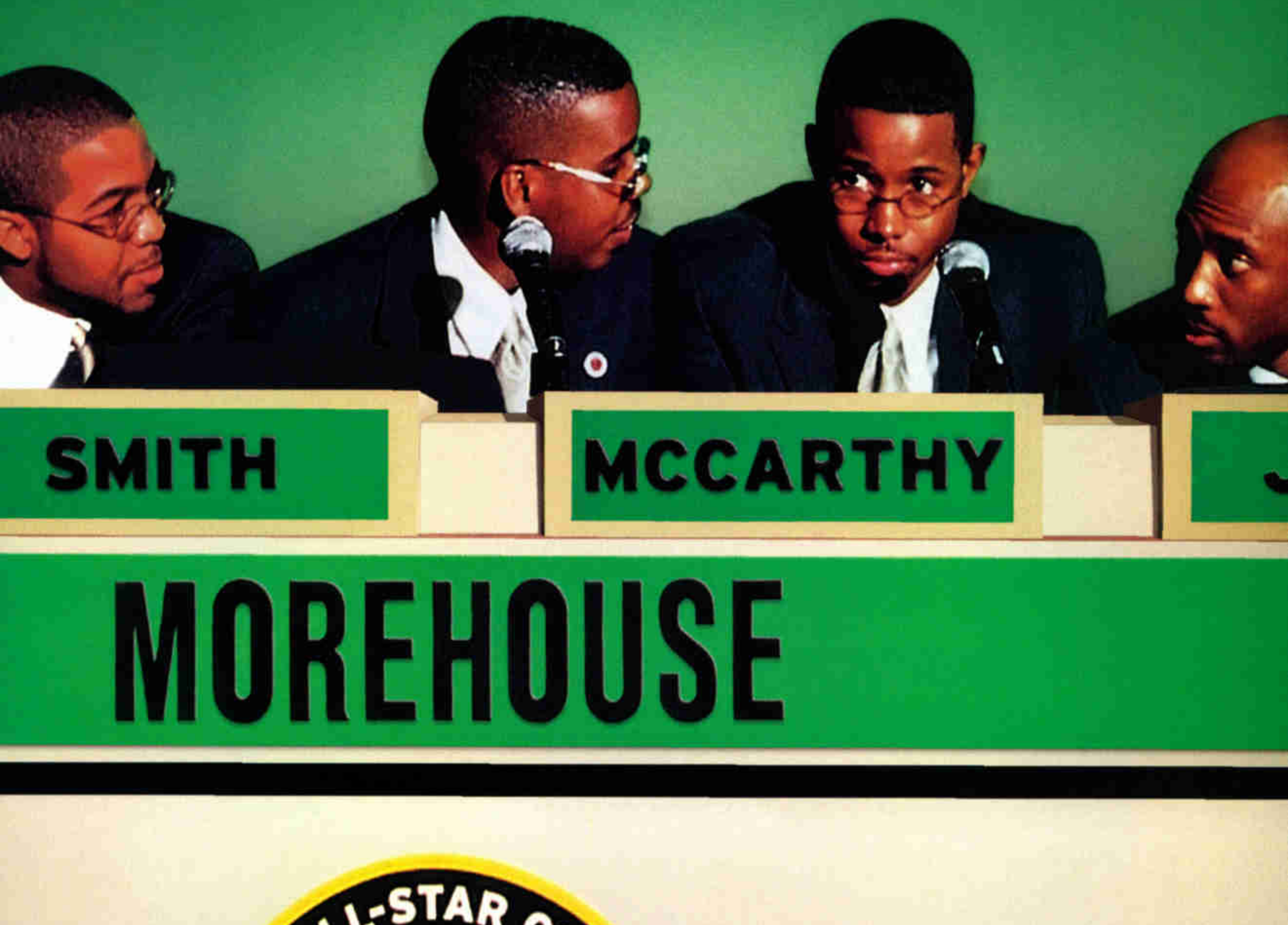


Opportunity doesn't always knock. Sometimes it buzzes in with the correct answer.

At Honda, we never wait for success to come to us. And, we've always admired and encouraged people who actively pursue opportunities. Which is why the Honda Campus All-Star Challenge was created.

It's a grueling test of mental fortitude, in which 64 teams of the best and brightest students from America's Historically Black Colleges and Universities square off against one another in academic competition. Since the program's inception in 1989, more than 15,000 students have participated, and Honda has awarded millions of dollars in grants to over 60 colleges.

These grants are used to enhance student programs, hire personnel and upgrade facilities. The result is an improvement of the students' entire college experience. Which, ultimately, creates more opportunities for those students who have all the right answers.

HONDA

The power of dreams:

From the Editor

NATIONAL GEOGRAPHIC PHOTOGRAPHER CHRIS JOHNS

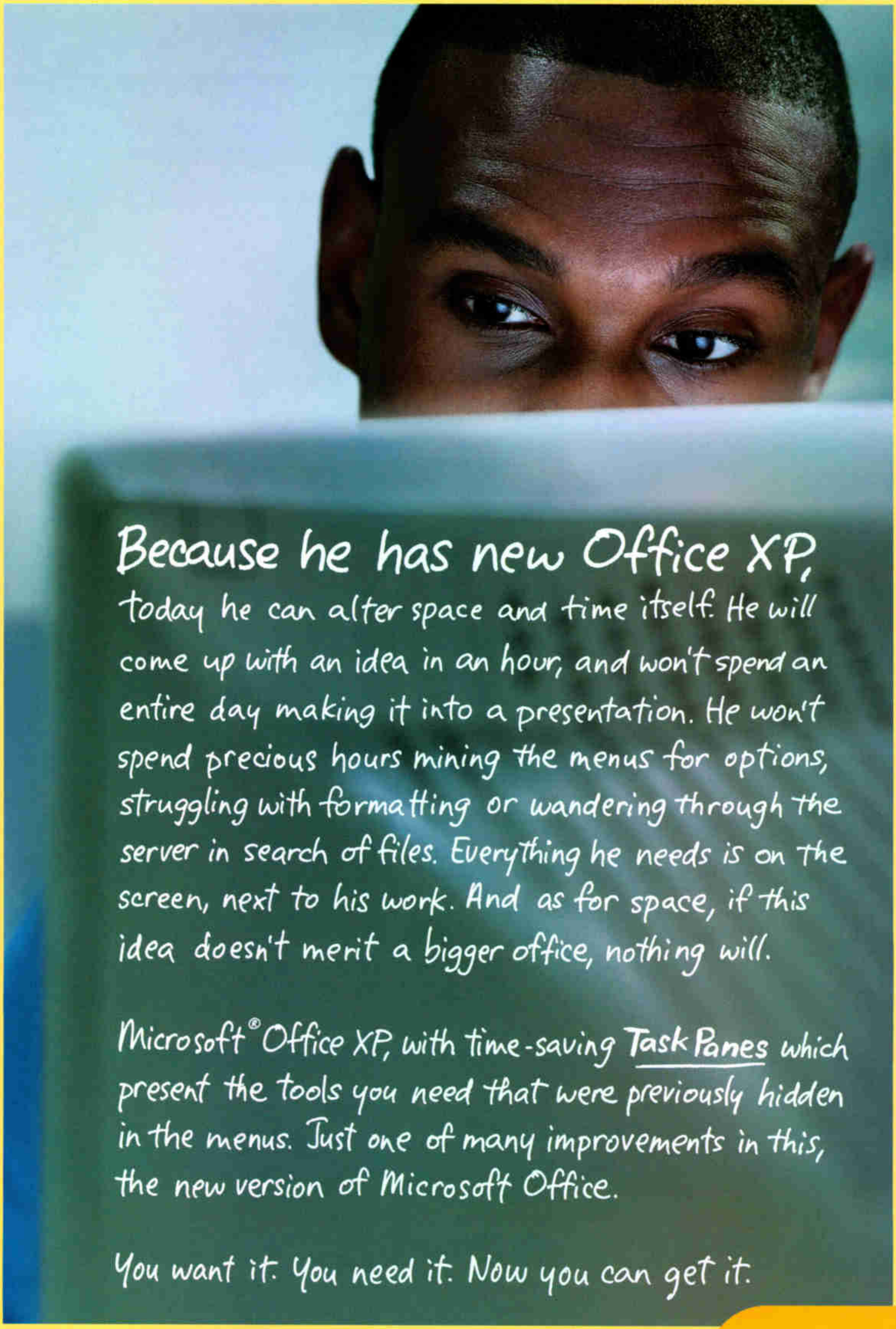
Echoes of automatic weapons' fire frequently drown out sounds of wildlife along contested borders—borders that are harsh reminders of division rather than connections between neighbors. But in southern Africa an intriguing idea is taking hold: Perhaps conservation of wildlife and habitat can transcend political differences and political boundaries to become a stepping-stone to lasting peace.

At this moment the first African transfrontier conservation area, the Kgalagadi Transfrontier Park, is operating successfully between Botswana and South Africa. As Peter Godwin and photographer Chris Johns report, Mozambique, Zimbabwe, and other nations of the Southern Africa Development Community are moving toward similar collaboration.

More regions of the world might look to this model. Could countries in the Middle East cooperate to preserve wildlife in border areas? Could the very symbol of division on the Korean peninsula—the demilitarized zone—serve as a bridge to reunification? Amid such tantalizing possibilities one thing is certain: Courageous leaders who bequeath a legacy of peace will long be remembered for their vision.

Trust among nations is a fragile commodity, yet it is something that NATIONAL GEOGRAPHIC has in large supply, built over the course of more than a century of unbiased global journalism. If our assistance as a neutral party can help pave the way to peace, we stand ready. Just ask.

Bill Allen



Because he has new Office XP, today he can alter space and time itself. He will come up with an idea in an hour, and won't spend an entire day making it into a presentation. He won't spend precious hours mining the menus for options, struggling with formatting or wandering through the server in search of files. Everything he needs is on the screen, next to his work. And as for space, if this idea doesn't merit a bigger office, nothing will.

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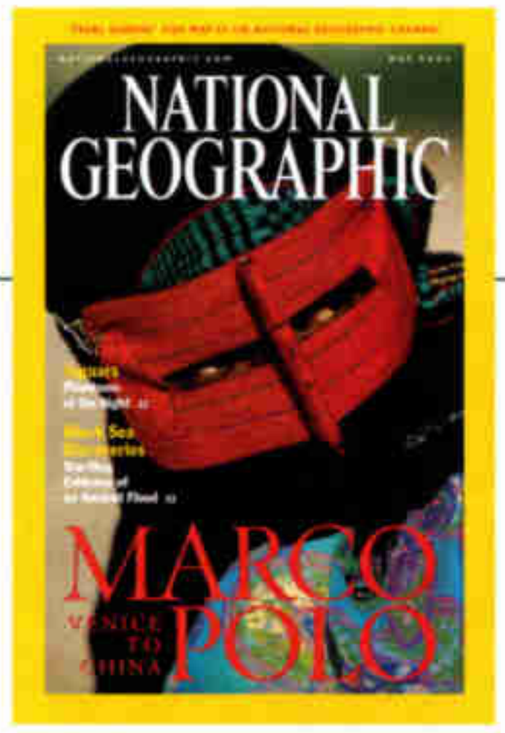

May 2001

Marco Polo's epic journey to China, spiced with tales of crossing raging rivers and dodging bandits, thrilled our readers. "Marco Polo was definitely an incredible man—a man who took chances and had adventure in his blood," one admirer wrote. But why would Marco risk his life on a dangerous trek from Venice to China? "That's part of the attraction," wrote another.

Marco Polo

It is surprising that Marco Polo observed that Persian boatbuilders built their ships with sewn planks and failed to inquire into it. It was common belief among Arab and Persian sailors in those days that the ocean floor was a giant magnet. This belief dictated against the use of metal for shipbuilding. "Sewn-up" ships were extremely reliable, covering the distance between Africa's east coast and China's trading centers in just a few months. Marco might have shortened his journey by a few years had he been more inquisitive. But then his *Description of the World* might not have been as fascinating.

BRUNO M. FRANCOIS
Hyattsville, Maryland

Realizing there had been cartographers earlier than the 1450s, I was interested to see the world as it was perceived to have existed then. I recognized nothing on the map on page 5 until I turned it upside down. Was the South Pole the historical point of reference for cartographers? If so, when did the reference become the North Pole?

JACKIE REID
Burlington, Ontario

When Fra Mauro designed this map, cartographers based their orientation on the purpose of the map, their own cultural background, or even the shape of the vellum they were using. Fra Mauro may have been influenced by Islamic world maps, many of which were oriented to the south.

I read the article on Marco Polo with interest because it was partly about my country—Iran. I was disappointed by the author's comment regarding his safety since the relationship between Iran and the United States "had been sour for years." After 22 years Americans have not distinguished between the conservatives and regular Iranians. Iranian people are hospitable and very kind. They do not hate the United States or any other country. In the 13 years I have lived in the States, I have noticed that Americans just see a minority on TV screaming "Death to America" and believe

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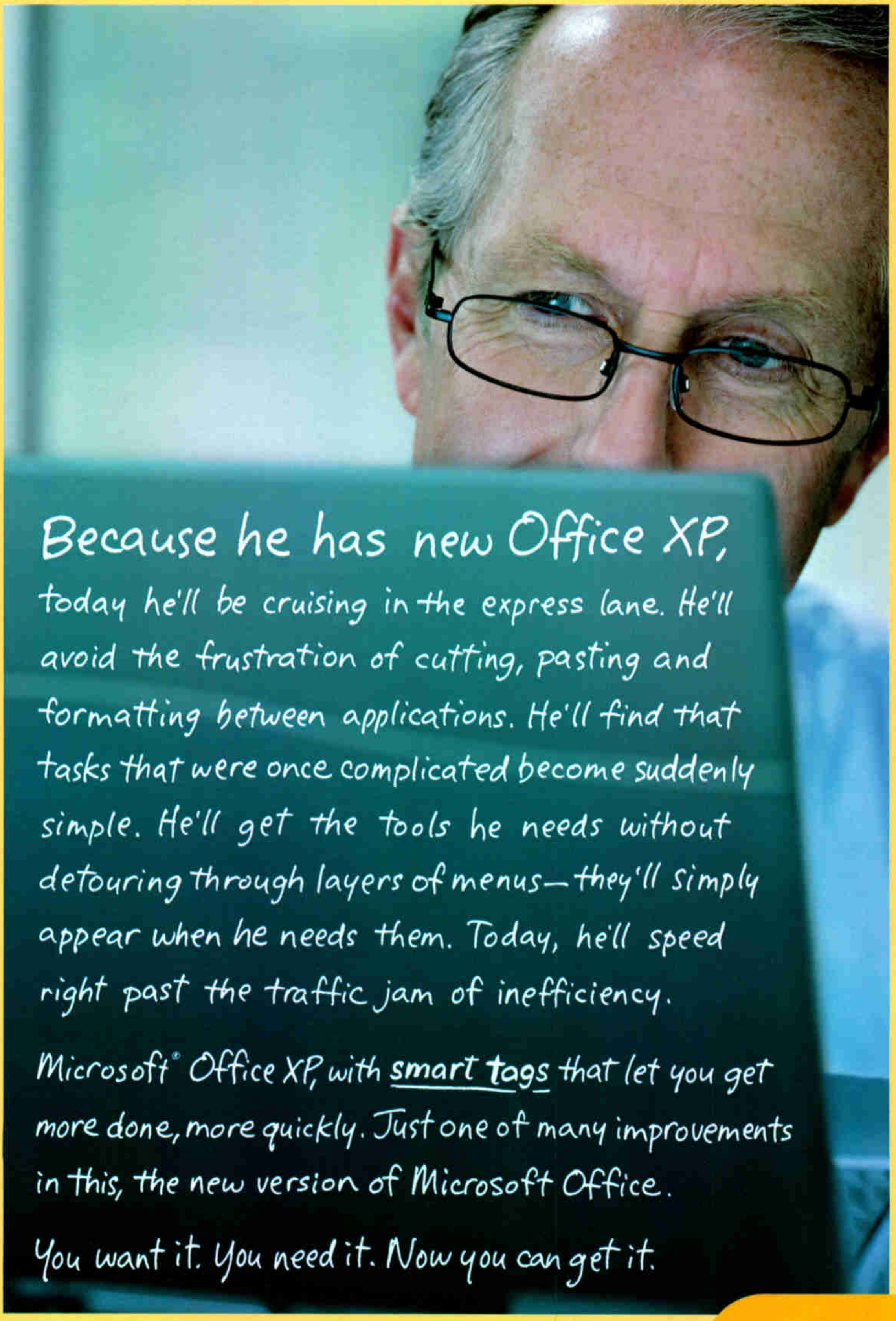

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Jaguars

Perhaps the caption on your photo of "cattle-killing jaguars" on page 37 should read, "Beef—it's what's for dinner." The livestock raised in this area does not feed the local people, who hunt the same forest animals as the jaguars. The livestock feeds the North American taste for beef. If readers truly want to help jaguars survive, less beef in our own diets is a simple first step.

MELISSA HOLMES
Pittsburgh, Pennsylvania

For once I read something positive about big business and the natural world—the Jaguar company donating money to help the animal it takes its name from. Some of the richest businesses in the world use animals for selling purposes but think nothing of the animal species they are borrowing from. The NFL has lions, bengals, and dolphins. The NBA has timber wolves. Big business has the ability to make a difference before all these species are gone forever.

LAVONNE BLACKWELL
Mars Hill, North Carolina

STEVE WINTER

Having been fortunate enough to have seen a leopard in the wild carrying a cub in its mouth, I appreciate the efforts of those who try to preserve the great cats. I believe that one way is through managed tourism. A few years ago I took a trip down the Amazon in the Iquitos area of Peru and stayed in a tourist village designed to give a taste of the Amazon and the jungle. Local Indians were employed in various roles as guides in the forest and on the river. Providing employment for the local people had largely removed the need for them to sustain themselves by hunting the wildlife for food. Jaguar tracks had been seen in the area for the first time in years.

BOB BURROWS
Macclesfield, England

all Iranians are like that. The Iranian people are forced to live the way they do. I hope they can manage to restore democracy in Iran and live the way they truly deserve.

NAZANIN S. FARD
Novato, California

Your article states that the Taliban's territory has become "the world's biggest supplier of opium." In fact, the Taliban has imposed a ban on opium-poppy production in Afghanistan. This has required a great sacrifice from Afghanistan's farmers.

RICHARD BATES HARRIS
Harvard, Massachusetts

Although Afghanistan was the leading opium supplier as of press time, the Taliban's efforts to stop opium-poppy cultivation appear to have been successful. The ban remains in place.

I believe Marco was misinformed. He wrote that the Magi were buried in Saveh, but if they were Zoroastrians, as is commonly believed, they would not have been buried at all. Zoroastrians expose the bodies of their dead in the desert for the vultures to feed on. No one would have had their bodies.

MELISSA KELLY
Glendale, Arizona

Frogs

The sad stories of the disappearing frogs have seemingly one thing in common: A herpetologist discovers and studies a population only to return to find the population gone or dying. Like other fungi, chytrids and their spores are likely very hardy. A herpetologist who is unknowingly carrying the chytrid fungus and handling frogs may be infecting disease-free populations. Is anyone looking into the possibility of unintended chytrid fungus contamination by humans?

MONIR TAHA
Toronto, Ontario

No link has been established between herpetologists and the spread of the chytrid fungus. However, it is possible for researchers to unknowingly carry chytrid spores on their clothing and equipment, so experts have recommended sterilization protocols such as dipping boots and traps in a weak bleach solution.

You are usually very careful to identify and label all interesting creatures, but you failed to do so with a very important organism —the chytrid killing everybody's

WRITE TO FORUM

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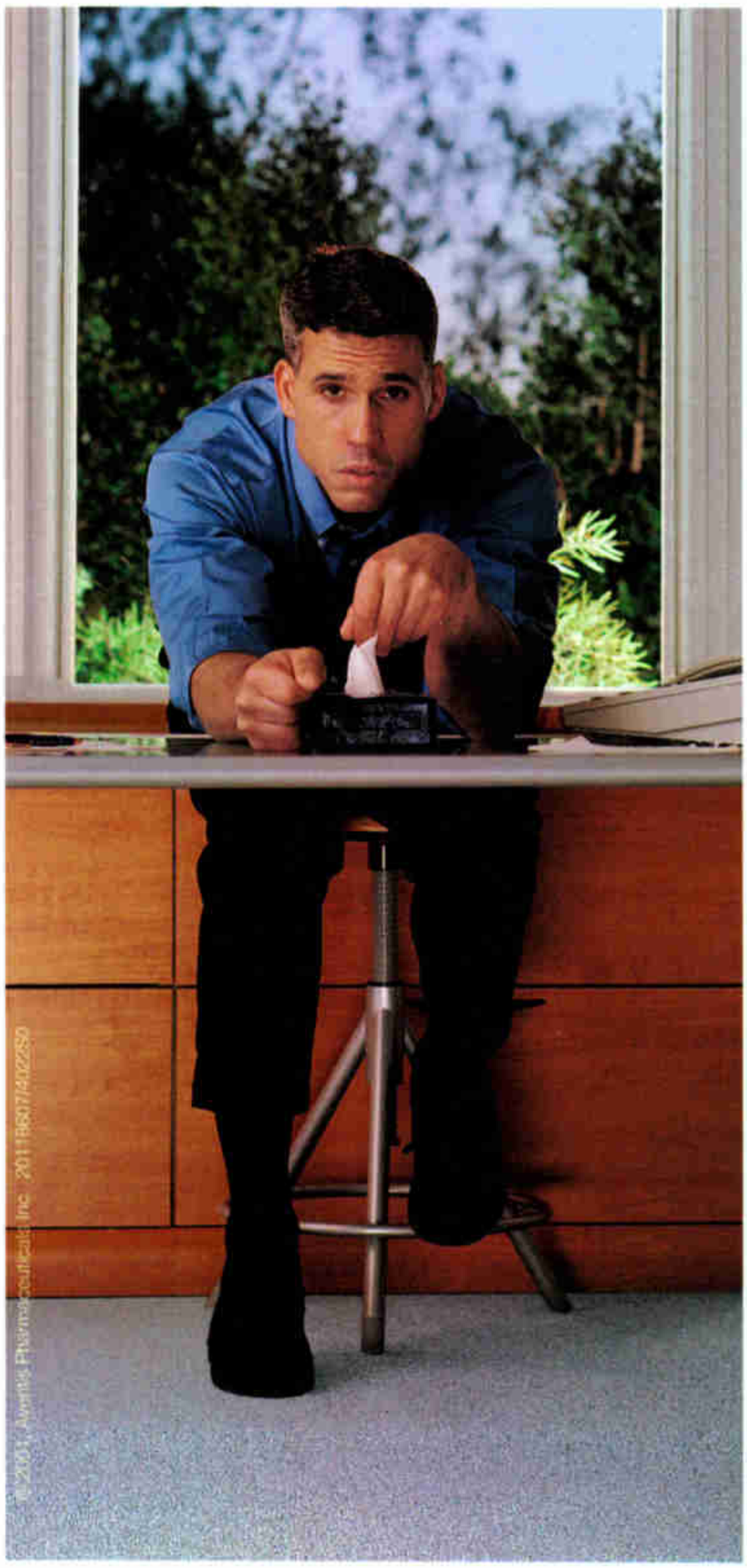
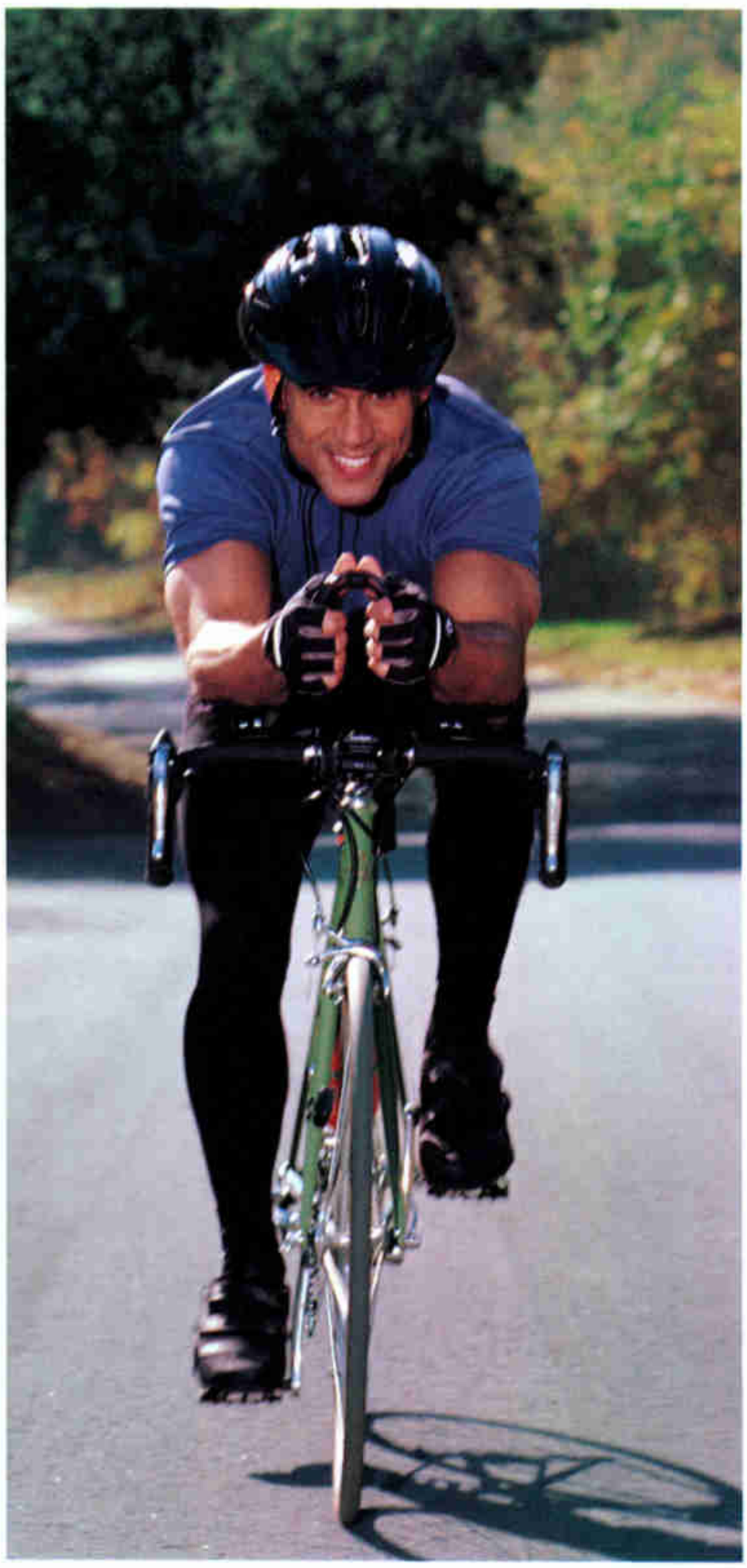


Allergy Season?



Allegra Season!

Seasonal allergies can make you feel miserable. Only once-daily Allegra 180 mg tablets have fexofenadine for long lasting, non-drowsy allergy relief, so you can feel more like yourself again. For people 12 and older. Side effects with Allegra 180mg are low and may include headache, upper respiratory tract infection and back pain. Please see additional important information on the next page. 1-800-ALLEGRA www.allegra.com Call your doctor or pharmacist now for more information.

Enjoy your world™

Brief Summary of Prescribing Information as of November 2000

ALLEGRA®

(fexofenadine hydrochloride)

Capsules and Tablets

INDICATIONS AND USAGE

Seasonal Allergic Rhinitis

ALLEGRA is indicated for the relief of symptoms associated with seasonal allergic rhinitis in adults and children 6 years of age and older. Symptoms treated effectively were sneezing, rhinorrhea, itchy nose/palate/throat, itchy/watery/red eyes.

Chronic Idiopathic Urticaria

ALLEGRA is indicated for treatment of uncomplicated skin manifestations of chronic idiopathic urticaria in adults and children 6 years of age and older. It significantly reduces pruritus and the number of wheals.

CONTRAINDICATIONS

ALLEGRA is contraindicated in patients with known hypersensitivity to any of its ingredients.

PRECAUTIONS

Drug Interaction with Erythromycin and Ketoconazole

Fexofenadine hydrochloride has been shown to exhibit minimal (ca. 5%) metabolism. However, co-administration of fexofenadine hydrochloride with ketoconazole and erythromycin led to increased plasma levels of fexofenadine hydrochloride. Fexofenadine hydrochloride had no effect on the pharmacokinetics of erythromycin and ketoconazole. In two separate studies, fexofenadine hydrochloride 120 mg twice daily (two times the recommended twice daily dose) was co-administered with erythromycin 500 mg every 8 hours or ketoconazole 400 mg once daily under steady-state conditions to normal, healthy volunteers (n=24, each study). No differences in adverse events or QT_c interval were observed when patients were administered fexofenadine hydrochloride alone or in combination with erythromycin or ketoconazole. The findings of these studies are summarized in the following table:

Effects on steady-state fexofenadine hydrochloride pharmacokinetics after 7 days of co-administration with fexofenadine hydrochloride 120 mg every 12 hours (two times the recommended twice daily dose) in normal volunteers (n=24)

Concomitant Drug	$C_{max SS}$ *(Peak plasma concentration)*	$AUC_{SS(0\text{-}12h)}$ *(Extent of systemic exposure)*
Erythromycin (500 mg every 8 hrs)	+82%	+109%
Ketoconazole (400 mg once daily)	+135%	+164%

The changes in plasma levels were within the range of plasma levels achieved in adequate and well-controlled clinical trials.

The mechanism of these interactions has been evaluated in *in vitro*, *in situ*, and *in vivo* animal models. These studies indicate that ketoconazole or erythromycin co-administration enhances fexofenadine gastrointestinal absorption. *In vivo* animal studies also suggest that in addition to increasing absorption, ketoconazole decreases fexofenadine hydrochloride gastrointestinal secretion, while erythromycin may also decrease biliary excretion.

Drug Interactions with Antacids

Administration of 120 mg of fexofenadine hydrochloride (2 x 60 mg capsule) within 15 minutes of an aluminum and magnesium containing antacid (Maalox®) decreased fexofenadine AUC by 41% and C_{max} by 43%. ALLEGRA should not be taken closely in time with aluminum and magnesium containing antacids.

Carcinogenesis, Mutagenesis, Impairment of Fertility

The carcinogenic potential and reproductive toxicity of fexofenadine hydrochloride were assessed using terfenadine studies with adequate fexofenadine hydrochloride exposure (based on plasma area-under-the-concentration vs. time [AUC] values). No evidence of carcinogenicity was observed in an 18-month study in mice and in a 24-month study in rats at oral doses up to 150 mg/kg of terfenadine (which led to fexofenadine exposures that were respectively approximately 3 and 5 times the exposure from the maximum recommended daily oral dose of fexofenadine hydrochloride in adults and children).

In *in vitro* (Bacterial Reverse Mutation, CHO/HGPRT Forward Mutation, and Rat Lymphocyte Chromosomal Aberration assays) and *in vivo* (Mouse Bone Marrow Micronucleus assay) tests, fexofenadine hydrochloride revealed no evidence of mutagenicity.

In rat fertility studies, dose-related reductions in implants and increases in postimplantation losses were observed at an oral dose of 150 mg/kg of terfenadine (which led to fexofenadine hydrochloride exposures that were approximately 3 times the exposure of the maximum recommended daily oral dose of fexofenadine hydrochloride in adults).

Pregnancy

Teratogenic Effects: Category C. There was no evidence of teratogenicity in rats or rabbits at oral doses of terfenadine up to 300 mg/kg (which led to fexofenadine exposures that were approximately 4 and 31 times, respectively, the exposure from the maximum recommended daily oral dose of fexofenadine in adults).

There are no adequate and well controlled studies in pregnant women. Fexofenadine should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus.

Nonteratogenic Effects. Dose-related decreases in pup weight gain and survival were observed in rats exposed to an oral dose of 150 mg/kg of terfenadine (approximately 3 times the maximum recommended daily oral dose of fexofenadine hydrochloride in adults based on comparison of fexofenadine hydrochloride AUCs).

Nursing Mothers

There are no adequate and well-controlled studies in women during lactation. Because many drugs are excreted in human milk, caution should be exercised when fexofenadine hydrochloride is administered to a nursing woman.

Pediatric Use

The recommended dose in patients 6 to 11 years of age is based on cross-study comparison of the pharmacokinetics of ALLEGRA in adults and pediatric patients and on the safety profile of fexofenadine hydrochloride in both adult and pediatric patients at doses equal to or higher than the recommended doses.

The safety of ALLEGRA tablets at a dose of 30 mg twice daily has been demonstrated in 438 pediatric patients 6 to 11 years of age in two placebo-controlled 2-week seasonal allergic rhinitis trials. The safety of ALLEGRA for the treatment of chronic idiopathic urticaria in patients 6 to 11 years of age is based on cross-study comparison of the pharmacokinetics of ALLEGRA in adult and pediatric patients and on the safety profile of fexofenadine in both adult and pediatric patients at doses equal to or higher than the recommended dose.

The effectiveness of ALLEGRA for the treatment of seasonal allergic rhinitis in patients 6 to 11 years of age was demonstrated in one trial (n=411) in which ALLEGRA tablets 30 mg twice daily significantly reduced total symptom scores compared to placebo, along with extrapolation of demonstrated efficacy in patients ages 12 years and above, and the pharmacokinetic comparisons in adults and children. The effectiveness of ALLEGRA for the treatment of chronic idiopathic urticaria in patients 6 to 11 years of age is based on an extrapolation of the demonstrated efficacy of ALLEGRA in adults with this condition and the likelihood that the disease course, pathophysiology and the drug's effect are substantially similar in children to that of adult patients.

The safety and effectiveness of ALLEGRA in pediatric patients under 6 years of age have not been established.

Geriatric Use

Clinical studies of ALLEGRA tablets and capsules did not include sufficient numbers of subjects aged 65 years and over to determine whether this population responds differently from younger patients. Other reported clinical experience has not identified differences in responses between the geriatric and younger patients. This drug is known to be substantially excreted by the kidney, and the risk of toxic reactions to this drug may be greater in patients with impaired renal function. Because elderly patients are more likely to have decreased renal function, care should be taken in dose selection, and may be useful to monitor renal function. (See CLINICAL PHARMACOLOGY).

ADVERSE REACTIONS

Seasonal Allergic Rhinitis

Adults. In placebo-controlled seasonal allergic rhinitis clinical trials in patients 12 years of age and older, which included 2461 patients receiving fexofenadine hydrochloride capsules at doses of 20 mg to 240 mg twice daily, adverse events were similar in fexofenadine hydrochloride and placebo-treated patients. All adverse events that were reported by greater than 1% of patients who received the recommended daily dose of fexofenadine hydrochloride (60 mg capsules twice daily), and that were more common with fexofenadine hydrochloride than placebo, are listed in Table 1.

In a placebo-controlled clinical study in the United States, which included 570 patients aged 12 years and older receiving fexofenadine hydrochloride tablets at doses of 120 or 180 mg once daily, adverse events were similar in fexofenadine hydrochloride and placebo-treated patients. Table 1 also lists adverse experiences that were reported by greater than 2% of patients treated with fexofenadine hydrochloride tablets at doses of 180 mg once daily and that were more common with fexofenadine hydrochloride than placebo.

The incidence of adverse events, including drowsiness, was not dose-related and was similar across subgroups defined by age, gender, and race.

Table 1

Adverse experiences in patients ages 12 years and older reported in placebo-controlled seasonal allergic rhinitis clinical trials in the United States

Twice daily dosing with fexofenadine capsules at rates of greater than 1%

Adverse experience	*Fexofenadine 60 mg Twice Daily (n=679)*	*Placebo Twice Daily (n=671)*
Viral Infection (cold, flu)	2.5%	1.5%
Nausea	1.6%	1.5%
Dysmenorrhea	1.5%	0.3%
Drowsiness	1.3%	0.9%
Dyspepsia	1.3%	0.6%
Fatigue	1.3%	0.9%

Once daily dosing with fexofenadine hydrochloride tablets at rates of greater than 2%

Adverse experience	*Fexofenadine 180 mg once daily (n=283)*	*Placebo (n=293)*
Headache	10.6%	7.5%
Upper Respiratory Tract Infection	3.2%	3.1%
Back Pain	2.8%	1.4%

The frequency and magnitude of laboratory abnormalities were similar in fexofenadine hydrochloride and placebo-treated patients.

Pediatric. Table 2 lists adverse experiences in patients aged 6 to 11 years of age which were reported by greater than 2% of patients treated with fexofenadine hydrochloride tablets at a dose of 30 mg twice daily in placebo-controlled seasonal allergic rhinitis studies in the United States and Canada that were more common with fexofenadine hydrochloride than placebo.

Table 2

Adverse experiences reported in placebo-controlled seasonal allergic rhinitis studies in pediatric patients ages 6 to 11 in the United States and Canada at rates of greater than 2%

Adverse experience	*Fexofenadine 30 mg twice daily (n=209)*	*Placebo (n=229)*
Headache	7.2%	6.6%
Accidental Injury	2.9%	1.3%
Coughing	3.8%	1.3%
Fever	2.4%	0.9%
Pain	2.4%	0.4%
Otitis Media	2.4%	0.0%
Upper Respiratory Tract Infection	4.3%	1.7%

Chronic Idiopathic Urticaria

Adverse events reported by patients 12 years of age and older in placebo-controlled chronic idiopathic urticaria studies were similar to those reported in placebo-controlled seasonal allergic rhinitis studies. In placebo-controlled chronic idiopathic urticaria clinical trials, which included 726 patients 12 years of age and older receiving fexofenadine hydrochloride tablets at doses of 20 to 240 mg twice daily, adverse events were similar in fexofenadine hydrochloride and placebo-treated patients. Table 3 lists adverse experiences in patients aged 12 years and older which were reported by greater than 2% of patients treated with fexofenadine hydrochloride 60 mg tablets twice daily in controlled clinical studies in the United States and Canada and that were more common with fexofenadine hydrochloride than placebo. The safety of fexofenadine hydrochloride in the treatment of chronic idiopathic urticaria in pediatric patients 6 to 11 years of age is based on the safety profile of fexofenadine hydrochloride in adults and adolescent patients at doses equal to or higher than the recommended dose (see Pediatric Use).

Table 3

Adverse experiences reported in patients 12 years and older in placebo-controlled chronic idiopathic urticaria studies in the United States and Canada at rates of greater than 2%

Adverse experience	*Fexofenadine 60 mg twice daily (n=186)*	*Placebo (n=178)*
Back Pain	2.2%	1.1%
Sinusitis	2.2%	1.1%
Dizziness	2.2%	0.6%
Drowsiness	2.2%	0.0%

Events that have been reported during controlled clinical trials involving seasonal allergic rhinitis and chronic idiopathic urticaria patients with incidences less than 1% and similar to placebo and have been rarely reported during postmarketing surveillance include: insomnia, nervousness, and sleep disorders or paroniria. In rare cases, rash, urticaria, pruritus and hypersensitivity reactions with manifestations such as angioedema, chest tightness, dyspnea, flushing and systemic anaphylaxis have been reported.

OVERDOSAGE

Reports of fexofenadine hydrochloride overdose have been infrequent and contain limited information. However, dizziness, drowsiness, and dry mouth have been reported. Single doses of fexofenadine hydrochloride up to 800 mg (six normal volunteers at this dose level), and doses up to 690 mg twice daily for 1 month (three normal volunteers at this dose level) or 240 mg once daily for 1 year (234 normal volunteers at this dose level) were administered without the development of clinically significant adverse events as compared to placebo.

In the event of overdose, consider standard measures to remove any unabsorbed drug. Symptomatic and supportive treatment is recommended.

Hemodialysis did not effectively remove fexofenadine hydrochloride from blood (1.7% removed) following terfenadine administration.

No deaths occurred at oral doses of fexofenadine hydrochloride up to 5000 mg/kg in mice (110 times the maximum recommended daily oral dose in adults and 200 times the maximum recommended daily oral dose in children based on mg/m^2) and up to 5000 mg/kg in rats (230 times the maximum recommended daily oral dose in adults and 400 times the maximum recommended daily oral dose in children based on mg/m^2). Additionally, no clinical signs of toxicity or gross pathological findings were observed. In dogs, no evidence of toxicity was observed at oral doses up to 2000 mg/kg (300 times the maximum recommended daily oral dose in adults and 530 times the maximum recommended daily oral dose in children based on mg/m^2).

Prescribing Information as of November 2000

Aventis Pharmaceuticals Inc.
Kansas City, MO 64137 USA

US Patents 4,254,129; 5,375,693; 5,578,610

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beloved frogs. The fungus is *Batrachochytrium dendrobatidis*, a chytrid that was named as a new genus and species in 1999. The discovery of the disease chytridiomycosis, apparently caused by *B. dendrobatidis*, is so important that there was a special international symposium organized to discuss it.

SCOTT A. REDHEAD
Curator
National Mycological Herbarium
Ottawa, Ontario

Cover

I have been monitoring articles on or related to Islamic culture. My question is, are there not other interesting portraits besides veiled women that qualify for the cover? I believe continuous emphasis of the veiled woman only worsens the existing stereotype of the status of women in Middle Eastern and south Asian and African cultures.

FURKAN KHAN
Alameda, California

EarthPulse

It's time to explore the fuel cell—the energy source of tomorrow. The fuel cell takes hydrogen and oxygen and converts them into electricity and pure water. It has no moving parts, so there is nothing to wear out, and it is Earth friendly—the only end product besides electric power is water so pure you can drink it.

JOHN K. ROOSA
Citrus Springs, Florida

You state that fuel-cell vehicles produce zero emissions. This omits the fact that to produce the hydrogen used in the fuel-cell reaction, electricity is required. Fuel cells may be a promising means of power storage, but as long as coal-fired power plants are used, fuel-cell cars are not zero-emission vehicles.

BRANDON BARCLAY
Bountiful, Utah

While fuel-cell cars themselves do not produce emissions, you are correct in pointing out that the plants where hydrogen is produced do. Scientists around the world are working on environmentally sound ways of manufacturing hydrogen by using renewable resources. For now electrolysis and refining, the two most common means of hydrogen production, usually require the burning of fossil fuels.

Geographica

As a descendant of Captain Kidd, I thought I should enlighten you that it was not William Kidd's turning pirate but England's turning against piracy that got my ancestor in trouble. Kidd was hired to be a pirate for the crown and had papers authorizing his piracy, which was a respectable profession then. While he was out on his last journey, the tide turned politically, and piracy was no longer an acceptable method of amassing a fortune. To show good faith in this change, an example was needed by England. William Kidd was a hired "legal" thief; his employer double-crossed him.

As a descendant of Captain Kidd, I thought I should enlighten you that it was not William Kidd's turning pirate but England's turning against piracy that got my ancestor in trouble.

RITA WHEELER
Greenville, California

You noted that Australia's inland taipan "tops the list of toxic snakes, though no fatalities have been attributed to this placid and rare species." Is it not a close relative of the taipan found along Queensland's coast? While bushwalking there, I received repeated warnings to watch out for the taipan, as it is considered not only the deadliest but also one of the most aggressive snakes.

JOE HLEBICA
San Diego, California

There are two species of taipans in Australia: the inland (Oxyuranus microlepidotus) *and the coastal* (O. scutellatus). *Although the inland taipan is more toxic, its coastal cousin is highly aggressive and known to kill humans.*

On Assignment

I was delighted to see Jonathan Blair in a pith helmet coexisting with some of the more charming of our prehistoric creatures. I haven't seen Jonathan since 1964 when I was a graduate painting student at the Rochester Institute of Technology in New York. He documented in photographs the evolution of my thesis—a three-panel painting—but the one subject on his mind at that time was his dream to work for NATIONAL GEOGRAPHIC.

SHEILA WELLS
Oakland, California

DID THE JOURNEY START WITH HIS HEART?

He grew up in the majesty of British Columbia. Lived extensively with indigenous people everywhere from the Amazon to the Arctic, Kenya to Tibet. Has authored several acclaimed books on his amazing experiences. Wanders the world over celebrating the enchantment of being human. And is dedicated to the survival of cultures, as well as preserving the poetry of diversity. Dr. Wade Davis, anthropologist, writer, ethnobotanist, and National Geographic explorer-in-residence, is one of Ford Motor Company's Heroes for the Planet. A program that's part of ongoing Ford Motor Company initiatives to underwrite and support efforts that make the world a better place. To learn more about Dr. Davis and other Heroes for the Planet, visit our website. You'll find fascinating information, including links to his favorite websites. Around the globe, there are amazing individuals who've dedicated their lives to our planet. You'll find them at www.ford.com/heroes. Stop by. The world is waiting.

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EarthPulse

HUMANS AND HABITATS

Cultural Extinctions Loom

Indigenous ways of life threatened by assimilation pressures, loss of land

Can dugout canoes and medicinal herbs withstand the cultural muscle of jets and cola drinks? About 300 million people in at least 5,000 distinct indigenous cultures still hold to their roots. But governments coerce minorities to modernize and join mainstream society, and economic interests appropriate their lands.

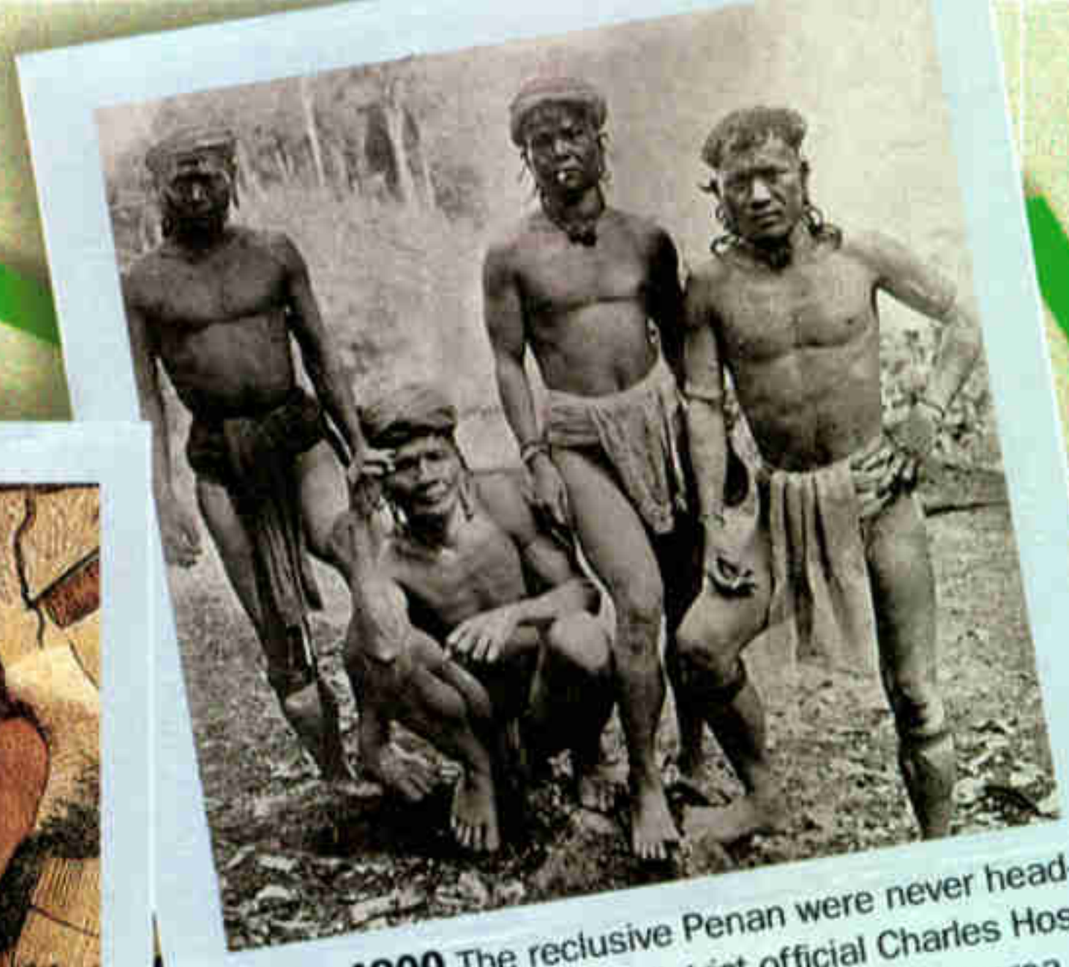
Forests that sustained northern Borneo's Penan in the Malaysian state of Sarawak have been decimated by logging. Of 7,000 Penan, all but 300 or so have given up nomadism and now live in settlements. Civil war in Colombia puts nearly 10,000 Kogi in the line of fire, while the fewer than 2,000 Waorani of the Ecuadorian Amazon battle oil interests. In Kenya, 10,000 nomadic Ariaal herdsmen resist pressure to settle. On Arctic tundra more than 100,000 Inuit face environmental threats: Toxics from industrial countries are accumulating in fish, seals, walruses—traditional foods whose hunting and preparation nourish Inuit culture.

The Forest Falls

1960 Old-growth trees cut commercially in Sarawak in 1960 totaled 1.2 million cubic meters of logs, foreshadowing the destruction of the Penan's forest home.

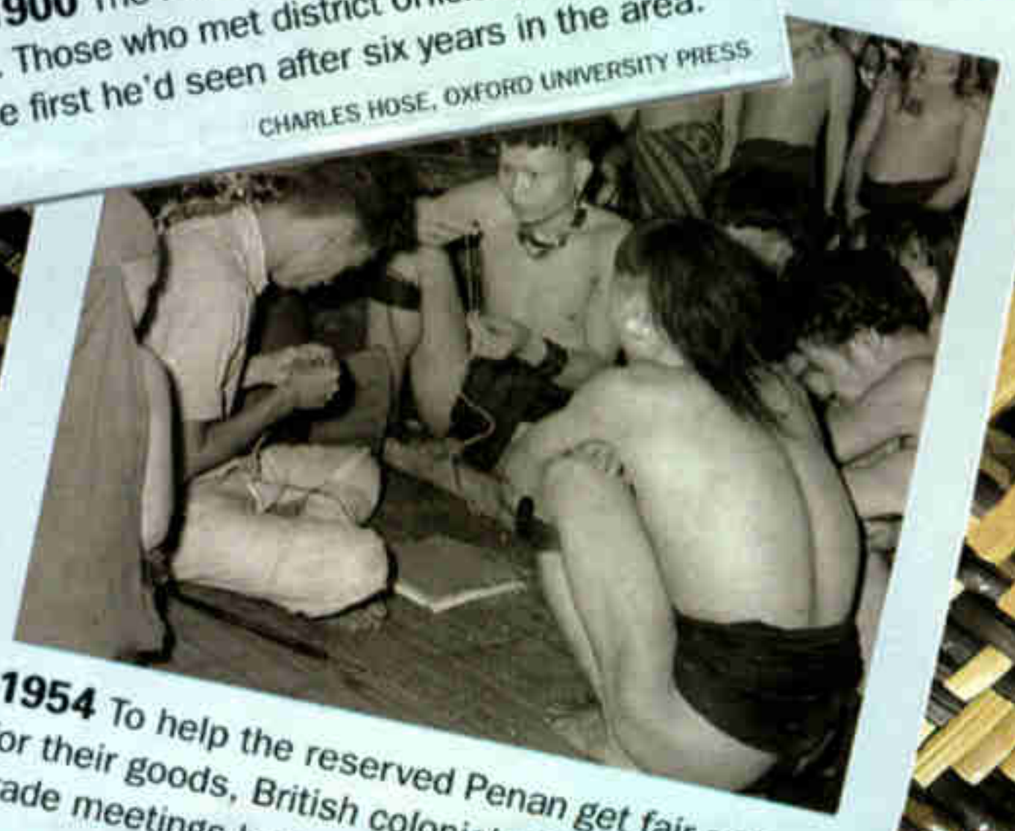
1881 A lithograph from *The Head-Hunters of Borneo* by explorer Carl Bock gave Westerners an early, idyllic glimpse of Borneo's forest nomads.

CARL BOCK, OXFORD UNIVERSITY PRESS



Circa 1900 The reclusive Penan were never headhunters. Those who met district official Charles Hose were the first he'd seen after six years in the area.

CHARLES HOSE, OXFORD UNIVERSITY PRESS



1954 To help the reserved Penan get fair rates for their goods, British colonial officials organized trade meetings between nomadic forest groups.

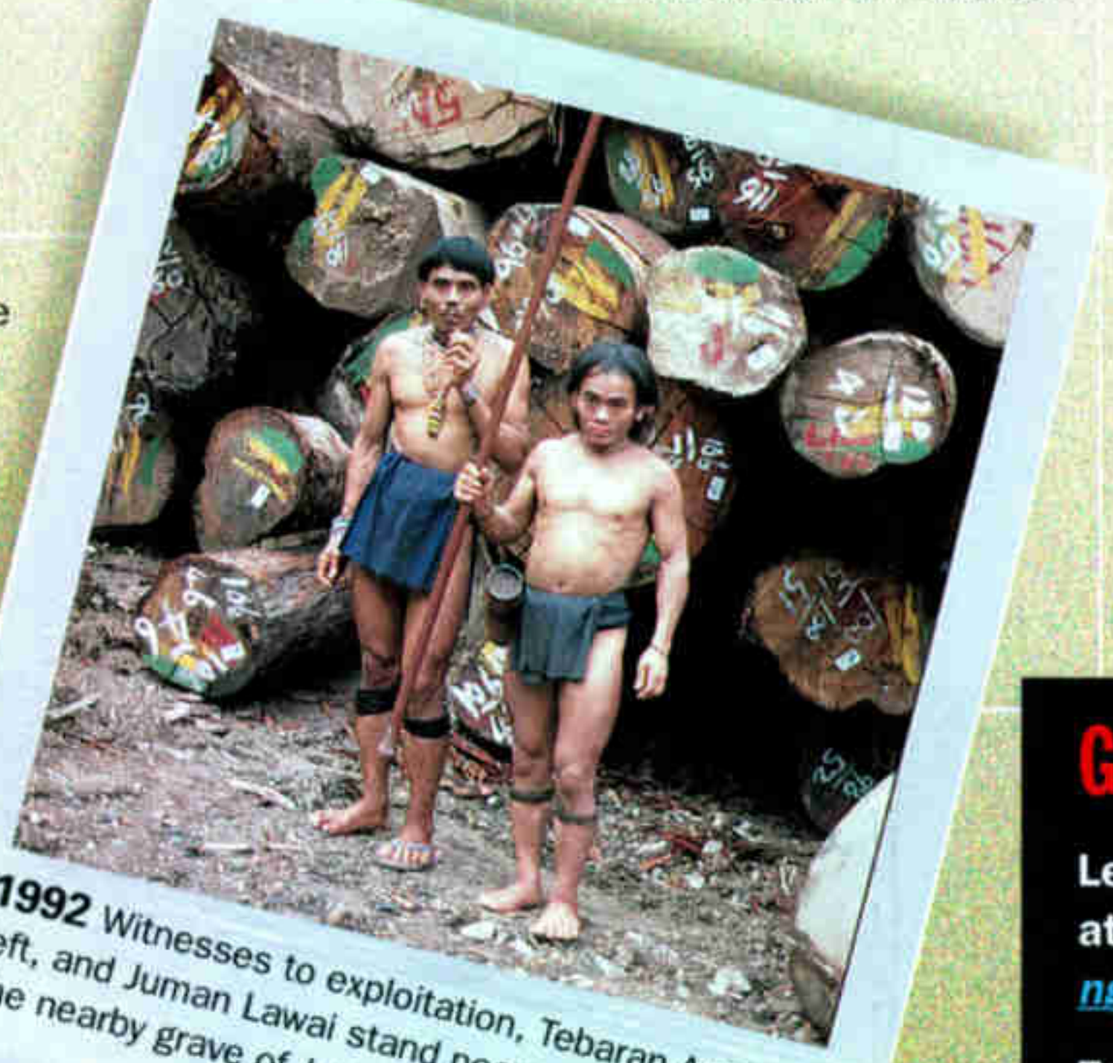
RODNEY NEEDHAM AND HEDDA MORRISON

- Existing language, marked in region of origin
- Nearly extinct language

NG MAPS; SOURCE: SIL INTERNATIONAL

The Besieged Penan

Their rain forest remained intact until the late 1970s, when logging roads penetrated Sarawak's interior. Within a decade Penan were confronting bulldozers with blockades in a vain effort to halt the logging. Their losses: food sources, ancestral graves, the rattan palms from which they weave baskets and mats, and—incalculable—a relationship to the land that has defined them.



1992 Witnesses to exploitation, Tebaran Agut, left, and Juman Lawai stand near a logging camp. The nearby grave of Juman's mother was lost.

PETER BROSIUS (ABOVE AND BELOW)

1992 Tebaran Agut, Penan headman, stands with his son before a fence of branches erected to warn loggers to halt. A bulldozer later flattened it.

Vanishing Languages

"A language is a flash of the human spirit," writes anthropologist Wade Davis. Throughout history perhaps 10,000 different languages have been spoken, but of the 6,800 heard today, many are not being taught to children, and fewer than half may survive this century. Some 450 tongues have only a few elderly speakers and are in immediate danger of extinction.

Get Involved

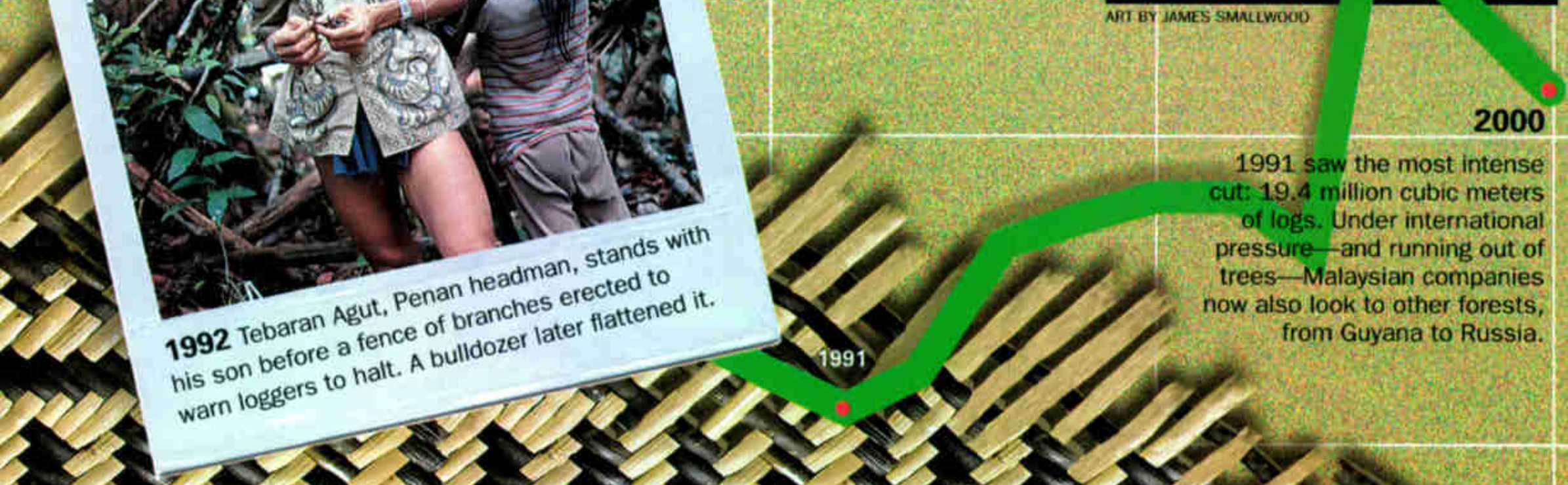
Learn more and find a forum at *nationalgeographic.com/ngm/0109*

Terralingua: *terralingua.org*

Cultural Survival: *cs.org*

Ethnologue: *www.sil.org/ethnologue*

ART BY JAMES SMALLWOOD

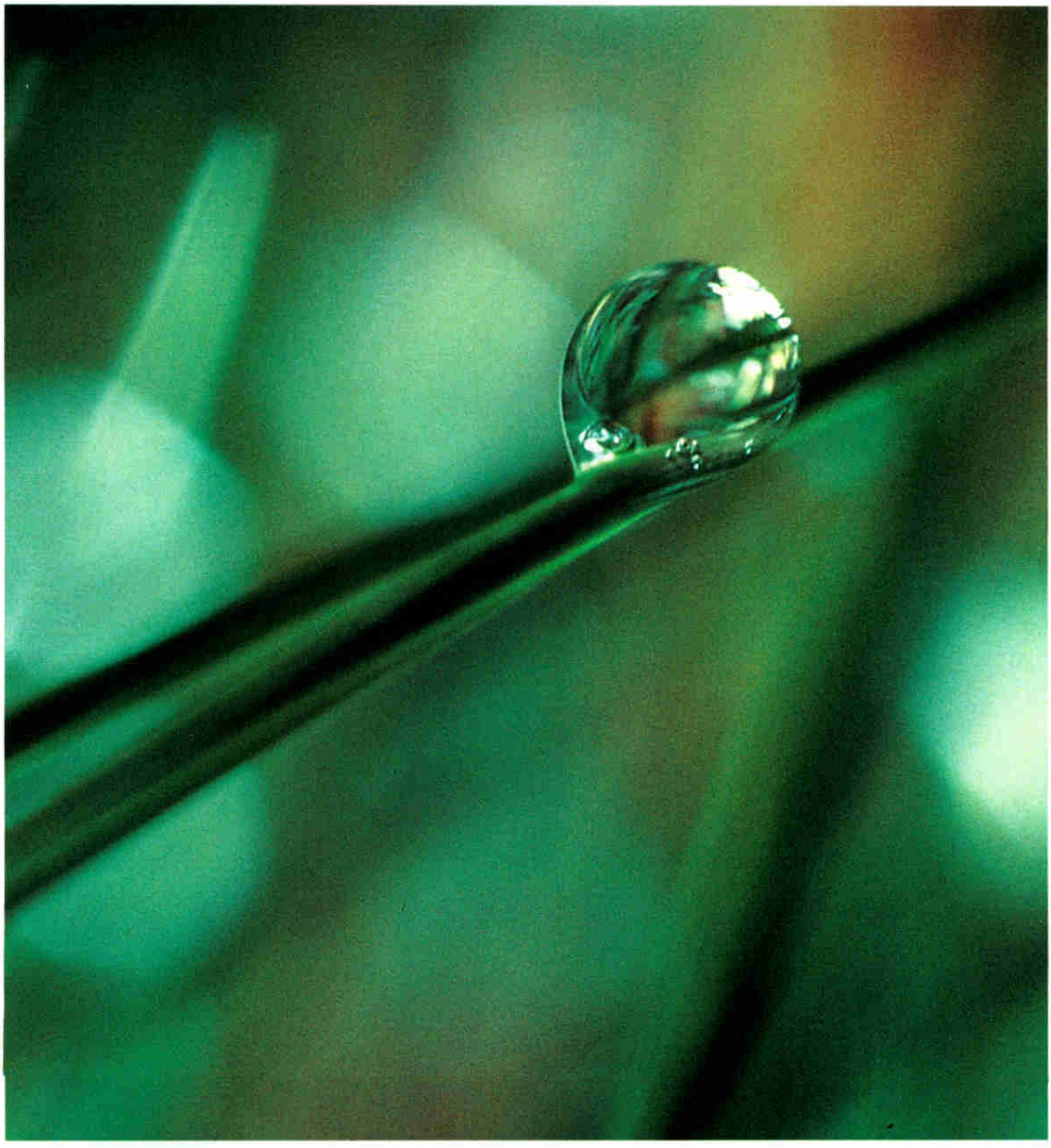


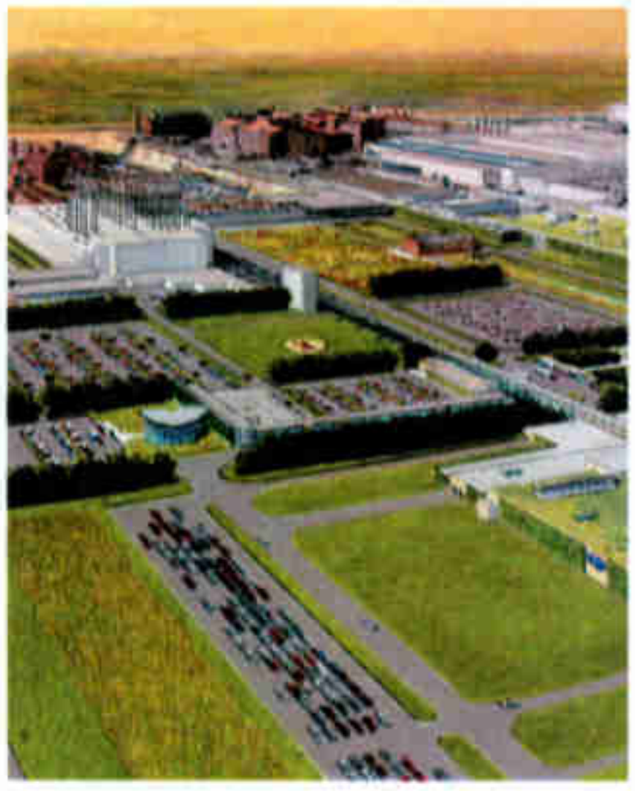
1991 saw the most intense cut: 19.4 million cubic meters of logs. Under international pressure—and running out of trees—Malaysian companies now also look to other forests, from Guyana to Russia.

NOT EVERY PLANT

that's good for the environment

IS CREATED BY NATURE





RENDERING OF THE
NEW ROUGE ASSEMBLY PLANT
DEARBORN, MICHIGAN

AT THE BEGINNING

of the last century Henry Ford wandered the Rouge River marshlands, his mind crowded with ideas. What if cars were produced so efficiently they could belong to millions, not just a privileged few? What if conservation and recycling could make the process more effective? In 1917, on that same land he roamed as a boy, Henry's dreams became reality. His Rouge plant was the only place on the earth where the entire auto-making process took place in one location. Business owners from around the world flocked to the Rouge—eager for a glimpse of the future—and the ingenuity of a Michigan farm boy.

NEARLY 100 YEARS LATER

the Rouge Plant is making history again—this time sparked by the vision of Henry Ford's great-grandson William Clay Ford, Jr. Dedicated to transforming the Rouge from a 20th century icon into a 21st century model, Bill Ford has begun an effort to create a world-class center for sustainable and environmentally sensitive manufacturing. The Rouge will become a living laboratory for testing advanced environmental concepts and expanding Ford Motor Company's vision. Lessons learned here will be an innovative model for future Ford facilities.

A vast 450,000 square-foot living roof will rise above the new Rouge plant. Covered with soil and plants, the roof will become a natural insulator, absorbing rainwater runoff and creating a natural habitat for hundreds of native species. Porous parking lot pavement will soak up storm water and send it through a biological filtering system before it reaches the Rouge River. Toxin-absorbing vegetation will clean contaminated land. Solar panels, fuel cells, and other renewable energy sources will be evaluated to provide power to the plant. Suppliers will be required to send all parts to the plant in returnable packaging. And employees will determine their own workspace climate with personal control buttons, greatly reducing energy consumption.

Even more remarkable, rather than guarding its ownership of these technical breakthroughs, Ford Motor Company is making them a gift to the world of manufacturing. As each idea is invented and patented by Ford, it becomes available—free of charge—to any company sharing Ford's commitment to the environment. Because in the competitive business world of automotive technology, Ford hopes this is one model everyone will copy.

A one-of-a-kind learning laboratory, the new Rouge assembly plant will test environmental technology for future use across Ford Motor Company's global network of plants. All 87 Ford plants worldwide meet the newest Global Environmental Standards—the first company in the world to achieve 100% compliance. Touching the lives of more than 300,000 plant workers, Ford's commitment to ecological innovation will be felt in 25 countries.

Ford Motor Company

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GEOGR

THE PEOPLE, PLACES, AND

NGS RESEARCH GRANT

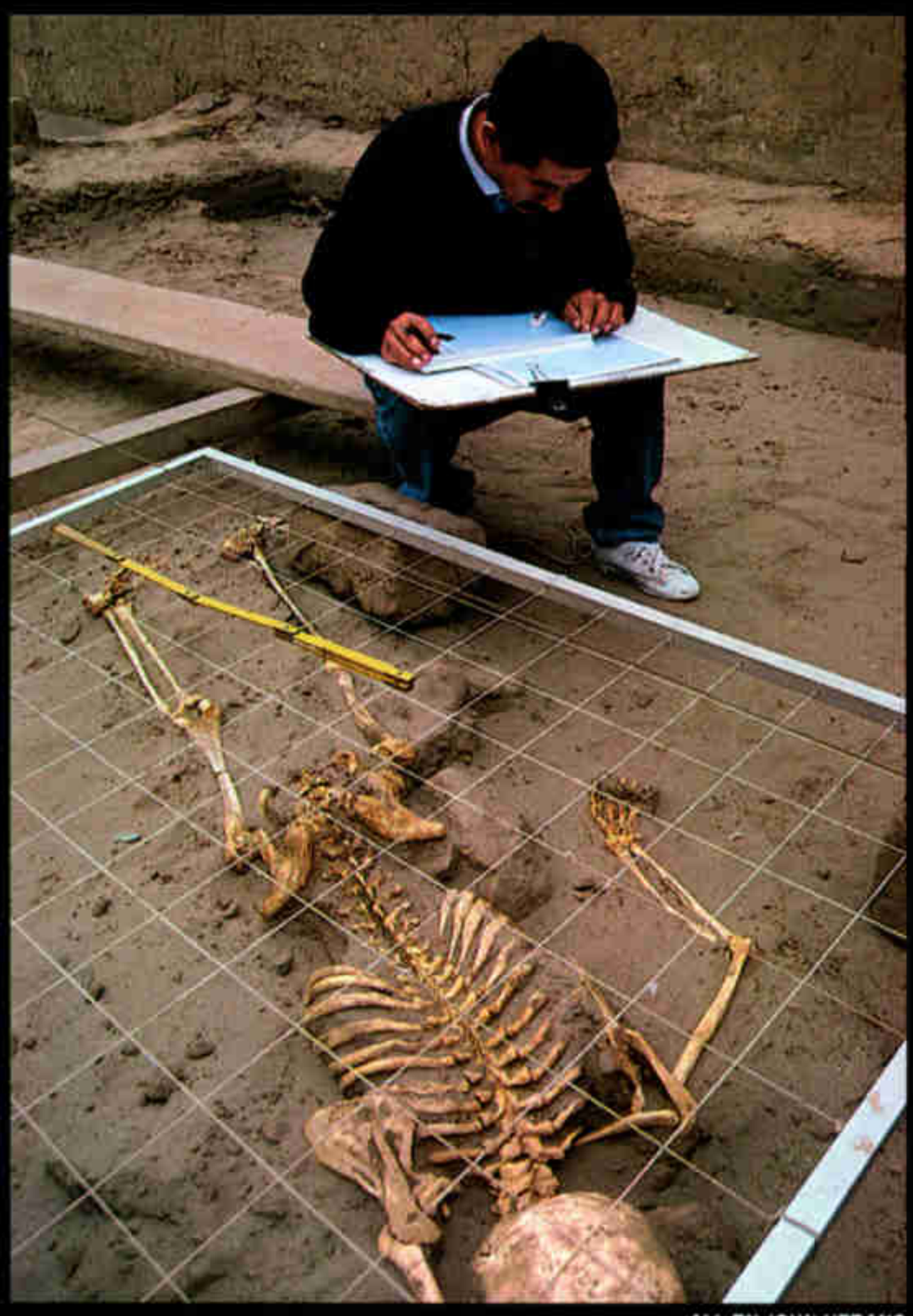
On the Trail of Ancient Offerings

Moche people practiced human sacrifice at the Pyramid of the Moon

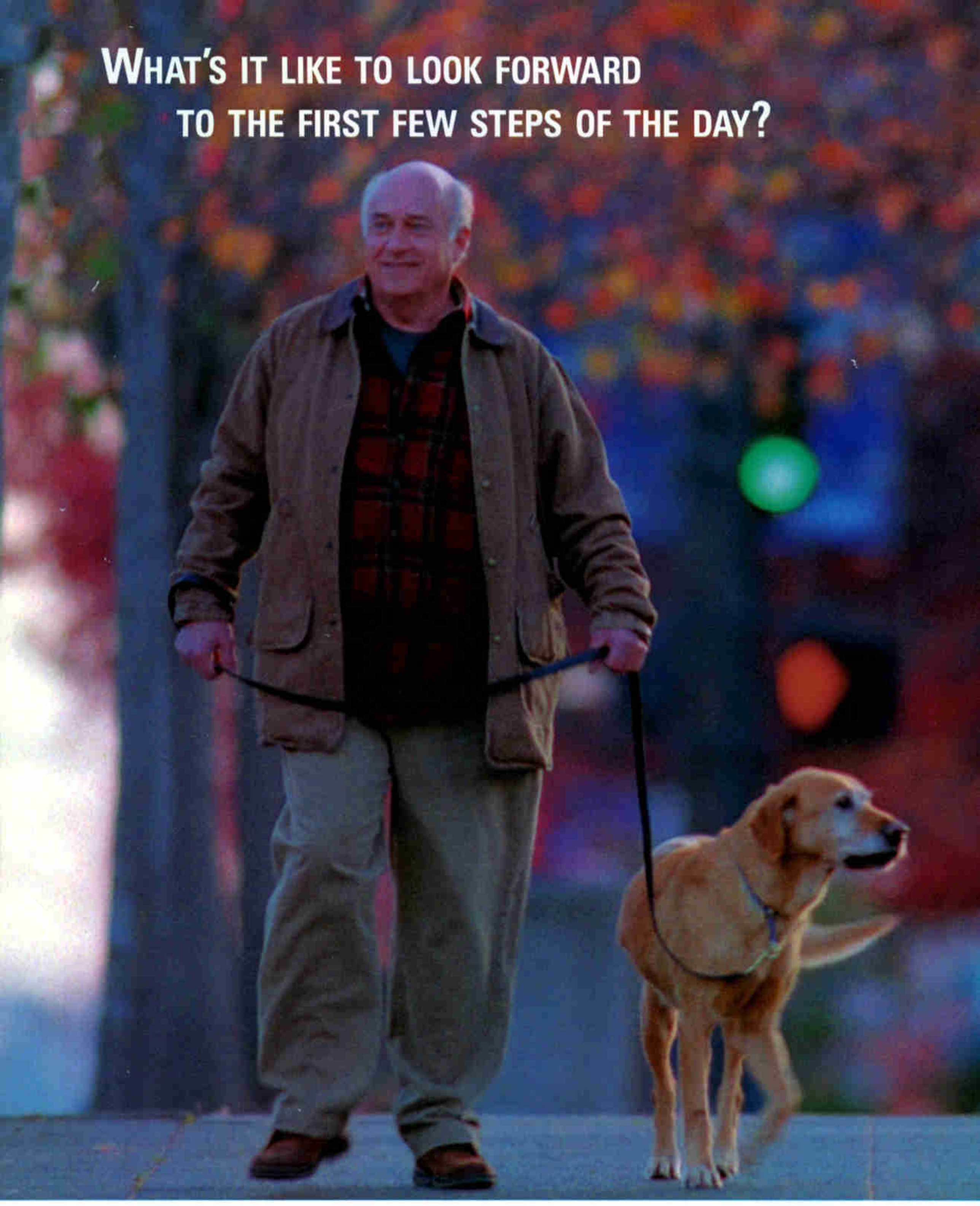
APHICA

CREATURES OF OUR UNIVERSE

Employing techniques that forensic scientists use to solve modern crimes, Society grantee John Verano is investigating warfare and human sacrifice in Moche culture. In one tomb at Peru's Pyramid of the Moon he found this "portrait head" vessel (left), which may represent the warrior interred there some 1,500 years ago. Also in the tomb were clay portraits of noosed prisoners—perhaps this man's victims. Verano and his team have found 15 full and about a dozen partial skeletons, all bearing evidence of sacrificial death. Cut marks on human ribs (above) suggest they were defleshed. Moisés Tufinio (right), a team archaeologist, plots a skeleton that had a rope around its neck, possibly to suspend it from the temple.



ALL BY JOHN VERANO



MERCK

VIOXX IS HERE. 24-HOUR RELIEF FOR THE MOST COMMON TYPE OF ARTHRITIS PAIN, OSTEOARTHRITIS.

It isn't about winning a marathon. Or making you feel like a kid again. It's about controlling the pain that keeps you from doing everyday things. And VIOXX may help. VIOXX is a prescription medicine for osteoarthritis, the most common type of arthritis.

ONE PILL—ALL DAY AND ALL NIGHT RELIEF.

You take VIOXX only once a day. Just one little pill can relieve your pain all day and all night for a full 24 hours.

VIOXX EFFECTIVELY REDUCED PAIN AND STIFFNESS.

In clinical studies, once-daily VIOXX effectively reduced pain and stiffness. So VIOXX can help make it easier for you to do the things you want to do. Like getting out for an early morning walk with a friend.

TAKE WITH OR WITHOUT FOOD.

VIOXX doesn't need to be taken with food. So, you don't have to worry about scheduling VIOXX around meals.

IMPORTANT INFORMATION ABOUT VIOXX.

In rare cases, serious stomach problems, such as bleeding, can occur without warning. People with allergic reactions, such as asthma, to aspirin or other arthritis medicines should not take VIOXX.

Tell your doctor if you have liver or kidney problems, or are pregnant. Also, VIOXX should not be used by women in late pregnancy.

VIOXX has been extensively studied in large clinical trials. Commonly reported side effects included upper respiratory infection, diarrhea, nausea and high blood pressure. Report any unusual symptoms to your doctor.

ASK YOUR DOCTOR OR HEALTHCARE PROFESSIONAL ABOUT VIOXX.

Call 1-800-MERCK-30 for more information, or visit www.vioxx.com. Please see important additional information on the next page.

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VIOXX®

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Patient Information about
VIOXX® (rofecoxib tablets and oral suspension)
VIOXX® (pronounced "VI-ox")
for Osteoarthritis and Pain
Generic name: rofecoxib ("ro-fa-COX-ib")

9183902

You should read this information before you start taking VIOXX*. Also, read the leaflet each time you refill your prescription, in case any information has changed. This leaflet provides only a summary of certain information about VIOXX. Your doctor or pharmacist can give you an additional leaflet that is written for health professionals that contains more complete information. This leaflet does not take the place of careful discussions with your doctor. You and your doctor should discuss VIOXX when you start taking your medicine and at regular checkups.

What is VIOXX?

VIOXX is a nonsteroidal anti-inflammatory drug (NSAID) that is used to reduce pain and inflammation (swelling and soreness). VIOXX is available as a tablet or a liquid that you take by mouth.

VIOXX is a medicine for:
- relief of osteoarthritis (the arthritis caused by age-related "wear and tear" on bones and joints)
- management of acute pain in adults (like the short-term pain you can get after a dental or surgical operation)
- treatment of menstrual pain (pain during women's monthly periods).

Who should not take VIOXX?

Do not take VIOXX if you:
- have had an allergic reaction such as asthma attacks, hives, or swelling of the throat and face to aspirin or other NSAIDs (for example, ibuprofen and naproxen).
- have had an allergic reaction to rofecoxib, which is the active ingredient of VIOXX, or to any of its inactive ingredients. (See Inactive Ingredients at the end of this leaflet.)

What should I tell my doctor before and during treatment with VIOXX?

Tell your doctor if you are:
- pregnant or plan to become pregnant. VIOXX should not be used in late pregnancy because it may harm the fetus.
- breast-feeding or plan to breast-feed. It is not known whether VIOXX is passed through to human breast milk and what its effects could be on a nursing child.

Tell your doctor if you have:
- kidney disease
- liver disease
- heart failure
- high blood pressure
- had an allergic reaction to aspirin or other NSAIDs
- had a serious stomach problem in the past.

Tell your doctor about:
- any other medical problems or allergies you have now or have had.
- all medicines that you are taking or plan to take, even those you can get without a prescription.

Tell your doctor if you develop:
- ulcer or bleeding symptoms (for instance, stomach burning or black stools, which are signs of possible stomach bleeding).
- unexplained weight gain or swelling of the feet and/or legs.
- skin rash or allergic reactions. If you have a severe allergic reaction, get medical help right away.

How should I take VIOXX?

VIOXX should be taken once a day. Your doctor will decide what dose of VIOXX you should take and how long you should take it. You may take VIOXX with or without food.

Can I take VIOXX with other medicines?

Tell your doctor about all of the other medicines you are taking or plan to take while you are on VIOXX, even other medicines that you can get without a prescription. Your doctor may want to check that your medicines are working properly together if you are taking other medicines such as:
- methotrexate (a medicine used to suppress the immune system)
- warfarin (a blood thinner)
- rifampin (an antibiotic)
- ACE inhibitors (medicines used for high blood pressure and heart failure)
- lithium (a medicine used to treat a certain type of depression).

What are the possible side effects of VIOXX?

Serious but rare side effects that have been reported in patients taking VIOXX and/or related medicines have included:

- Serious stomach problems, such as stomach and intestinal bleeding, can occur with or without warning symptoms. These problems, if severe, could lead to hospitalization or death. Although this happens rarely, you should watch for signs that you may have this serious side effect and tell your doctor right away.

- Serious allergic reactions including swelling of the face, lips, tongue, and/or throat which may cause difficulty breathing or swallowing occur rarely but may require treatment right away. Severe skin reactions have also been reported.

- Serious kidney problems occur rarely, including acute kidney failure and worsening of chronic kidney failure.

- Severe liver problems, including hepatitis and jaundice, occur rarely in patients taking NSAIDs, including VIOXX. Tell your doctor if you develop symptoms of liver problems. These include nausea, tiredness, itching, tenderness in the right upper abdomen, and flu-like symptoms.

In addition, the following side effects have been reported: confusion, hair loss, hallucinations, low blood cell counts, unusual headache with stiff neck (aseptic meningitis).

More common, but less serious side effects reported with VIOXX have included the following:

Upper and/or lower respiratory infection and/or inflammation
Headache
Dizziness
Diarrhea
Nausea and/or vomiting
Heartburn, stomach pain and upset
Swelling of the legs and/or feet
High blood pressure
Back pain
Tiredness
Urinary tract infection.

These side effects were reported in at least 2% of osteoarthritis patients receiving daily doses of VIOXX 12.5 mg to 25 mg in clinical studies.

The side effects described above do not include all of the side effects reported with VIOXX. Do not rely on this leaflet alone for information about side effects. Your doctor or pharmacist can discuss with you a more complete list of side effects. Any time you have a medical problem you think may be related to VIOXX, talk to your doctor.

What else can I do to help manage my osteoarthritis pain?

Talk to your doctor about:
- Exercise
- Controlling your weight
- Hot and cold treatments
- Using support devices.

What else should I know about VIOXX?

This leaflet provides a summary of certain information about VIOXX. If you have any questions or concerns about VIOXX, osteoarthritis or pain, talk to your health professional. Your pharmacist can give you an additional leaflet that is written for health professionals.

Do not share VIOXX with anyone else; it was prescribed only for you. It should be taken only for the condition for which it was prescribed.

Keep VIOXX and all medicines out of the reach of children.

Inactive Ingredients:

Oral suspension: citric acid (monohydrate), sodium citrate (dihydrate), sorbitol solution, strawberry flavor, xanthan gum, sodium methylparaben, sodium propylparaben.

Tablets: croscarmellose sodium, hydroxypropyl cellulose, lactose, magnesium stearate, microcrystalline cellulose, and yellow ferric oxide.

Issued July 2000

MERCK & CO., INC.
Whitehouse Station, NJ 08889, USA

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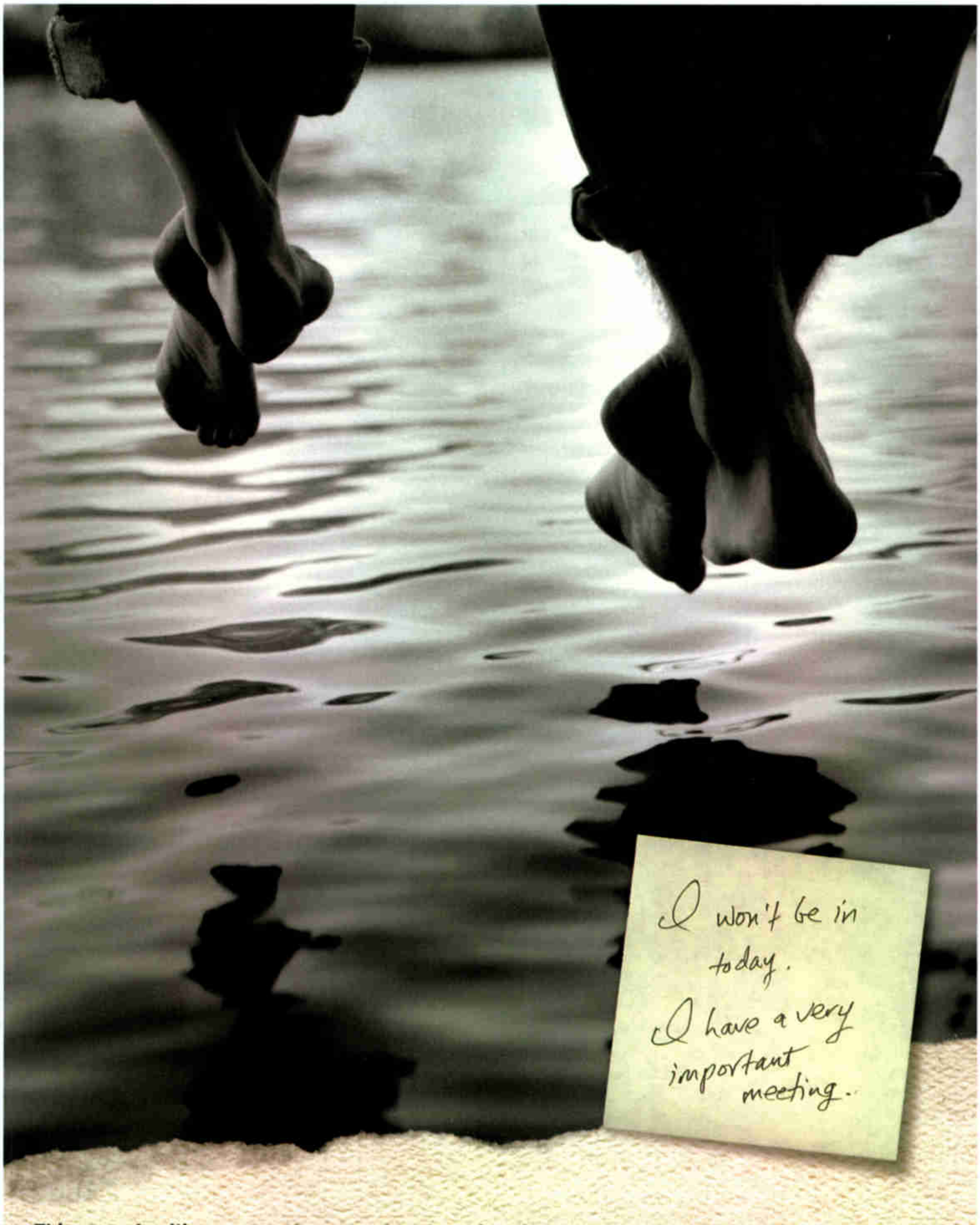

This year, families across the country are making river conservation a priority.
And whether in class, outdoors, or online, National Geographic's education outreach program, *Geography Action! Rivers 2001*, helps bring conservation closer to home. See how your whole family can take action for our rivers at www.nationalgeographic.com/geographyaction.

Rivers...the course our future takes.

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GEOGRAPHY ACTION! *Rivers 2001*

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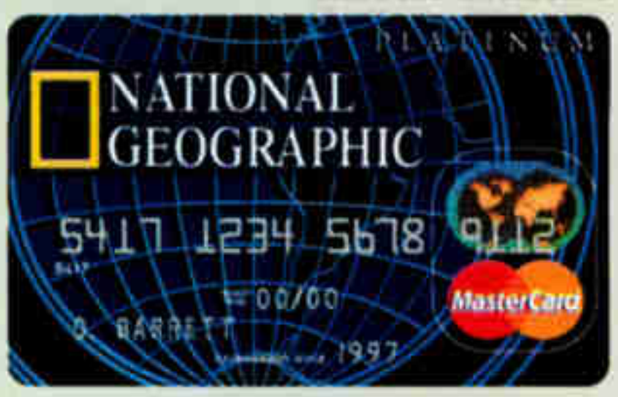

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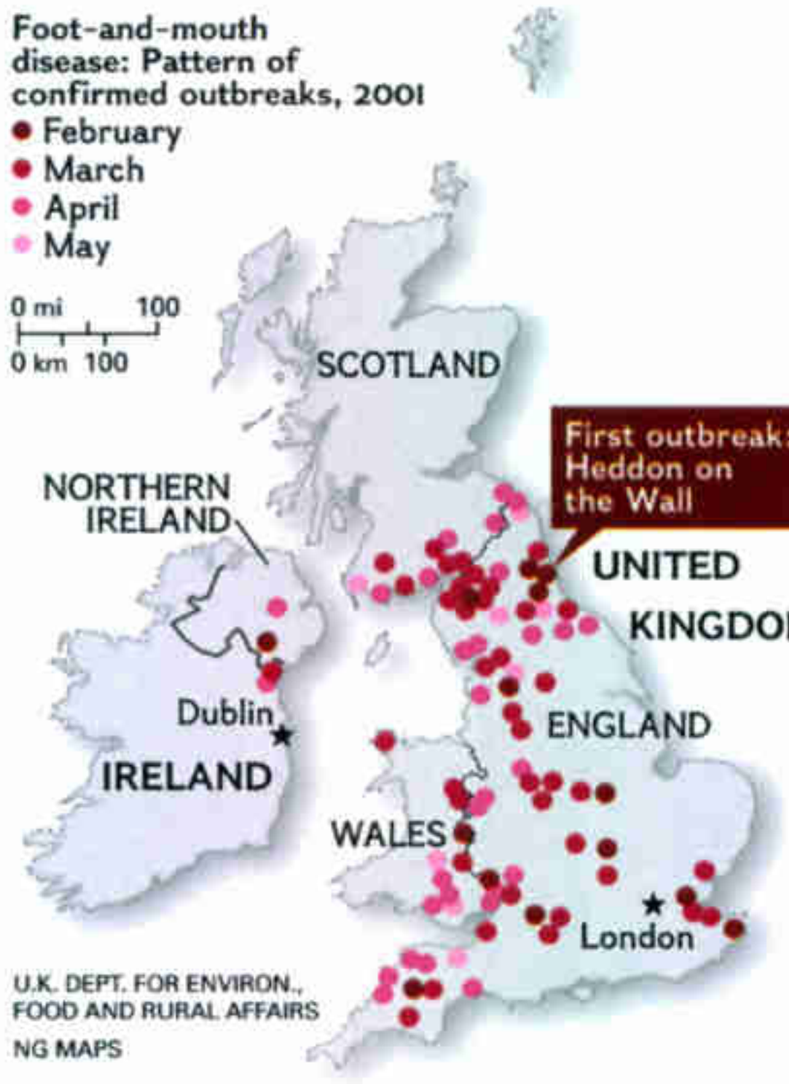

HEALTH

Origins of a Runaway Virus

Foot-and-mouth disease devastates United Kingdom

It all may have started in a pig's trough. Britain's epidemic of foot-and-mouth disease—sometimes called hoof-and-mouth and currently on the rise throughout the world—began in February 2001, when, some experts believe, infected meat was imported to the U.K., then sold as hog fodder to a farm at Heddon on the Wall in north-eastern England. The meat was never heated, as required by law, to kill the lurking virus; the first hogs to eat it sickened within weeks. By the end of May almost 1,700 cows, pigs, and sheep had contracted foot-and-mouth. All of them, as well as many more uninfected but susceptible animals, were killed to help control the disease's progress (map, above). Though humans do not ordinarily catch foot-and-mouth, their travels help spread it. As the epidemic raged, disinfectant stations (above left) dotted the countryside—an effort to control the disease, foot by foot.

MARINE LIFE

Whale of a Record

CANDICE K. EMMONS, NEW ENGLAND AQUARIUM

With a population of perhaps 300, northern right whales, the most endangered whale species, may never recover, some biologists worry. But last winter females that gave birth off Georgia and Florida offered some cause for optimism. Thirty new calves were sighted—the most in 20 years—compared with just one in 2000.

"This is very exciting," says Scott Kraus, director of the New England Aquarium. "I suspect that during the past few years there has been a famine or disease event, and that event has now abated."

ALMANAC

September

Memorable feat: From August to December, bold jay-size birds of western North America called Clark's nutcrackers go into a seed-caching frenzy. A single bird can collect 100,000 pine seeds and store them in 25,000 sites. And these birdbrains remember the locations, digging up the seeds under spring snow.

ART BY SHAWN GOULD

Introducing the Outback L.L.Bean Edition from Subaru. Its six

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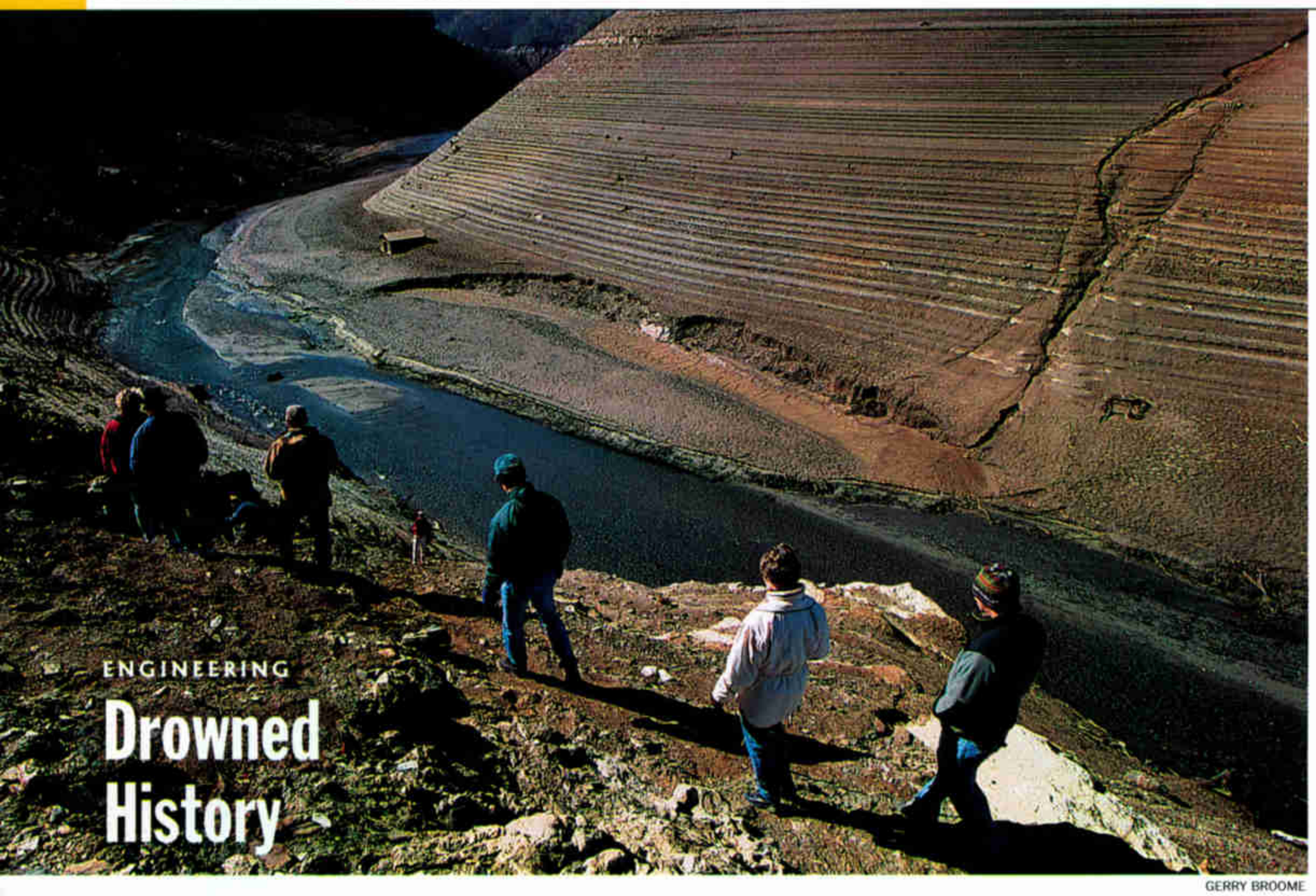


ENGINEERING

Drowned History

GERRY BROOME

When the Tennessee Valley Authority finished building Fontana Dam in the mountains of North Carolina in 1944, the 11,685-acre lake it created displaced about 600 families, who were relocated. Occasionally the places where those families lived and worked can be revisited. Last fall the lake was drawn down 145 feet, as it is every five years so that engineers can inspect intake and sluice gates behind the 480-foot-high dam. While the water level was low, the public toured many of the old settlements.

Wood buildings in the path of the flooding were dismantled and burned to reduce floating debris in the reservoir. Today all that remains is their ghostly foundations. Along with broken crockery and scattered bricks—all federally protected artifacts—visitors can see the remnants of railroad lines that once operated in the area and concrete bunkers that held explosives used in a local copper mine.

ENVIRONMENT

Thermometers a Hot Issue

Health worries cause switch to digital

Mercury thermometers have been banned in Boston, among other cities. The mercury in just one thermometer can contaminate an 11-acre lake, and broken thermometers add some 17 tons of mercury to the U.S. waste stream annually. Fish take up the metal, which can cause neurological damage in humans, so the EPA has recommended limits on fish consumption. To help stanch the flow of mercury, Boston-area stores are offering digital and other safer thermometers in exchange for mercury models.

ART BY RICHARD DOWNS

Photographed by Ingrid Visser

WILDLIFE AS CANON SEES IT

A group of Hector's dolphins swims quietly at the surface, revealing the species' characteristic rounded dorsal fin with its convex trailing edge. Living within a few kilometers of New Zealand's coastline, this small, stocky dolphin feeds on a wide variety of fish and squid. Hector's dolphin has a low potential for population growth: its lifespan is only 20 years, it matures late and females give birth to just one calf every two to four years. It is therefore important to increase the survival rate of this rare and endemic cetacean. Reducing gillnet mortality—the main threat to Hector's dolphin—will help ensure its future survival.

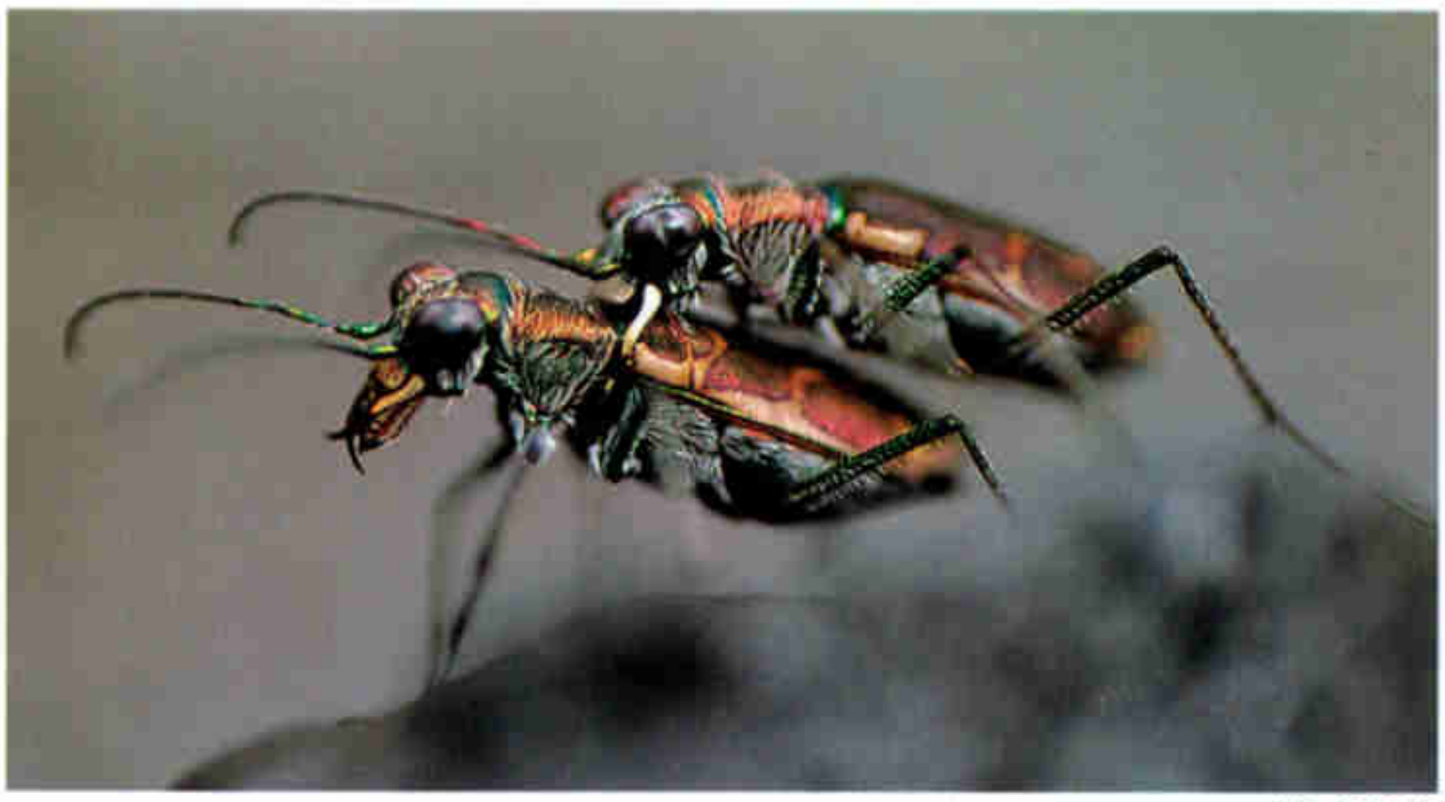
As a global corporation committed to social and environmental concerns, we join in worldwide efforts to promote greater awareness of endangered species for the benefit of future generations.

Hector's Dolphin *(Cephalorhynchus hectori)*
Size: Length, 119-145 cm (males are slightly smaller than females)
Weight: 42-57 kg
Habitat: Endemic to the coastal waters of New Zealand
Surviving number: Estimated at 3,000-4,000; the North Island population may be fewer than 100

CONSERVATION

Nebraska Lists Rare Beetle

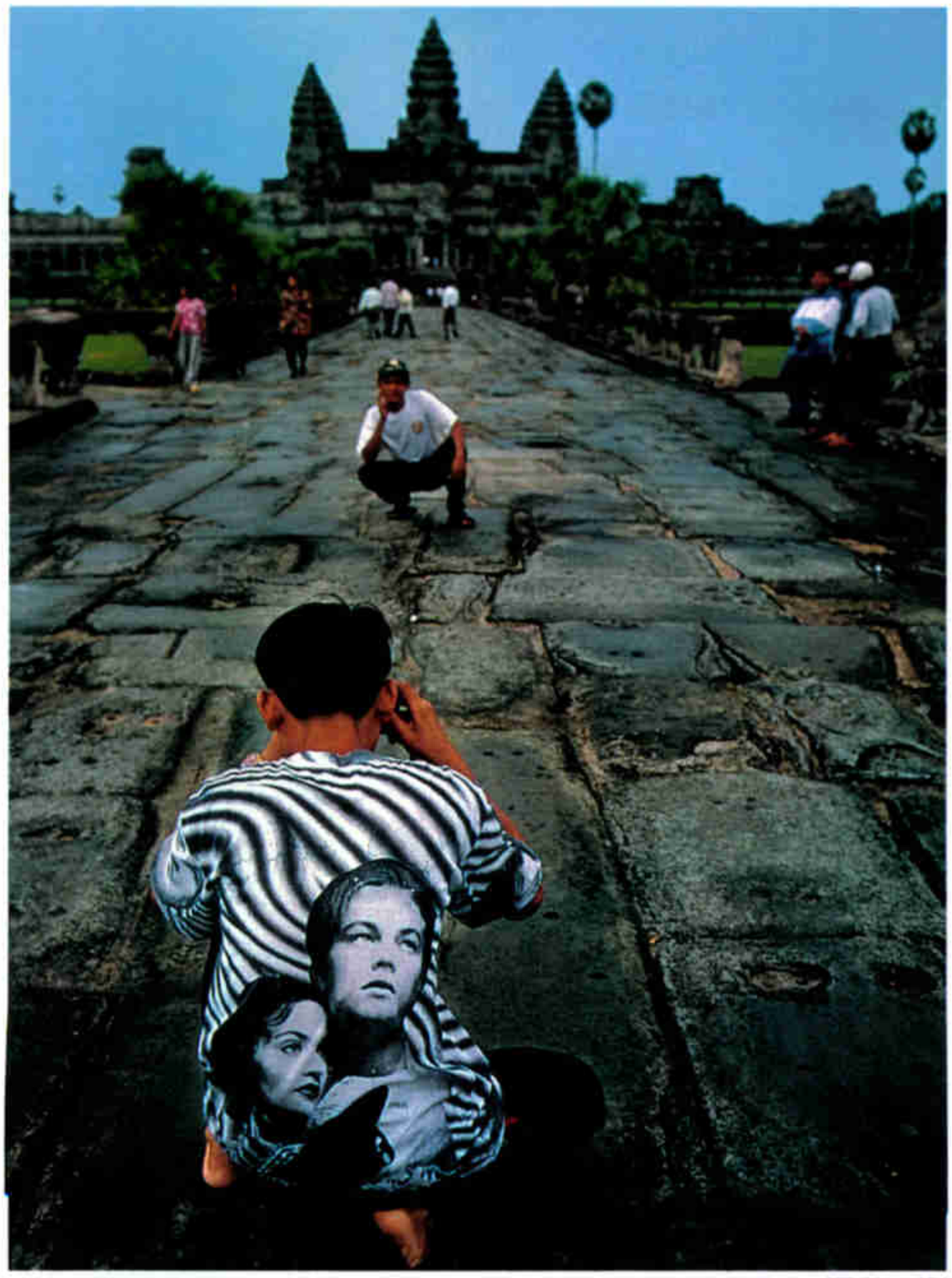
Sprawl to blame for habitat loss



JOEL SARTORE

Salt marshes may seem an unlikely habitat for Nebraska, but they do exist —what's left of them. Legacy of the last glaciers, these saline wetlands may once have covered 16,000 acres. But the state capital, Lincoln, is sprawling northward, and development has reduced the marshes to some 1,000 acres. In this mud, and nowhere else on Earth, lives an insect so rare that it has been added to the state's endangered species list—the Salt Creek tiger beetle.

"Last year's census found about 300, same as the previous two years," says Stephen Spomer, a University of Nebraska entomologist. Is this a potential snail darter in the making, with conservationists and developers headed for war? "So far, so good. There have been no legal conflicts," Spomer says.



STEVE McCURRY

PRESERVATION

Crowding the Temples

Tourism rising rapidly at Cambodia's Angkor

Angkor—religious center of ancient Khmer kings, plagued for decades by wars and looters—now faces siege by new invaders: tourists (left). The site was put on the UNESCO List of World Heritage in Danger in 1992, and more guards and rope barriers were enlisted to protect the temples' priceless art. Visiting hours have also been limited. But the number of foreign tourists at the complex rose from 147,000 in 1999 to 194,000 in 2000. Three times that number are expected four years from now, and a million by 2008.

Cambodia needs the money its visitors spend. Tourism rivals agriculture as the nation's biggest industry, and Angkor is the biggest attraction.

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ENVIRONMENT

Can Coral Be Cultivated?

DARLENE AND NORMAN McCULLOUGH, GREYSTONE PHOTOGRAPHICS (ABOVE); BARBARA ADAMS

Ripped apart by the storm surge from Hurricane Lenny in November 1999, reefs off the Caribbean island of Mustique are getting a second chance. On nearby Dominica, Alan Lowe and his Applied Marine Technologies Limited crew cultivate small pieces of coral they have harvested from the sea. Last year they flew 1,200 coral patches to Mustique and attached them to concrete domes sunk near the ruined reefs. The half-ton domes were positioned using rubber air bladders. After the divers removed each air bladder, they transferred the coral from brightly colored mesh bags to their new home (above).

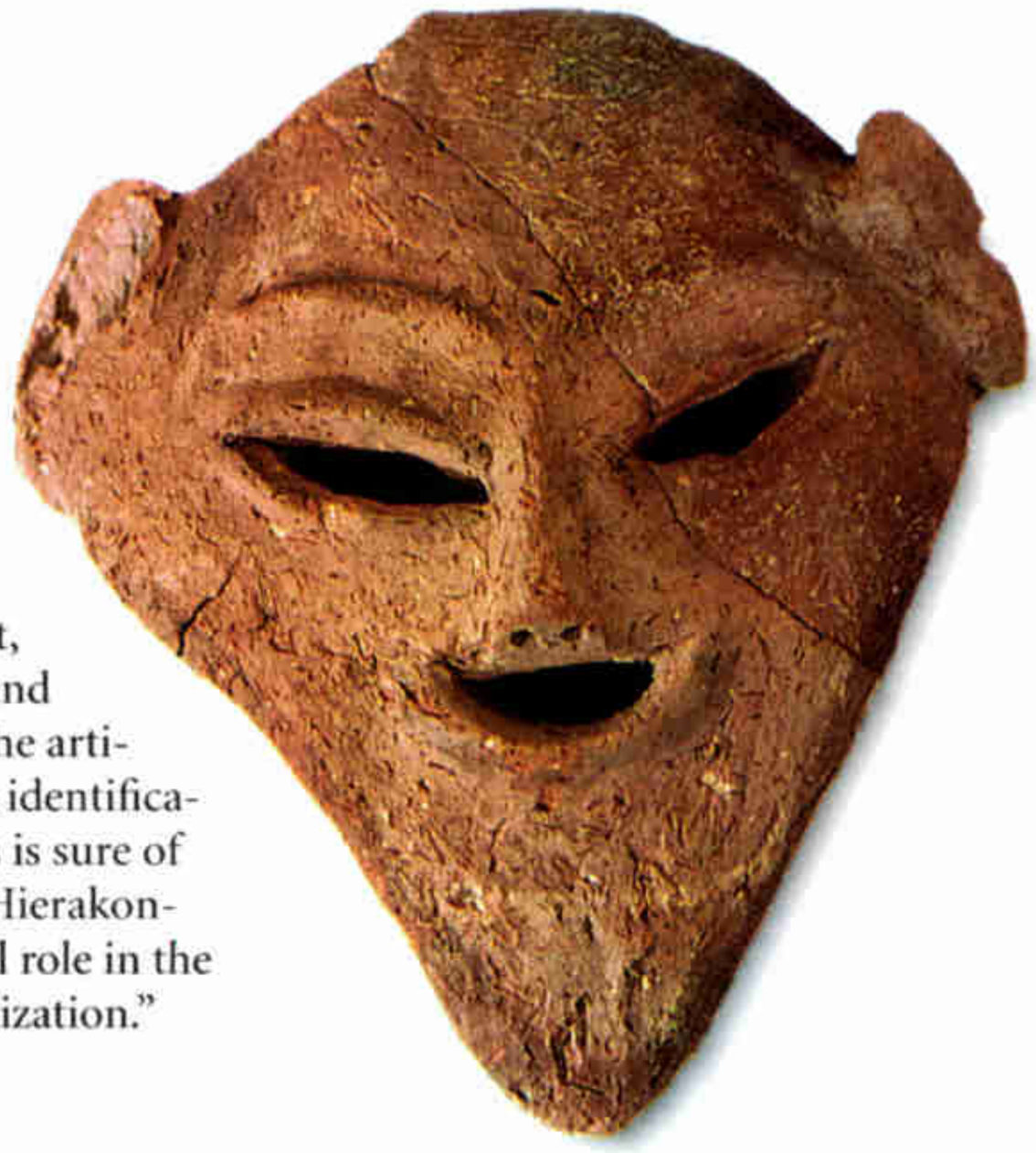
Lowe's team used 15 species of coral; some of the polyps will propagate within only six weeks. Although natural reefs may take thousands of years to grow, Lowe thinks they can be built a piece at a time. More than 40 percent of the world's coral reefs already have been damaged by climate change, disease, and pollution.

NGS RESEARCH GRANT

Behind the Mask

New find in an ancient Egyptian burial site

Egyptologist Barbara Adams believes that the pottery mask (right) she found in a predynastic cemetery at Hierakonpolis in Egypt was meant to be worn. Pieced together from three fragments found in two different tombs, "it fits a human face perfectly," says the Society grantee, who has been excavating the site since 1980. "It has perforations behind each ear so that it can be tied onto the head." The mask, which dates from about 3600 B.C. and may have been used in funeral ceremonies, provides "180° vision," Adams says, "so normal sight is not impaired." The site has been looted, and that, along with the rare and scattered nature of the artifacts, makes positive identification difficult. Adams is sure of one thing though: "Hierakonpolis played a central role in the rise of Egyptian civilization."



ENGINEERING

Canaletto to the Rescue

Looking to art for clues to save a soggy Venice

ART RESOURCE (ABOVE); MICHAEL YAMASHITA

Three centuries after the artist Giovanni Antonio Canal—better known as Canaletto—painted his realistic views of Venice's architecture (above right), his work may help Italians protect that city's treasured buildings from being swamped regularly by flooding seawater (above). Comparing the 18th-century tidemarks portrayed in Canaletto's paintings with modern marks should help engineers in charge of a proposed dam to determine Venice's optimum water level. The project will hold the water, which now fluctuates with rising sea levels and seasonal storms, close to that optimum point.

Sea levels will likely rise 18 more inches in the next century. In addition, Venice's landmass is sinking—ten inches over the past 100 years, says a recent study.

CONSERVATION

Snakes Feel the Bite on Cambodian Lake

Declining fish catches over the past three years in Cambodia's Tonle Sap—the largest freshwater body in Southeast Asia—have led to heavy exploitation of the region's water snakes. Snakes have replaced fish as feed for local crocodile farms and are also consumed by humans. Water snake eggs, like these being extracted at a Cambodian market (right), are a particular delicacy. During 1999 and 2000 more than 8,500 water snakes were caught each day during the wet season. That rate of harvest may not be sustainable, says researcher Bryan Stuart of the Wildlife Conservation Society. He hopes to teach fishermen to recognize and release the most endangered of the snake species.

BRYAN STUART

Q: HOW DO YOU GAIN ALTITUDE WHILE ROLLING BACK?

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Behind the SCENES

AT THE NATIONAL GEOGRAPHIC SOCIETY

NATIONAL GEOGRAPHIC PHOTOGRAPHER MARK THIESSEN

Back-to-School Program

Lecturers, new magazine take us into the classroom

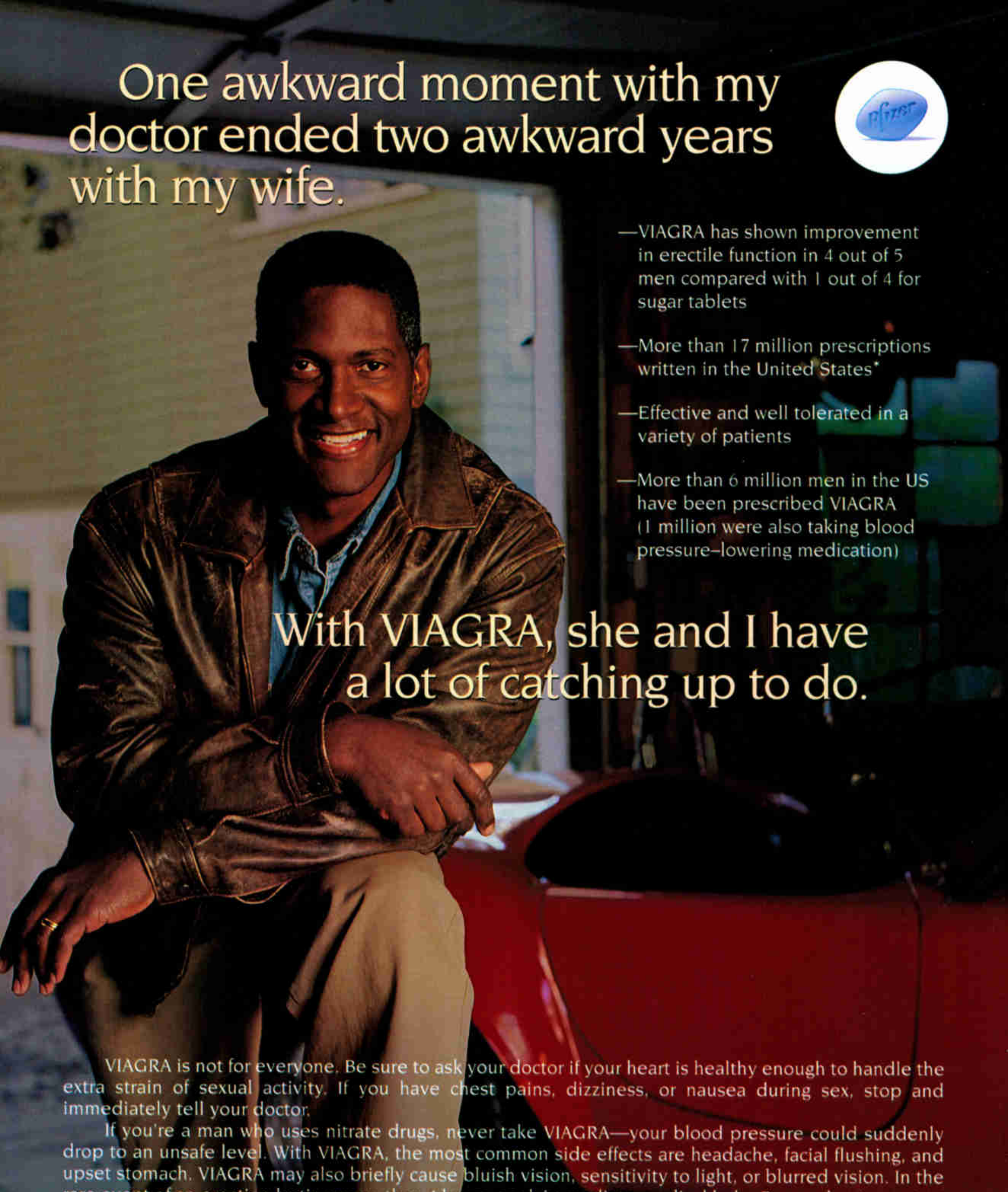
Photographer David Doubilet gave Beverly Battle's sixth-grade class at Harriet Tubman Elementary School in Washington, D.C., an eyeful when he showed them a seal decoy that had been attacked by a great white shark (above). David went to Tubman as part of a new Society project that takes lecturers into classrooms in selected cities to meet students. Those at Tubman were well prepared, says David. "I could answer questions without talking down to them as children."

Energizing youngsters is also the goal of *National Geographic for Kids* (right), a magazine that debuts this month as part of the Geographic's school-based literacy campaign. "With world-class reporting, stunning photography, and illustrative maps, charts, and graphs, it's designed both to be a good read and to turn children into good readers," says editor Mary Dalheim.

Produced six times a year for grades three through six, in partnership with the International Paper Company Foundation, the magazine features teaching guides and links to Web resources *(nationalgeographic.com/ngforkids)*.

"Our aim," says Ericka Markman, senior vice president of school publishing, "is to help children develop the skills necessary to read and understand nonfiction materials and become informed citizens of the world."

One awkward moment with my doctor ended two awkward years with my wife.



—VIAGRA has shown improvement in erectile function in 4 out of 5 men compared with 1 out of 4 for sugar tablets

—More than 17 million prescriptions written in the United States*

—Effective and well tolerated in a variety of patients

—More than 6 million men in the US have been prescribed VIAGRA (1 million were also taking blood pressure–lowering medication)

With VIAGRA, she and I have a lot of catching up to do.

VIAGRA is not for everyone. Be sure to ask your doctor if your heart is healthy enough to handle the extra strain of sexual activity. If you have chest pains, dizziness, or nausea during sex, stop and immediately tell your doctor.

If you're a man who uses nitrate drugs, never take VIAGRA—your blood pressure could suddenly drop to an unsafe level. With VIAGRA, the most common side effects are headache, facial flushing, and upset stomach. VIAGRA may also briefly cause bluish vision, sensitivity to light, or blurred vision. In the rare event of an erection lasting more than 4 hours, seek immediate medical help. Remember to protect yourself and your partner from sexually transmitted diseases.

Please see patient summary of information about VIAGRA (25-mg, 50-mg, 100-mg) *tablets on the following page.*

*Data on file. Pfizer Inc, New York, NY.

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For more information, call 1-888-4VIAGRA or visit www.viagra.com.

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Love life again.

PATIENT SUMMARY OF INFORMATION ABOUT

VIAGRA®
(sildenafil citrate) tablets

This summary contains important information about VIAGRA®. It is not meant to take the place of your doctor's instructions. Read this information carefully before you start taking VIAGRA. Ask your doctor or pharmacist if you do not understand any of this information or if you want to know more about VIAGRA.

This medicine can help many men when it is used as prescribed by their doctors. However, VIAGRA is not for everyone. It is intended for use only by men who have a condition called erectile dysfunction. **VIAGRA must never be used by men who are taking medicines that contain nitrates of any kind, at any time. This includes nitroglycerin. If you take VIAGRA with any nitrate medicine your blood pressure could suddenly drop to an unsafe or life threatening level.**

What Is VIAGRA?

VIAGRA is a pill used to treat erectile dysfunction (impotence) in men. It can help many men who have erectile dysfunction get and keep an erection when they become sexually excited (stimulated).

You will not get an erection just by taking this medicine. VIAGRA helps a man with erectile dysfunction get an erection only when he is sexually excited.

How Sex Affects the Body

When a man is sexually excited, the penis rapidly fills with more blood than usual. The penis then expands and hardens. This is called an erection. After the man is done having sex, this extra blood flows out of the penis back into the body. The erection goes away. If an erection lasts for a long time (more than 6 hours), it can permanently damage your penis. You should call a doctor immediately if you ever have a prolonged erection that lasts more than 4 hours.

Some conditions and medicines interfere with this natural erection process. The penis cannot fill with enough blood. The man cannot have an erection. This is called erectile dysfunction if it becomes a frequent problem.

During sex, your heart works harder. Therefore sexual activity may not be advisable for people who have heart problems. Before you start any treatment for erectile dysfunction, ask your doctor if your heart is healthy enough to handle the extra strain of having sex. If you have chest pains, dizziness or nausea during sex, stop having sex and immediately tell your doctor you have had this problem.

How VIAGRA Works

VIAGRA enables many men with erectile dysfunction to respond to sexual stimulation. When a man is sexually excited, VIAGRA helps the penis fill with enough blood to cause an erection. After sex is over, the erection goes away.

VIAGRA Is Not for Everyone

As noted above (*How Sex Affects the Body*), ask your doctor if your heart is healthy enough for sexual activity.

If you take any medicines that contain nitrates–either regularly or as needed–you should never take VIAGRA. If you take VIAGRA with any nitrate medicine or recreational drug containing nitrates, your blood pressure could suddenly drop to an unsafe level. You could get dizzy, faint, or even have a heart attack or stroke. Nitrates are found in many prescription medicines that are used to treat angina (chest pain due to heart disease)such as:

- nitroglycerin (sprays, ointments, skin patches or pastes, and tablets that are swallowed or dissolved in the mouth)
- isosorbide mononitrate and isosorbide dinitrate (tablets that are swallowed, chewed, or dissolved in the mouth)

Nitrates are also found in recreational drugs such as amyl nitrate or nitrite ("poppers"). If you are not sure if any of your medicines contain nitrates, or if you do not understand what nitrates are, ask your doctor or pharmacist.

VIAGRA is only for patients with erectile dysfunction. VIAGRA is not for newborns, children, or women. Do not let anyone else take your VIAGRA. VIAGRA must be used only under a doctor's supervision.

What VIAGRA Does Not Do

- VIAGRA does not cure erectile dysfunction. It is a treatment for erectile dysfunction.
- VIAGRA does not protect you or your partner from getting sexually transmitted diseases, including HIV–the virus that causes AIDS.
- VIAGRA is not a hormone or an aphrodisiac.

What To Tell Your Doctor Before You Begin VIAGRA

Only your doctor can decide if VIAGRA is right for you. VIAGRA can cause mild, temporary lowering of your blood pressure. You will need to have a thorough medical exam to diagnose your erectile dysfunction and to find out if you can safely take VIAGRA alone or with your other medicines. Your doctor should determine if your heart is healthy enough to handle the extra strain of having sex.

Be sure to tell your doctor if you:

- have ever had any heart problems (e.g., angina, chest pain, heart failure, irregular heart beats, or heart attack)
- have ever had a stroke
- have low or high blood pressure
- have a rare inherited eye disease called retinitis pigmentosa
- have ever had any kidney problems
- have ever had any liver problems
- have ever had any blood problems, including sickle cell anemia or leukemia
- are allergic to sildenafil or any of the other ingredients of VIAGRA tablets
- have a deformed penis, Peyronie's disease, or ever had an erection that lasted more than 4 hours
- have stomach ulcers or any types of bleeding problems
- are taking any other medicines

VIAGRA and Other Medicines

Some medicines can change the way VIAGRA works. Tell your doctor about **any medicines** you are taking. Do not start or stop taking any medicines before checking with your doctor or pharmacist. This includes prescription and nonprescription medicines or remedies. Remember, VIAGRA should never be used with medicines that contain nitrates (see *VIAGRA Is Not for Everyone*). If you are taking a protease inhibitor, your dose may be adjusted (please see *Finding the Right Dose for You.*) VIAGRA should not be used with any other medical treatments that cause erections. These treatments include pills, medicines that are injected or inserted into the penis, implants or vacuum pumps.

Finding the Right Dose for You

VIAGRA comes in different doses (25 mg, 50 mg and 100 mg). If you do not get the results you expect, talk with your doctor. You and your doctor can determine the dose that works best for you.

- Do not take more VIAGRA than your doctor prescribes.
- If you think you need a larger dose of VIAGRA, check with your doctor.
- VIAGRA should not be taken more than once a day.

If you are older than age 65, or have serious liver or kidney problems, your doctor may start you at the lowest dose (25 mg) of VIAGRA. If you are taking protease inhibitors, such as for the treatment of HIV, your doctor may recommend a 25 mg dose and may limit you to a maximum single dose of 25 mg of VIAGRA in a 48 hour period.

How To Take VIAGRA

Take VIAGRA about one hour before you plan to have sex. Beginning in about 30 minutes and for up to 4 hours, VIAGRA can help you get an erection if you are sexually excited. If you take VIAGRA after a high-fat meal (such as a cheeseburger and french fries), the medicine may take a little longer to start working. VIAGRA can help you get an erection when you are sexually excited. You will not get an erection just by taking the pill.

Possible Side Effects

Like all medicines, VIAGRA can cause some side effects. These effects are usually mild to moderate and usually don't last longer than a few hours. Some of these side effects are more likely to occur with higher doses. The most common side effects of VIAGRA are headache, flushing of the face, and upset stomach. Less common side effects that may occur are temporary changes in color vision (such as trouble telling the difference between blue and green objects or having a blue color tinge to them), eyes being more sensitive to light, or blurred vision.

In rare instances, men have reported an erection that lasts many hours. You should call a doctor immediately if you ever have an erection that lasts more than 4 hours. If not treated right away, permanent damage to your penis could occur (see *How Sex Affects the Body*).

Heart attack, stroke, irregular heart beats, and death have been reported rarely in men taking VIAGRA. Most, but not all, of these men had heart problems before taking this medicine. It is not possible to determine whether these events were directly related to VIAGRA.

VIAGRA may cause other side effects besides those listed on this sheet. If you want more information or develop any side effects or symptoms you are concerned about, call your doctor.

Accidental Overdose

In case of accidental overdose, call your doctor right away.

Storing VIAGRA

Keep VIAGRA out of the reach of children. Keep VIAGRA in its original container. Store at room temperature, 59°-86°F (15°-30°C).

For More Information on VIAGRA

VIAGRA is a prescription medicine used to treat erectile dysfunction. Only your doctor can decide if it is right for you. This sheet is only a summary. If you have any questions or want more information about VIAGRA, talk with your doctor or pharmacist, visit www.viagra.com, or call 1-888-4VIAGRA.

23-5515-00-4

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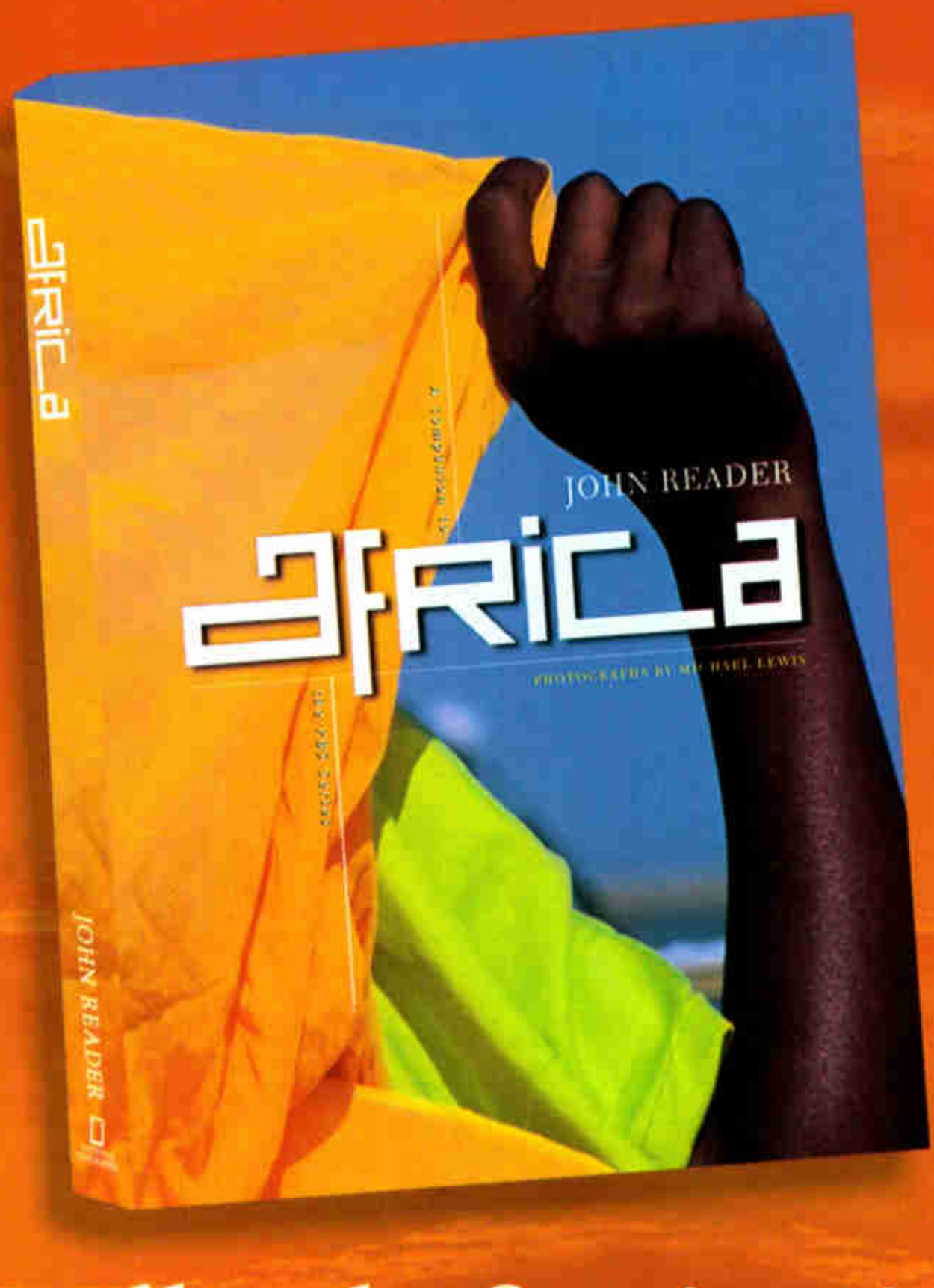
(sildenafil citrate) tablets



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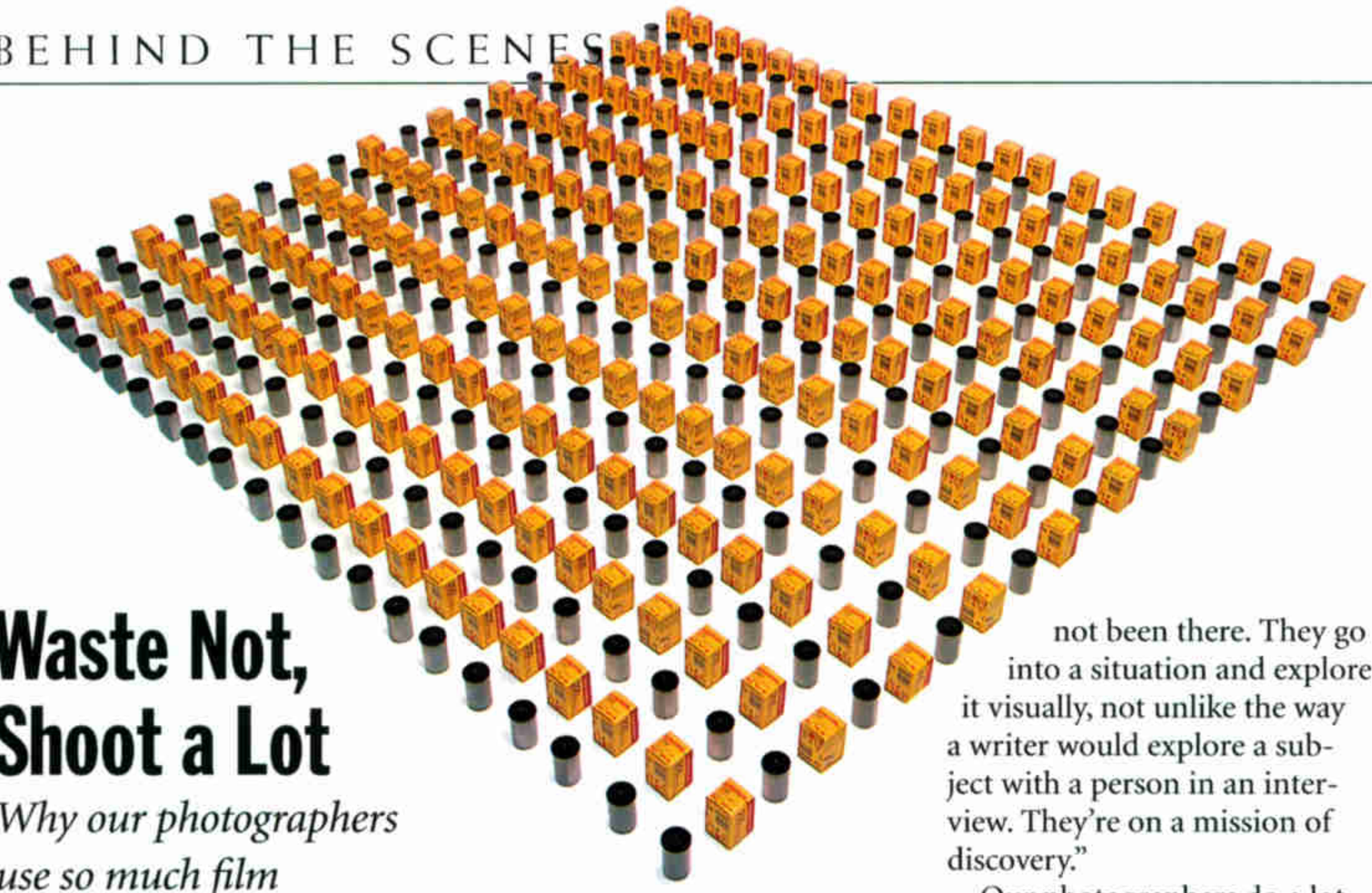

Waste Not, Shoot a Lot

Why our photographers use so much film

All those film boxes and cans (above) fill the camera bags of a GEOGRAPHIC photographer going on assignment. Why so many? And does that constitute a waste of film? No, explains Kent Kobersteen, our director of photography. There's a difference, he says, between amateur photographers and professionals, a difference in their goals.

"Most people on vacation shoot photographs that serve to remind them of places they've been, of things they've seen," Kent says. "Our photographers use photography to communicate about places, people, and animals with people who have not been there. They go into a situation and explore it visually, not unlike the way a writer would explore a subject with a person in an interview. They're on a mission of discovery."

Our photographers do a lot of "sketching" with their cameras, Kent says, and, as with all artists, many of their sketches end up in the wastebasket. That's not a waste of film, Kent notes: "The amount of film shot is no different from the number of notebooks a writer uses. That's insignificant. It's what you end up with that counts."

Retired, but Not Shy

For 28 years Henry, a macaw who had earlier made his home in Washington's National Zoo, perched as a living exhibit in our headquarters museum, Explorers Hall. In the early 1990s, after he developed infections and sinus ailments, veterinarians decided he'd do better in a private home. Terra Sroka, the museum staffer who fed and took care of Henry, volunteered to adopt him.

Now about 50 years old, Henry lives a happy, if raucous, retirement in Florida. Terra and husband Scott moved to the St. Petersburg area, where Scott is a photographer and Terra oversees medical conferences. Henry, whose Florida vet says he's one of the oldest birds she's known,

MARK THIESSEN (TOP); SCOTT SROKA

dominates the household, chasing a pet chow, scrambling around fruit trees, and squawking when he doesn't get his way. "He's pretty high maintenance," Terra admits. "People must think we're crazy. But he's really affectionate. He's just Henry, and we take care of him. *I* think he misses Explorers Hall though."

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You've got to get the story

Freelance video cameraman Dominic Frederico filmed the capture of 28 bighorn sheep near Georgetown, Colorado, for our Channel's *National Geographic Today* show, then set off the next day to see state wildlife officials release them in a remote canyon between Durango and Silverton. But it snowed. And snowed. And snowed. When Dominic (right, in dark parka) arrived at the release site—after riding up the canyon on an open-sided track-maintenance

BOTH BY SUSAN GAETZ

vehicle—he stepped off into snow up to his armpits, then "waddled around" to create a vantage point for his camera. Finally a Durango & Silverton Narrow Gauge Railroad train arrived, and sheep began "jumping like kangaroos" out of a vintage boxcar (top) and disappeared into the canyon. Eight frigid hours after his day began, Dominic got his shots.

Since the Channel's launch in January, crews for *National Geographic Today* have roamed from Belize to Borneo to get stories for the nightly newscast. "Our mission is to look at the world daily and to report what's happening through the National Geographic prism," says Mark Nelson, the show's executive producer. "So we have to get out and cover the world." Even in armpit-deep snow.

100 YEARS AGO

September

"Words can hardly exaggerate the momentous significance of the Trans-Siberian Railway, a work not yet completed, and the parts already in operation not yet beyond the initial, experimental stage."

—From "Siberia," by Edwin A. Grosvenor

A Medal for a Native Son

Honors in Estonia

For service to his native land, senior writer Priit J. Vesilind (above, at right) accepts a medal from Estonia's president, Lennart Meri. Priit's family fled Estonia when he was a baby in 1944, when Soviets reclaimed the country, reaching the U.S. in 1949. His award, Third Order of the White Star (inset), honored his GEOGRAPHIC articles on Estonia and the Baltic, covertly distributed there at a time "when there was the greatest hopelessness," Priit says, "when Estonians felt no one was hearing their voice."

ERIK PEINAR (TOP)

FOR MORE INFORMATION

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GEORGE STEINMETZ

Experience the Real Africa

All this month National Geographic is exploring the unexpected in Africa—from the gold mines of South Africa to salt-evaporation ponds in the Sahara (left). It all starts on PBS with *Africa*, an eight-part series that reveals the continent through the eyes of its people. The journey continues online with photo galleries, interviews with National Geographic photographers, and links to virtual tours, time lines, video clips, kid-friendly fun, and more at *nationalgeographic.com/africa*.

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A Wild Romp With Walruses

Come behind the scenes as Norbert Rosing describes the joys and tribulations of photographing these colossal yet surprisingly graceful creatures while dodging ice floes and polar bears. A video link captures a polar bear, another giant of the Arctic ice, going in for the kill on an Atlantic walrus calf. Learn tips for capturing wildlife on film at *nationalgeographic.com/ngm/0109*.

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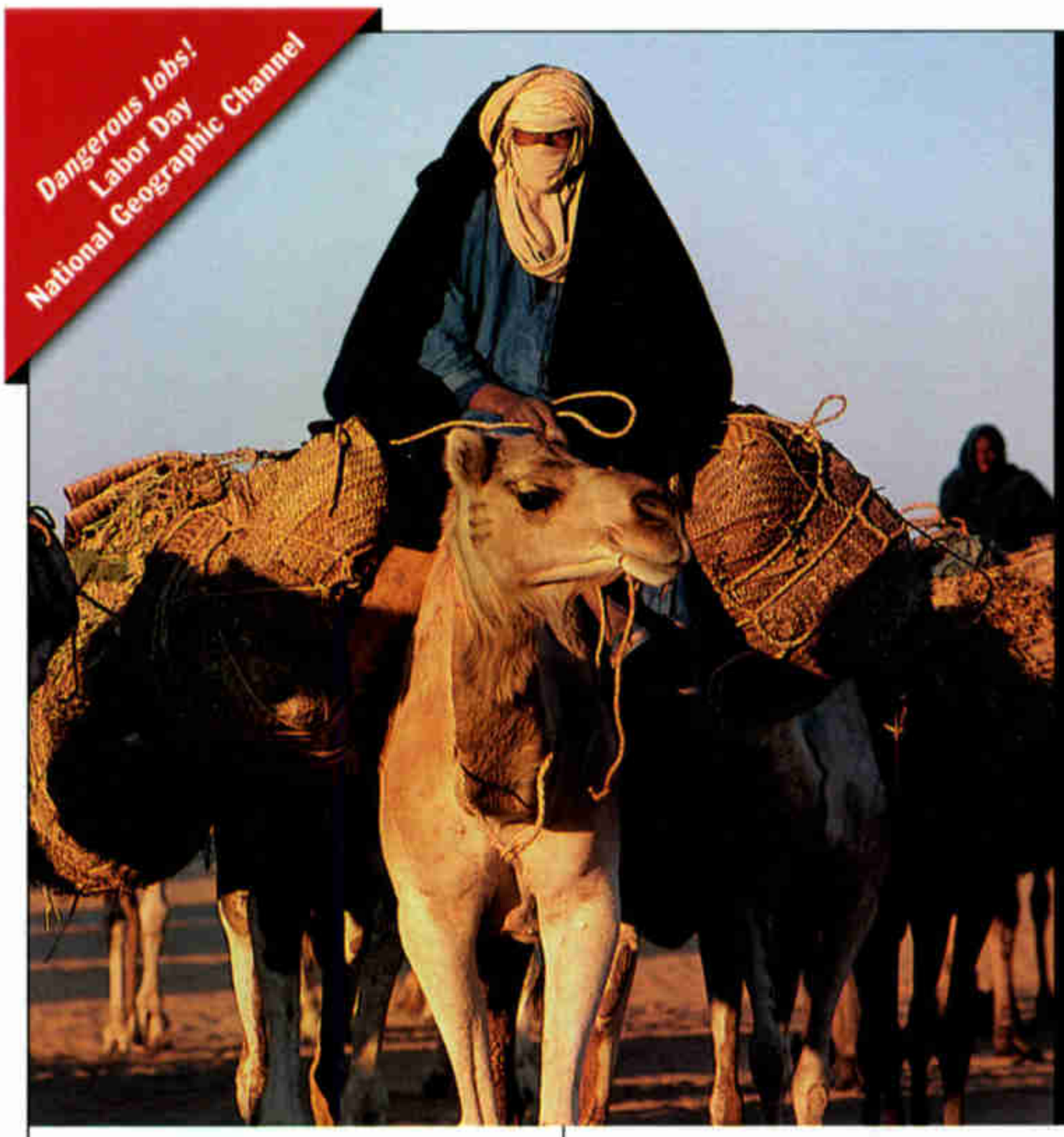


NATIONAL GEOGRAPHIC TELEVISION, PBS

Fierce Sahara

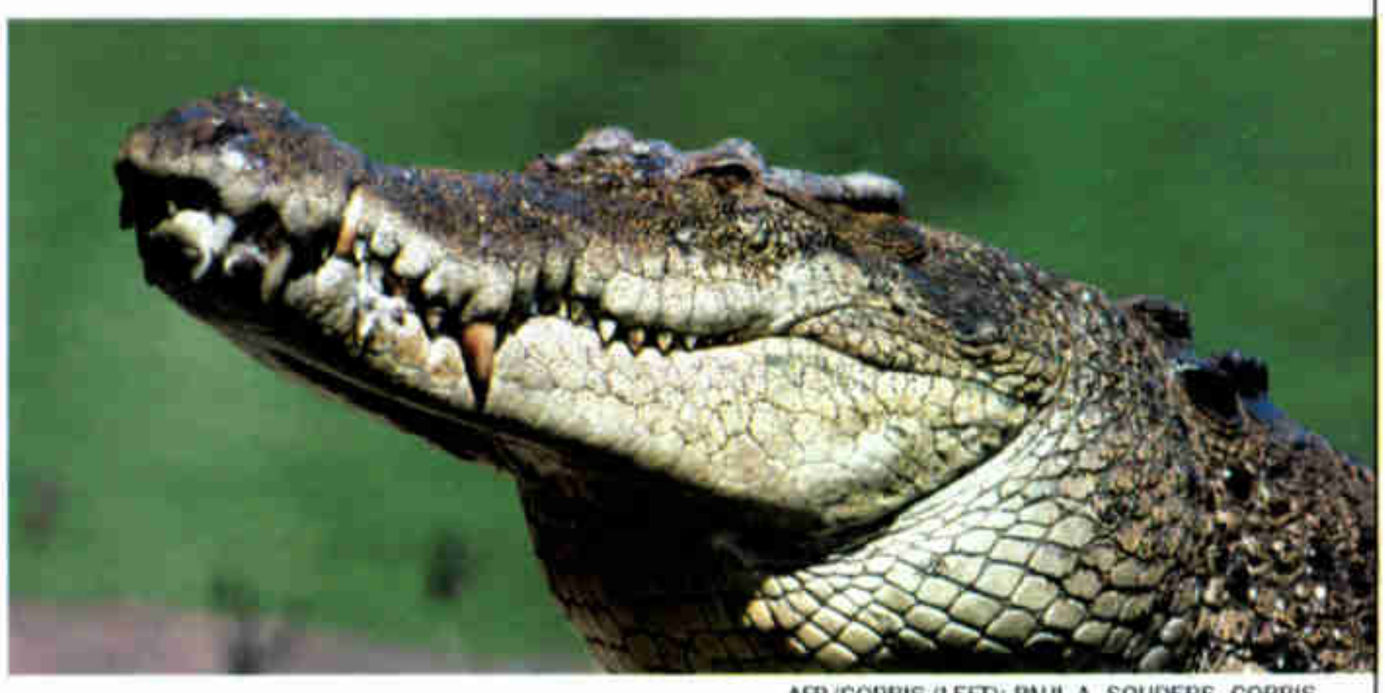
Withering heat and trackless dunes challenge the survival skills of Tuareg salt traders leading a caravan across the Sahara in *Desert Odyssey,* the second episode of a groundbreaking eight-part series on Africa that starts September 9. "We are looking beyond the statistics and calamities to find the human pulse of Africa," says co-executive producer Jennifer Lawson. Exploring African cultures, history, and wildlife, the series combines the talents of NGT and Thirteen/WNET New York's *Nature* series to create an intimate portrait of a continent.

MICHAEL LEWIS

NATIONAL GEOGRAPHIC CHANNEL, SEPTEMBER 13

Faces of War

In salute to the 109 Emmy-winning NGT films, a 2000 winner, *War Child,* airs with an emotional look at an Albanian refugee camp.



AFP/CORBIS (LEFT); PAUL A. SOUDERS, CORBIS

NATIONAL GEOGRAPHIC EXPLORER, CNBC

Handle With Care

Living on an Australian game ranch doesn't mellow a saltwater crocodile one bit. *Croc Country: Nest Raiders* follows ranch hands as they avoid snapping jaws and savage lunges to collect "saltie" eggs during the nesting season.

National Geographic EXPLORER CNBC. Weekends, 8 p.m. ET/PT. **National Geographic Specials** PBS. See local listings. **National Geographic Videos, Kids Videos, and DVDs** Call 1-800-627-5162. **National Geographic Channel** *Call your cable or satellite provider.*

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Nexium™ *(esomeprazole magnesium)*

20-MG, 40-MG Delayed-Release Capsules

BRIEF SUMMARY Before prescribing NEXIUM, please see full Prescribing Information. **INDICATIONS AND USAGE** NEXIUM is indicated for the short-term treatment (4 to 8 weeks) in the healing and symptomatic resolution of diagnostically confirmed erosive esophagitis. **CONTRAINDICATIONS** NEXIUM is contraindicated in patients with known hypersensitivity to any component of the formulation or to substituted benzimidazoles. **PRECAUTIONS** Symptomatic response to therapy with NEXIUM does not preclude the presence of gastric malignancy. Atrophic gastritis has been noted occasionally in gastric corpus biopsies from patients treated long-term with omeprazole, of which NEXIUM is an enantiomer. **Information for Patients:** NEXIUM Delayed-Release Capsules should be taken at least one hour before meals. For patients who have difficulty swallowing capsules, one tablespoon of applesauce can be added to an empty bowl and the capsule opened, and the pellets carefully emptied onto the applesauce. The pellets should be mixed with the applesauce and then swallowed immediately. The applesauce used should not be hot and should be soft enough to be swallowed without chewing. The pellets should not be chewed or crushed. The pellet/applesauce mixture should not be stored for future use. Antacids may be used while taking NEXIUM. **DRUG INTERACTIONS** Esomeprazole is extensively metabolized in the liver by CYP2C19 and CYP3A4. *In vitro* and *in vivo* studies have shown that esomeprazole is not likely to inhibit CYPs 1A2, 2A6, 2C9, 2D6, 2E1 and 3A4. No clinically relevant interactions with drugs metabolized by these CYP enzymes would be expected. Drug interaction studies have shown that esomeprazole does not have any clinically significant interactions with phenytoin, warfarin, quinidine, clarithromycin or amoxicillin. Esomeprazole may potentially interfere with CYP2C19, the major esomeprazole-metabolizing enzyme. Coadministration of esomeprazole 30 mg and diazepam, a CYP2C19 substrate, resulted in a 45% decrease in clearance of diazepam. Increased plasma levels of diazepam were observed 12 hours after dosing and onwards. However, at that time, the plasma levels of diazepam were below the therapeutic interval, and thus this interaction is unlikely to be of clinical relevance. Coadministration of oral contraceptives, diazepam, phenytoin, or quinidine did not seem to change the pharmacokinetic profile of esomeprazole. Esomeprazole inhibits gastric acid secretion, therefore, it is theoretically possible that esomeprazole and omeprazole may interfere with absorption of drugs where gastric pH is an important determinant of their bioavailability (eg, ketoconazole, ampicillin esters, digoxin, and iron salts). **Carcinogenesis, Mutagenesis, Impairment of Fertility:** The carcinogenic potential of esomeprazole was assessed using omeprazole studies. In two 24-month carcinogenicity studies in rats, omeprazole at daily doses of 1.7, 3.4, 13.8, 44.0 and 140.8 mg/kg/day (about 0.7 to 57 times the human dose of 20 mg/day expressed on a body surface area basis) produced gastric ECL cell carcinoids in a dose-related manner in both male and female rats; the incidence of this effect was markedly higher in female rats, which had higher blood levels of omeprazole. Gastric carcinoids seldom occur in the untreated rat. In addition, ECL cell hyperplasia was present in all treated groups of both sexes. In one of these studies, female rats were treated with 13.8 mg omeprazole/kg/day (about 5.6 times the human dose on a body surface area basis) for 1 year, then followed for an additional year without the drug. No carcinoids were seen in these rats. An increased incidence of treatment-related ECL cell hyperplasia was observed at the end of 1 year (94% treated vs 10% controls). By the second year the difference between treated and control rats was much smaller (46% vs 26%) but still showed more hyperplasia in the treated group. Gastric adenocarcinoma was seen in one rat (2%). No similar tumor was seen in male or female rats treated for 2 years. For this strain of rat no similar tumor has been noted historically, but a finding involving only one tumor is difficult to interpret. A 78-week mouse carcinogenicity study of omeprazole did not show increased tumor occurrence, but the study was not conclusive. Esomeprazole was negative in the Ames mutation test, in the *in vivo* rat bone marrow cell chromosome aberration test, and the *in vivo* mouse micronucleus test. Esomeprazole, however, was positive in the *in vitro* human lymphocyte chromosome aberration test. Omeprazole was positive in the *in vitro* human lymphocyte chromosome aberration test, the *in vivo* mouse bone marrow cell chromosome aberration test, and the *in vivo* mouse micronucleus test. The potential effects of esomeprazole on fertility and reproductive performance were assessed using omeprazole studies. Omeprazole at oral doses up to 138 mg/kg/day in rats (about 56 times the human dose on a body surface area basis) was found to have no effect on reproductive performance of parental animals. **Pregnancy:** *Teratogenic Effects. Pregnancy Category B* - Teratology studies have been performed in rats at oral doses up to 280 mg/kg/day (about 57 times the human dose on a body surface area basis) and in rabbits at oral doses up to 86 mg/kg/day (about 35 times the human dose on a body surface area basis) and have revealed no evidence of impaired fertility or harm to the fetus due to esomeprazole. There are, however, no adequate and well-controlled studies in pregnant women. Because animal reproduction studies are not always predictive of human response, this drug should be used during pregnancy only if clearly needed. Teratology studies conducted with omeprazole in rats at oral doses up to 138 mg/kg/day (about 56 times the human dose on a body surface area basis) and in rabbits at doses up to 69 mg/kg/day (about 56 times the human dose on a body surface area basis) did not disclose any evidence for a teratogenic potential of omeprazole. In rabbits, omeprazole in a dose range of 6.9 to 69.1 mg/kg/day (about 5.5 to 56 times the human dose on a body surface area basis) produced dose-related increases in embryo-lethality, fetal resorptions, and pregnancy disruptions. In rats, dose-related embryo/fetal toxicity and postnatal developmental toxicity were observed in offspring resulting from parents treated with omeprazole at 13.8 to 138.0 mg/kg/day (about 5.6 to 56 times the human doses on a body surface area basis). There are no adequate and well-controlled studies in pregnant women. Sporadic reports have been received of congenital abnormalities occurring in infants born to women who have received omeprazole during pregnancy. **Nursing Mothers:** The excretion of esomeprazole in milk has not been studied. However, omeprazole concentrations have been measured in breast milk of a woman following oral administration of 20 mg. Because esomeprazole and omeprazole are likely to be excreted in human milk, and because of the potential for serious adverse reactions in nursing infants from esomeprazole and because of the potential for tumorigenicity shown for omeprazole in rat carcinogenicity studies, a decision should be made to discontinue the drug, taking into account the importance of the drug to the mother. **Pediatric Use:** Safety and effectiveness in pediatric patients have not been established. **Geriatric Use:** Of the total number of patients who received NEXIUM in clinical trials, 778 were 65 to 74 years of age and 124 patients were ≥ 75 years of age. No overall differences in safety and efficacy were observed between the elderly and younger individuals, and other reported clinical experience has not identified differences in responses between the elderly and younger patients, but greater sensitivity of some older individuals cannot be ruled out. **ADVERSE REACTIONS** The safety of NEXIUM was evaluated in over 10,000 patients (aged 18-84 years) in clinical trials worldwide including over 7,400 patients in the United States and over 2,600 patients in Europe and Canada. Over 2,900 patients were treated in long-term studies for up to 6-12 months. In general, NEXIUM was well tolerated in both short- and long-term clinical trials. The safety in the treatment of healing of erosive esophagitis was assessed in four randomized comparative clinical trials, which included 1,240 patients on NEXIUM 20 mg, 2,434 patients on NEXIUM 40 mg, and 3,008 patients on omeprazole 20 mg daily. The most frequently occurring adverse events (≥1%) in all three groups was headache (5.5, 5.0, and 3.8, respectively) and diarrhea (no difference among the three groups). Nausea, flatulence, abdominal pain, constipation, and dry mouth occurred at similar rates among patients taking NEXIUM or omeprazole. Additional adverse events that were reported as possibly or probably related to NEXIUM with an incidence < 1% are listed below by body system: ***Body as a Whole:*** abdomen enlarged, allergic reaction, asthenia, back pain, chest pain, chest pain substernal, facial edema, peripheral edema, hot flushes, fatigue, fever, flu-like disorder, generalized edema, leg edema, malaise, pain, rigors; ***Cardiovascular:*** flushing, hypertension, tachycardia; ***Endocrine:*** goiter; ***Gastrointestinal:*** bowel irregularity, constipation aggravated, dyspepsia, dysphagia, dysplasia GI, epigastric pain, eructation, esophageal disorder, frequent stools, gastroenteritis, GI hemorrhage, GI symptoms NOS, hiccup, melena, mouth disorder, pharynx disorder, rectal disorder, serum gastrin increased, tongue disorder, tongue edema, ulcerative stomatitis, vomiting; ***Hearing:*** earache, tinnitus; ***Hematologic:*** anemia, anemia hypochromic, cervical lymphoadenopathy, epistaxis, leukocytosis, leukopenia, thrombocytopenia; ***Hepatic:*** bilirubinemia, hepatic function abnormal, SGOT increased, SGPT increased; ***Metabolic/Nutritional:*** glycosuria, hyperuricemia, hyponatremia, increased alkaline phosphatase, thirst, vitamin B12 deficiency, weight increase, weight decrease; ***Musculoskeletal:*** arthralgia, arthritis aggravated, arthropathy, cramps, fibromyalgia syndrome, hernia, polymyalgia rheumatica; ***Nervous System/Psychiatric:*** anorexia, apathy, appetite increased, confusion, depression aggravated, dizziness, hypertonia, nervousness, hypoesthesia, impotence, insomnia, migraine, migraine aggravated, paresthesia, sleep disorder, somnolence, tremor, vertigo, visual field defect; ***Reproductive:*** dysmenorrhea, menstrual disorder, vaginitis; ***Respiratory:*** asthma aggravated, coughing, dyspnea, larynx edema, pharyngitis, rhinitis, sinusitis; ***Skin and Appendages:*** acne, angioedema, dermatitis, pruritus, pruritus ani, rash, rash erythematous, rash maculo-papular, skin inflammation, sweating increased, urticaria; ***Special Senses:*** otitis media, parosmia, taste loss, taste perversion; ***Urogenital:*** abnormal urine, albuminuria, cystitis, dysuria, fungal infection, hematuria, micturition frequency, moniliasis, genital moniliasis, polyuria; ***Visual:*** conjunctivitis, vision abnormal. Endoscopic findings that were reported as adverse events include: duodenitis, esophagitis, esophageal stricture, esophageal ulceration, esophageal varices, gastric ulcer, gastritis, hernia, benign polyps or nodules, Barrett's esophagus, and mucosal discoloration. Other adverse events not observed with NEXIUM, but occurring with omeprazole can be found in the omeprazole package insert. **OVERDOSAGE** A single oral dose of esomeprazole at 510 mg/kg (about 103 times the human dose on a body surface area basis), was lethal to rats. The major signs of acute toxicity were reduced motor activity, changes in respiratory frequency, tremor, ataxia, and intermittent clonic convulsions. There have been no reports of overdose with esomeprazole. Reports have been received of overdosage with omeprazole in humans. Doses ranged up to 2,400 mg (120 times the usual recommended clinical dose). Manifestations were variable, but included confusion, drowsiness, blurred vision, tachycardia, nausea, diaphoresis, flushing, headache, dry mouth, and other adverse reactions similar to those seen in normal clinical experience (see omeprazole package insert-**ADVERSE REACTIONS**). No specific antidote for esomeprazole is known. Since esomeprazole is extensively protein bound, it is not expected to be removed by dialysis. In the event of overdosage, treatment should be symptomatic and supportive. As with the management of any overdose, the possibility of multiple drug ingestion should be considered. For current information on treatment of any drug overdose, a certified Regional Poison Control Center should be contacted. Telephone numbers are listed in the Physicians' Desk Reference (PDR) or local telephone book.

Prilosec® *(omeprazole)*

20-MG Delayed-Release Capsules

BRIEF SUMMARY Before prescribing PRILOSEC, please see full Prescribing Information. **INDICATIONS AND USAGE** *Erosive Esophagitis:* PRILOSEC Delayed-Release Capsules are indicated for the short-term treatment (4-8 weeks) in the healing of erosive esophagitis, which has been diagnosed by endoscopy. **CONTRAINDICATIONS Omeprazole** PRILOSEC Delayed-Release Capsules are contraindicated in patients with known hypersensitivity to any component of the formulation. **PRECAUTIONS** Symptomatic response to therapy with omeprazole does not preclude the presence of gastric malignancy. Atrophic gastritis has been noted occasionally in gastric corpus biopsies from patients treated long-term with omeprazole. **Information for Patients:** PRILOSEC Delayed-Release Capsules should be taken before eating and should not be opened, chewed or crushed, and should be swallowed whole. **DRUG INTERACTIONS** *Other* Omeprazole can prolong the elimination of diazepam, warfarin and phenytoin, drugs that are metabolized by oxidation in the liver. Although in normal subjects no interaction with theophylline or propranolol was found, there have been clinical reports of interaction with other drugs metabolized via the cytochrome P-450 system (eg, cyclosporine, disulfiram, and benzodiazepines). Patients should be monitored to determine if it is necessary to adjust the dosage of these drugs when taken concomitantly with PRILOSEC. Omeprazole inhibits gastric acid secretion, therefore, it is theoretically possible that omeprazole may interfere with absorption of drugs where gastric pH is an important determinant of their bioavailability (eg, ketoconazole, ampicillin esters, digoxin, and iron salts). In clinical trials, antacids were used concomitantly with the administration of PRILOSEC. **Carcinogenesis, Mutagenesis, Impairment of Fertility:** In two 24-month carcinogenicity studies in rats, omeprazole at daily doses of 1.7, 3.4, 13.8, 44.0 and 140.8 mg/kg/day (approximately 4 to 352 times the human dose, based on a patient weight of 50 kg and a human dose of 20 mg) produced gastric ECL cell carcinoids in a dose-related manner in both male and female rats; the incidence of this effect was markedly higher in female rats, which had higher blood levels of omeprazole. Gastric carcinoids seldom occur in the untreated rat. In addition, ECL cell hyperplasia was present in all treated groups of both sexes. In one of these studies, female rats were treated with 13.8 mg omeprazole/kg/day (approximately 35 times the human dose) for one year, then followed for an additional year without the drug. No carcinoids were seen in these rats. An increased incidence of treatment-related ECL cell hyperplasia was observed at the end of one year (94% treated vs 10% controls). By the second year the difference between treated and control rats was much smaller (46% vs 26%) but still showed more hyperplasia in the treated group. *An unusual primary malignant tumor in the stomach was seen in one rat (2%).* No similar tumor was seen in male or female rats treated for two years. For this strain of rat no similar tumor has been noted historically, but a finding involving only one tumor is difficult to interpret. A 78-week mouse carcinogenicity study of omeprazole did not show increased tumor occurrence, but the study was not conclusive. Omeprazole was not mutagenic in an *in vitro*

Ames *Salmonella typhimurium* assay, an *in vitro* mouse lymphoma cell assay and an *in vivo* rat liver DNA damage assay. A mouse micronucleus test at 625 and 6250 times the human dose gave a borderline result, as did an *in vivo* bone marrow chromosome aberration test. A second mouse micronucleus study at 2000 times the human dose, but with different (suboptimal) sampling times, was negative. In a rat fertility and general reproductive performance test, omeprazole in a dose range of 13.8 to 138.0 mg/kg/day (approximately 35 to 345 times the human dose) was not toxic or deleterious to the reproductive performance of parental animals. **Pregnancy:** *Category C* - Teratology studies conducted in pregnant rats at doses up to 138 mg/kg/day (approximately 345 times the human dose) and in pregnant rabbits at doses up to 69 mg/kg/day (approximately 172 times the human dose) did not disclose any evidence for a teratogenic potential of omeprazole). In rabbits, omeprazole in a dose range of 6.9 to 69.1 mg/kg/day (approximately 17 to 172 times the human dose) produced dose-related increases in embryo-lethality, fetal resorptions and pregnancy disruptions. In rats, dose-related embryo/ fetal toxicity and postnatal developmental toxicity were observed in offspring resulting from parents treated with omeprazole 13.8 to 138.0 mg/kg/day (approximately 35 to 345 times the human dose). There are no adequate or well-controlled studies in pregnant women. Sporadic reports have been received of congenital abnormalities occurring in infants born to women who have received omeprazole during pregnancy. Omeprazole should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus. **Nursing Mothers:** It is not known whether omeprazole is excreted in human milk. In rats, omeprazole administration during late gestation and lactation at doses of 13.8 to 138 mg/kg/day (35 to 345 times the human dose) resulted in decreased weight gain in pups. Because many drugs are excreted in human milk, because of the potential for serious adverse reactions in nursing infants from omeprazole, and because of the potential for tumorigenicity shown for omeprazole in rat carcinogenicity studies, a decision should be made whether to discontinue nursing or to discontinue the drug, taking into account the importance of the drug to the mother. **Pediatric Use:** Safety and effectiveness in pediatric patients have not been established. **Geriatric Use:** No overall differences in safety and efficacy were observed between the elderly and younger individuals, and other reported clinical experience has not identified differences in responses between the elderly and younger patients, but greater sensitivity of some older individuals cannot be ruled out. **ADVERSE REACTIONS** In the U.S. clinical trial population of 465 patients (including duodenal ulcer, Zollinger-Ellison syndrome and resistant ulcer patients), the following adverse experiences were reported to occur in 1% or more of patients on therapy with PRILOSEC. Numbers in parentheses indicate percentages of the adverse experiences considered by investigators as possibly, probably or definitely related to the drug:

	Omeprazole (n=465)	Placebo (n=64)	Ranitidine (n=195)
Headache	6.9 (2.4)	6.3	7.7 (2.6)
Diarrhea	3.0 (1.9)	3.1 (1.6)	2.1 (0.5)
Abdominal Pain	2.4 (0.4)	3.1	2.1
Nausea	2.2 (0.9)	3.1	4.1 (0.5)
URI	1.9	1.6	2.6
Dizziness	1.5 (0.6)	0.0	2.6 (1.0)
Vomiting	1.5 (0.4)	4.7	1.5 (0.5)
Rash	1.5 (1.1)	0.0	0.0
Constipation	1.1 (0.9)	0.0	0.0
Cough	1.1	0.0	1.5
Asthenia	1.1 (0.2)	1.6 (1.6)	1.5 (1.0)
Back Pain	1.1	0.0	0.5

The following adverse reactions which occurred in 1% or more of omeprazole-treated patients have been reported in international double-blind, and open-label, clinical trials in which 2,631 patients and subjects received omeprazole and 120 patients took a placebo. A causal relationship was not assessed. The percentages are given omeprazole then placebo, respectively. *Body as a Whole, site unspecified:* Abdominal Pain 5.2% and 3.3%; Asthenia 1.3% and 0.8%. *Digestive System:* Constipation 1.5 and 0.8; Diarrhea 3.7 and 2.5; Flatulence 2.7 and 5.8; Nausea 4.0 and 6.7; Vomiting 3.2 and 10.0; Acid regurgitation 1.9 and 3.3: *Nervous System/Psychiatric:* Headache 2.9 and 2.5. Additional adverse experiences occurring in < 1% of patients or subjects in domestic and/or international trials, or occurring since the drug was marketed, are shown below within each body system. In many instances, the relationship to PRILOSEC was unclear. *Body As a Whole:* Allergic reactions, including, rarely, anaphylaxis (see also *Skin* below), fever, pain, fatigue, malaise, abdominal swelling. *Cardiovascular:* Chest pain or angina, tachycardia, bradycardia, palpitation, elevated blood pressure, peripheral edema. *Gastrointestinal:* Pancreatitis (some fatal), anorexia, irritable colon, flatulence, fecal discoloration, esophageal candidiasis, mucosal atrophy of the tongue, dry mouth. During treatment with omeprazole, gastric fundic gland polyps have been noted rarely. These polyps are benign and appear to be reversible when treatment is discontinued. Gastroduodenal carcinoids have been reported in patients with ZE syndrome on long-term treatment with PRILOSEC. This finding is believed to be a manifestation of the underlying condition, which is known to be associated with such tumors. *Hepatic:* Mild and, rarely, marked elevations of liver function tests [ALT (SGPT), AST (SGOT), γ-glutamyl transpeptidase, alkaline phosphatase, and bilirubin (jaundice)]. In rare instances, overt liver disease has occurred, including hepatocellular, cholestatic, or mixed hepatitis, liver necrosis (some fatal), hepatic failure (some fatal), and hepatic encephalopathy. *Metabolic/Nutritional:* Hyponatremia, hypoglycemia, weight gain. *Musculoskeletal:* Muscle cramps, myalgia, muscle weakness, joint pain, leg pain. *Nervous System/Psychiatric:* Psychic disturbances including depression, aggression, hallucinations, confusion, insomnia, nervousness, tremors, apathy, somnolence, anxiety, dream abnormalities; vertigo; paresthesia; hemifacial dysesthesia. *Respiratory:* Epistaxis, pharyngeal pain. *Skin:* Rash and, rarely, cases of severe generalized skin reactions including toxic epidermal necrolysis (TEN; some fatal), Stevens-Johnson syndrome, and erythema multiforme (some severe); purpura and/or petechiae (some with rechallenge); skin inflammation, urticaria, angioedema, pruritus, alopecia, dry skin, hyperhidrosis. *Special Senses:* Tinnitus, taste perversion. *Urogenital:* Interstitial nephritis (some with positive rechallenge), urinary tract infection, microscopic pyuria, urinary frequency, elevated serum creatinine, proteinuria, hematuria, glycosuria, testicular pain, gynecomastia. *Hematologic:* Rare instances of pancytopenia, agranulocytosis (some fatal), thrombocytopenia, neutropenia, anemia, leucocytosis, and hemolytic anemia have been reported. **OVERDOSAGE** Rare reports have been received of overdosage with omeprazole. Doses ranged from 320 mg to 900 mg (16-45 times the usual recommended clinical dose). Manifestations were variable, but included confusion, drowsiness, blurred vision, tachycardia, nausea, diaphoresis, flushing, headache, and dry mouth. Symptoms were transient, and no serious clinical outcome has been reported. No specific antidote for omeprazole overdosage is known. Omeprazole is extensively protein bound and is, therefore, not readily dialyzable. In the event of overdosage, treatment should be symptomatic and supportive.

AstraZeneca

NOTE: This summary provides important information about NEXIUM and PRILOSEC. If you would like more information, ask your doctor or pharmacist to let you read the professional labeling and then discuss it with them.

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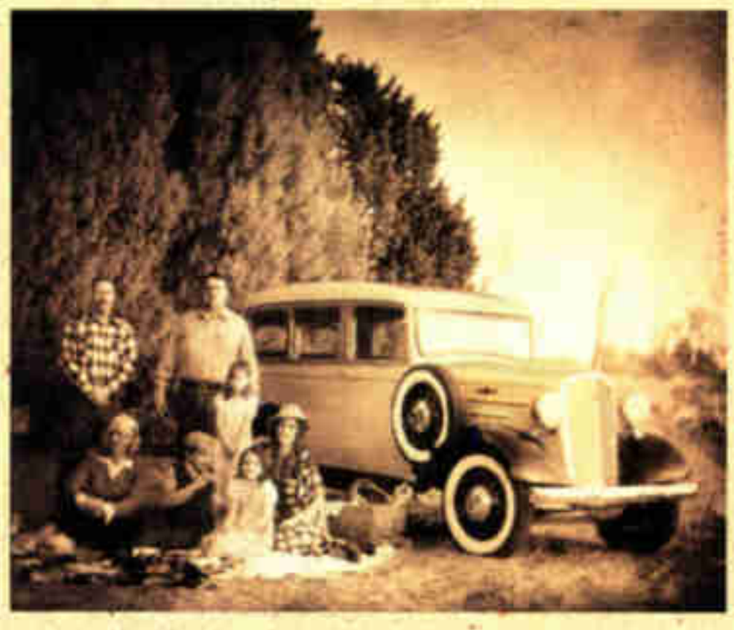

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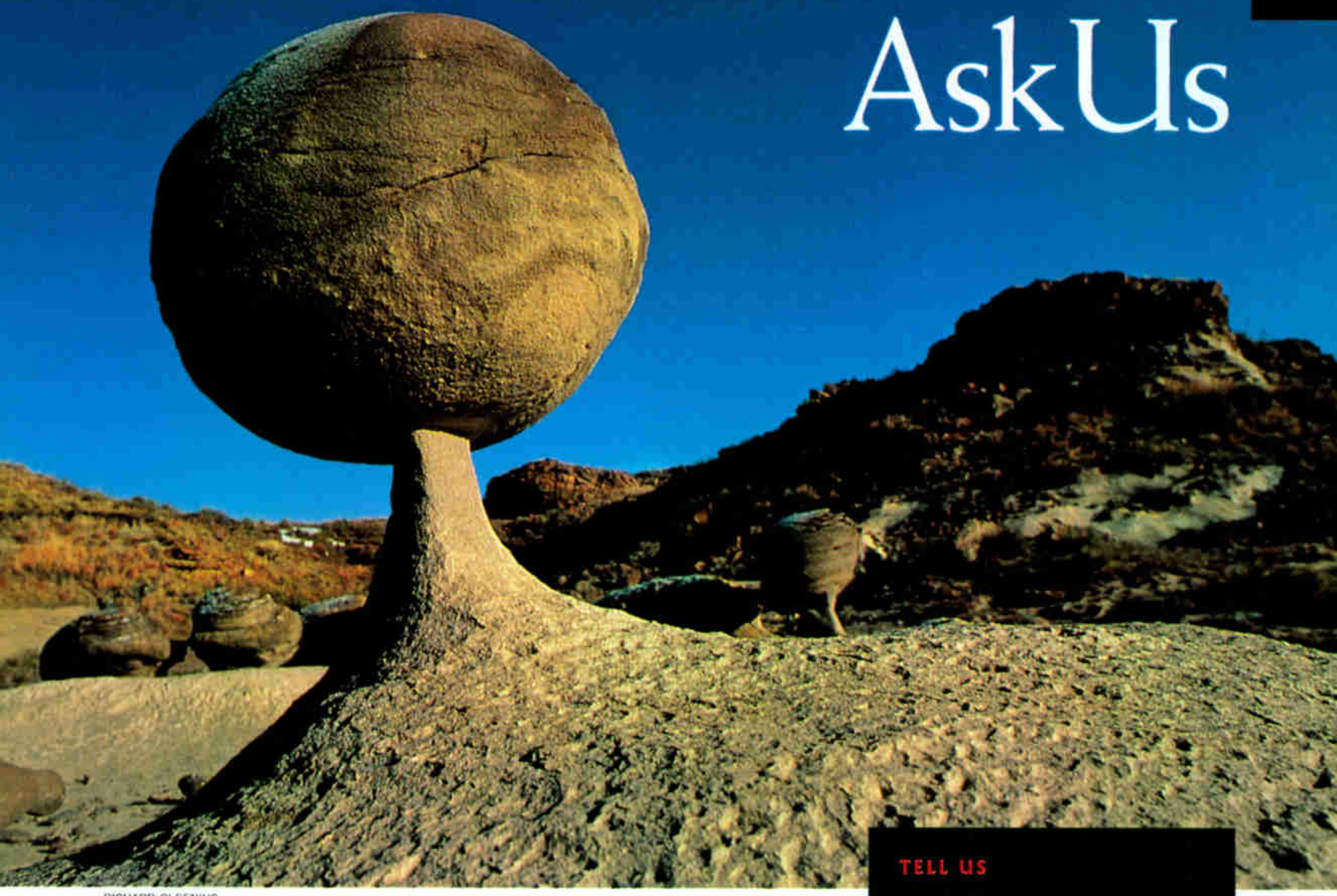


RICHARD OLSENIUS

THE ANSWER PLACE

Our Research Correspondence staff responds to questions from curious readers.

Q What percentage of the Canadian population lives within a hundred miles of the U.S. border?

A Just over 72 percent, according to Statistics Canada, a government agency.

Q How did the Sphinx lose its nose?

A Napoleon's troops are often blamed—erroneously. Earlier drawings of the gigantic sculpture indicate that the damage occurred in the 14th or 15th century. Experts still don't know who defaced the monument or why, but they know how it was done: Vandals hammered rods or chisels into the top of the nose of the Sphinx and under its right nostril, then pried off the nose.

Q Have the waters of Niagara Falls ever stopped flowing naturally?

A In 1848 an ice jam on the Niagara River above Niagara Falls reduced the flow of water to a trickle. This phenomenon lasted more than a day, enabling residents and visitors to walk and ride their horses on the riverbed above the falls, picking up weapons and other artifacts from the War of 1812.

Q Why was the wood of the *Titanic* eaten away while the Swedish ship *Kronan* was found practically intact?

A Location, location, location. Wood-eating shipworms thrive in the North Atlantic waters where the *Titanic* lies, but the low salinity of the Baltic Sea, where the *Kronan* was found, prevents their growth.

TELL US

How did this boulder come to rest on its sandstone pedestal near Lusk, Wyoming?

Think you know the answer? Go online to nationalgeographic.com/ngm/tellus/0109 and test yourself, or read it here in next month's issue.

August Answer A sadhu, or Hindu holy man, in Allahabad, India, buries his head in a feat of breath control that demonstrates his mastery of yoga techniques.

MORE INFORMATION

Send questions to **Ask Us, National Geographic Magazine, PO Box 96095, Washington, DC 20090-6095** or via the Internet to **ngsaskus@nationalgeographic.com**. Include name, address, and daytime phone number.

UNITING AFRICA'S

A Chobe River swim can take an elephant from Botswana to Namibia to Zambia, passport free.

BORDERS

WILDLIFE RESERVES

Southern Africa's peoples are reaching across borders to protect their shared environment.

FLEET FEET AND EAGER DOGS help a hunter in KwaZulu-Natal Province, South Africa, catch cane rats—abundant rodents prized for their meat. Recognizing that traditional

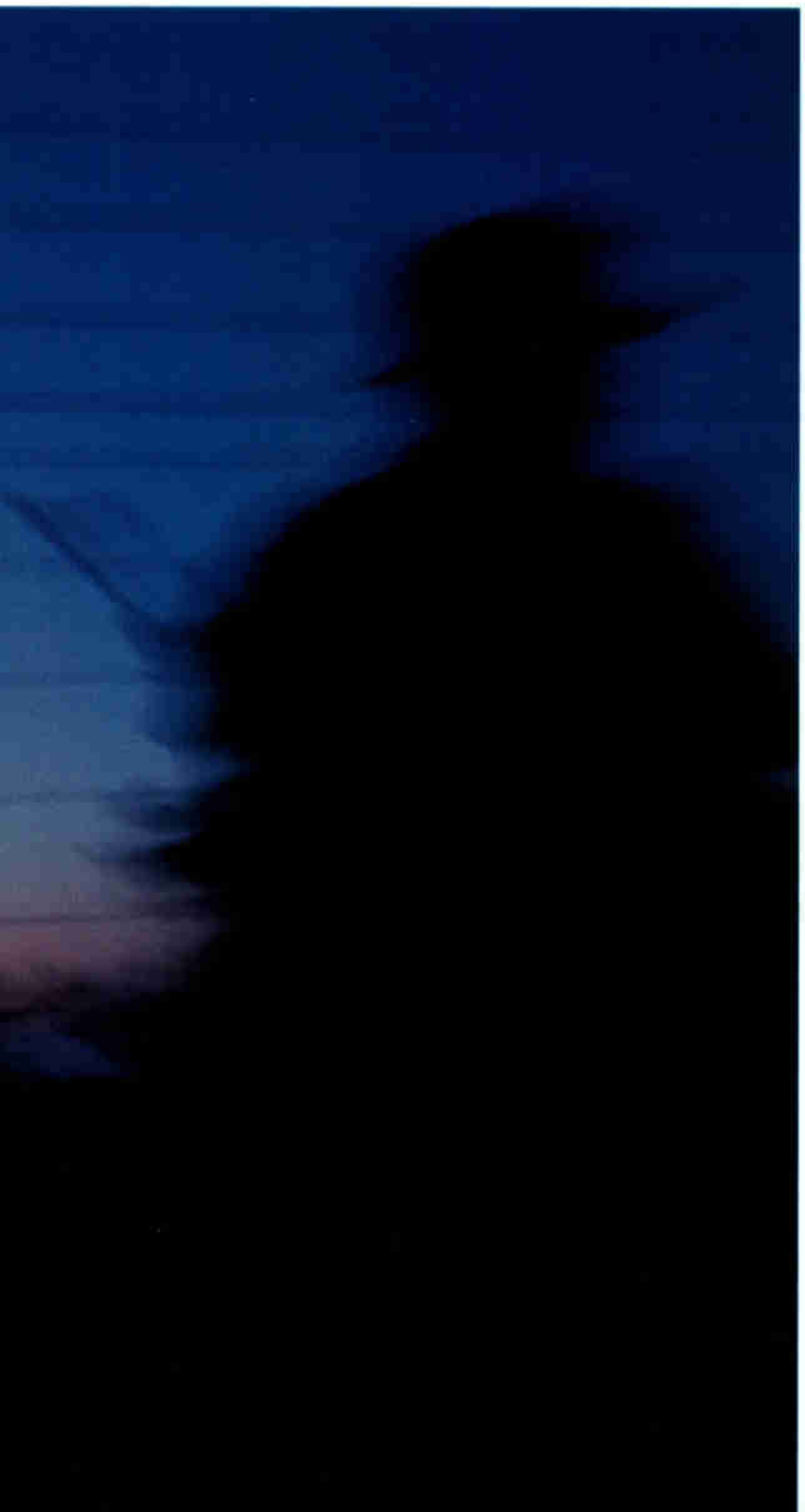
hunting and gathering activities remain critical to many communities' survival, new conservation initiatives incorporate sustainable-use zones in their land-management plans.

BY PETER GODWIN PHOTOGRAPHS BY CHRIS JOHNS
NATIONAL GEOGRAPHIC PHOTOGRAPHER

The fence along the eastern side of Kruger National Park is a mighty fence indeed. Five thick cables and a tough web of diamond mesh are stretched between anchor posts made of railway track rooted in concrete. There is something starkly alien about this vast man-made cordon, this African Iron Curtain. Its silver spine slices in a straight line for nearly 250 miles across the bush, following an arbitrary colonial border, dividing an ecosystem, and blocking ancient game trails. But it has been the most vital weapon protecting South Africa's flagship wildlife sanctuary from the wildlife Armageddon on the other side. On the other side few birds sing. You can fly over it for hours, as I did, skimming beneath the towering cumulonimbus clouds and craning down at Coutada 16, the Mozambican wilderness area that adjoins Kruger, and see not a single animal, not a solitary game trail. Twenty years of civil war cost Mozambique perhaps a million human lives and devastated its wildlife.

Ian Whyte, Kruger's resident elephant specialist, describes the scene routinely witnessed. "Vehicles drove up and down the fence, shooting anything that moved, irrespective of size or sex or species. AK-47s were common, so any impala, kudu, or duiker was fair game. Even smaller animals such as genets and porcupines got shot." Park employees observed that when elephants crossed over, as is possible if a section of fence washes away along a river, they knew to come back that very same night, or they wouldn't survive.

Now, however, the South Africans have cut back on the dedicated fence-repair teams who constantly patrolled the line. And since peace has returned to Mozambique, Pretoria's conservation czars are considering something that until very recently would have been labeled by many as insane: bringing down the fence altogether. If the plan succeeds, similar fences will soon be coming down all over southern Africa and beyond, to create a series of "peace parks," or transfrontier conservation areas. It is one of the most ambitious conservation moves since the creation of Africa's first game reserve, which is now Kruger National Park, a century ago. It is also a high-risk, high-reward proposal, the fate of which will, in large measure, determine the future of conservation in Africa—after all, its goal is nothing less than to change the conservation map of a continent.



The first transfrontier conservation park, launched last year, was the Kgalagadi Transfrontier Park, which unites the Gemsbok National Park in Botswana with the Kalahari Gemsbok National Park in South Africa. Such a union presents few problems—the two parks were separated only by an unfenced dry riverbed. A joint management plan has been devised to run the area as a single ecological unit, and tourists who enter one park may now pass freely into the other and back again, thus increasing traffic and revenue to both. In many ways this unification is a no-brainer.

Other transfrontier areas are more complex and ambitious. What they attempt to do, as explained in a groundbreaking report by the World Bank in 1996, is to bring conservation to the people. The aim is to show the local communities living alongside traditional game reserves that money can be made from wildlife, and in so doing to undercut the resentment felt by many of these people at being prevented from farming the land. South Africa's Nelson Mandela explained it to me thus: "If the government unilaterally decides to establish transfrontier parks without consulting the community, then the community will not cooperate." (See "A Conversation With Nelson Mandela," page 30.)

Three pilot transfrontier areas have been put on the fast track: The first, and in size the most ambitious, is Gaza-Kruger-Gonarezhou (map, page 24). This will join Kruger to Gonarezhou National Park in Zimbabwe and Coutada 16, a huge chunk of state-owned land in Mozambique's Gaza Province, to create one superpark.

Not all fences will come down. Armed patrols along the boundary of South Africa's Tembe Elephant Park help protect nearby villages from damage by elephants and reduce the chance of predators' attacking livestock.

SAFE AMONG FEVER TREES in South Africa's Ndumo Game Reserve, a giraffe can eat 140 pounds of leaves and twigs daily. Linking this area with protected lands in Swaziland

and Mozambique means more range for big browsers. “These initiatives are good news,” says Conservation International’s John Hanks. “And Africa desperately needs good news.”

In time this would form the core of a mixed-use conservation area covering 60,000 square miles, a swath of land the size of Florida.

The second pilot project is Chimanimani, which will join a mountainous reserve in eastern Zimbabwe with the rest of the Chimanimani range in Mozambique, including the forests of the foothills.

The third, Lubombo (map, page 12), aims to unify two existing South African parks, Tembe and Ndumo, with Maputo Elephant Reserve in southern Mozambique and ultimately with Hlane Royal National Park and two adjacent nature reserves in Swaziland. The Lubombo units are not your typical African game reserves; they consist of floodplains and sand forests with dense foliage that can make for inconvenient game spotting. It's so thick that local people call one section Mahemane?—which conveys the sense of "where are we?" But it has other compensations, principal among them its great variety of bird and amphibian life. The area, in fact, is one of the most extraordinary centers of biodiversity in the world.

From the teak deck of the Ndumo Wilderness Camp, I watch a patrol of four hippos snort like riverine horses up the Banzi pan and past a grove of fever trees whose peeling trunks

IT IS A HIGH-RISK, HIGH-REWARD PROPOSAL. ITS GOAL IS TO CHANGE THE CONSERVATION MAP OF A CONTINENT.

glow luminously green in the dying rays of the day. The low unmistakable profile of a crocodile snout breaks the water, and the air is thick with the mating calls of frogs: foam-nest frogs, waterlily frogs, and banded rubber frogs. Bubbling kassinas. Greater leaf-folding frogs and tropical platannas. Snoring puddle frogs and bushveld rain frogs and tremolo sand frogs. Together they produce an ear-ringing chorus to the gathering night.

My guide here is Clive Poultney. With a shaved head and full beard and gold rings in his ears, he strides around in a *kikoyi*, a bright cloth wrap knotted at his waist, and an epauletted khaki shirt. It's a juxtaposition that accurately reflects his personality. He's been working here for 22 years, as an anthropologist, a trader, a development consultant, and a negotiator. After national service in the South African Army, Poultney was recruited in the field by the African National Congress's (ANC's) armed wing, Umkhonto we Sizwe, Spear of the Nation, where he perfected his fluent Zulu. He also leads cultural tours, introducing visitors to the mysterious world of the rural *izangoma*, traditional healers, who historically have been great defenders of the environment.

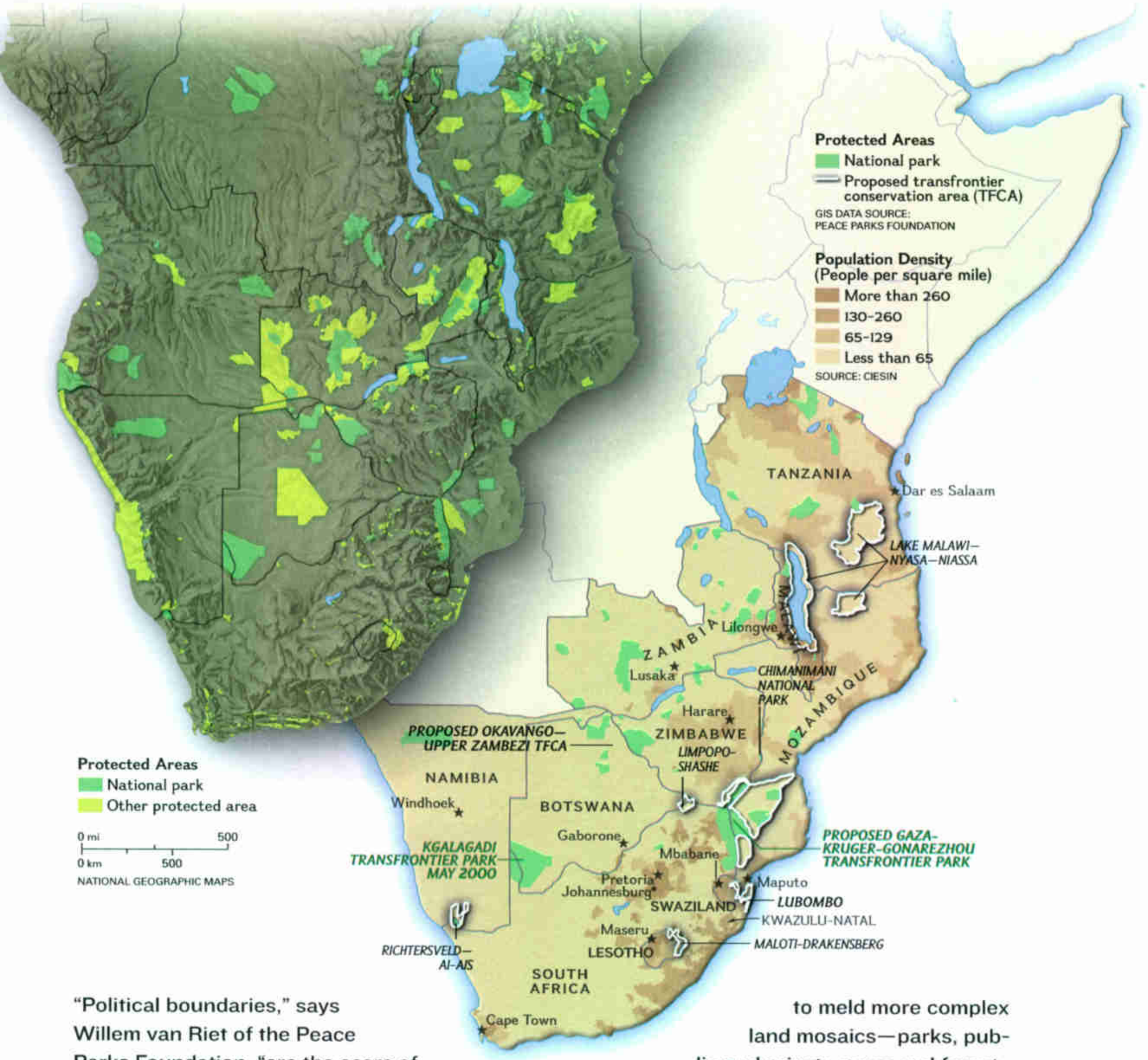
Today all is not well with Clive, however. He is stumbling with malaria. Beads of sweat chase each other down the brown dome of his lightly stubbled head. Every few hours he swallows a few quinine pills and declares himself, "Better, thank you. Much better." It has been a bad year for malaria up here. And cholera. The front pages of the Johannesburg newspapers have been dominated by headlines of the cholera outbreak, calling it "the worst in living memory," scaring the tourists and somewhat muting my enthusiasm for this expedition. I have armed myself with broad-spectrum antibiotics, and I'm popping an antimalarial prophylactic called Larium, which has a list of possible side effects a foot long, among them "psychotic episodes."

I fall asleep in my cabin under a slapping fan, to be woken before dawn by a couple of warthogs feuding noisily among the cabin stilts, squealing and grunting, until one of the warthogs butts a stilt, and the whole structure shivers with the force of it.

The dawn sun is a raw egg yolk, bulging fat upon the horizon over the reeds by the time the frogs' nocturnal cacophony is replaced by the raucous chorus of birds: goldenrumped tinker barbets, Burchell's coucals, Klaas's cuckoos, spotted dikkops, purplecrested louries, and tambourine doves.

This reserve is packed with nyalas, sunis, red duikers, and, blocking our way this morning, two of the biggest giraffes I have ever seen. They peer down at our Land Rover from their lofty elevation and continue browsing, unmoved. It is 15 minutes before they deign to shift. Around the next bend a barrel-bodied white rhino cow heaves into view, a little armored calf skittering at her feet. In spite of its name the white rhino is in fact a dark gray. The white of its name is a corruption of the

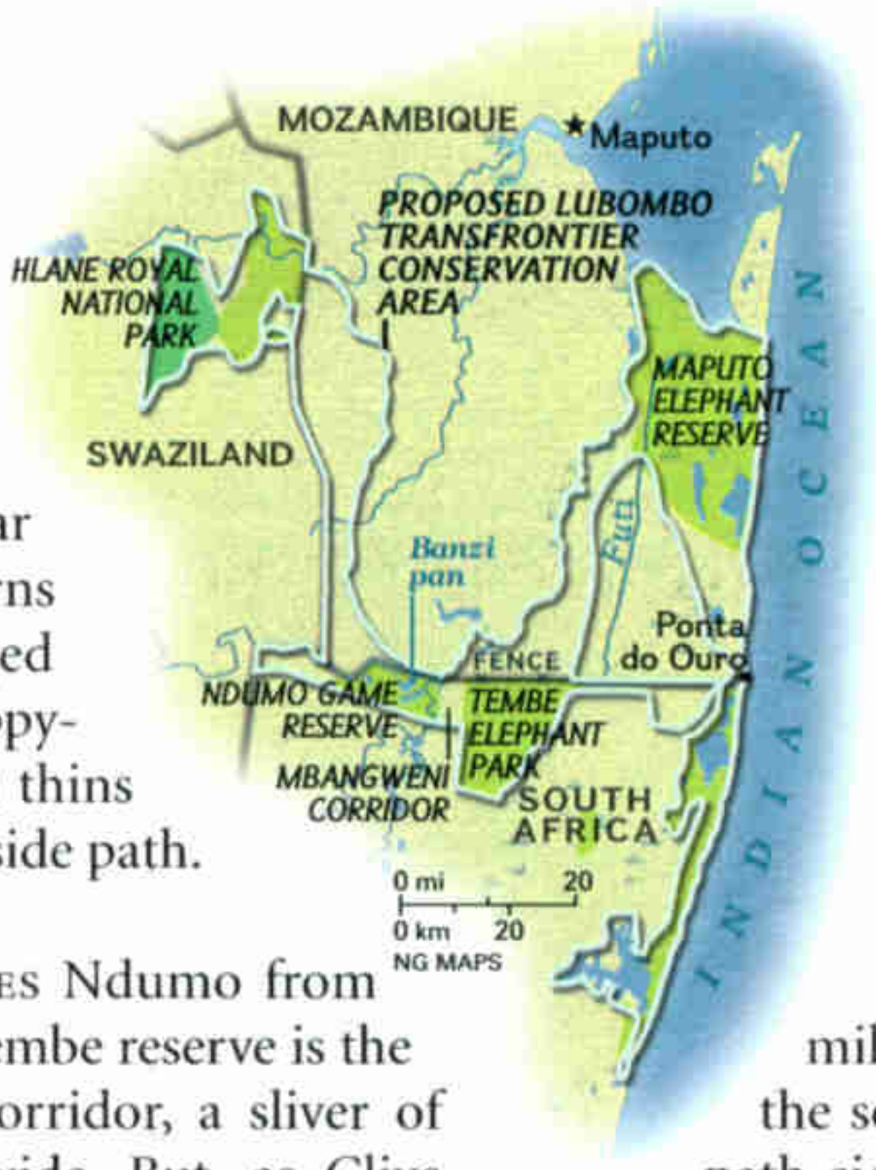
AFRICA'S NEW CONSERVATION VISION



"Political boundaries," says Willem van Riet of the Peace Parks Foundation, "are the scars of history." In southern Africa national borders partition ecosystems, block animal migration routes, and divide ethnic communities. One such scar was healed on May 12, 2000, with the formal opening of Kgalagadi Transfrontier Park, uniting South Africa's Kalahari Gemsbok and Botswana's Gemsbok National Parks. Run as a single ecological unit, the 14,669-square-mile park allows people and animals to move freely between the two nations. Built on a half century of informal cooperation, Kgalagadi is Africa's first "peace park."

Elsewhere conservation leaders are seeking to meld more complex land mosaics—parks, public and private game and forest reserves (upper map), plus hunting and tourism concessions, and communal and tribal lands—into transfrontier conservation areas (TFCAs, lower map). Enhanced wildlife protection and sustainable community development are chief TFCA objectives, but many proponents hope these initiatives will serve a less tangible goal: promoting a "culture of peace" among countries devastated by decades of political and ethnic conflict. Working together on practical goals, says van Riet, will encourage "the development of trust, which is fundamental to peace between countries."

Afrikaans for "wide," so called because it has a wide mouth, unlike the black rhino, which isn't really black at all and has a narrow pointed mouth, almost like a beak. The mother swings the scimitar of her horn at us, then turns and canters off stiff-legged down the road with her puppy-hoofed calf, until the bush thins enough for them to take a side path.



Embracing an extraordinary diversity of landscapes and wildlife, Lubombo TFCA will unite coastal wetlands and elephant habitat in South Africa and Mozambique with Swaziland's rhino-rich Hlane Royal National Park.

ALL THAT SEPARATES Ndumo from neighboring Tembe reserve is the Mbangweni Corridor, a sliver of land barely three miles wide. But, as Clive explains, years of efforts to close the gap have failed. This area is home to the Thonga people, who have long been traders and can make far more money using the corridor as a transborder smuggling route than they will likely see from any conservation spin-offs.

We drive north along a sand track dimpled by the hooves of cattle until we reach the fence marking the Mozambique border. Once this was a highly sensitive frontier, and you can still see the remnants of the sisal lanes planted by

"THE WILD ANIMALS DESTROY OUR CROPS, AND THEY KILL PEOPLE. WHY SHOULD WE SHARE OUR LAND WITH THEM?"

the old South African Army in the hope that the spiky interlocking leaves would form an impenetrable barrier against armed guerrillas seeking to topple white South Africa. Clive promises me that "most" of the antipersonnel mines laid by the army have been lifted. But then he does have malaria. And he admits that occasionally local people are blown up, mostly when they till new land or after heavy rain.

There is a constant passage of pedestrians across the border. Lefe Mthethwa, barefoot and ragged, is crossing south, ducking under the fence with a basket of tilapia fish to sell at market in South Africa, where she will buy sugar and cooking oil. Mthethwa admits that not all the contraband that makes this journey is quite so benign. "They sell guns too," she says. "At night when we are asleep, they bring them across."

Trudging north a couple of miles into Mozambique through the soggy heat, we find a welcome path-side tavern with a gas-powered fridge serving South African Lion lager in quart bottles. Sophia Tembe and her husband, William, are also resting up, on their way to visit a clinic on the South African side. "We lived in South Africa during the war," William Tembe explains, "but we moved back to Mozambique to farm when peace came."

The medieval Portuguese navigators who sailed this coast called it Terra dos Fumos, Land of Smoke—smoke caused by Thonga slash-and-burn agriculture, a land-hungry method still widely practiced in southern Mozambique by Tembe and his fellow farmers.

William Tembe hasn't even heard about the plans to establish a conservation area here, but when I explain, he is distinctly lukewarm. "It's always the same. They say to us, 'You must share the land with wild animals,' but they end up kicking us out." His wife adds, "The wild animals destroy our crops, and they kill people. Why should we share our land with them?"

Not all the surrounding people are this hostile to wildlife. In fact, two local communities on the South African side are in the process of trying to turn over large chunks of their own territory to conservation.

Herman Els, an environmental anthropologist, has come down from the University of Pretoria to help get one of these projects off the ground. Els hands me the report he has just helped write on the "anthropological component" of the Lubombo Transfrontier Conservation Area. "The essence of this report is absolute poverty," he says bluntly. In Mozambique the average income is less than $375 a

BURDENED by poverty, women struggle to coax crops from small plots in KwaZulu-Natal. Conservation planners hope that increased tourism will create new jobs, replacing dead-end subsistence farming with opportunities to earn a living wage.

year. In the communal areas of South Africa (former apartheid homelands that make up 14 percent of the country and on which half of the population still lives) it's still under $750.

Zeblon Gumede is chairman of the Manqakulani Development Committee, which is meeting with Els today to talk about dedicating 10,000 acres of their communal land to ecotourism. "The objective," Gumede tells me on the veranda of the Tembe Elephant Park office, "is to set aside an area for wildlife tourism, which could generate jobs and money. From the outside we see the tourists coming to this park and spending money—so we asked ourselves how we could get them to come and visit us too." One of the sea changes in rural Africa today is the growing unpopularity of the traditional agrarian lifestyle. "These days the youngsters don't want to farm," says Gumede. "They want better jobs."

WHEN the Tembe Elephant Park was proclaimed in 1983, local communities insisted that it be fenced off to protect them from the ravages of elephants. But the northern border with Mozambique was left open to allow the historic movement of the herds up and down the nutrient-rich Futi corridor, which stretches 25 miles to the Maputo Elephant Reserve. By 1989, however, that avenue was also fenced off by the South African park authorities to protect the Tembe elephants from massive poaching in war-torn Mozambique. What had been a single elephant population was thus split in two. Those animals that happened to be inside Tembe, 104 of them, remained there.

Ferdie Myberg, who is in charge of the park's antipoaching operations, is proud to tell me they haven't lost a single elephant to poaching since then. He uses a metal detector to scan the carcasses of elephants when they die, just to be sure. Many of the animals were refugees from the slaughter in Mozambique, and they bear the scars to prove it. Inside one bull elephant, which eventually died of old age, Myberg dug out no fewer than 31 bullets.

Since Tembe's enclosure, its resident population has grown to more than 130, too many for the small park to sustain without major damage to its flora, including the rare sand forests. And as Wayne Matthews, Tembe's ecologist, who can often be spotted riding his bicycle around the park, explained, the population is age- and gender-skewed, with bulls making up about 70 percent, instead of the usual 15 percent or so. This disparity distorts elephant behavior by increasing tensions among bulls. It also increases pressure on the vegetation, since bulls are more destructive foragers. If Tembe's northern border was reopened, this would allow the elephants to mingle freely with the 300 elephants based in the Maputo Elephant Reserve, fewer than 60 of which are bulls.

I leave Tembe and follow the paved road northeast until it comes to an abrupt halt at the Mozambique border, where we put the vehicle into four-wheel drive. It pitches and yaws, churning through the scorching beach-sand track up the coast. Hard to believe that this

CHARRED TREES LITTER a Mozambique hillside in the Chimanimani Mountains, shared with Zimbabwe. “In 13 years of working in Africa it’s the worst slash-and-burn I’ve

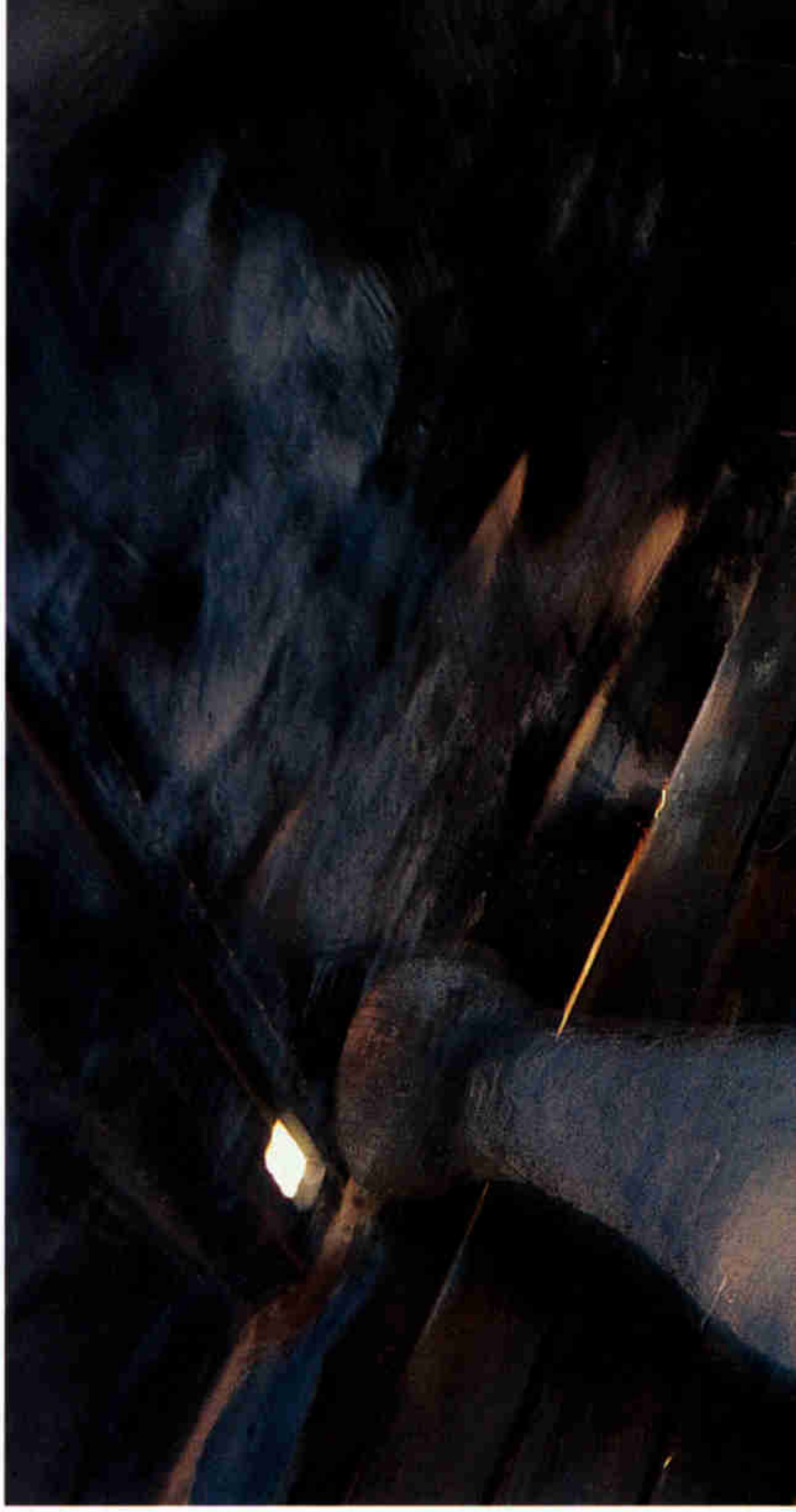
seen," reports photographer Chris Johns. Exposing thin soil on steep slopes, "people here know they'll get only a couple of years' worth of crops," he says, "but they're desperate."

country once attracted nearly as many visitors as Zimbabwe and South Africa combined. Hard to believe, not because of a lack of beauty—the Indian Ocean beaches here are world-beaters—but because the towns and villages are ruins of their former selves.

Ponta do Ouro (Point of Gold), the southernmost town, is once again hosting visitors, but this species of holidaymaker spends little money. An entirely self-sufficient community of vacationing Afrikaans farmers has taken over a rudimentary campsite. They have brought with them boats, generators, fuel, army tents, food, water, beer, fridges, servants, even their own wooden dance floor for a New Year's bash. Their SUVs have scoured blond scars into the nearby hills, which they scale daily to pick up the cell-phone signal from across the border.

The distance from here to the Maputo Elephant Reserve is not great, but there is no real road for much of the way. We drive through a largely uninhabited, untouched territory banded by sea on one side and the Futi wetlands on the other. This area may end up in the transfrontier conservation area, or it may become the site of eucalyptus plantations, a deep-sea port, and a railway link; its fate still hangs in the balance.

Suddenly, incongruously, after the miles of emptiness in southern Mozambique, the towers of the capital, Maputo, rise above the acacia tree line like a mini-Manhattan. At the edge of the Rio Maputo estuary we load the vehicle



RISKY for animals and gamekeepers alike, sedating and relocating elephants has helped relieve overcrowding in South Africa's Kruger National Park. Opening borders with adjoining protected lands in Mozambique and Zimbabwe offers a less disruptive prospect in the long term.

onto an elderly freighter, the *Bagamoyo,* which has an alarming list to starboard as we chug across, leaving in our wake an unspoiled landscape and heading toward the neon and air-conditioning of the city.

THE IDEA of joining wildlife areas across national borders is not new to Africa. As long ago as 1938, Gomes de Sousa, a Portuguese biologist, was pointing out its logic. In 1990 the South African multimillionaire Anton Rupert, a businessman who was president of what is now that country's branch of the Worldwide Fund for Nature, met with Mozambican President Joaquim Chissano to discuss such a linkup. Chissano was enthusiastic, so Rupert set about forming the Peace Parks Foundation, with Nelson Mandela as patron, to make it happen. When I was first shown the transfrontier plans some three years ago by John Hanks, then the executive director of the foundation, I was staggered by the sheer size of the vision. It seemed nothing less than an ecological Cape to Cairo dream.

Today Hanks's successor at the Peace Parks Foundation, Willem van Riet, an expert on park planning, is wrestling with the details. In a darkened room at the offices of Mozambique's National Directorate for Forestry and Wildlife on the Square of the Heroes in Maputo, van Riet runs computer models gleaned from satellite data for an audience of senior Mozambican officials. The current thinking on rehabilitating Coutada 16, the huge territory adjoining Kruger Park that will make up Mozambique's part of Gaza-Kruger-Gonarezhou, is to divide

ON THE MOVE across the Okavango Delta, Cape buffalo herds (here with an egret aerial escort) number as many as 2,000 animals. One of the hunter-prized "big five"—lions, rhinos,

leopards, and elephants are the others—Cape buffalo play a key role in the delta ecosystem. Feeding on tall, coarse grasses, they make smaller tender plants accessible to other grazers.

"WHAT'S IN IT for this Mozambican fisherman?" asks conservation consultant John Griffin. "There must be value in collaborating beyond boundaries. Initiatives will succeed only if they produce a sense of interdependence and real shared benefits."

it up into three separate zones of use: a tourist zone, a wilderness zone, and a resource utilization zone. The most controversial of these, the utilization zone, in which hunting would be permitted, is to be buffered from Kruger by the other two zones to prevent the Trojan horse possibility that haunts so many Kruger rangers —hunters lined up along the eastern edge of Kruger, lying in wait for big mammals to cross. "That will never be allowed to happen," said van Riet, who is also on the board of South African National Parks (SANParks).

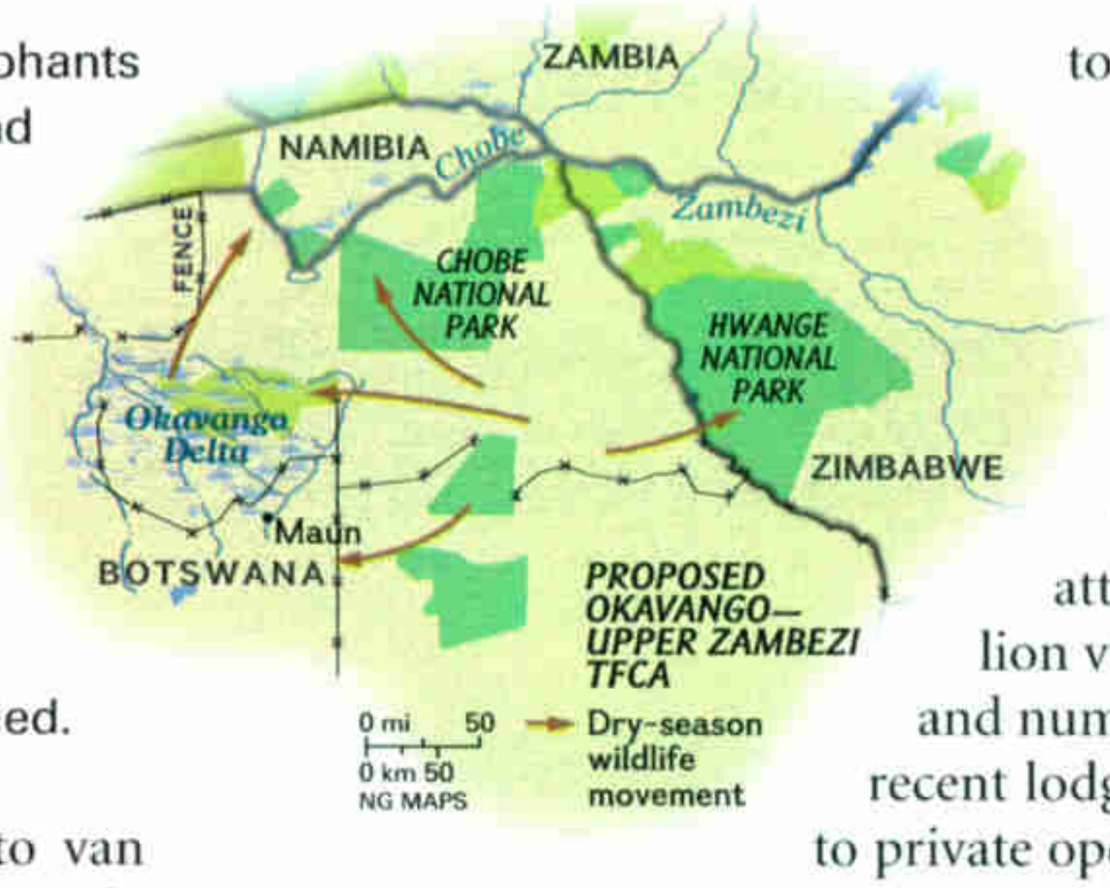
But van Riet is careful to leave the actual decisions up to his Mozambican hosts. They are very sensitive to the South African big brother syndrome. In the past some South Africans have referred to this transfrontier park as the "Kruger expansion," and one hears mutterings of ecological imperialism. There is a grotesque disparity in management capacity; Mozambique has virtually no professional conservators, and the educated class here, with its European clutch bags and well-cut suits, is intensely urban. But Arlito Cuco, the head of the wildlife department at the forestry and wildlife directorate, told me as we waited on the runway for the plane that was to fly us over Coutada 16, "The political will to establish these transfrontier parks is there—at the very highest level. This thing will definitely happen." And the one problem that the project doesn't face at this stage is lack of money—the World Bank, the Germans, the Americans, are all lining up to help, in fact are impatient that funds already earmarked are yet unspent.

FROM MAPUTO WE FLY north, stopping first at Massingir dam on the southern edge of Coutada 16. The little town of Massingir is to be the Mozambican administrative headquarters of the new park. Massingir dam was intended to feed a grand irrigation project, but like so many things in Mozambique the scheme was interrupted by war. Van Riet thinks the lake behind the dam can be one of the most important of Coutada 16's tourism features. The peninsulas that probe into the water are prime wildlife real estate, where leases will be auctioned off for some of the first lodge sites.

North of Massingir is just bush, lush virgin bush, dotted with pans and streams flowing down from the Lubombo hills ("bridge of the nose" in Shangaan), crisscrossed with avenues of trees that follow the water forced up along rhyolitic fault lines. Because there are so few large animals, much of the bush is unnaturally thick. "You're looking at something very few people have ever seen," exults van Riet. For the four hours that we fly over Coutada 16, we observe almost no signs of human habitation —the footprint of man is very faint indeed.

Finally we reach the eastern boundary of the proposed park—the Limpopo, "the great, grey-green, greasy Limpopo River, all set about with fever-trees," as Rudyard Kipling described it in *The Elephant's Child*. But today it is none of these things. Today it is choked with silt, and much of its ancient riverine foliage, including its fever trees, has been ripped away by the force of last year's tremendous floods. This

More than 100,000 elephants roam the Okavango and upper Zambezi River Basins, shared by Angola, Botswana, Namibia, Zambia, and Zimbabwe. Joint wetland and wildlife conservation is planned, though no details have been settled.



river is well known to van Riet: He once spent six weeks canoeing down it to the sea. Halfway, he encountered Zambezi sharks and crocodiles in the same stretch of water. "One shark took the stern of my kayak in its jaws and gave it a great shake," he recalls. He taped up the hole and paddled on.

Most of the 12,000 people living in Coutada 16 farm on the fertile soils of the riverbank. They are to be the first beneficiaries of the jobs created by the new reserve. Ironically, in light of the eventual dropping of the Kruger fence, the first jobs will be constructing a new electric fence to keep the elephants out of populated areas. Solar panels erected to charge this fence will also provide a source of power for local villagers. "This is not going to be a people problem, this park," says van Riet confidently, and Cuco nods his agreement as we fly south again over more vast tracts of uninhabited land.

Reduced to its most simple equation, Mozambique has the space, Kruger has the animals—and one animal in particular: elephants. Kruger's crisis with elephant overpopulation is urgently spurring the whole transfrontier park process here.*

In many ways the story of Kruger National Park is the polar opposite to that of Mozambique's wildlife areas. While Mozambique's parks have languished completely unmanaged, Kruger has enjoyed the most sophisticated management of any African park (though, in an effort to rationalize its organization, Kruger's staff has recently been cut by a fourth). But in its hands-on management experience lies a cautionary tale, and maybe a little hubris too, for Kruger has proved a painful illustration of how bad humans are at trying to replicate the subtleties of nature.

After the emptiness of Mozambique, Kruger comes as a bit of a culture shock. More than a hundred years old, the park now attracts more than a million visitors a year to 25 lodges and numerous campsites. Among recent lodge concessions auctioned to private operators, Nwanetsi, on the border with Mozambique, went for a down payment of a million dollars, which goes into the national parks kitty, with further payments linked to income. It's an optimistic indication of the kind of largesse in store for Coutada 16 once it gains access to Kruger's extensive tourism catchment. Kruger brings in more money by far than any other national park in South Africa, helping to subsidize most of the others. It has 600 miles of paved road, more than some entire African countries. Kruger's headquarters are at Skukuza, named after the Shangaan nickname (meaning "he who sweeps clean") of the park's first warden, Col. James Stevenson-Hamilton, a stickler for tidiness. Based here is the battalion of ecologists who try to steer the three principal architects of the park's bushveld: fire, water, and elephants. But recently the park's managers had to execute U-turns in their policies on all three.

THE PEACE PARKS IDEA HANGS ON THE GOLDEN THREAD OF POLITICAL STABILITY, STILL A FRAGILE THREAD IN AFRICA.

Their policy of controlled burning was dropped after they belatedly realized that such fires burned hotter than natural fires and were harming wildlife habitat. And the firebreaks themselves sometimes caused serious erosion. Today you can also see the abandoned wells of their "water for animals" program, a misconceived network of 400 artificial water holes that distorted seasonal migrations and undermined the natural competitive advantage enjoyed by less water-dependent animals.

*See "A Place for Parks in the New South Africa," by Douglas H. Chadwick, NATIONAL GEOGRAPHIC, July 1996.

GRADUATION DANCES and a beach bonfire celebrate the training of new *izangoma* in South Africa's KwaZulu-Natal. Part spirit medium, part herbalist, izangoma gather plant and

animal materials to use in rituals against sickness and bad luck. Some izangoma now work with conservationists to limit the impact of such collecting on threatened species.

The third architect of the bush is *Loxodonta africana*—the African elephant. Elephant numbers are not self-limiting, at least not in the medium term. Whereas populations of species like buffalo and impalas (and the predators that eat them) will grow and decline with the 20-year cycles of wet and dry weather that characterize the region, elephants, being less specialized feeders, just keep on reproducing—decreasing only after devastating their terrain. So Kruger rangers culled their elephants annually for nearly three decades until 1994, when, under intense pressure from animal rights groups, SANParks dropped this controversial policy. Since then the elephant population has climbed to more than 9,000 and is showing no signs of slowing. With workable contraceptive techniques still some years off and other small overflow reserves full, Coutada 16 is a desperately needed lifeboat for Kruger's elephants.

"IF YOU DON'T HAVE SUSTAINABLE DEVELOPMENT AROUND THESE PARKS, THEN PEOPLE WILL HAVE NO INTEREST IN THEM."

But how to get significant numbers of elephants to cross over the border once the fence is lowered is something of an ecological mystery. Ian Whyte, the elephant specialist, reckons that initially only a few elephants, mostly bulls, would cross on their own. Each breeding herd has a home range, and the clans don't overlap that much, says Whyte. If left to their own devices, elephants would move across to Coutada 16 only very gradually. "But nobody knows," admits Whyte. "It's all speculation. Nothing like this has ever happened before."

Instead, large numbers of Kruger elephants will have to be translocated, and plans have been made to move a thousand, in family units. This would be by far the biggest mass movement of elephants ever attempted, and it will be an astonishing feat. Estimates of the cost range from $1,000 to $2,500 an elephant. The first 250 animals will be trucked out by the end of this year.

Disparities between South Africa and its less prosperous neighbors can make it difficult to meet as equals. Kruger National Park hosts a million visitors yearly; Zimbabwe's Gonarezhou gets 5,000. Kruger's Conservation Department alone employs 631 people; 312 park staff serve all Mozambique.

When they arrive in Mozambique, the elephants will start out in adaptation *bomas*, corralled by an electric fence. "Elephants are extremely sensitive to electric fencing. They don't like being shocked one bit, and once one or two have received a jolt, none of them will touch it again," says Whyte. "Once they have settled in the boma, after about 48 hours, the fence will be quietly opened to allow them to disperse in their own time."

Initially, Kruger rangers think, the boundary fence should stay up, to prevent the elephants from trekking back to their home ranges—their first instinct. Once the fence is lowered, says Whyte, other species will slowly cross on their own, the antelopes first and then their predators. This raises another problem: Many of Kruger's buffalo are infected with bovine tuberculosis, and the disease is now crossing over to lions and could spread further.

All eyes will be on the first elephants to be moved. Should poaching—either for the pot by local people or by illegal ivory traders—prove to be a major problem, then translocations will cease. The key to preventing poaching is not so much training up a corps of guards—which is being done—but convincing the surrounding communities that they can profit more from wildlife in other ways than by killing it.

It is this community component that is the key to the long-term success of transfrontier conservation areas. In this field Zimbabwe was the pioneer, with its Communal Areas Management Programme for Indigenous Resources, or CAMPFIRE, now widely copied elsewhere on the continent. CAMPFIRE was the

AT A BARBED BORDER spanning the Mbangweni Corridor between Ndumo and Tembe parks, Mozambican women smuggle fish to South African markets. Gunrunners also cross here, making some leaders nervous about loosening border controls.

first scheme that really acknowledged two conservation fundamentals that had been largely neglected: Most African wildlife lives outside actual game reserves, and unless local communities see direct economic benefits from wildlife, whether through ecotourism or hunting safaris, they will ultimately wipe it out. By ceding wildlife decision-making to local people, CAMPFIRE empowered them to take responsibility for it.

A few years ago I stayed at Chilo Gorge Lodge, on the edge of the Gonarezhou National Park, a hundred miles north of the Kruger boundary and soon to be part of the same new transfrontier park. In the local dialect Gonarezhou means "home of the elephants," but Gonarezhou's elephants had been so badly mauled in Zimbabwe's war for independence and the Mozambican civil war that they became pathologically shy of humans. Chilo lodge perches on the prow of a cliff overlooking the Save River. The lodge and another nearby are run in partnership with the Mahenye community. These local people provided the lodge sites and the labor to build them. The lodge owners guaranteed employment for more than 150 people and agreed to pay 10 percent of their revenues to the Mahenye. They have also improved access roads and extended electricity to the community clinic and grinding mill. Once projects like this and licensed hunting safaris began pumping income into this marginal community, poaching dropped off dramatically. CAMPFIRE had turned poachers into gamekeepers.

After dinner I stood at the cliff edge with Mike Muvishi, the senior ranger at Chilo, and we watched as the kitchen staff climbed down a steep set of stairs to the river below. They boarded a raft and set off downstream to their village for the night. The raft floated around a bend in the river and passed a low island, little more than a sandbank caught in the restless sweep of their flashlight. "It's called Gayiseni Island," explained Muvishi. "It was named after the migrants, the *gayiseni,* who journeyed south to work in the mines at Johannesburg—eGoli, City of Gold." For nearly a century people from here had been making that economic pilgrimage, and the island was their perilous stepping-stone across the barrier of the crocodile-ridden Save. "But now these people have found work closer to home," said Muvishi. "Now they can remain with their families."

Later that night the quickening breeze brought with it the sounds of drums, cracking whips, and women ululating. I took it to be some sort of celebration, but later I found it was local farmers trying to scare the elephants away from their cornfields. A few years before, they'd probably have tried to kill them. It was simple economics: The elephants were worth more alive than dead.

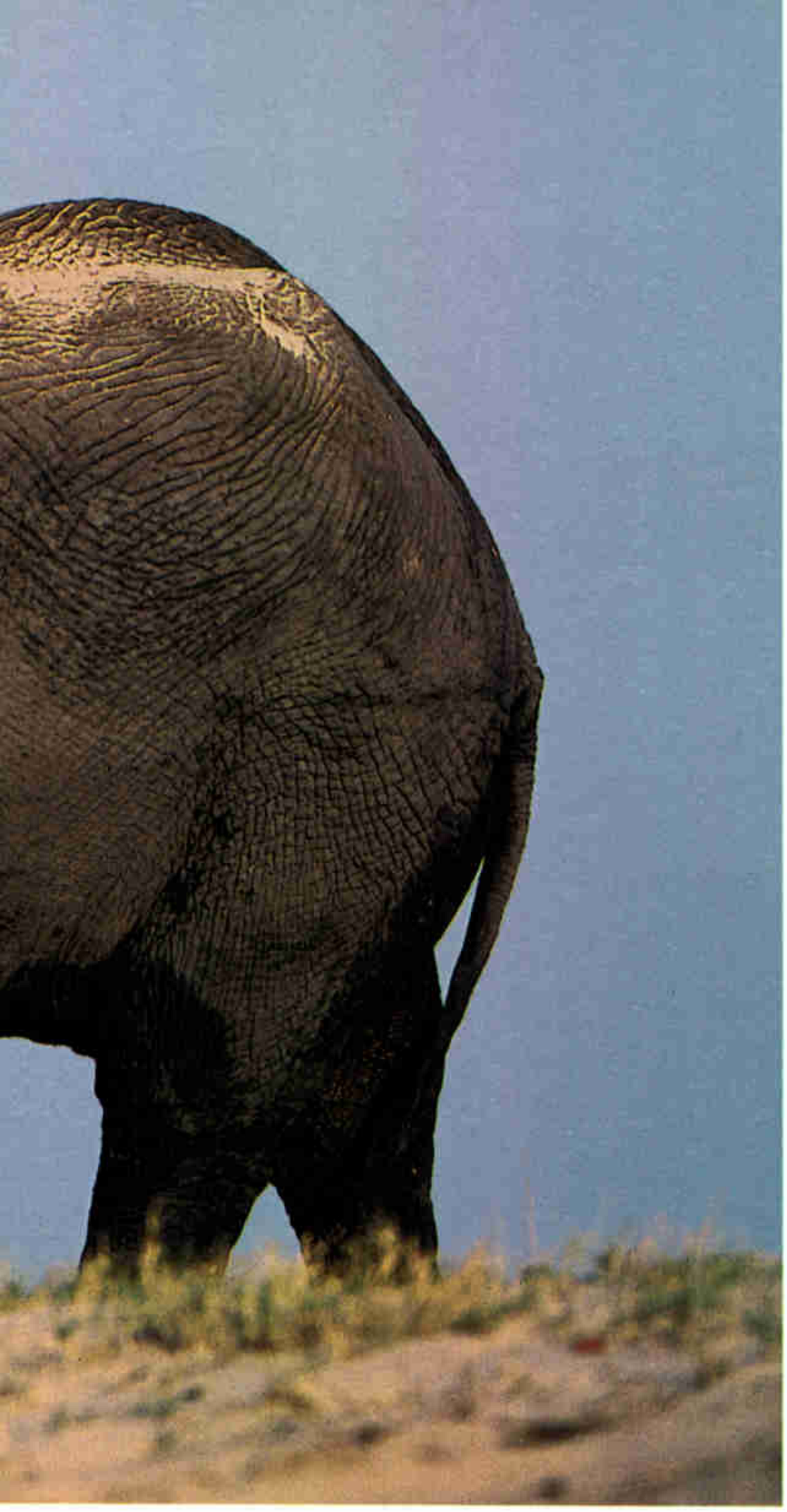
In time CAMPFIRE became a template for African wildlife management outside reserves, though there is a sad postscript to its progress. Zimbabwe itself has recently been plunged into political chaos as its increasingly unpopular president, Robert Mugabe, unleashes violent party activists upon his opponents. This has

LEAVING A WAKE LIKE A SKIPPED ROCK, an antelope speeds through water in Mozambique's Maputo Elephant Reserve. In addition to the reserve's namesake pachyderms,

the region harbors loggerhead and leatherback turtles and nearly 500 species of birds. Some 2,500 plant species, many endemic, make this a globally important center of plant diversity.

damaged the Save Conservancy, a large block of former cattle ranches adjacent to Gonarezhou given over to wildlife in 1991, which was supposed to form part of the transfrontier park. Save has now been invaded by government-backed squatters and poachers. In a six-month period last year, on just one of the conservancy's 21 units, scouts collected 2,291 wire snares, but not before losing 3 elephants, 2 cheetahs, 245 impalas, 49 warthogs, 32 kudu—and 160 miles of fencing. This state-sponsored turmoil has led to the suspension of bilateral aid and the collapse of tourism in Zimbabwe. CAMPFIRE and the whole national parks network has foundered. The situation is a sobering reminder of how the whole peace parks idea hangs on the golden thread of political stability, sadly still such a fragile thread in Africa.

LATER, when I visit the new Southern African Wildlife College on the western edge of Kruger, I mention to Eugene Moll, its outgoing director, that all the fine maps and presentations, the triumphal press releases and political protocols, can sometimes seem a world away from the situation I have encountered on the ground. It's here at this thatched campus in the bush that Moll has been training the first of the corps of transnational wildlife managers. He acknowledges my doubts and knows full well the huge practical problems that his students will face out there in the real world. "That's why," he tells me, "these courses are designed to turn out graduates who can take up jobs as wardens of under-resourced parks, practical leaders, above all, who know how to improvise in



difficult situations." And he reiterates the message I've heard all along on this trip, the message that has almost become the mantra of conservation in Africa. "Ultimately conservation is about *people*," he says. "If you don't have sustainable development around these parks, then people will have no interest in them, and the parks will not survive."

On my last night I take a drive with Moll and his wife in an open Land Rover out into the bush surrounding the campus. Impalas and zebras graze on the rain-gorged pastures, and a civet scurries away. After an hour we are rewarded with a spotted hyena. It is sitting in a shallow dust hole, ears twitching at the night sounds, mouth open and panting, its wide white fangs gleaming dully in the moonlight.

I am reminded of the power of the dream. A dream of a wilderness unified and vast, stretching across this great continent. Of Nelson Mandela's dream. "I dream of an Africa which is in peace with itself," he told me in his Johannesburg study, set in a lush garden. "I dream of the realization of the unity of Africa, whereby its leaders combine in their efforts to solve the problems of this continent. I dream of our vast deserts, of our forests, of all our great wildernesses. We must never forget that it is our duty to protect this environment. Transfrontier parks are a way we can do just that."

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MANAGED to death, an elephant fetus died when its mother was culled from Kruger's herd in 1985. Africa's new conservation dream is to reinstate nature's rule over life and death—and save room for the dust baths (above) that soothe the irritations of an elephant's day.

A CONVERSATION WITH NELSON MANDELA

Imprisoned for 28 years for resisting apartheid, Nelson Mandela was finally released in 1990 by South African President F. W. de Klerk, with whom he jointly won the Nobel Peace Prize. Four years later Mandela replaced de Klerk, becoming the nation's first black president. Now retired from office, Mandela divides his time between African diplomacy and charitable work. He is patron emeritus of the Peace Parks Foundation, and it was in this capacity that he talked with Peter Godwin in July 2000 in Johannesburg.

PETER GODWIN: How important is wildlife in your own life?

NELSON MANDELA: I was born on the banks of a famous river in our part of the world, [though] it can't be as famous as the Mississippi! It was called the Mbashe River, and it was full of forests, and there were animals. And so I am used to that.

PG: Did you miss it during your 28 years in prison?

NM: There is no doubt. When I was moved to a place called Pollsmoor, behind us there was a forest. I kept on saying, "Look, I was born in a forest: A blade of grass, a leaf, to me means a lot. Can we just go to the forest and walk?" Oh, they thought I was planning my escape! They said, "Never. And don't talk about that!"

And snakes used to come into the yard because we were close to a forest. And one time I was nearly pricked by a snake because one of the officers, when he saw the snake, he ran for a stick. And I said to him, "No, look, don't kill it." We are used to snakes. A snake will never attack you unless you frighten it, or you put your foot on it, or unless you stand between it and its hole. Now [the officer] was worried that if a snake bit me, he would have to answer. We were arguing. He went forward to kill the snake. I tried to stop him, but he was very strong and tall. When he bumped against me, I fell next to the snake, and it immediately struck.

PG: It bit you?

NM: No, no. I just ran away. I was younger at that time!

PG: You must get countless requests to be the patron of organizations and causes. What made you decide to support the peace parks plan?

NM: Linking up adjoining conservation centers between two or more countries restores the natural parts of Africa and enables animals to move in a greater area than before. The concept of transfrontier parks sends a powerful symbol that countries are ready to live in peace and solidarity. And these parks attract a large number of foreign tourists, which provides jobs to the people in that area.

PG: How do you think one can convince local communities adjacent to the parks to accept the existence of these parks when many of them would like to farm on that land?

NM: If the government unilaterally decides to establish transfrontier parks without consulting the community, then the community will not cooperate. But if the community is properly consulted and becomes part of the process, then they will cooperate —especially if they derive benefits from the transfrontier park system.

PG: How does one overcome the problem of poaching, one

DELA

of the biggest threats to wildlife in Africa?

NM: [We] have some parks along the Kruger National Park, some private parks, where companies in the cities, like Johannesburg and Pretoria, have a partnership with the local community, and they own the parks jointly. Once that happens, once the community understands—this is our facility; it can give us jobs; it can give us foreign exchange—then poaching comes to an end.

PG: What do you think about the complaint some Africans make that Westerners lecture African countries to conserve wildlife when so many wild animals, especially predators, have largely been wiped out in Western countries?

NM: Well, it's like elections. If the United States of America or Britain is having elections, they don't ask for observers from Africa or from Asia. But when we have elections, they want observers.

Now we had as a community—long before the arrival of whites—very good laws on conservation. The chief of a particular area would say, "If you people want to go cut firewood, you must come to me or to a foreman who is selected. If you want to go and hunt game, it should not be done in a chaotic manner, because we want to preserve [the animals], so you must get permission." And the chief would say, "I am going to have a particular period in the year when there can be hunting."

So conservation was there long before the whites came. Of course there are the latest methods of conservation, such as education; we have to take them from the West. But conservation was there.

PG: Are you conscious of the resentment among some other African countries at South Africa's economic dominance and the sensitivities that even this peace parks project is dominated by South Africa?

NM: We have inherited a system from the apartheid regime where, because of their big economy and their developed financial system, their army and so on, they were able to bully the neighboring countries. Now we have changed that type of government. But from the point of view of the neighbors, there is still the resentment. So the best thing to do is to be part of the regional organization here—SADC [Southern African Development Community]. [Then] we are actually obeying the collective effort of the region. That is the only way we can remove that resentment and be able to share our resources. We have to be very careful and wait for an invitation and not suggest what we can do.

PG: Do you ever find time now to go to the bush?

NM: Oh, I do go to game parks as often as I can. I like going there. But because of the pressure of work I don't get much time to do that. □

EGYPT'S HIDDEN TOMBS REVEALED

By ZAHI HAWASS
EXPLORER-IN-RESIDENCE

Photographs by KENNETH GARRETT

STIRRING UP THE DUST OF AGES, workers clear rubble from the 2,600-year-old tomb of Zed-Khons-uef-ankh, governor of a prosperous oasis in Egypt's Western Desert. Scientists had sought his tomb for more than 60 years. Now a team led by Egyptian archaeologist and National Geographic Explorer-in-Residence Zahi Hawass has finally found the governor, his father, and his wife.

GOLD COBRA AMULET

Found at last: the powerful man who ruled a flourishing outpost far from the Nile Valley

The streets of El Bawiti, the largest town in Bahariya Oasis, are busier now. Hotels have been built since more than 200 Greco-Roman mummies were discovered nearby.* Yet El Bawiti hid an older secret. We have found the tombs of Bahariya's legendary governor, Zed-Khons-uef-ankh (left), his father, and his wife in a maze of chambers beneath local homes (right). Archaeologists had been looking for Zed-Khons-uef-ankh ever since my countryman Ahmed Fakhry found tombs of three of the governor's relatives in 1938. Zed-Khons-uef-ankh ruled Bahariya during Egypt's 26th dynasty (664-525 B.C.), a time when the isolated oases of the Western Desert were strategically important buffers against Libyan invaders. Source of fine wines, Bahariya thrived at the crossroads of caravan routes. Its governors were wealthy men with connections to the throne. Zed-Khons-uef-ankh built a chapel in a temple nearby with a relief depicting him as large as the pharaoh, a bold assertion from a powerful man we now know better.

*See "Valley of the Mummies," by Donovan Webster, NATIONAL GEOGRAPHIC, October 1999.

The workers chanted and prayed to help us

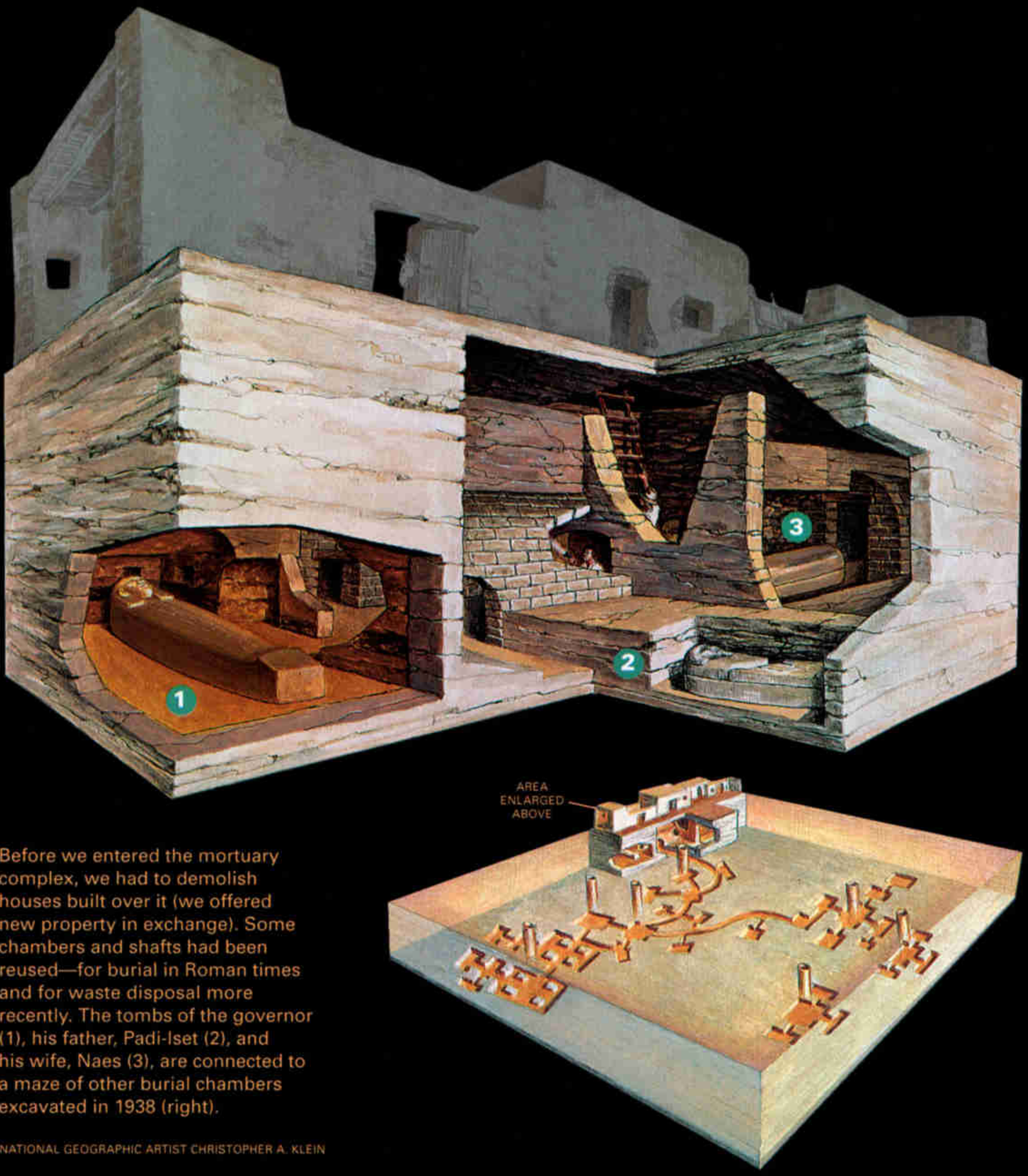
Two years ago we broke into a mortuary complex below the Sheikh Sobi neighborhood. Who was buried there? A sealed doorway inscribed with Zed-Khonsuef-ankh's name tantalized us, but we had to wait until the next field season to enter the chamber, remove rubble, and then haul out bag after bag of yellow hematite powder of unknown origin. It was backbreaking work, but our reward was great: a massive limestone sarcophagus (top left) with a splendid face, probably the work of master sculptors in distant Memphis, and an inscription identifying its occupant—Zed-Khonsuef-ankh, governor of Waht-Smenkht, a previously unknown epithet meaning

move the 12-ton lid of the sarcophagus.

"deep-rooted oasis," which suggests a long, peaceful rule.

Days later the chamber echoed with the chants of workers as the lid was pushed aside, exposing a second sarcophagus, made of alabaster. I noticed a hole in its side, cut by looters during the Roman period. I waited with my notebook as its lid was removed (bottom left). Inside, the wooden coffin and the mummy had decayed, leaving only dark organic matter.

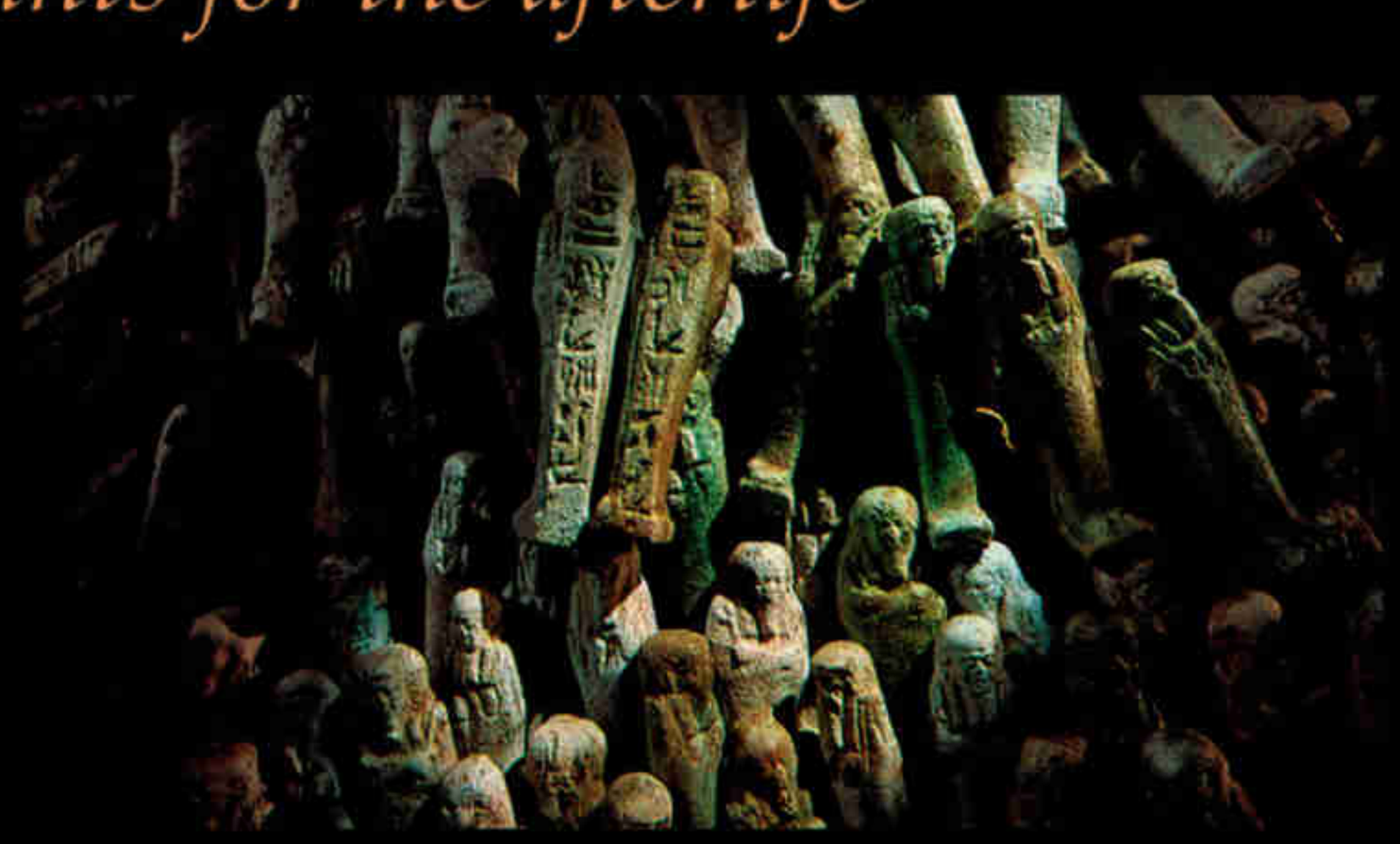
As we combed the chamber and sifted the powder, we discovered remnants of the governor's beaded shroud left by the robbers (below): a gold *ba*—winged symbol of the soul—and protective cobras. In between the sarcophagi we found a gold amulet of Qebeh-sennuef (above), guardian of the intestines, removed during mummification.



Before we entered the mortuary complex, we had to demolish houses built over it (we offered new property in exchange). Some chambers and shafts had been reused—for burial in Roman times and for waste disposal more recently. The tombs of the governor (1), his father, Padi-Iset (2), and his wife, Naes (3), are connected to a maze of other burial chambers excavated in 1938 (right).

NATIONAL GEOGRAPHIC ARTIST CHRISTOPHER A. KLEIN

A team of servants for the afterlife



The sarcophagus of Zed-Khons-uef-ankh's father (facing page), former governor Padi-Iset, lay amid glazed ushabti (right), stand-ins for the deceased should the gods demand labor in the afterlife. Carved to look like mummies and inscribed with his name, Padi-Iset's ushabti were even finer than his son's.

Splendid adornments for the wife of a man

A surprise waited for us north of Zed-Khons-uef-ankh's burial chamber. Beneath a pile of caved-in sandstone we uncovered the sarcophagus of a woman called Naes (above, being examined by my assistant Mansour Boriak). Inscriptions on 224 ushabti found beside her sarcophagus suggest that she was the governor's wife.

Looters paid little attention to her. Apart from a missing ornamental collar—her spine was broken at the neck by its hasty removal—most of her adornments remain where we would expect to find them in an undisturbed tomb. Her burial shroud was decorated with amulets of precious stone (top right), as well as at least 84 gold beads. Embalmers replaced her tongue with a shield-shaped piece of gold (right, at center). She wore a gold ring on her left hand, gold fingertips, and gold toe covers. A gold amulet with a heart *(ib)* below a sun disk *(re)*—seen at right under her right fingertip covers—is a symbolic representation of Pharaoh Apries's birth name, Wah-Ib-Re. We think it was a gift to the governor from a satisfied king.

The splendor of their mortuary complex reflects the family's status. The gold objects in Naes's partly looted

tomb are more numerous and of purer gold than those discovered in the undisturbed tomb of Iufaa at Abusir (National Geographic, November 1998). The governor's sarcophagi were transported to the site from quarries in the Nile Valley. Zed-Khons-uef-ankh seems to have ruled well and earned favor. We hope to learn more when we find his mother's burial chamber—she must be nearby. With luck we'll complete the family tree. □

MORE ON OUR WEBSITE

See more of Governor Zed-Khons-uef-ankh's tomb online at **nationalgeographic.com/ngm/0109**.

who earned the pharaoh's favor

"The great melting-pot of America, the place where we are all made Americans of, is the public school, where men of every race, and of every origin, and of every station of life send their children, or ought to send their children, and where, being mixed together, they are all infused with the American spirit and developed into the American man and the American woman."

— Woodrow Wilson, 1913

An influx of immigrants, especially Asian and Hispanic,

Changing

By JOEL L. SWERDLOW
ASSISTANT EDITOR

is changing the face of the United States—and the prom scene for students at a Virginia high school.

America

Photographs by KAREN KASMAUSKI

Kids here know they're in a blender: People of different colors

"It's as if you took the whole human race and threw it up in the air—and everyone ended up here," says Mel Riddile, principal of J. E. B. Stuart High School in Fairfax County, Virginia. Students come from some 70 different countries, and more than half of them must learn English as a second

go in, and a mixture that appears homogeneous comes out.

language. Stuart's seniors, posing here for their class portrait, often discover that post-graduation life can be much more balkanized—economically, ethnically, racially. "But at Stuart they mix," says Riddile. "Everybody's a minority here—and that's the best mix of all."

J. E. B. STUART HIGH SCHOOL opened in Falls Church, Virginia, in 1959. At that time the school, named for a famous Confederate cavalry commander in the American Civil War, possessed a student body of 1,616—virtually all Anglo-American. Change came slowly, accelerating during the mid-1990s, when immigration to the United States—legal and illegal—reached today's near-record level of a million people a year. According to the 2000 census, 10 percent of America's 281 million residents were born in other countries, the highest percentage since 1930 and the largest number in U.S. history. Before 1965 more than three-quarters of all immigrants to the U.S. came from Europe, owing largely to quotas that favored northern Europeans. In 1965 Congress removed those quotas, and since then more than 60 percent of immigrants have come from Asia, Africa, the Caribbean,

the Middle East, and Latin America. Says Kenneth Prewitt, former director of the U.S. Census Bureau, "We're on our way to becoming the first country in history that is literally made up of every part of the world."

Immigration patterns worldwide show a flow of people from poor countries to those with stronger economies, especially to industrialized countries with aging workforces. The influx is changing the makeup of populations in Britain, now 7 percent foreign-born, and France, also 7 percent. Immigrants now constitute nearly 10 percent of Germany's population, and 17 percent of residents in Canada are non-Canadian. In many ways J. E. B. Stuart mirrors this immigration revolution. Half of its 1,400 students were born in 70 countries.

In "Combating Intolerance," an elective course for juniors and seniors at Stuart, class discussions cover such topics as hate crimes, Ku Klux Klan violence, and why "No Irish Need Apply" appeared on job posters in cities where Irish immigrants looked for work in the 19th century. The morning I sit in, one of the students remarks: "America is a country of immigrants but also a country that sometimes hates immigrants."

"So why would anyone want to immigrate to the U.S.?" I ask, wondering if the students can reconcile this country's ideals with its shortcomings.

Hands go up. "It's a country that gives people a chance to escape," a boy from Eritrea says. "People have a natural right to life, liberty, and the pursuit of happiness," declares a girl from Nicaragua. More hands wave. "What makes America special is that things are more

Frying egg rolls for their fund-raiser, Stuart High's Vietnamese Club will sell 200 of them—and fast, says Thuy-Lan Phan, center, whose family came to the U.S. in 1993. "My dad spent six years as a political prisoner," she says. "He came so my brother and I could get a better education. And to be free."

Among the books on the classroom's shelves are dictionaries:

Italian, Korean, Persian, Russian, Turkish, French, Hindi. . . .

'wishable,' more likely to happen here," says a boy from Vietnam. "It's the tolerance," adds one voice. And then another: "The best way for us to learn tolerance is just seeing people of other cultures every day here." Heads nod in agreement.

They seem a little smug to me. "What's it like in this school for kids who don't speak English?" I ask. The class on intolerance is silent. "Do you ever do anything with them?" Someone in the back makes a comment, and the last row laughs.

Students in this class reflect a wide range of colors and cultures, but all speak English fluently and with no accent. Earlier that morning I'd eaten in the cafeteria and had heard many students who could not answer even simple questions from the people at the cash registers.

In 1990 some 32 million U.S. residents spoke a language other than English at home, and more than 7 million lived in households with no fluent English speaker over 14 years old. When language data from the 2000 census become available next year, the number of households with little or no English is sure to be much larger.

A basic command of English is a requirement for U.S. citizenship. Many argue that it also constitutes a foundation for economic self-sufficiency.

For the students who arrive at J. E. B. Stuart speaking no English, life can be tough. Two volunteers from "Combating Intolerance" escort me to a nearby corridor where English as a Second Language (ESL) is taught. "I *never* come here," says one. He was born in Pakistan but learned English when he came to the U.S.

Beneath the sameness in fashion is a current of ethnic soul—

Flip through the 1964 yearbook from Stuart High School (above, at left) and you'll count 14 students with the surname Smith but none named Martinez or Nguyen. By 2000 there were only 6 Smiths, and 11 Martinezes and 23 Nguyens—an influx of Hispanics and Asians that echoes a national trend. Sokthear Van, born in a refugee camp in Thailand after his family fled from Cambodia in 1980, finds that his roots still manage to find him.

a diversity that students cling to even as they conform.

When he was sidelined with a football injury (bottom left), a family friend rushed to his side with a bottle of tiger balm, a traditional remedy. Culture clashes rarely faze Stuart's students (above) but can unsettle their parents. "My mom and dad grew up in El Salvador, in a culture where the first person you date is the person you marry," says Jesse Castellon, getting ready for the homecoming dance (below). "But it's not like that here."

at age ten. "Yeah," adds the other boy, born in the U.S. but whose parents are Middle Eastern. "I haven't been here in *years.*"

Ruth DeJong's ESL class emphasizes experiential learning. Students color pictures of objects in books to show that they understand words she is using. They get up and stand next to the window when she says "window." They write the new words and use them in sentences. As DeJong helps them pronounce words, her enthusiasm makes the students laugh. "Is anybody in here handsome?" she asks. A student raises his hand. "Yes," he says haltingly, "I am handsome."

DeJong's classroom is filled with teenagers, but the props make it look like a room for first or second graders. Stuffed animals lie on a sofa. Wall charts show pronouns, colors, parts of the human body. Everything—"window," "blinds," "pencil sharpener"—has a label. Among the books on the shelves are *What the Dinosaurs Saw, Morris the Moose,* and *Who Sees You at the Zoo?* Along with them are dictionaries: Italian, Korean, Persian, Russian, Turkish, French, Hindi, Spanish, Portuguese, Vietnamese, Swahili, Serbo-Croatian.

DeJong, who has taught ESL for 20 years, says, "About a fifth of the students now are nonliterate in their native language. That makes it much more difficult for them to learn English." A child's age of arrival in the U.S., she explains, is crucial. Young children have little difficulty with English, learning it in elementary school at the same time they learn to read. For many of the students in her class, who are beginning English and only starting to read at ages 14 to 17, it is much harder.

"Let's do some reading now," DeJong says, passing out a booklet written by local teachers. It contains reading and vocabulary lessons based on fictional students. "Many students are at school," reads one student. "They are talking and laughing. They are not talking to Ali. He is sad and afraid."

Slowly and softly, DeJong calls on everyone, even those who never raise their hands. She is both gentle and persistent. If they don't learn to speak and read English now, she knows, they won't stay in school—no matter how intelligent they are.

Getting the royal treatment from local congressman Tom Davis, homecoming king Kevin Wiafe commences his reign. Wiafe's family left Ghana in 1980, inspired, says Kevin's mom, by "curiosity and adventure." And what a trip it's been: Dancing with the homecoming queen, says Kevin, was "sort of like Cinderella."

Young people whose backgrounds span the spectrum of

One-fifth of the full-time jobs in the U.S. pay eight dollars an hour or less. Filling most of these jobs are the 40 percent of the workforce who have no education beyond high school. Similar figures characterize most industrialized countries. For immigrants with poor language skills and little money, entering a technology-driven job market is increasingly difficult.

J. E. B. Stuart's computer labs are furnished with up-to-date equipment. The teachers are patient, and students still struggling with English participate here along with everyone else, learning to use word-processing software and to cruise the Internet. I find Mel Riddile, the high school's principal, standing in the hall outside one of the labs, greeting each passing student by name.

human cultures are becoming "normal American teenagers."

"Maybe the key to success lies in computers," I suggest. Riddile disagrees. "Computers are important," he says, "but not as important as literacy. The kids have to be able to read or they can't even use computers," Riddile continues. "Here we spell hope 'r-e-a-d.' We make them 'haves' by teaching them to read. It's no guarantee, but it's essential."

Riddile shows me how reading programs permeate the school's curriculum. Students who need extra help attend a reading laboratory, but even in science and mathematics a systematic effort is made to teach reading. In the school's library, students seem to feel no social stigma as they select the easiest books.

Emphasizing that more than half of his students qualify for free or reduced-price meals in the cafeteria, Riddile describes efforts to keep them in school: 6 a.m. automated wake-up calls help, as do special counselors who speak foreign languages. But some still drop out, he says, because they either need to work or become too discouraged. Parents, unfamiliar with the inner workings of an American high school and sometimes illiterate in their own language, are ill-equipped to help their children succeed. "We're the best hope these kids have," says Riddile.

In the end Riddile is upbeat. Students who attend Stuart enjoy a special advantage, he says. "Going to school here makes them better prepared for the world. They're living in the workplace of the 21st century."

A visit to the counselors' offices offers further perspective on the workplace of the 21st century. "Immigrants often do the work no one else wants to do," says one of the counselors, referring to child care, housekeeping,

New Americans: Their Origins, Their Destinations

Who is an immigrant? A person from another country who comes to the U.S. to take up permanent residence. In 1998, the latest year for which immigration figures are available, 660,477 such noncitizens from 208 countries around the world (19 of which are noted below) were granted permanent resident status. The largest group came from Mexico, boosting the Hispanic count to record levels in the 2000 census. "The Southwest attracts huge numbers of them, but Hispanics have been living there for centuries," says demographer Rebecca Clark. "After all, Spanish colonization began before 1600."

VIETNAM
17,649
Nearly 70 percent arrived for "family reunification."

CHINA
42,159
Second only to Mexico for immigrants to U.S. Figure includes 5,275 from Hong Kong.

INDIA
36,482
Nearly 20 percent were already in the U.S. as temporary workers.

PAKISTAN
13,094
New York absorbed 3,900; California, 1,711; Montana, zero.

UKRAINE
7,448
Roughly half were refugees or asylum seekers.

RUSSIA
11,529
More than one-third were adopted children.

POLAND
8,469
When the Cold War ended, the Polish exodus sped up.

SOUTH KOREA
14,268
One in three were sponsored by U.S. employers.

CANADA
10,190
In the same year 4,140 people from the U.S. moved to Canada.

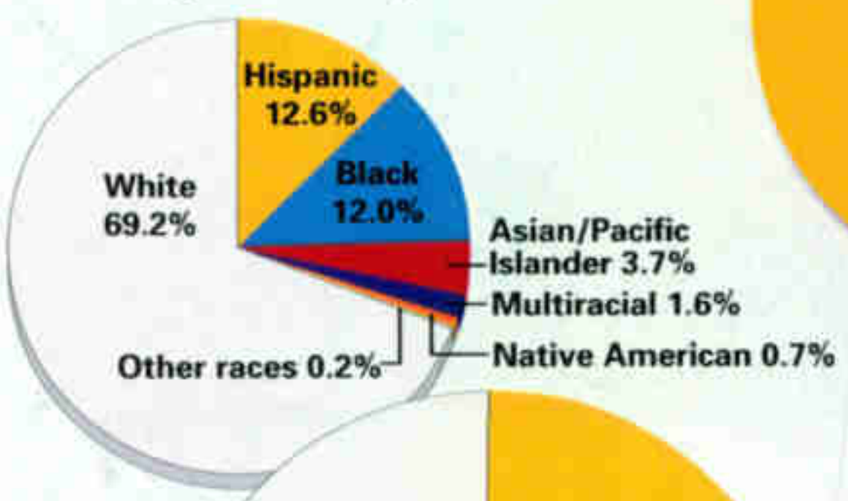
UNITED KINGDOM
9,018
Once a major source of immigrants, the U.K. now sends only 1.3 percent of the total.

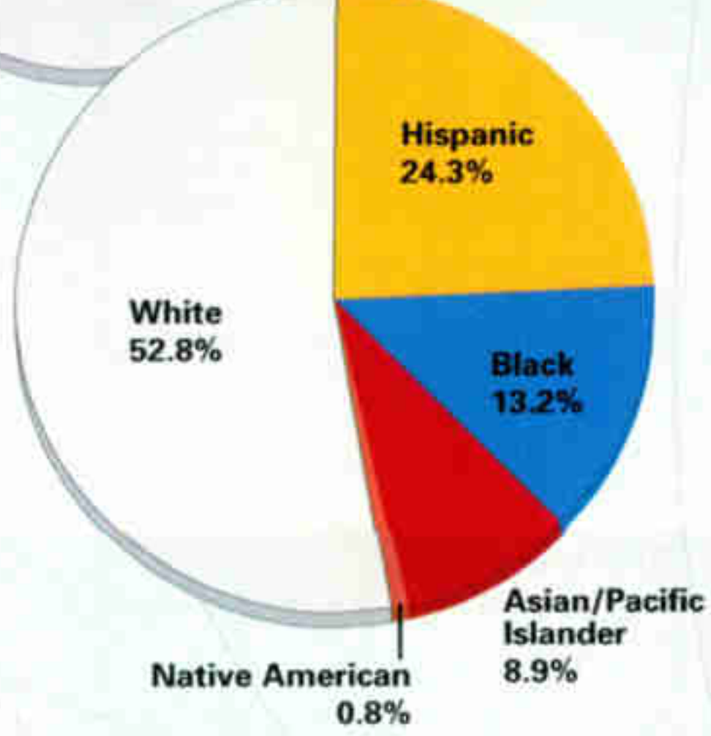
PHILIPPINES
34,466
Accounted for 57 percent of immigrants to Hawaii.

UNITED STATES

U.S. POPULATION 2000

During the 1990s the U.S. population grew by 33 million; about one-third were immigrants. Hispanics surpassed blacks to become the nation's largest minority.





MEXICO
131,575
Biggest number. Does not include illegal aliens.

PERU
10,154
New Jersey was the top destination for Peruvians.

CUBA
17,375
Most were refugees permitted to leave.

NIGERIA
7,746
Largest number of African immigrants came from here. Egypt ranked second with 4,831.

JAMAICA, HAITI, DOMINICAN REPUBLIC
48,982
Sent one in five of New York State's new immigrants.

COLOMBIA
11,836
Some 70 percent were immediate relatives of U.S. citizens.

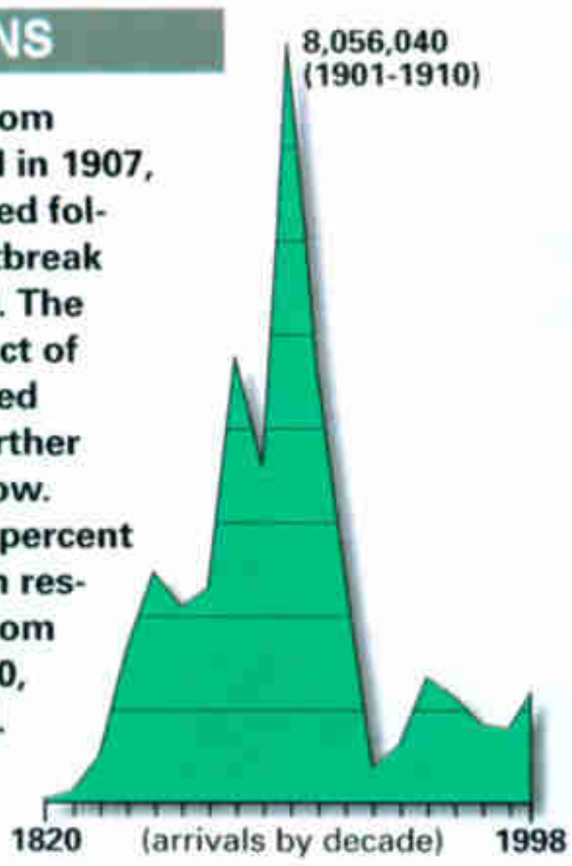
U.S. POPULATION 2050

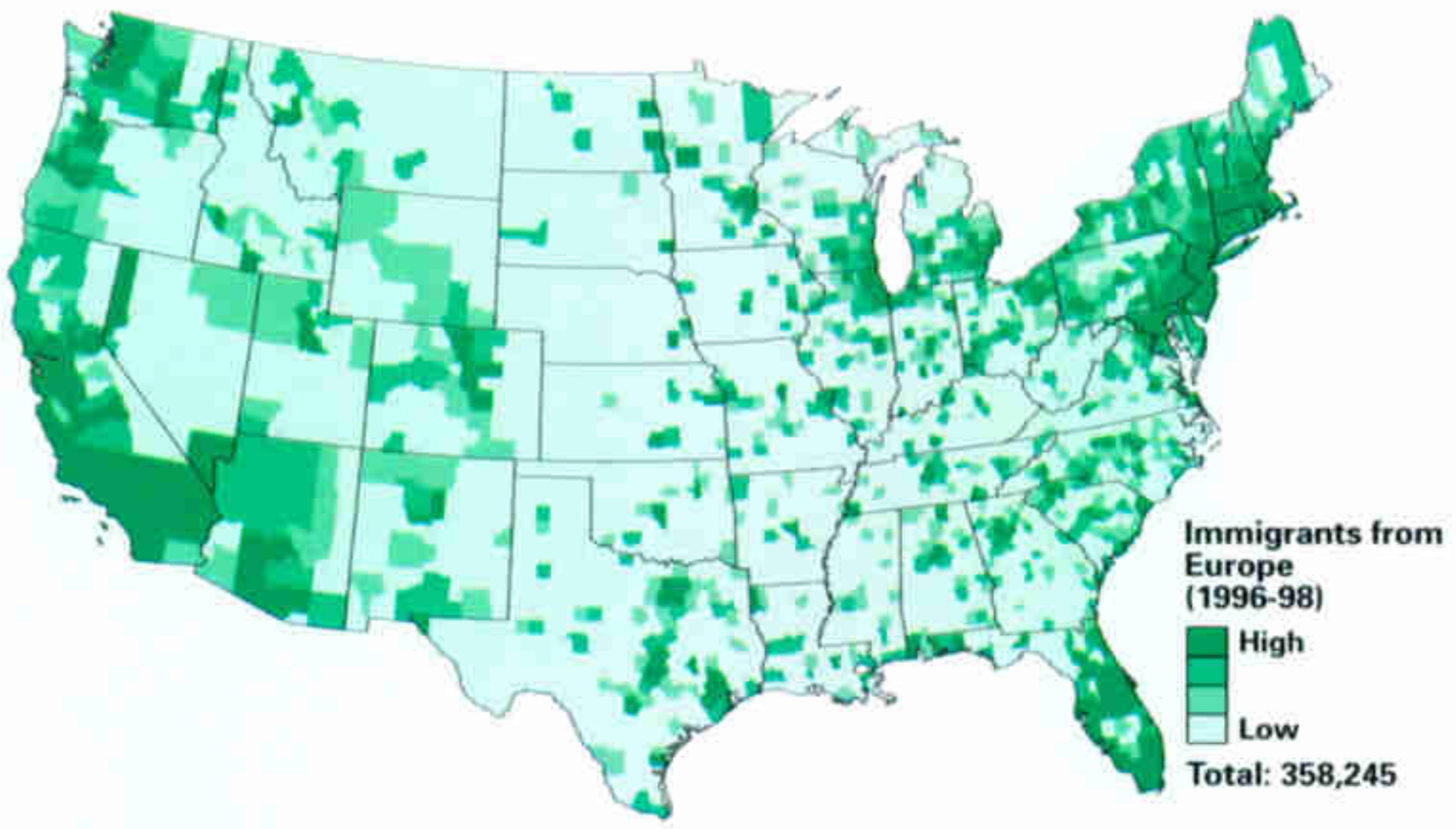
U.S. total is projected to exceed 400 million by 2050. The greatest increase will be among Hispanics, due in part to higher birthrates.

SOURCES: U.S. BUREAU OF THE CENSUS (PIE CHARTS); MICHAEL D. HOEFER, IMMIGRATION AND NATURALIZATION SERVICE (1998 WORLD MAP, 1996-98 U.S. MAPS, GRAPHS); CARL HAUB, POPULATION REFERENCE BUREAU, NATIONAL GEOGRAPHIC MAPS

EUROPEANS

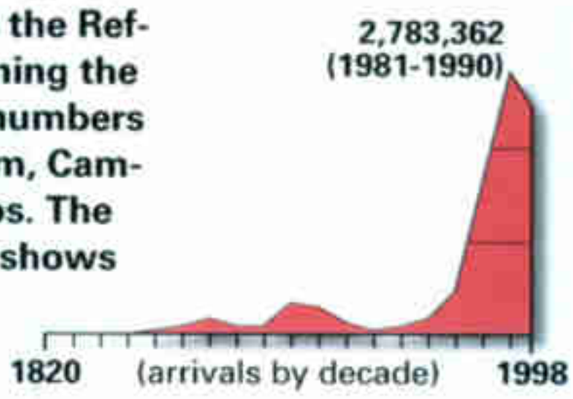
Immigration from Europe peaked in 1907, then plummeted following the outbreak of World War I. The Immigration Act of 1924 established quotas that further reduced the flow. Today only 15 percent of foreign-born residents come from Europe; in 1960, 75 percent did.

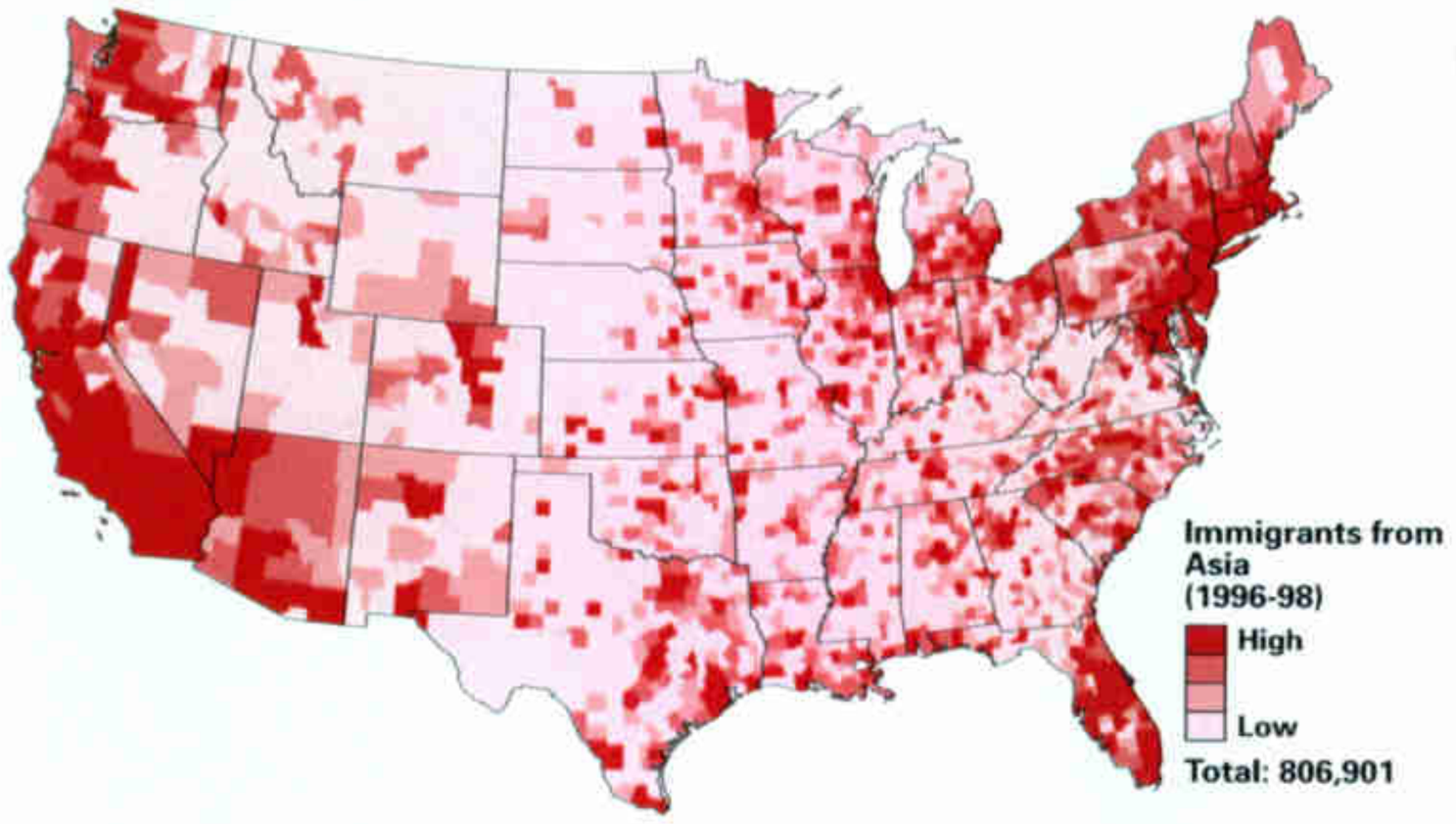




ASIANS

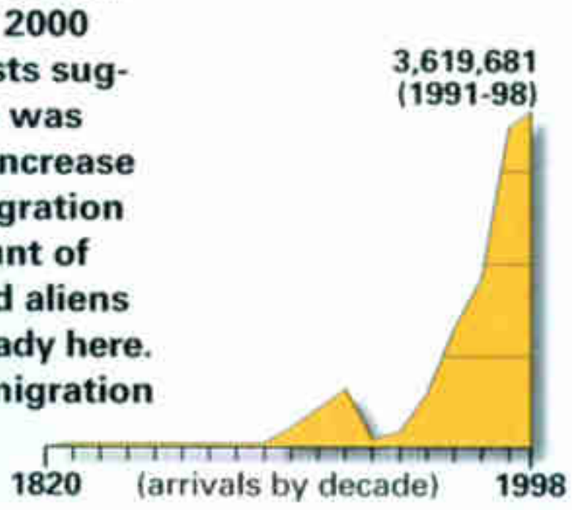
In 1965 Congress removed the legal barriers that restricted Asian immigration to the United States. In 1980 it passed the Refugee Act, opening the door to large numbers fleeing Vietnam, Cambodia, and Laos. The graph at right shows the resulting spike in Asian immigration.

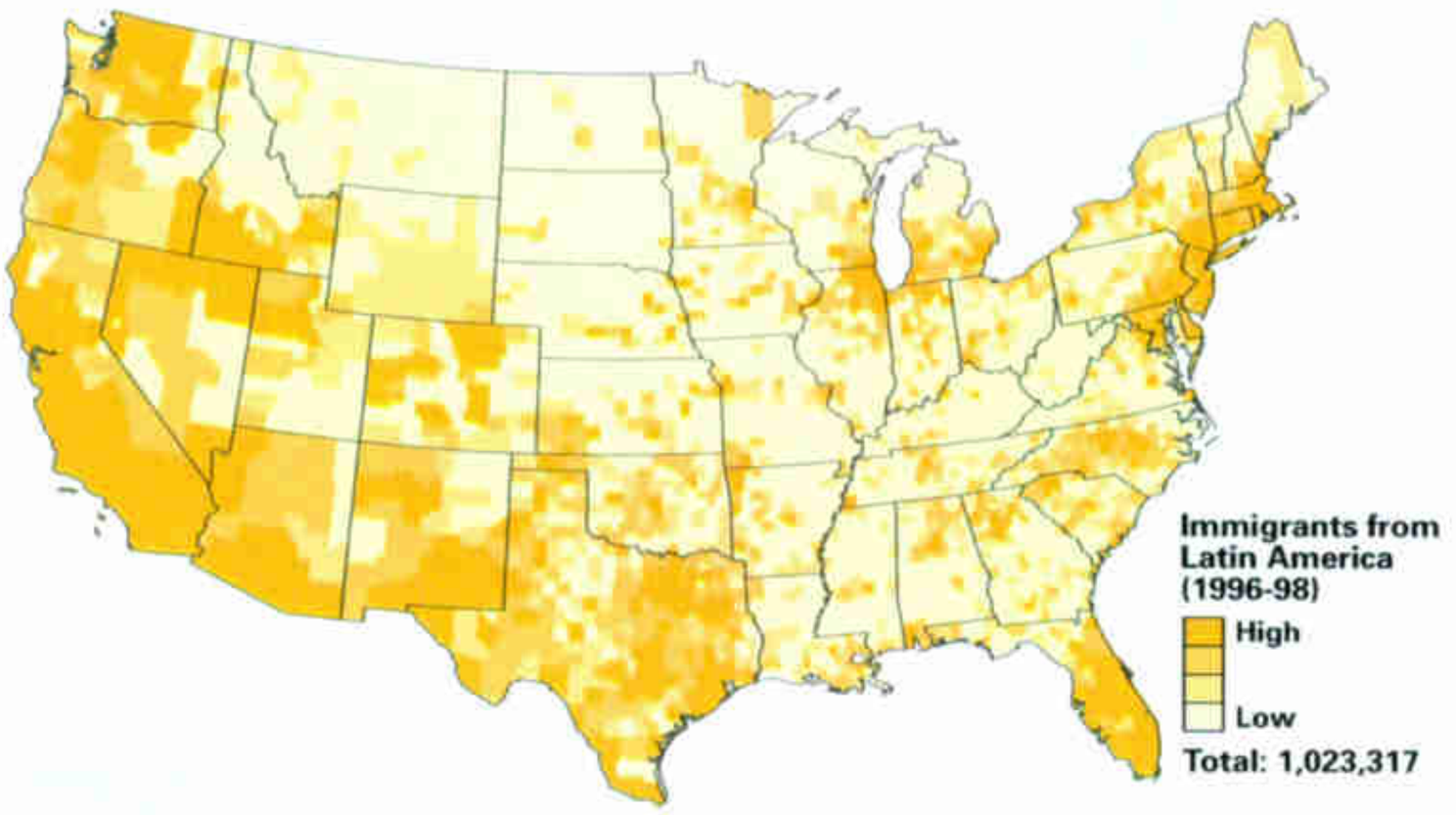




HISPANICS

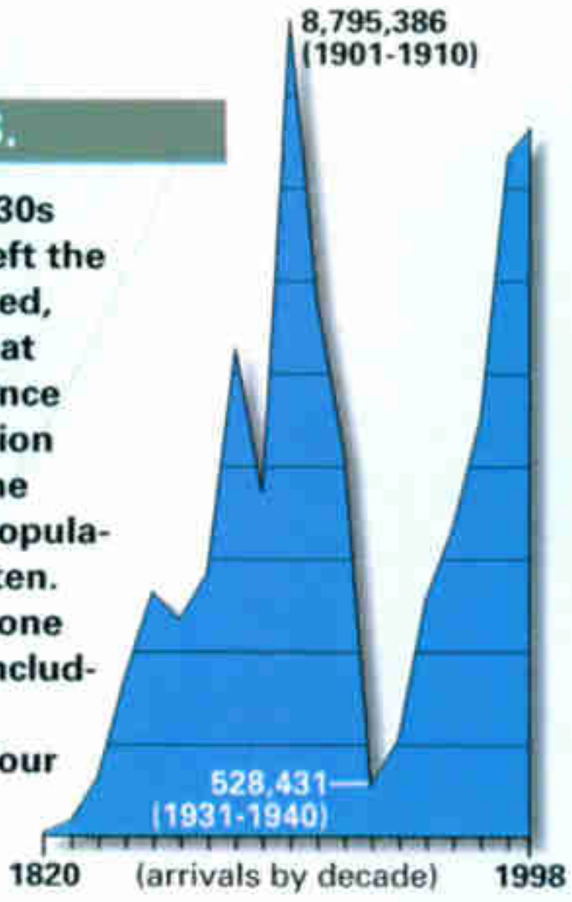
The rapid growth of the Hispanic population—now 35 million strong—was a big surprise from the 2000 census. Analysts suggest the surge was caused by an increase in illegal immigration or a better count of undocumented aliens who were already here. Only legal immigration is reflected on this graph.

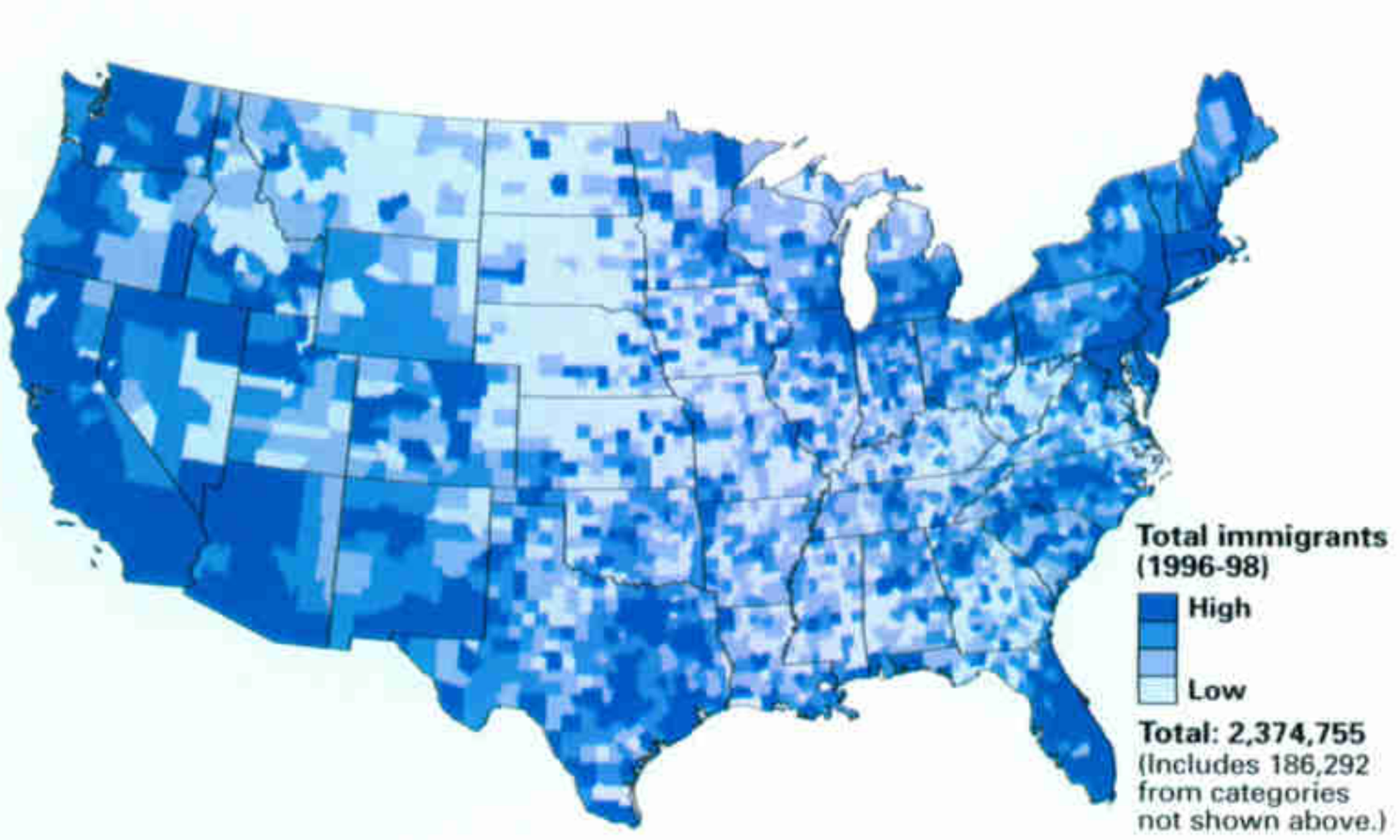




TOTAL U.S.

In the early 1930s more people left the U.S. than arrived, due to the Great Depression. Since then immigration has boosted the foreign-born population to one in ten. Most settle in one of six states, including California, where one in four residents is foreign-born.





"The best way for us to learn tolerance," says one student,

and restaurant work. There is no shortage of such jobs in Fairfax County, Virginia, the jurisdiction that operates J. E. B. Stuart—where the median household income is $80,000 a year. "But students don't want these types of jobs. Their parents do this kind of work out of necessity, but most of the students hope to do something more professional."

"How many go on to college?" I ask.

"About 59 percent of the student body as a whole goes on to four-year colleges and 21 percent to two-year schools," another counselor replies. "But the numbers are much lower for foreign-born students. The big economic jump may be made by their children. Remember that many of the kids here have already passed through a great filter. They have a much better chance of making it than do lots who don't get here. It's relative. For them, to have a job and a home and enough money to feed a family can be a very big accomplishment."

"Too many very capable students simply do not think of themselves as college material," says Mark Rogers, coordinator of J. E. B. Stuart's International Baccalaureate (or IB, for short) program, a rigorous precollege curriculum for juniors and seniors. The work required is significant: For every course, a student can count on at least one hour of homework every night.

Some 250 students (about 20 percent of the student body) take at least one IB course, although the program is open to all upperclassmen. Most of the students in the IB classes I visited were nonimmigrant whites. Rogers says teachers try to recruit a broader range of students by persuading them to take special preparatory courses in the ninth and

Pausing to pray during a private girls-only ice skating party, members of a Muslim youth group maintain their modesty. "Wearing the head scarf is a big challenge," says Fatima Abdallah, the group's 22-year-old coordinator. "People call us terrorists or foreigners. But most of us grew up here and are part of this society."

"I don't want to be white," says a white student from Poland. I'm in the library with a cross section of students who volunteered to speak with me.

Others agree with the Polish-born youth, but I'm confused. They explain. To call someone "white" is an insult, as are synonymous terms like Wonder bread. "I don't consider myself white," says a young woman from Russia. She has white skin. "Whites act white and do white stuff."

"What's 'white stuff?' " I ask.

"White kids act different. They hang out differently. Whites are privileged. They're smart, do homework on time, run the student government, participate in plays and musicals, sell stuff, have parents who are involved in the school."

"When you go to apply for a job," says one boy, "you have to act white."

"What do you do on weekends?" I ask. They all answer: Eat at a diner, talk, chill, watch television, go to an outlet mall, be with a boyfriend while he gets his car inspected, talk on the telephone, go to a movie.

"Sounds like what a white person would do," I say. Several students shake their heads, amazed at my inability to understand.

Most white students remain silent during these discussions. "I won't apologize for being white," says one.

"is just seeing people of other cultures every day here."

tenth grades. But the work is especially difficult for immigrant students because courses require fluency in English.

One pattern is clear: The longer immigrant families have been in the U.S.—and the longer they have spoken English—the more likely their children are to take IB courses. They are following the same pattern that has characterized most assimilation in the U.S.

STATISTICS ABOUT LITERACY and language and college prospects aside, what about being a teenager at J. E. B. Stuart—an immigrant teenager *or* an American teenager in this small-scale melting pot? A teenager with black skin or white skin, brown, yellow, or red skin—a teenager who speaks English or Spanish or Chinese or Hindi?

I end up wondering if these kids aren't just struggling with an age-old adolescent dilemma: wanting to achieve versus wanting to be "cool." If achievement—or at least too much achievement—is unfashionable and achievement, as they have defined it, is "white," then "white" is not cool.

Whether they want to end up "white" or not, the kids here know they're in a blender: People of different colors and textures go in, and a mixture that appears homogeneous comes out. Everyone has a backpack. Most boys wear jeans and T-shirts; *many girls wear* short skirts or tight pants, showing a bit of bare midriff. Boys and girls wear earrings and talk about the same music.

But running beneath the sameness in fashion and attitude is a current of ethnic soul—a diversity that many *(Continued on page 60)*

Students here come from places where there's war or civil unrest.

Bound together by belief, parishioners from St. Anthony's Roman Catholic Church in Northern Virginia reenact the stations of the cross each year during Holy Week. The church, which provides immigrants with a wide range of free medical and legal advice, is roughly 60 percent Hispanic and

Some have horrible memories; a few have seen family killed.

40 percent white, with a few African immigrants mixed in, says Father Eugenio Hoyos. "We don't see many differences when we come together. We have the same faith, the same Eucharist, the same sacraments, and the same rules and regulations from the Vatican. The Catholic Church is universal."

"We're on our way to becoming the first country in history

Immigrants flock to certain areas for good reasons. The Washington, D.C., area, for instance, welcomed Afghans fleeing war in the early 1980s. Today that community is a magnet for another wave of Afghan refugees (below). Once established here, families sometimes help relatives back home get a visa, move, then settle in. Many Vietnamese families sign their children up to be Scouts (above) because the values of the pack and

that is literally made up of every part of the world."

troop—discipline, loyalty, love of God and country—echo their own. Groom Phong Mai and his bride, Anh, had a traditional Vietnamese wedding (below), followed by a less traditional party that night. Jobs also lure people (above). "Without this influx of immigrant labor, we wouldn't come close to meeting the demand for housing in this area," says Craig Havenner, former president of the Northern Virginia Building Industry Association.

of the students cling to even as they conform. They may sense that they are losing their family stories in the blender. Students here come from places where there's war, civil unrest, or extreme poverty. Some have horrible memories; a few have seen family killed. Most of them, though, have asked their parents very little about their decisions to immigrate. "My parents don't talk much about it," one explains. Another girl says, "I'm Malaysian, but one set of my grandparents was from Thailand. I don't know anything beyond that."

The students' ethnic awareness coupled with the sense of losing their ethnic identity creates a subtle tension, even in the relatively benign atmosphere of the high school. "Hey, Italian!" evokes a response of "Hey, mulatto!" Pakistani girls are teased about wearing pajamas to school.

"I'm forgetting Arabic," says one student. "I can feel it fading away, being sucked away from me."

"It's part of becoming an American," says a friend.

This pattern persists even in the Hispanic community, which now constitutes more than 12 percent of U.S. residents. Roughly half of second-generation Hispanics assimilate so completely that they don't learn Spanish.

"We feel better with our own people," explains one student when I ask about apparently segregated groups in the cafeteria, which has a distinct geography that all the students can readily map out. Groups that sit together include Pakistani, Spanish-speakers, Moroccan, freshmen, cheerleaders, slackers, and nerds. Blacks who have recently arrived from Africa do not sit with the black Americans. Some tables are frequented by students who live in the same apartment building.

Despite such boundaries, most tables appear just plain mixed. At what looks like a typical table I pass out a piece of paper and ask everyone to write down his or her ethnic background. The results: "half Greek, half Middle Eastern," "Greek," "Saudi Arabian," "Bolivian," "African American," "Hispanic," "white (American)," "Russian," "African," "Pakistani," "confused," "mixed—black with??"

Lunch in the cafeteria seems dominated by interaction between two groups that transcend ethnic differences: boys and girls. Handholding, hugging, and occasional kissing have been very much in evidence throughout the school. Even some of the Muslim girls, who wear clothes that cover their entire bodies, have magazine pictures of muscular black men wearing only bikini briefs taped up inside their lockers.

What do these teenagers think of the cultural rules their parents try to enforce? A Sikh student says he finally talked his father into letting him cut his hair. Some of the Muslim girls argue with their parents about what kinds of dresses they can wear. One girl says that her mother told her she would have to marry an Asian man, and another girl insists that people must marry for love. A third girl reports that her mother says that people marry people, not cultures.

But most Stuart students are too young to be thinking of marriage. Conversations,

As one chapter ends for graduating senior Truc Nguyen and her classmates at Stuart High, another one commences. "The great social adventure of America is no longer the conquest of the wilderness but the absorption of fifty different peoples," observed journalist Walter Lippmann in 1913. Today the adventure continues.

"What makes America special is

that things are more 'wishable,' more likely to happen here."

especially among the boys, quickly turn to cars. "A car means freedom," one says. "You can go anywhere—your car is your life." A friend, who is saving his minimum-wage earnings for a car, says, "I know this girl farther out in Virginia I want to visit. With a car we could go to the shore or to New York. Doesn't everyone want to get away?"

At 2:05 p.m. the school day ends, and a rush to buses and cars begins. Some students get rides with parents or friends. Music blares from radios, kids sit on the grass, shouting, laughing, and flirting.

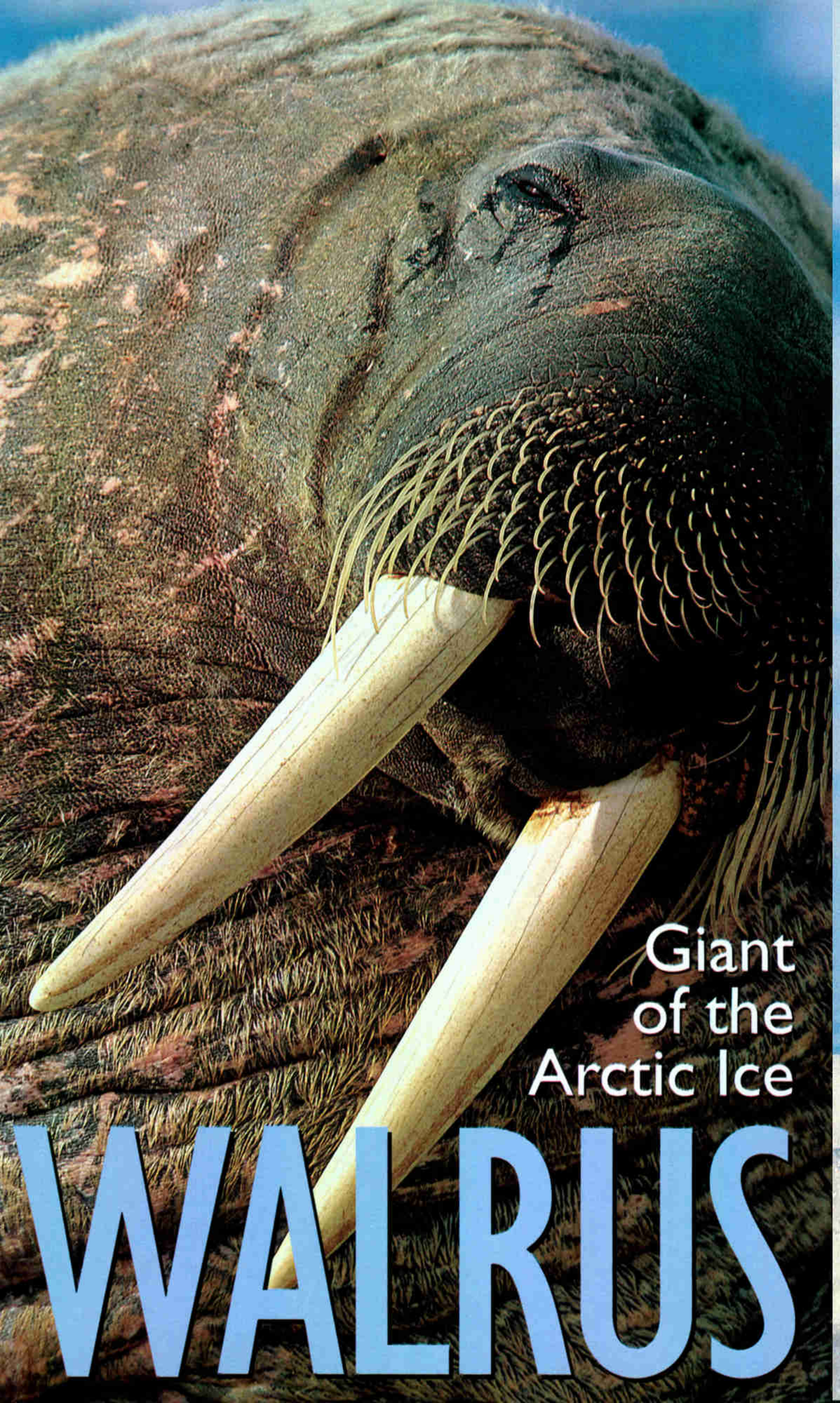
I go for ice cream with several boys, most from the football team. It's a typical J. E. B. Stuart group: an African American, an Afghan Italian, a Cambodian, and a Palestinian. They're talking about rap music when two girls walk in. One of the boys goes over to talk to them. When he returns, the others tease him. He defends himself: "I just asked if they'd like to chill together sometime."

These are normal American teenagers, I think, wondering how I'll get them to discuss immigration issues. Then I realize that they've already taught me the most important lesson. Young people whose backgrounds span the spectrum of human cultures are becoming "normal American teenagers," and in the process they will change America. We may not know yet what the change will mean, but the kids themselves know they are at the heart of something significant. As one boy, speaking simply and confidently, told me: "We make America more interesting." □

MORE ON OUR WEBSITE

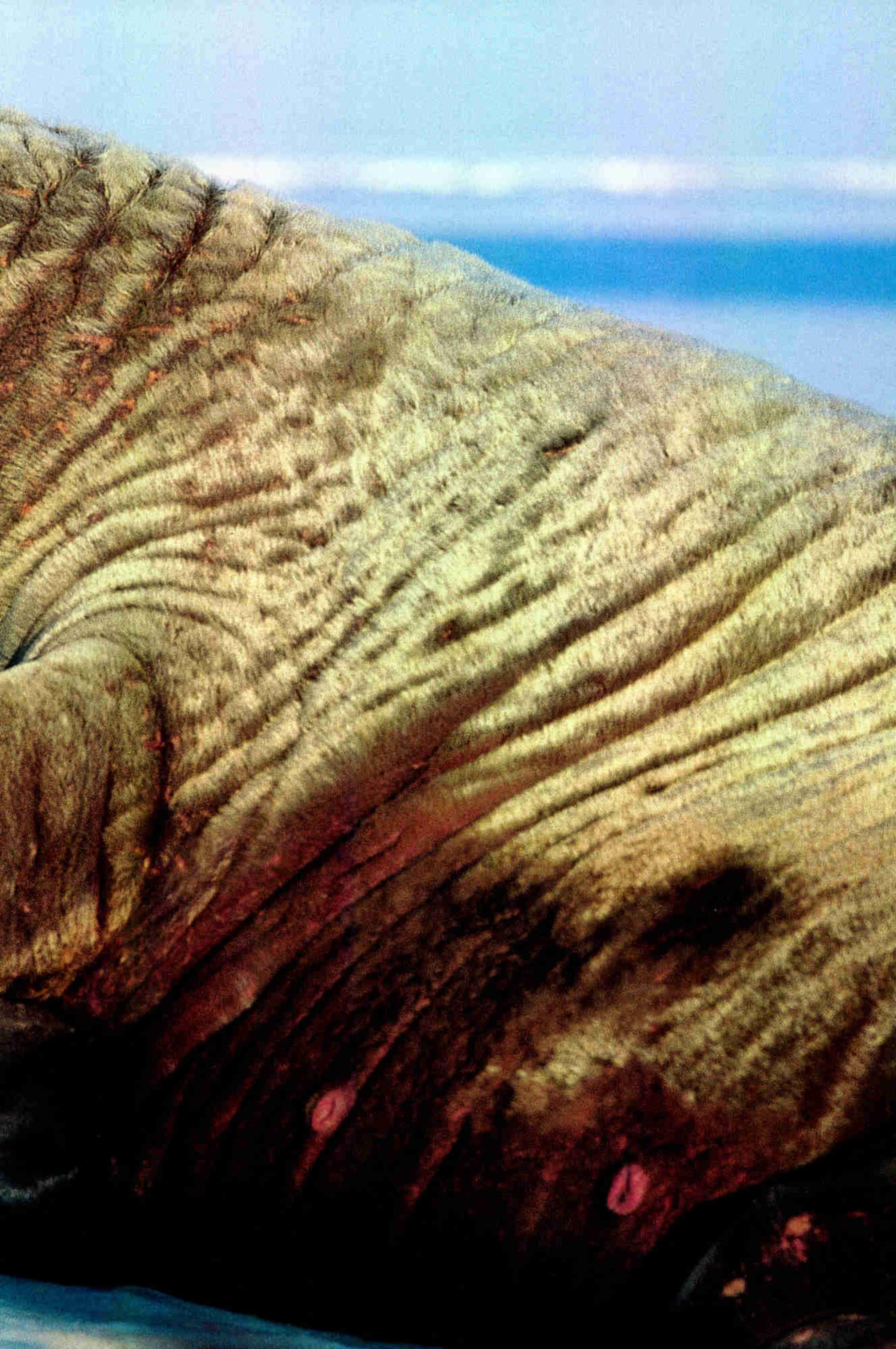
Are U.S. immigration levels too high or too low? Join the discussion at **nationalgeographic.com/ngm/0109.**

Roiling logjam of walruses seek a measure of safety in numbers on a Canadian islet. Their condensed breath visibly thickens when a polar bear or other threat sets them scrambling. The tusks of a bull are formidable weapons; the whiskered muzzle of a cow can calm a newborn calf (following pages).



Giant
of the
Arctic Ice

WALRUS



Article and photographs by **NORBERT ROSING**

Arctic sunlight bathes Canada's Foxe Basin, where bodies clumsy on land swim with fluent grace. This fleeting glimpse at Atlantic walruses was hard earned. Equipment failures and impossible weather doomed my initial attempts to photograph these notoriously difficult subjects. In 1994, four trips to the Arctic yielded only one productive shooting day. But when I traveled to Igloolik in Canada's Nunavut territory in 2000, I often found seas smooth as blue glass. Two Inuit guides adroitly kept our 23-foot boat away from dangerous currents that could have wedged us between crushing ice floes. I was rewarded with rarely photographed scenes of polar bears attacking walrus herds and walrus females bestowing tender care on calves just hours old.

Walruses can dive 300 feet to feed on the ocean floor for as long as 12 minutes before surfacing. Weighing an average of 2,000 pounds, they have enormous appetites. Stiff whiskers help locate clams and other shellfish, which they hold with their lips to suck out the soft tissue. Predators, including humans, killer whales, and polar bears, attack

MORE ON OUR WEBSITE

Find more of Norbert Rosing's photographs and field notes from his walrus coverage at **nationalgeographic.com/ngm/0109**.

Gentle sweeping with her whiskers, called vibrissae, cements the bond between a female and her newborn calf as the mother inhales its scent. A nursing calf (below left) will rapidly gain weight from mother's fatty milk. Babies swim within hours of birth, but nurturing continues for about two years. A calf may take rides on its mother's back (center) or be reassured by a flipper hug and a tusk rub after a solo swim (right).

Males wait for females to enter the water to mate. About 15 months later—usually between April and June—a female delivers a single calf.

walruses—but at their own peril. Tusks reach some three feet and are brandished with such lethal force that polar bears rarely take on adults. Bears were always on our minds, however—and with good reason. Once I was caught flat-footed as a white giant galloped straight at me. I grabbed my camera and ran toward our tent 900 feet away. The bear passed by, plunged into a walrus herd, and made a kill.

Atlantic walruses were seriously depleted after centuries of wholesale slaughter by commercial ships, which harvested blubber for oil and tusks for ivory. The animals today number between 10,000 and 50,000, far below the Pacific population of more than 200,000. Thanks to the United States' Marine Mammal Protection Act of 1972, the Atlantic population is growing. Inuit can legally hunt them, but each family is allowed only four kills a year.

The walrus is tightly intertwined with the Inuit culture, providing food as well as skin and bone for clothing, shelter, tools, and weapons. If hunters kill a walrus during the summer months, they will cut out the stomach, bury it until winter, then dig it up and feast on it as a delicacy. I politely declined offers of Inuit food. Instead I stuck to instant noodles, chocolate bars, and a feast of photographic wonders.

Roused from lethargy, a group senses danger as a polar bear and her cubs paddle by. Walrus herds of up to several thousand can often be found huddled together on ice floes. Territory at the edge gives a better chance to flee predators by splashing into the relative safety of the water.

Panic erupts as a looming bear ignites a churning frenzy to escape. Wary of adults armed with tusks powered by enormous girth, the stalker presses its search for the young and defenseless (below and bottom). Dragging a calf by the head (facing page), the bear retires to the end of the islet where for ten minutes it mauls and tosses its prey before dispatching it with a bite

to the throat. Bears flay their victims to eat the blubber and muscle. The predators show remarkable finesse. Zoologist Daryl Boness of the Smithsonian Institution has seen small walrus skeletons, almost completely articulated, lying near skins so intact that one could fit inside the other like a hand in a mitten.

Pointed disputes between males over females or territory leave bloody scars, though deaths from fighting are rare. Tusks may fend off attackers, but only time and laws enforced by humans can stem the depredations to walruses brought on by humans themselves. □

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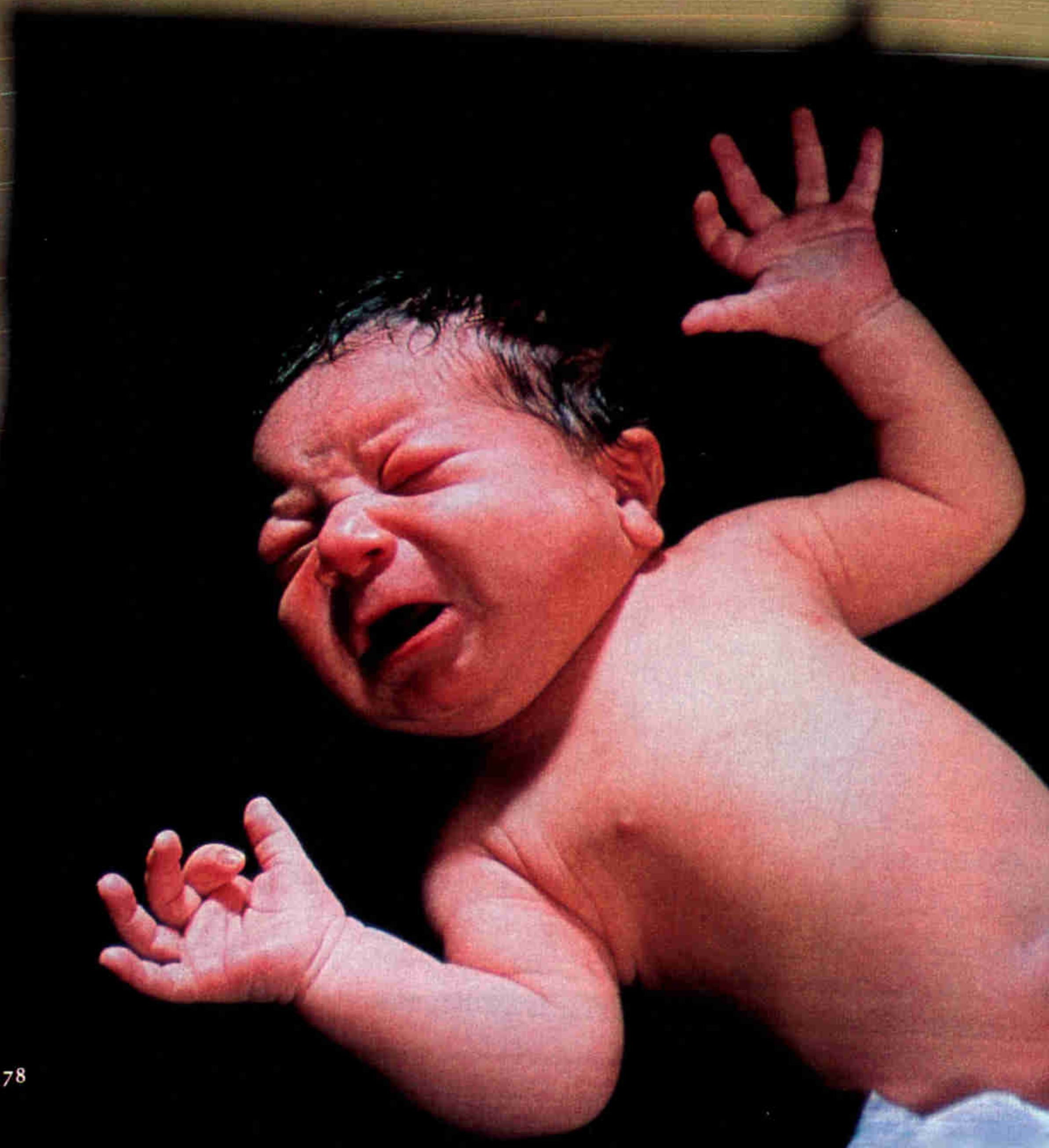

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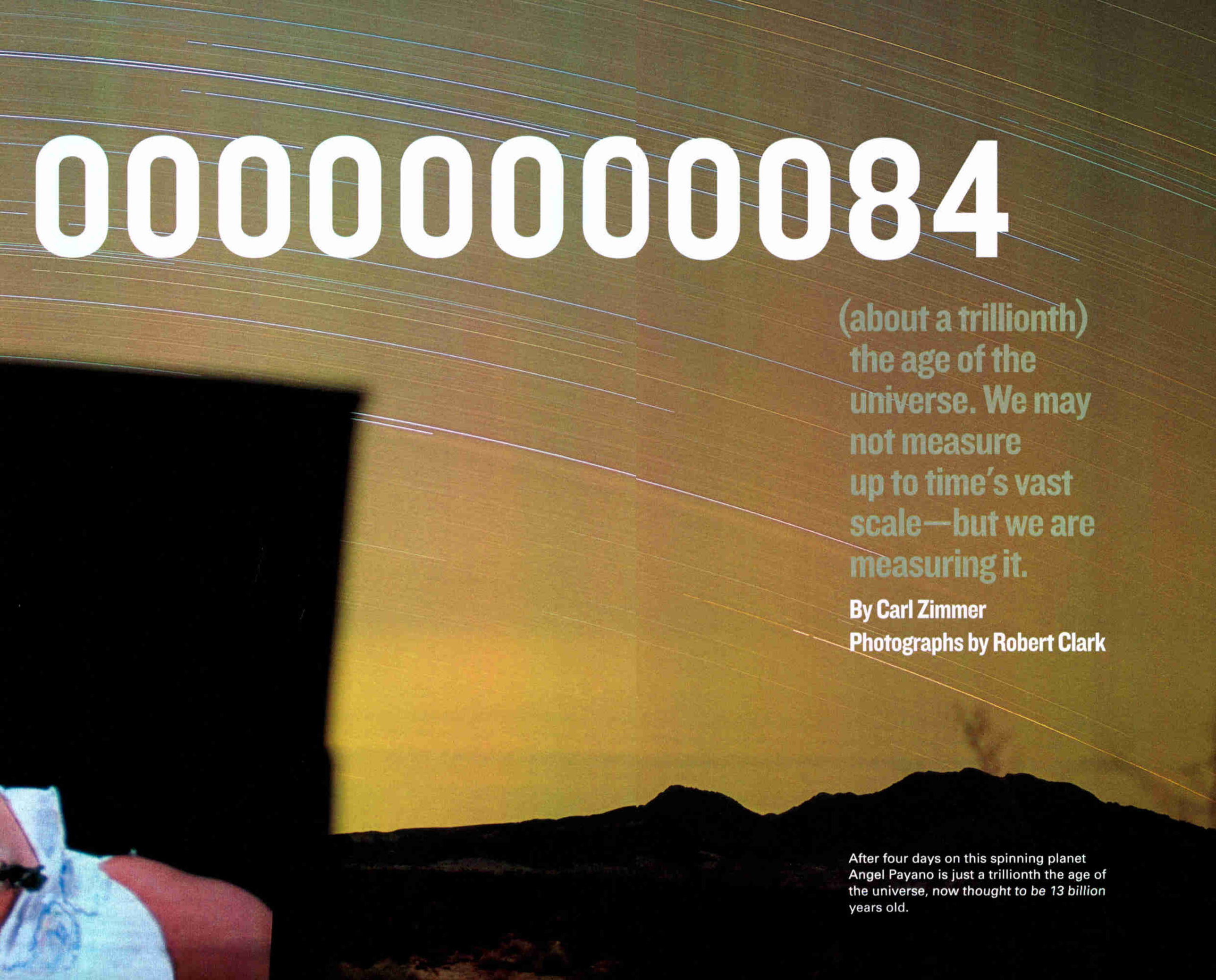
(about a trillionth) the age of the universe. We may not measure up to time's vast scale—but we are measuring it.

By Carl Zimmer

Photographs by Robert Clark



After four days on this spinning planet Angel Payano is just a trillionth the age of the universe, *now thought to be 13 billion* years old.

HOW OLD IS...

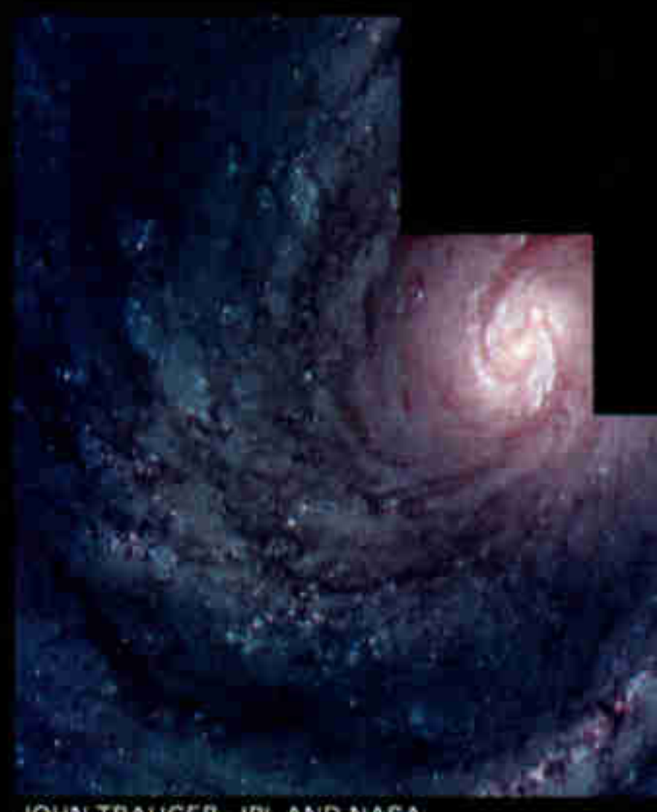
THE UNIVERSE
EARTH'S OLDEST ROCK
J. DOE
MESOZOIC FOSSILS
THE SHROUD OF TURIN
MODERN HUMANS
ANCIENT POTTERY
COMPLEX ANIMAL LIFE
THIS BABY?
A SABER-TOOTHED CAT
THE EGYPTIAN PYRAMIDS
MAMMALS
THE GRAND CANYON
AUSTRALIA'S MEGAFAUNA
STONEHENGE
THE M100 GALAXY

Whenever I feel prematurely old and creaky, I look at a rock that sits on a corner of my desk. It is a dark gray hunk of granite-like rock called gneiss, flecked with bits of feldspar. I picked it up off the ground along the Acasta River in Canada's Northwest Territories, and it's pretty much like any other piece of gneiss except for one thing: It comes from a formation that dates back more than four billion years—the oldest rock yet found on Earth.

Its age is so vast that it's almost impossible to comprehend. From our planet's infancy the atoms that make it up have held together, even as continents have been torn apart and rearranged. If you think of a year as equaling one yard of twine, you'd need enough twine to stretch between the Earth and the moon more than four and a half times to equal the age of the Acasta rock.

Seeing the Light

As hard as it is to date something as vast and complex as the universe, the methods often rest on simple principles. Stars are like these strobe lights: The closer they are, the brighter they look. When scientists know how bright a star actually is, they can determine its distance by comparing its true brightness with how bright it appears. As distances become known, the universe's age comes into sharper focus. Pegged at 50 million light-years away, the M100 galaxy (right) is one piece recently snapped into the puzzle.



JOHN TRAUGER, JPL AND NASA

How can we possibly know this? Nature doesn't print birth certificates or hammer a year on its creations as if they were coins. Scientists have learned to tell the age of bones, rocks, planets, and stars by using clocks that tick away in the very atoms that form them.

And with these natural chronometers—which they can read with staggering resolution—they can understand the forces that have shaped the continents, life itself, human civilization, the galaxy. No longer can human history match the scale of natural history. If the age of the universe, about 13 billion years, were equal to one summer day, then the past 100,000 years—which saw the rise of modern humans, the dawn of agriculture, and all of written history—would fit into the flash of a firefly at sunset.

Scientists can choose among different kinds of natural clocks depending on the scale of time they work with. For the period reaching back 40,000 years or so, they rely on radioactive carbon. By measuring the amount of radioactive carbon in a sample from something that was once alive, they can determine how long it has been dead. For example, archaeologists know that one of the oldest parts of Stonehenge, a ditch that encircles the famous stones, was dug with antlers found at the site. By measuring the carbon in those antlers, they have determined that the digging took place 5,000 years ago.

Where does radioactive carbon come from? All atoms—carbon atoms and atoms of every other element—contain subatomic particles in their nuclei, including positively charged protons and (except for hydrogen) neutrally charged neutrons. Generally atoms of the same element have the same number of protons and neutrons. Carbon, for example, usually has six protons and six neutrons, which added together give this form of carbon its name: carbon 12.

When atoms of the same element have different numbers of neutrons in their nuclei, the atoms are called isotopes. Carbon 12 is one carbon isotope; another is carbon 14, which has eight neutrons and is radioactive. Carbon 14 is formed when particles from space slam into nitrogen atoms in the atmosphere.

Radioactive isotopes decay at a predictable rate, and carbon 14 is no exception. If you bottled up a pound of it, half the bottle would

How Old Is . . . the Universe?

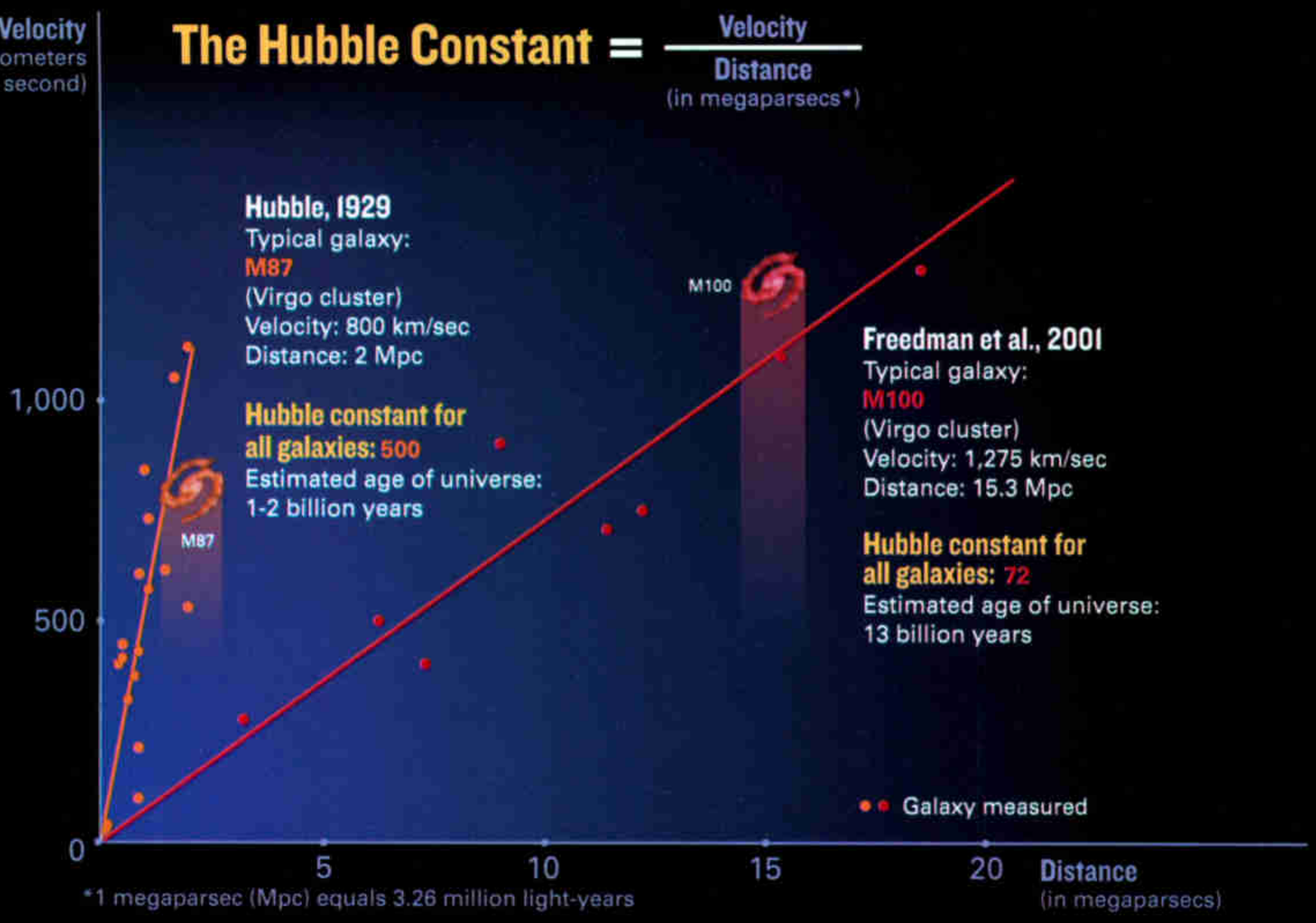
Until Edwin Hubble came on the scene, astronomers not only had no way to gauge the age of the universe, they weren't sure that anything existed beyond the Milky Way. Then in 1924 Hubble discovered that there was more. (There are, in fact, billions of galaxies.) But he didn't stop there; by decade's end Hubble had proved that the universe is expanding—and that its expansion rate can help tell us its age.

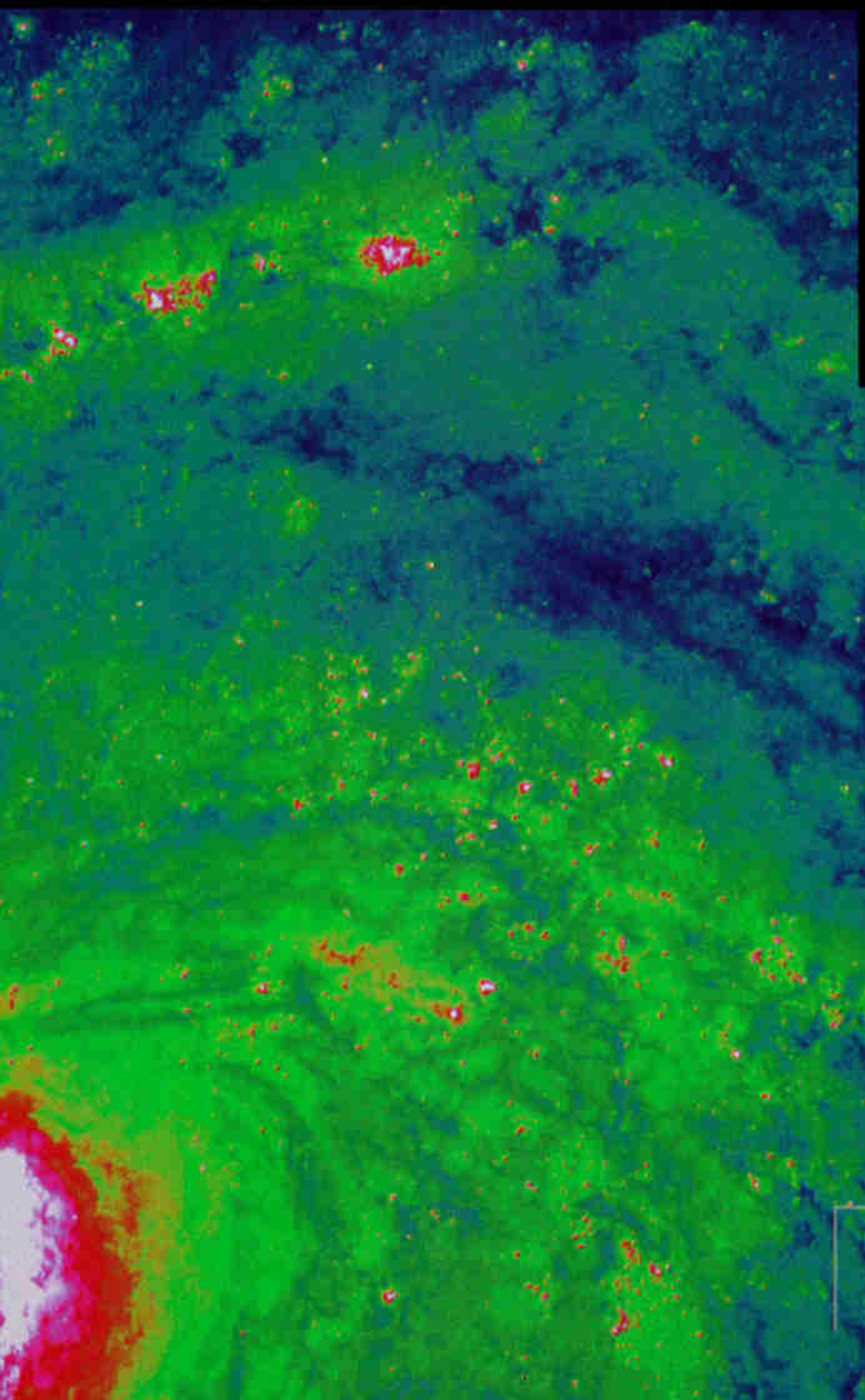
Hubble found that galaxies move away from each other at speeds that increase proportionally with distance. If we know how fast galaxies are moving away from our own and how far away they are, we can determine the expansion rate of the universe—known as the Hubble constant. Then it's possible to calculate the universe's age. But it has been hard to get a dependable figure for the constant. Velocities are relatively easy to measure by looking at a galaxy's light spectrum: The more it is shifted into the red end, the faster the galaxy is moving away from us. But measuring distances is difficult—so much so that Hubble's measurement of his own constant turned out to be wrong by a factor of almost ten.

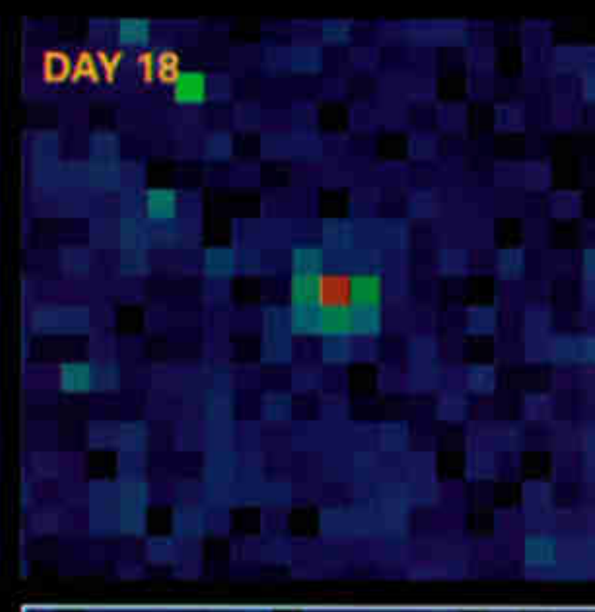
In the 1990s a second Hubble weighed in: The Hubble Space Telescope brought crucial data to Hubble's equation. In the M100 galaxy (right) astronomers found 52 Cepheid variables, young stars that pulsate at rates that correlate with their brightness. By measuring the period of the pulse (in the case of the star outlined, 50 days), one can calculate a Cepheid's absolute brightness, compare that with its apparent brightness, and determine how far the star is from Earth. This is how researchers concluded that M100 is 50 million light-years away. Using distances derived from Cepheids in 27 galaxies, astronomer Wendy Freedman and other investigators calculated a Hubble constant of 72. Combined with other cosmological data, this yields an age for the universe of about 13 billion years.

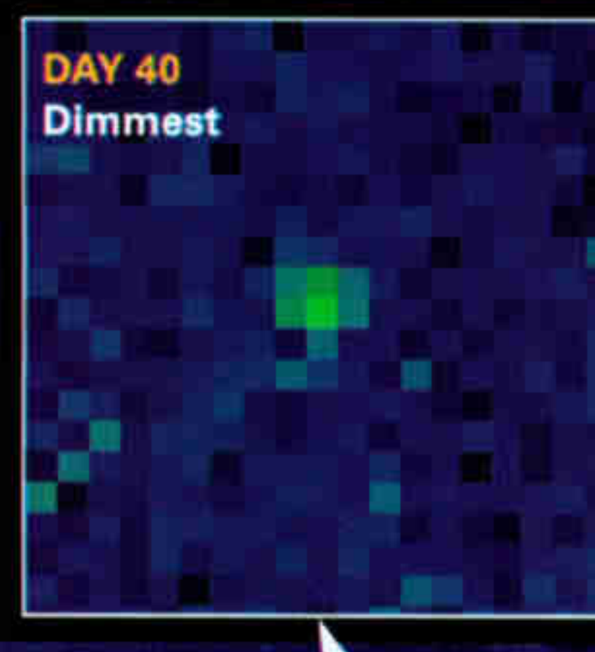
LAURA FERRARESE, WENDY FREEDMAN, HUBBLE SPACE TELESCOPE KEY PROJECT TEAM AND NASA (RIGHT). CHRISTOPHER P. SLOAN, NGM ART; SOURCE: LAURA FERRARESE, RUTGERS UNIVERSITY, AND MARIO LIVIO, SPACE TELESCOPE SCIENCE INSTITUTE, BALTIMORE

The Hubble Constant = Velocity / Distance (in megaparsecs*)









Answer **13 Billion Years**

How Old Is . . . J. Doe?

Whoever first wished to be a "fly on the wall" to see the truth of something doubtless did not have forensic entomology in mind, but this burgeoning field—using flies and other insects to determine how, where, and when people died—is one of the hottest new tools in crime labs. "There's a specific pattern in the decomposition of the body," says William Rodriguez, a leading expert. "One insect comes to feed on the body very shortly after death, then another comes once the body decomposes a little bit, and so on." By looking at which insects are feeding on a corpse, and at what developmental stage they are in, investigators often can pinpoint the time of death.

Uncannily attracted to carrion and blood, the common blowfly is almost always the first on the scene of a death. It quickly lays eggs in wounds and other body openings, and once hatched, the larvae—maggots—

Stage One
30 hours

Stage Two
52 hours

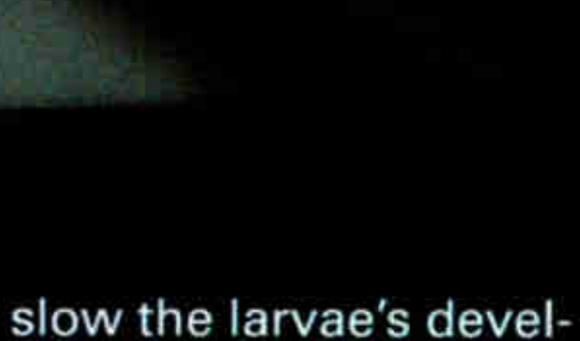
Maximum time to reach each stage at 23.3°C (73.9°F).
FLY STAGES: DARLYNE A. MURAWSKI

begin eating the flesh so voraciously that in warm weather they can help reduce a corpse to a skeleton within days. The larvae go through three stages before pupating and emerging as flies (below), and they do it at very predictable rates. As long as investigators know climatic conditions such as temperature, humidity, and sunlight, which can speed or slow the larvae's development, they can closely estimate time of death. Even when the flesh has been eaten and the insects are gone, the exoskeletons they leave behind can reveal the season of death. From insect evidence and other clues, investigators concluded that this murder victim had been dead two years.

Stage Three
85 hours

Pupa
279 hours

Adult
500 hours



Answer 2 Years (Postmortem)

decay in 5,730 years. After another 5,730 years, only a quarter of it would be left. (Physicists call these 5,730-year periods the half-life of carbon 14.) Plants and animals that are alive and absorbing carbon dioxide from the air have constant levels of both carbon 12 and carbon 14. But as soon as they die, the supply of carbon 14, which decays back to nitrogen 14 at a known rate, begins to dwindle. By comparing the carbon 14 level to the total amount of carbon in the material, scientists can calculate how long ago the plant or animal died.

Fossils older than 40,000 years have so little carbon 14 left in them that scientists have had to search for other ways to determine their age. A geologist named Gifford Miller from the University of Colorado showed me around a site at Lake Victoria in southern Australia where he used two new dating techniques to get around the limits of carbon 14.

Lake Victoria is bounded by an enormous crescent of high dunes, piled up over tens of thousands of years. Under swarms of pink-breasted galah cockatoos, Miller and I hiked the rippled sands. Signs of Australia's history, unburied by scouring winds, were everywhere. We saw rusted shell casings left from Royal Australian Air Force training runs in the 1940s. From deeper layers of the dunes—and farther back in time—came piles of mussel shells that had been collected from the lake by Aborigines. Spearpoints lay nearby along with the bones of kangaroo and emu the Aborigines hunted.

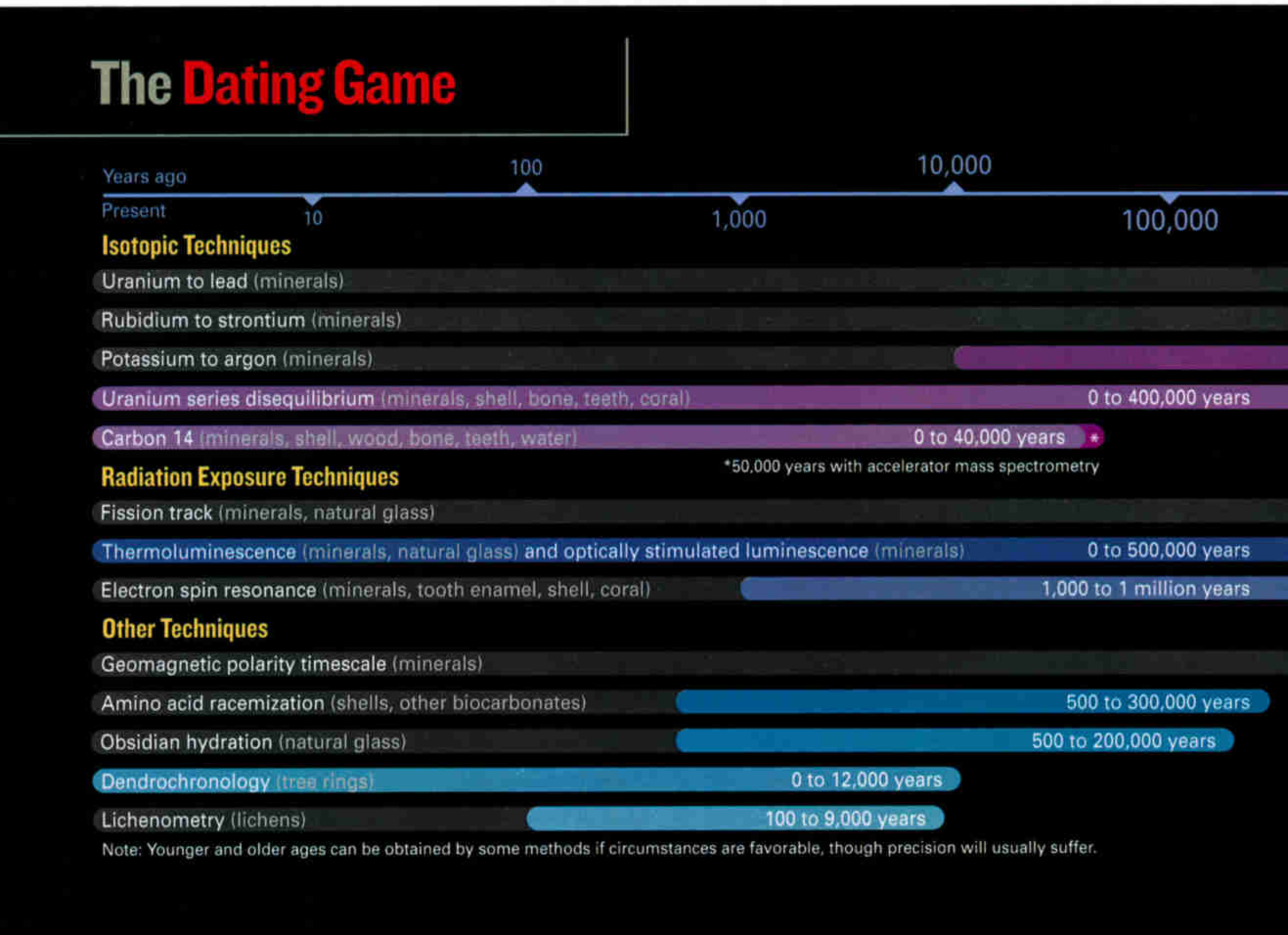
Descending into a gully, we walked down toward the water and further back through time. "Here is the extinction layer, I think," Miller said, stamping a layer of clay. Below it paleontologists have found the skeletons of hippo-size marsupials, kangaroos ten feet tall, marsupial lions—a collection of giants.

There's a debate in Australia over how those giants became extinct. Did humans wipe them out, or was it a climate change? The first step in solving the mystery is to decipher the age of the fossils, but there's not enough carbon 14 left in them to measure their age accurately. So Miller has become a connoisseur of new clocks.

"There it is. *Genyornis,*" he said, picking up a fragment the size of his fingernail. *Genyornis* is the name of one of the vanished monsters: a 400-pound flightless bird. Miller held a piece of an eggshell from one of them—the color of putty, with small dimples on its surface.

He has amassed a collection of thousands of similar shell fragments from many sites in southeastern Australia. It turns out they're

The Dating Game



everywhere, and once you know what to look for, it's easy to spot them against the sand. "It's amazing," he says. "Who'd think you could just go around picking up eggshells?"

Miller and his colleagues have determined the age of *Genyornis* shells with two kinds of clocks. The first measures age by determining how long it has been since a mineral—such as quartz in the sand where the shells are buried—was exposed to sunlight.

Radioactive atoms surrounding and inside such buried quartz release particles that can knock electrons out of their normal positions, orbiting the nucleus in an atom. The released electrons sometimes get stuck in a defect in the crystal structure of the quartz. These crystal traps gradually fill up with electrons in a regular, clocklike way. If you know the rate of the trapping and can count the trapped electrons, you can figure out how long it's been since the quartz saw the light of day—a method called optically stimulated luminescence.

Miller's challenge was to find shells in sand containing quartz that had not been exposed to light since the moment it was first buried. If the sand was exposed at any point, sunlight would have given the trapped electrons enough energy to break out and return to their original places. In only a few seconds sunlight can clear out all the trapped electrons in a grain of quartz, setting the clock back to zero.

To date quartz crystals with trapped electrons, he enlisted an expert in this kind of dating, Nigel A. Spooner, a physicist from the Australian National University. Spooner hammered hollow stainless steel cylinders into the sand that held *Genyornis* shells. He quickly capped the cylinders, wrapped them in black plastic, and brought them to his lab. There, under dim red darkroom lights, he put grains of quartz in a machine that fired a beam of photons at them, releasing the trapped electrons. As the electrons settled back into their atoms they shed some energy as light. By measuring that light, Spooner could count the electrons that had been trapped and figure out the age of the shells.

Miller himself perfected another method of dating the shells by examining the proteins preserved within them—amino acid racemization. The building blocks of proteins, amino acids can take either a left-handed or right-handed form. For reasons still unknown, nature overwhelmingly prefers left-handed amino acids. Once an amino acid is formed, however, it can spontaneously flip over to

From young organic items to the oldest rocks on Earth, scientists have discovered scores of ways to date things; this chart lists only some of them. Multiple methods can corroborate ages. Pottery, for instance, can be dated by measuring the effects of radiation via thermoluminescence, by carbon-dating food remnants, or by dating the sediment layer in which an artifact was found.

ART BY CHRISTOPHER P. SLOAN; SOURCE: W. JACK RINK, McMASTER UNIVERSITY, ONTARIO. HARAPPA GOBLET, INDUS CIVILIZATION, 2200-1900 B.C., BY RANDY OLSON

How Old Is . . . Earth's Oldest Rock?

When radioactivity was discovered a century ago, it explained one of science's great conundrums: How could the Earth have hosted eons of evolution when its core seemed too hot to be more than 400 million years old? The answer—heat from internal radiation—was just the start, for radioactivity also gives geologists a precise timepiece. A radioactive atom is an unstable isotope of an element that over time decays into a stable atom. Different isotopes decay at different rates. Uranium 235, for instance, decays into lead 207 (below) at a rate at which one-half of the uranium atoms turn into lead every 704 million years. By counting the number of each type of atom in a sample, one can tell how long it has been decaying—if the sample does not gain or lose atoms. Enter zircons, tiny crystals perfect for dating rock. They form in magma with uranium in their lattice (art, above) and can help date most igneous rock. The world's oldest known rock was dated with a zircon (photograph, top) at 4.03 billion years. The Earth itself goes back 4.5 billion years, but few rocks survived its molten youth.

Uranium 235 atoms	1,000,000	500,000	250,000	125,000	62,500	31,250	15,625
Lead 207 atoms	0	500,000	750,000	875,000	937,500	968,750	984,375
Half-life (figures rounded for clarity)	**Zero** 4.2 billion years ago	**One** 3.5 billion years ago	**Two** 2.8 billion years ago	**Three** 2.1 billion years ago	**Four** 1.4 billion years ago	**Five** 700 million years ago	**Six** Today

IAN S. WILLIAMS, *CONTRIBUTIONS TO MINERALOGY AND PETROLOGY* (TOP). ART BY DAVID C. FIERSTEIN; SOURCE: FRANCIS Ó. DUDÁS, MASSACHUSETTS INSTITUTE OF TECHNOLOGY. VANUATU VOLCANO BY CARSTEN PETER

Answer 4.03 Billion Years

become right-handed. The rate at which amino acids flip isn't as regular as radioactive decay because it depends on temperature: Heat speeds up the reaction and cold slows it down. But Miller has been able to account for these variables by estimating climate changes in Australia over the past 100,000 years.

Both clocks point to the same age for the *Genyornis* shells: The bird became extinct about 50,000 years ago. Miller thinks his result rules out environmental causes for the extinction. Climatic records from his sites show that 50,000 years ago water, and therefore vegetation, was abundant. Australian scientists have found a clue to the truth a hundred miles away on the dunes surrounding Lake Mungo, where they have counted trapped electrons to date a human skeleton and quartz from surrounding sediments back to 60,000 years—the oldest signs of humanity in Australia. The presence of humans at the time of the extinction—along with evidence that environmental factors were favorable for survival—implies that humans were the agents of *Genyornis*'s destruction.

"If humans hadn't been there, the extinction would not have happened," says Miller. "The real struggle is to say how people did it." He suggests that by hunting prey and altering their habitat by fire, humans wiped out the giant fauna, and did so in a geologic blink of an eye.

The ages that Miller tosses around in conversation—50,000 years, 60,000—would have been absurd to a European in 1700. Scholars had painstakingly studied the chronology of the Bible to calculate how much time had passed since the days of Eden, adding up the ages of Adam and his descendants. In the 1650s Archbishop James Ussher came up with the date that would become the standard for over 200 years: God created the Earth in 4004 B.C.—on October 22, to be precise.

Scientists began to dismantle the idea of a young Earth in the late 1700s, when they discovered that the planet's rocks are organized into a system of layers. The layers were formed by forces that we can still see at work today: the steady grinding down of mountains and the gentle rain of sediment to the bottom of rivers. But these forces work slowly, and for them to have actually created today's landscapes, the Earth would have to be billions of years old.

It would take until the 20th century for scientists to determine exactly how old the Earth is. Shortly after physicists discovered radioactivity and realized it could be used to fix dates to rocks, they realized they could also use it to find the age of the planet itself.

Some of Earth's radioactive atoms were blasted out of neighboring stars in supernova explosions. They were swept up in a primordial disk revolving around the young sun and eventually helped form the solar system, coalescing into planets, comets, and meteoroids.

Because they've been with Earth from the start, these radioactive atoms can tell us how old the planet is. Some of them are uranium isotopes that decay into lead: uranium 235 into lead 207, with a half-life of 704 million years, and uranium 238 into lead 206, with a half-life of 4.47 billion years.

In the 1950s Clair Patterson, an American geochemist, compared the amounts of uranium and lead in rocks from Earth and in meteorites that had struck Earth. All his samples pointed back to a common origin at the dawn of the solar system. The age of the Earth, Patterson calculated, was 4.55 billion years.

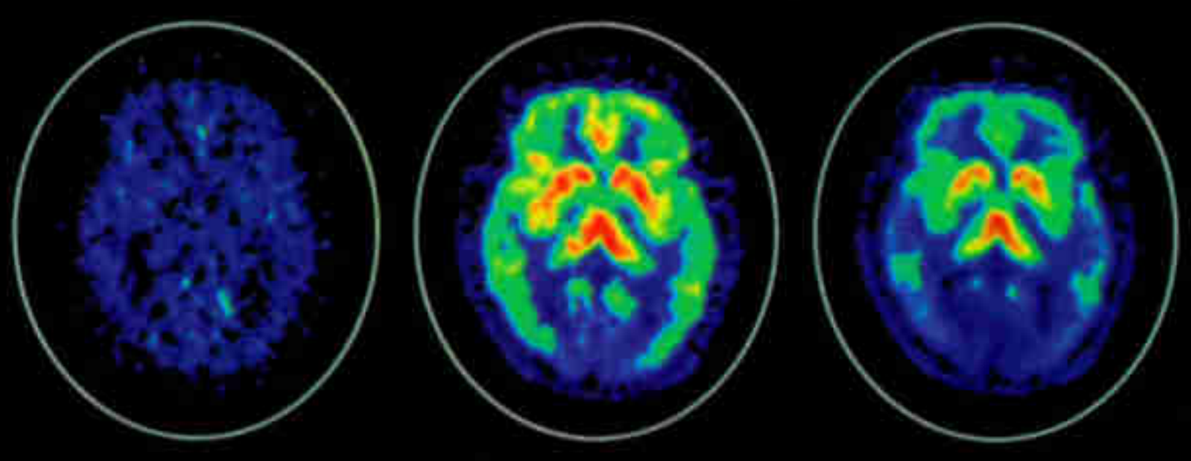
As the Earth cooled down and developed a crust, the first rocks formed—the Canadian Acasta rock that sits on my desk among them. Discovering the age of the earliest rocks turns out to be more difficult than calculating the age of the Earth itself. Once a rock forms, its uranium starts slowly turning to lead—but if underground water adds lead or uranium (or takes them away), researchers will end up with the wrong age.

Fortunately, nature has created the perfect rock clock for geologists. When magma cools, rugged little crystals known as zircons form. Made of zirconium, silicon, and oxygen, zircons also lock a few uranium atoms into their lattices. Once formed, a zircon shuts out just about any contaminant and can survive for billions of years. Over those billions of years, the trapped uranium steadily decays to lead. "Zircons are God's gift to geochemistry," says Ian Williams of the Australian National University. They can survive even after the rock where they originally formed erodes away. In Western Australia geologists have found a zircon crystal 4.4 billion years old trapped inside a rock that dates back only 3.1 billion years.

Zircons allow scientists to put dates on the

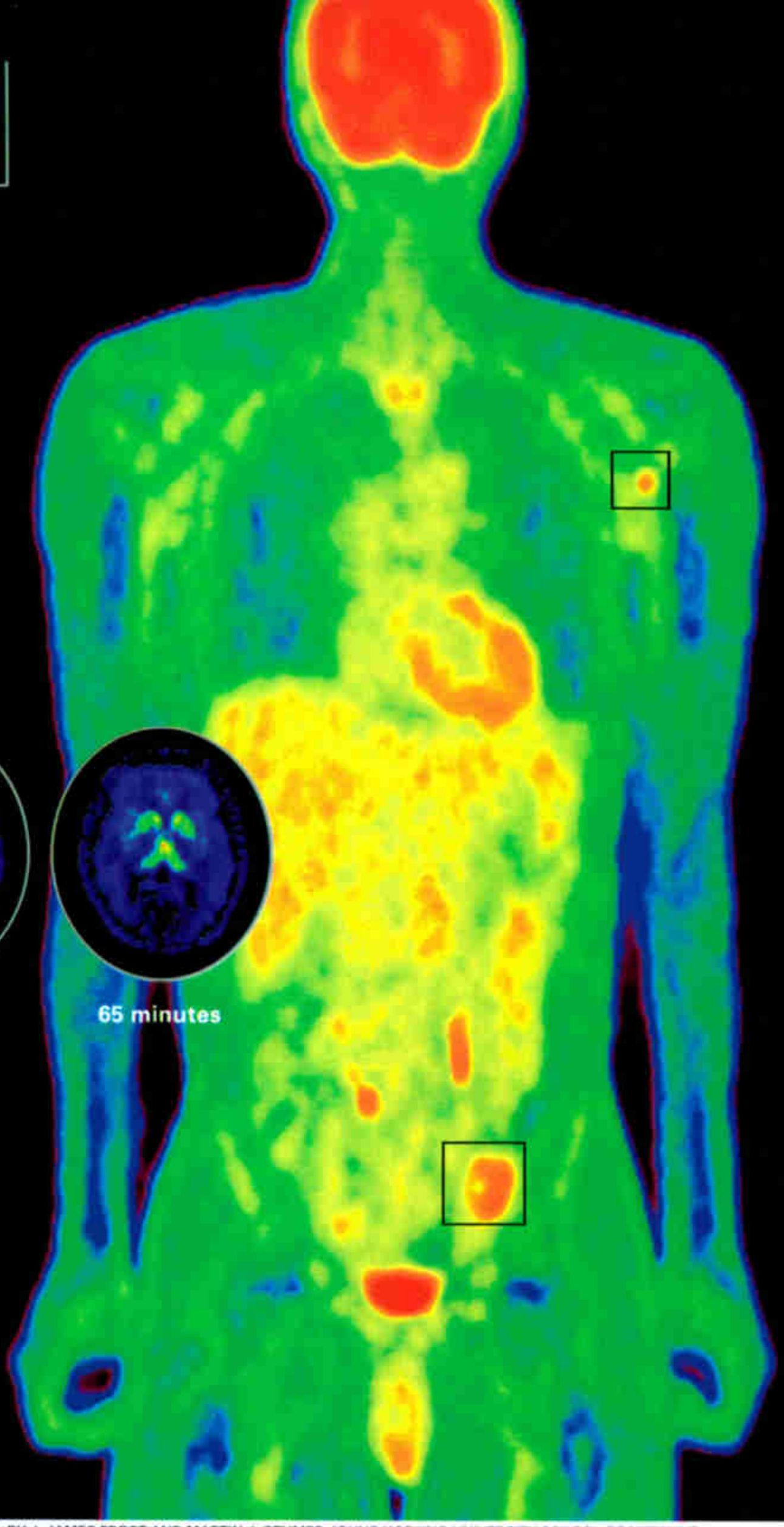
Radioactive Medicine

The same principle of radioactive decay that lets geologists date four-billion-year-old rocks is expanding the frontiers of medicine. Using radioisotopes with very short half-lives, positron-emission tomography (PET) helps doctors detect cancer. When a man with metastatic melanoma (right) is injected with F-18 FDG (a radioactive fluorine compound that mimics glucose), the body's more active parts—including the brain, heart, and malignant tumors (outlined)—disproportionally take



up the radioactive compound. With a half-life of two hours the FDG quickly decays, releasing gamma rays that are measured by a PET scanner.

To study the brain's natural opioid system (above), researchers use a drug tagged with carbon 11, a radioactive isotope with a half-life of just 20 minutes, to show the distribution and number of the brain's opioid receptors (red, yellow, green, and blue, in descending concentration).



ALL BY J. JAMES FROST AND MARTIN J. STUMPF, JOHNS HOPKINS UNIVERSITY SCHOOL OF MEDICINE

history of the Earth, but zircons are not easy to find. I learned just how difficult and intense the search can be as I stood one chilly May morning at the harbor at Admiral's Beach on the southeast coast of Newfoundland. There on the beach was a 15-foot wooden boat that would carry me and three scientists—Sam Bowring, a geologist from the Massachusetts Institute of Technology, Paul Myrow, a geologist from Colorado College, and Ed Landing, the state paleontologist from the New York State Museum—to deserted Great Colinet Island, three miles away.

We made our way along the west side of the island toward its southern end, motoring past merciless sea cliffs that exploded the waves into spray. As we lurched through the water, Landing identified the layers of rock exposed on the cliffs. They were from the late Precambrian, ranging roughly from 600 to 550 million years old. It was around that time that animal life proliferated.

The first distinct chemical signs of life that scientists have detected on Earth are actually much older than that—found in Greenland in the planet's oldest sedimentary rock. We know their age because the rock is enclosed in slightly younger zircon-bearing rock that indicates a date of 3.9 billion years. But for well over 3 billion years after those first imprints, life left only microscopic marks in the fossil record. Then, not long before the Cambrian, strange multicellular fossils appear—giant

fronds, ornamented disks, and other oddities collectively known as Ediacaran.

Paleontologists aren't sure which, if any, of these creatures are the forerunners of later animals. What they do know is that in the early Cambrian the earliest fossils of most of the major groups of animals turn up. By dating fossil-bearing rocks from around the world, Bowring and his colleagues have shown that the burst of evolution known as the Cambrian explosion began around 530 million years ago. Short of the origin of life itself, that episode represents evolution's supreme scientific challenge.

Bowring was on Great Colinet Island to test a theory championed in 1998 by Paul Hoffman, a geologist from Harvard, about what triggered the Cambrian explosion. The theory suggests that evolution was given a hard push when the planet fell into an ice age that got out of control. Glaciers kept growing until they covered the entire Earth, and life died back to almost nothing. After a few million years volcanic eruptions had released enough carbon dioxide to create a greenhouse effect that raised the planet's temperature. The glaciers melted, and the rising ocean created vast shallow seas that life could recolonize, giving evolution a tremendous jolt.

This "snowball Earth," as Hoffman and others call it, may have lasted ten million years. And if it did exist, it should have left its mark on Great Colinet Island. "This is one of the few places in the world where you can find glacial deposits that you could hope to date, because they're interlayered with volcanic rocks," Myrow explained. Using the zircons in the volcanic rocks, the geologists were hoping to bracket the ice age—to find ash layers as close to the bottom and the top of the glacier-delivered rocks as possible. This could possibly tell them not just how old the ice age is but also how long it lasted.

We split up to hunt for zircons. I went with Myrow and Bowring. We climbed to the flat grassy top of the island. We hiked through bogs, past nests of flecked gull eggs, over mats of dwarf spruce trees. The struggle was worth it. Scrambling down among boulders battered by waves, Myrow spotted two layers of good volcanic rock, one of them 6 meters below the bottom of the glacial deposits and one of them 1.2 meters into them.

"Oh baby, it's all ash," he shouted. Bowring pointed to the rocks he wanted, and the two of them hammered away, with water pouring down the cliff onto their heads.

Bowring stuffed the samples into canvas bags and helped me load some of them into my backpack. The three of us started the long march back to the boat, to put the zircons on a plane, get them back to Bowring's lab in Massachusetts, put dates on them, and try to figure out if it was "snowball Earth" that triggered the Cambrian explosion.

Blair Hedges, a biologist at Pennsylvania State University, is investigating the origins of animals with a different kind of clock. I stood with him in front of a bank of humming freezers while he inspected an ice-encrusted tray of little tubes, each filled with tissue. Hedges is creating a refrigerated zoo, collecting tissues from animals scattered among the 35 major taxonomic groups known as phyla. In his trays he had tissue from scorpions, centipedes, peanut worms, octopuses, mollusks, jellyfish, sponges—"we've got about three-quarters of all the phyla right here," he said.

Those cells contain clocks of their own that can tell time for hundreds of millions of years. From generation to generation certain genes of a species mutate at relatively steady rates. If you compare the genes of two species, say humans and chimpanzees—and you know the rates at which their genes have been mutating—you can estimate how long it has been since their ancestors diverged from a common ancestor.

This kind of molecular clock, as it's known, has come into its own in the past ten years. In 1996 Hedges caused a stir by using molecular clocks to date the dawn of mammals. When paleontologists look at the record of mammal fossils, they see a burst of diversity just after dinosaurs became extinct 65 million years ago. It was this burst, they theorize, that produced most of the orders alive today—from hoofed mammals to bats to us primates. But when Hedges and his colleagues look beyond the fossil records at the genes of mammals, they see their roots extending back more than 100 million years.

Hedges is now investigating what molecular clocks have to say about the Cambrian explosion, which researchers such as Sam Bowring have determined took place 530 to 520 million years ago. Again, Hedges's results are far different

How Old Are . . .
Mesozoic Fossils?

Mohawks and facial studs may go in and out of style, but unlike fashion, evolution rarely repeats itself, and this gives scientists a valuable dating tool: index fossils. The fossils in this chap's eye sockets are ammonites, mollusks common in the Earth's seas in the Mesozoic era, between 245 and 65 million years ago. Ammonites evolved so quickly that many species are like time capsules that can reveal the age of rocks in which they are found, as well as the age of other fossils found with them.

210-130 Million Years Old (left)
150-145 Million Years Old (right)

How Old Is . . .
Complex Animal Life?

Scientists studying the fossil record have long been stumped by the Cambrian explosion. Around 530 million years ago (m.y.a.), many types of animals burst onto the scene, where before there had been mostly simple animals, including relatives of jellyfish and sponges. What had these complex animals evolved from? The fossil record was maddeningly silent until 1998, when scientists found evidence of complex multicellular life in an ancient seabed in China. Fossilized in a tiny patch of calcium phosphate were embryos no bigger than sand grains (below). The embryos cannot be directly dated, but scientists were able to fix their age by using two types of measuring sticks based on global patterns in Earth's stratigraphy (far right).

First, rock formations around the world (map) have revealed fluctuations in the proportion of carbon 13 in seawater over time. Scientists can date this fluctuation in places where volcanic activity has created zircons. The isotope pattern in China matches a pattern dated in Namibia, bracketing the embryos between 548 and 590 m.y.a. Second, the embryos were found beneath a layer of Pertatataka fossils, which disappear globally by the time ash beds at the White Sea in Russia were made 555 m.y.a., and they were above glacial deposits dated at 590 m.y.a. Within these limits, scientists estimate the embryos to be between 555 and 590 million years old.

EMBRYOS: SHUHAI XIAO, TULANE UNIVERSITY, AND ANDREW H. KNOLL, HARVARD UNIVERSITY. DIAGRAM BY CHRISTOPHER P. SLOAN AND DAVID C. FIERSTEIN; IMAGES TOP TO BOTTOM: O. LOUIS MAZZATENTA (TOP TWO), ANDREW H. KNOLL, DAVID C. FIERSTEIN. SOURCE: ANDREW H. KNOLL. MAP BY NG MAPS

Global Geologic Pattern

Complex animal life such as *Anomalocaris* flourished during the Cambrian period, which began 543 m.y.a.

Cambrian Fossils

Millions of years ago

543

Rock Layers Found in Southern China

Global Carbon Isotope Pattern

–0.8% +0.8%

Precambrian animals called Ediacaran, like this *Mawsonites*, ranged worldwide.

Ediacaran Fossils

544 to 565

548

Isotopic peak

Pertatataka fossils of plankton give upper boundary for embryos at 555 m.y.a.

Pertatataka Fossils

555

Embryos

Upper boundary of ice age glacial deposits in China

Glacial Deposits

590

590

Sharp negative swing

Date constraints for embryos

Answer **555-590 Million Years**

from what fossil records show. He and his colleagues have compared genes from three animal phyla, and their molecular clocks point to an origin over a billion years ago—once more a doubling of evolutionary history.

The conflict between fossils and genes will take a long time to sort out. Critics of molecular clocks suspect that evolution can make them speed up or slow down. But Hedges counters that he and his colleagues can guard against this sort of variability, and when they do, their dates still hold up. As for the lack of fossils to support his dates, Hedges argues that the earliest forms didn't leave fossils behind, or at least any that have yet been discovered. Only around the start of the Cambrian did they get big enough for us to find.

Telling time is important not just to the history of life but to the history of the universe itself. Clocks that pin down the formation of the solar system can be found in meteorites that have fallen to Earth after wandering around the sun for billions of years. But for more ancient time telling, scientists cannot use any clock to be found on Earth. They have to look at the sky.

The sky was cloudy on the evening I met George Djorgovski, an astronomer from Caltech working in Hawaii, and rain was falling as we walked quickly across a dark lawn. "Can you believe we can look at stars in this weather?" he asked. We entered a small building and slipped into a room filled with bright fluorescent light and eight giant computer screens. Even if the sky was clear, we couldn't have seen the stars through the drawn blinds.

Djorgovski sat in front of three computer screens pushed next to each other. The computers are hooked up to data cables that run 48 miles from this room to the 13,800-foot-high summit of Mauna Kea—and to two of the finest telescopes in the world, at the W. M. Keck Observatory.

As the sun set, Djorgovski sent coordinates to technicians at the top of Mauna Kea, and the telescope he was using swung across the sky. A disembodied voice from one of the computers in the room said, "Exposure complete," and a white field filled with black spots appeared. One giant blob dominated the center of the picture—a ferociously bright object known as a quasar, with the intensity of trillions of suns. "That's our guy," said Djorgovski.

He touched the image of the quasar with one finger. "Just think," he said. "As the Earth formed, the light from this had already traveled two-thirds of its way here."

Quasars and galaxies are hurtling away from us as the universe expands. As they speed off, the light they emit lowers in frequency and shifts toward the red end of the spectrum—much as a train whistle drops in pitch as it passes

How Old Is . . .

. . . the Grand Canyon?

Bottom layer: 2 billion years old

Top layer: 250 million years old

Dating techniques:

Bottom layer: Radiometric. Top layer: Fossils

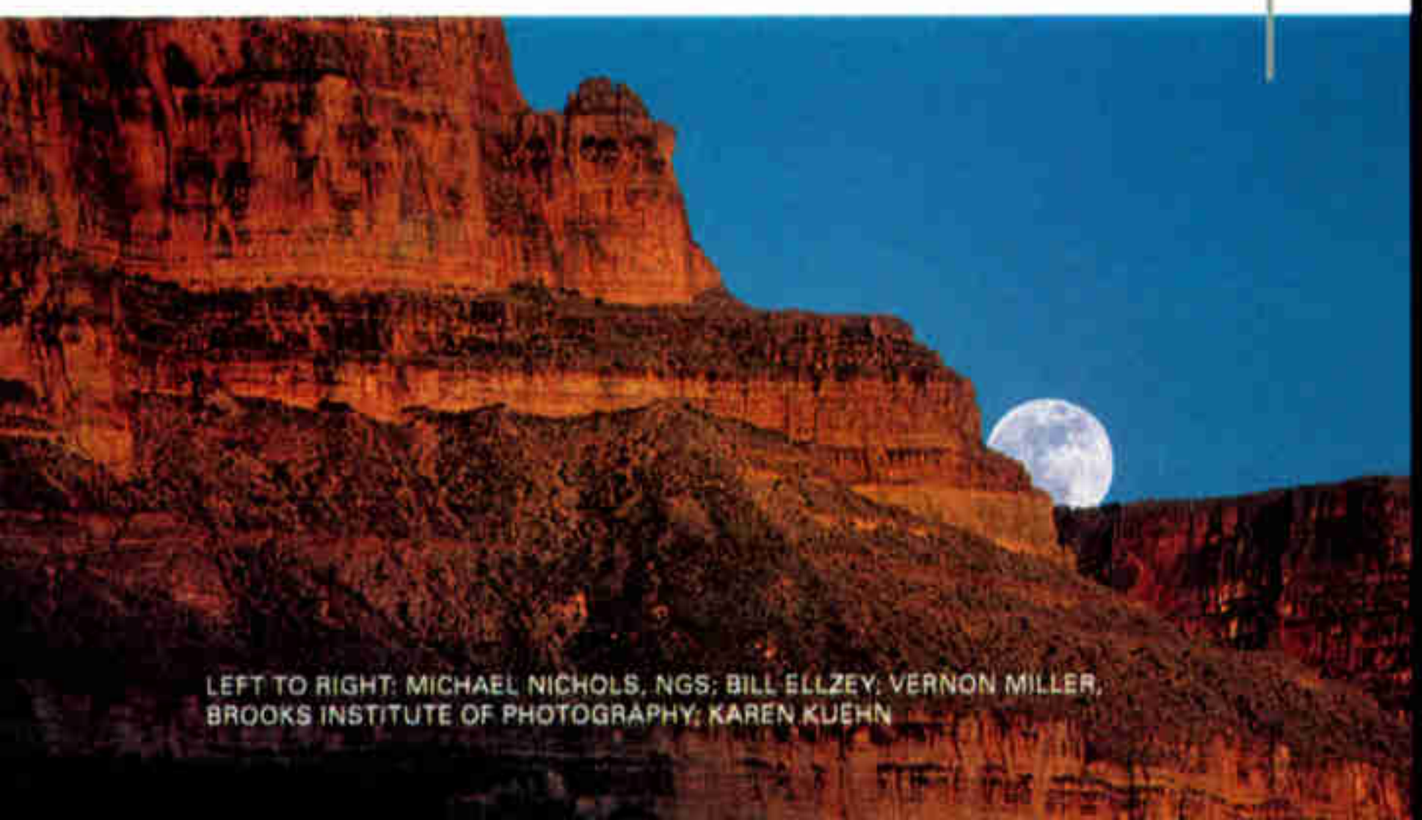
Although the Grand Canyon's oldest known rocks are almost half the age of Earth, the Colorado River did not start carving the canyon itself until just five or six million years ago—a blink of the eye in geologic time.

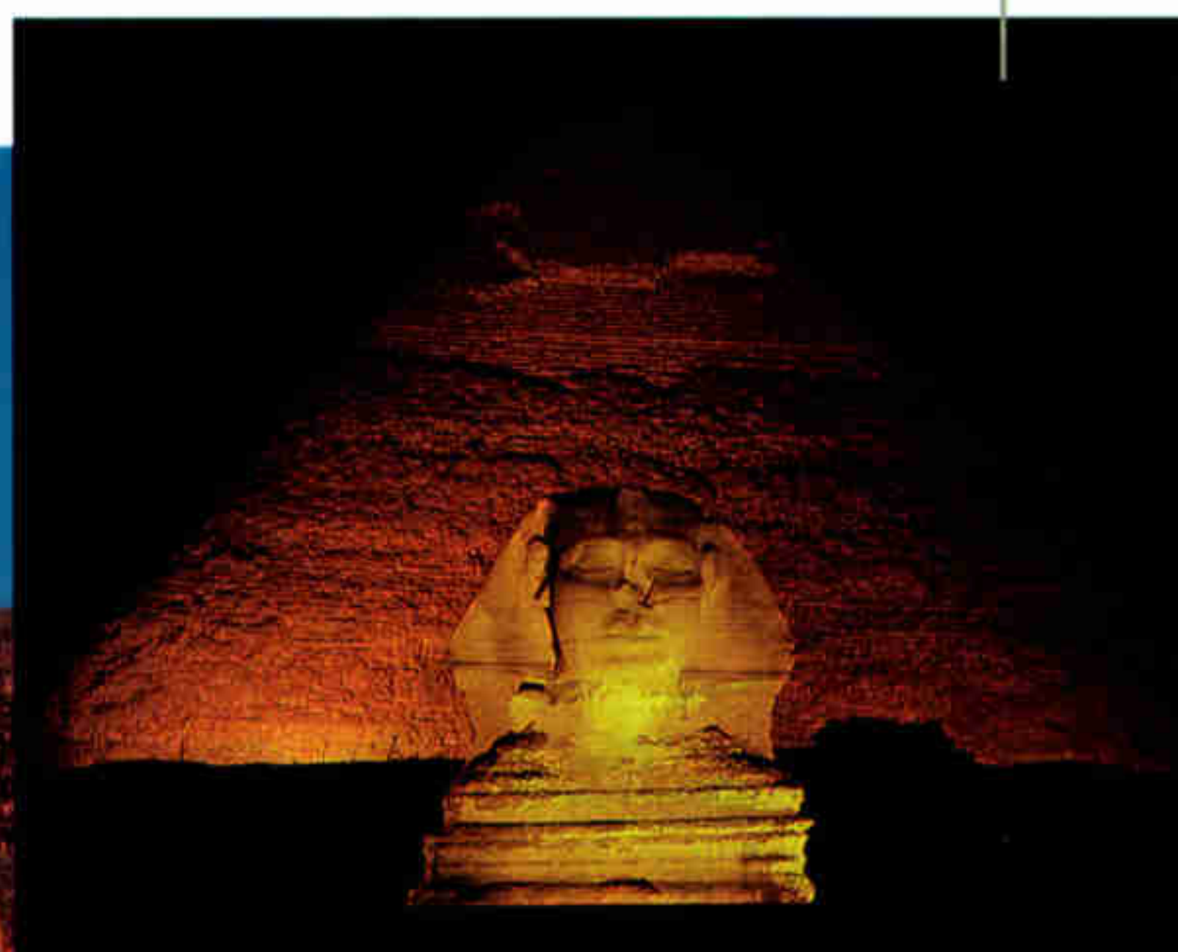
. . . this Pyramid?

4,449 years old?

Dating technique: Star alignment

The Pyramid of Khafre may be about 70 years younger than usually thought, says a new theory, which shows that the northern alignment of the Pyramids at Gîza matches that of two polar stars visible during that era.





LEFT TO RIGHT: MICHAEL NICHOLS, NGS; BILL ELLZEY; VERNON MILLER, BROOKS INSTITUTE OF PHOTOGRAPHY; KAREN KUEHN

by. This process is known as redshift, and by measuring it—and thus the rate at which the galaxies are flying apart—it's possible to figure how long it has been since they were all contained together in one point of infinite density at the moment of the creation of the cosmos. In other words, astronomers can use that rate along with other cosmological data to tell how old the universe is. Today's estimate for the expansion rate indicates that the universe is 13 billion years old.

Knowing the age of the universe is as important to astronomers as knowing the age of the Earth is to geologists. It lets them start putting together its history. How, for example, did the universe get from a uniform big bang to the state it's in today, with galaxies separated by vast stretches of relatively empty space? Did giant clusters of matter break down into galaxies, or did groups of stars join together?

Djorgovski's quasar has a redshift that indicates it formed less than a billion years after the universe began. "What we're after is the first galaxies," he says. Djorgovski and others have been puzzled by evidence that these youngest galaxies are already rich with elements like carbon and oxygen—elements that can only be produced in mature stars. "We find galaxies in a good state of assembly after only a few hundred million years. How did they form so quickly?" says Djorgovski. Well into the 21st century, astronomers will be wrestling with the puzzle of how so many galaxies evolved so fast after the dawn of the universe.

By ten o'clock Djorgovski was waiting for the next observation. Sitting there with him, looking at the signs of young galaxies, I thought about what it means for something to be old. If you are 12 years old, or 50, or 90, that only means that a certain network of atoms has come together for that time. Many of the individual atoms that make up that network will stay in your body only a short time before being replaced by new ones. And all of those atoms have been wandering through the air and ground and ocean for billions of years, and before then they were made in stars out of other atoms, which in turn reach back to the dawn of galaxies, to the first second of the universe when all matter came into being.

"Hey, George, how's your little girl?" asked Teresa Chelminiak, an observatory assistant working at the computer next to Djorgovski.

"Let me show you," Djorgovski said. With one kick, he propelled his chair over to another screen. "Here's the other thing these machines are good for," he said. He got on the Web and pulled up his home page. Slowly, strip by strip, the spectrum of a baby galaxy was hidden behind a photograph of Djorgovski's own baby. She was uncomplicated in her happiness. Her carbon 14 had no anomaly. Her redshift was zero. Once again, the clock was reset.

MORE ON OUR WEBSITE

Find resources and field notes from the author and photographer at **nationalgeographic.com/ngm/0109**.

...the Shroud of Turin?

610 to 740 years old

Dating technique: Carbon 14

Long revered by many Roman Catholics as Christ's burial covering, the linen Shroud of Turin was dated to A.D. 1260-1390 with carbon 14, a radioactive isotope used to date organic material. How it works: Cosmic rays turn nitrogen in the upper atmosphere into C 14, which is taken in by all living things. When an organism dies, its C 14 intake stops, and the C 14 within it decays at a measurable rate.

...this Sabertooth Skull?

12,000 years old

Dating technique: Carbon 14

Discovered alongside many other Pleistocene animals in California's La Brea tar pits, this saber-toothed cat was one of the last to walk the Earth. The final ice age extinction happened roughly 11,500 years ago.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How Old Are . . . We?

High above Times Square, one of the first humans looks over the site where today's *Homo sapiens* gather each New Year to celebrate time's passage and marvel at their long history. But reduce the Earth's 4.5 billion years to a single day and this 100,000-year-old human doesn't come on the scene until two seconds to midnight. Fortunately, our youth doesn't keep us from unlocking the planet's secrets.

This skull, found in a cave in Qafzeh, Israel, was dated with two cutting-edge techniques that measure radiation exposure. The Earth is awash in low-level radiation from uranium, thorium, and potassium. When the radiation hits atoms in crystalline material like tooth enamel, it displaces electrons that can be counted with a method called electron spin resonance (ESR). The more displaced electrons an object has, the older it is. The skull was found with other fossils, including a horse tooth (right, top) that was ESR-dated at roughly 100,000 years old. It was also found with burned flints (right). When a flint or other crystalline object is heated to a certain point, it releases its displaced electrons in the form of light, and its radiation "clock" is reset. With a technique called thermoluminescence, scientists reheat a flint and measure the light it emits to find out when it was used—in the case of these flints, also around 100,000 years ago. The significance of these dates? They tell us that modern humans left Africa much earlier than had been thought, even coexisting with Neandertals, once believed to be our ancestors. So we ask "How old are we?" and wind up getting some answers to another question: "Who are we?" □

LEONID PADRUL

Answer 100,000 Years

The Garífuna

Weaving a Future From a Tangled Past

Beneath loving hands a Garífuna woman exudes the pride of her people. A fusion of African and Carib Indian, the Garífuna struggle to retain their culture along the Central American coast.

Article and photographs by Susie Post Rust

A Tragic Journey

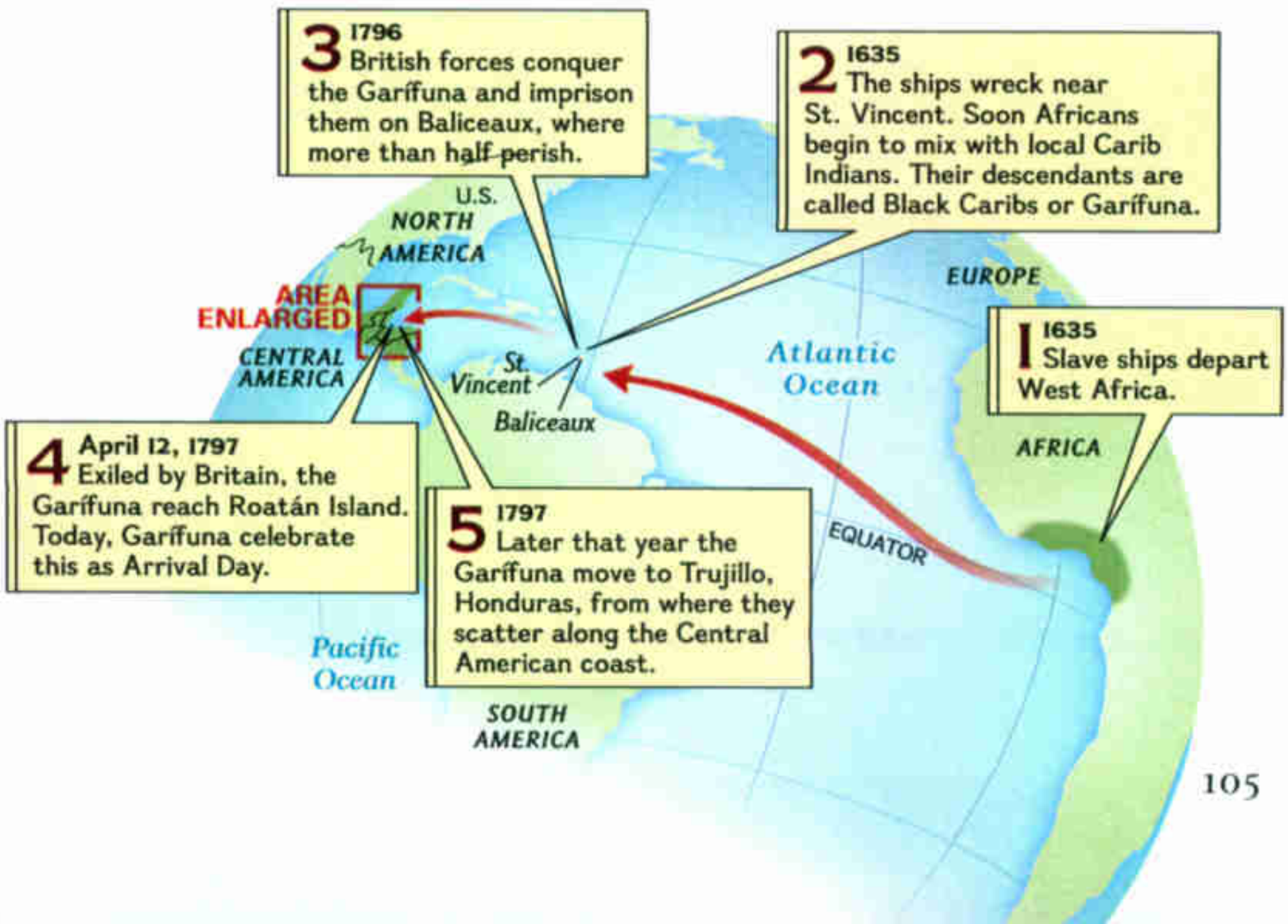
Dancing through the streets of Dangriga, Belize, college students reenact the arrival of their Garífuna ancestors, who began trickling into Belize from Honduras around 1802. The Garífuna journey to Central America had begun long before—and was far from joyous.

Herded aboard slave ships in West Africa, a group of Garífuna forebears were likely destined for New World mines and plantations when they wrecked off St. Vincent in 1635. They found refuge with the island's Carib Indians, immigrants from South America. The two peoples blended through marriage, creating the Garífuna culture—Caribbean fishing and farming traditions with a mixture of South American and African music, dance, and spirituality.

The Garífuna prospered and coexisted peacefully with French settlers who came later in the 17th century. Tensions arose when English colonists began to arrive and demand land. Those tensions eventually turned to war. Hopelessly outnumbered by British troops, the Garífuna and their French supporters surrendered in 1796. The victors exiled the Garífuna to the island of Baliceaux. Imprisoned there in appalling conditions, more than half died. The following year survivors were shipped to Roatán Island off the coast of Honduras. According to legend, the Garífuna hid

cassava, a mainstay of their diet, inside their clothes, where it stayed alive watered by the sweat of the tightly packed captives. They planted the cassava on Roatán, where it grew abundantly. Soon the Garífuna established fishing villages in Honduras, Nicaragua, Guatemala, and Belize. Each year in Belize, when locals reenact the arrival in that land, they slip out to sea in boats, then ride the surf onto shore, waving palm fronds and banana leaves to symbolize the cassava that sustained their ancestors. This ritual, rich in music and dance, helps sustain Garífuna culture.

Today some 60 Garífuna fishing villages dot the Central American coast, but population numbers are hard to pin down. Estimates range from 450,000 to fewer than 100,000. This year the Garífuna were named a World Heritage culture, a new United Nations designation that recognizes and urges protection for endangered heritages.



An Enduring Way of Life

Wooden dories rest on the shore of a lagoon in Nueva Armenia on the Honduran coast, where most of the Garífuna have settled. The sea still serves as a byway, grocery, laundry, workplace, and playground for the Garífuna people, much as it has for centuries.

In Nueva Armenia, I was struck by the timeless rhythms of daily life. Fishermen rise before daybreak to head out to sea. Women work farms, raise the children, and prepare meals of fresh fish and cassava, plantains, pineapples, and coconuts plucked from village trees.

Children help with family chores, scrubbing dirty clothes and cleaning fish hauled in by their fathers (upper right). This subsistence lifestyle, as well as physical isolation, has helped reinforce the Garífuna's cultural independence.

In recent years, however, there has been an accelerated

shift toward a wage economy, according to Roy Cayetano, president of the National Garífuna Council in Belize. "We are not as self-sufficient as we used to be," he says. Many people have moved to larger cities and even to the United States in search of jobs, "seduced into working for wages."

In Nueva Armenia, José Vuelto Bátis (above) has found a balance between the old way of life and the new. At midday he waits on the sandbar for fishermen to return from the sea. He buys surplus catch not needed for village families, then sells the fish to restaurants in La Ceiba, a nearby city of some 150,000 people. This business as a seafood middleman allows him to make a living and support his family while continuing to live in the village he loves—a rare straddling of two very different worlds.

Unfazed that a battered dory refuses to stay afloat, children of Dangriga amuse themselves along the shore. Yet salt spray, sun, and the sea's simple gifts can't entirely stem the desire for material goods that sends many villagers to inland cities in search of jobs.

"The day they take our

smiles away, we'll be finished."

Conflict and Continuity

Drumbeats for change first fell on deaf ears as Garífuna protesters met police near a government building in Tegucigalpa, Honduras. This face-off occurred when hundreds of Garífuna from around Honduras traveled to the capital city to protest a law that would make some of the Garífuna's coastal land vulnerable to tourist development.

The protest felt more like a party as people danced, sang, and beat their drums, but the message was solemn. "The land is like your mother. You don't sell her, nor do you rent her. In her we are born, and toward her we are returned at the end of our existence."

These words came from a video shown by Celeo Alvarez Casildo, president of ODECO, one of the largest Garífuna organizations in Central America. "The culture is at risk if the people lose their land," he says. The Honduran

government has agreed to reconsider land sales that would affect Garífuna villages.

In Belize protecting language is also a primary goal. "We are beginning to make demands . . . that our spirit, our language, our history must be taught in our schools," says National Garífuna Council president Cayetano. "We have a reason to celebrate," he adds. "We are the children of survivors." Sacred Heart Elementary in Dangriga (lower left) has taken up this cause. And at nearby Sacred Heart Catholic Church women display the brilliant colors and patterns of traditional Garífuna dress on holidays (above). But the quest to maintain culture seems to hang by a scarlet thread. "I think we're at a turning point," says Clement Flores, who returned to Dangriga after living in the U.S. "It's so easy to live by somebody else's standard."

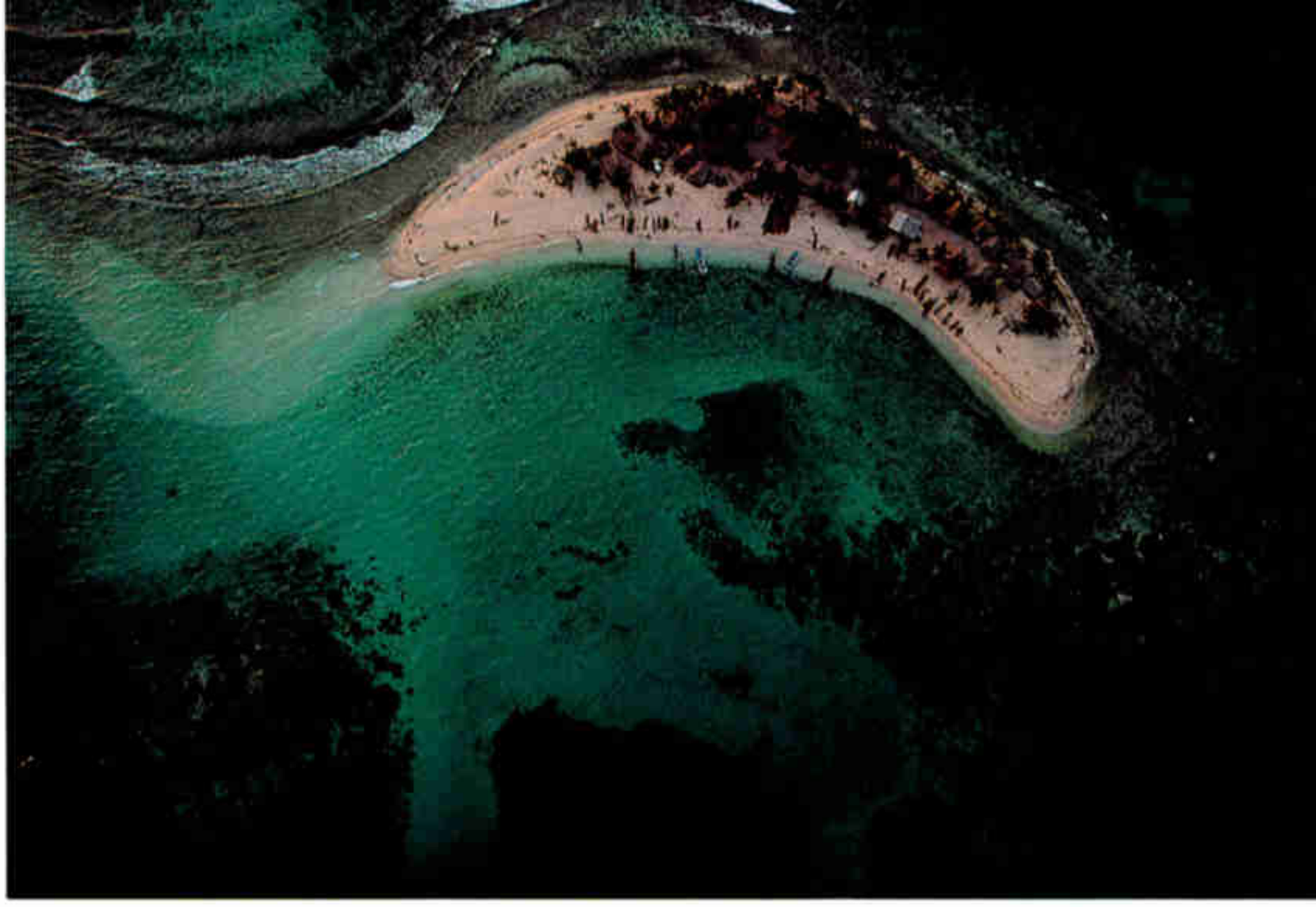
Immersed in Their Faith

With reverence, joy, and a sense of duty women from one extended family wade out to meet returning fishing boats as part of a ritual called the *dügü*—the most sacred ceremony of the Garífuna religion. When a family experiences persistent problems, the spirits of their dead ancestors request a dügü to reestablish spiritual, physical, and social harmony. All relatives must attend, whether they live on a tiny Honduran island (right) or in New York City. At this dügü in Barranco, a remote village in southern Belize, family members also came from Guatemala, Honduras, and the U.S. After three days of fishing the boats return, and the family marches to a temple for two days of drumming and

MORE ON OUR WEBSITE

Hear the music of the Garífuna—a rhythmic blend of drums and resonant voices—and see more pictures at **nationalgeographic.com/ngm/0109.**

singing. During a dance called the *mali*, dancers believe they can summon healing by capturing the spirits of their ancestors. If the ancestors are appeased, the family will heal. This ritual brings family members together, strengthening the bonds that unite the Garífuna. □



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DAYTON, TENNESSEE

37321

Born, raised, and still in Dayton, Reba Keylon, with husband Don, reclines La-Z-Boy style. "We mostly live a very simple life," Reba says.

Buckle of the Bible Belt

BY CATHY NEWMAN PHOTOGRAPHS BY VINCENT J. MUSI
NATIONAL GEOGRAPHIC SENIOR WRITER

BIGGEST EMPLOYER: La-Z-Boy
CLAIM TO FAME: 1925 Scopes "Monkey" trial
NUMBER OF BIBLES IN HIGH SCHOOL LIBRARY: 11
COPIES OF DARWIN'S *ORIGIN OF SPECIES*: 0
FAVORITE FARE AT DAYTON COFFEE SHOPPE: Chicken-n-dumplings; 1,800 servings sold each month
BAD DAY TO EAT THERE: Saturday: cook's day off

It was Thursday night in Dayton, Tennessee, and from the McDonald's on Highway 27 you could hear the sound of gospel music floating high above the Golden Arches. It was fast food for the soul—a mix of Big Macs and hymns like "Hillbilly Heaven" and "Have a Little Talk With Jesus." Among the gathered was Marcella Harris, who used to be a honky-tonk singer but changed her tune and was saved. And Henry Harris (no relation), who answered the call 25 years ago when he was running a bulldozer in a gravel pit and heard the voice of the Lord in the sound of the machine's gears.

The McDonald's gospel sing has been going for two years and is so popular that, word has it, Wendy's is about to start one too. "There's also one at the Hardee's in Soddy-Daisy," a town 20 minutes down the road, Anna Kyle informed me. A tiny woman with a mass of golden curls, Kyle acts as unofficial hostess for the big sing. "Hardee's holds theirs the same night as ours," she added. She did not look pleased.

In Dayton you can spend practically every night worshiping: the Wednesday night prayer meeting, the gospel sing on Thursday, a Friday night "Jesus Jam" (Jesus is an "awesome dude," one teen explained), and a performance by the Dayton Christian Ballet on Saturday.

To the question "Why are folks in Dayton so passionately religious?" Daytonians would answer: "Why is everyone else not?" There are places to live, and there are communities. Dayton is a community. It's a town where generosity is a given, whether in the form of a casserole or a grant for a local college, a place where kids grow up without the threat of drive-by shootings. It is founded on the rock-hard conviction that the world—not to mention Dayton, Tennessee—runs by the grace of God.

This is Bible Belt country. The defining question is not "What do you do?" but "What church do you belong to?" Dayton is the county seat of Rhea (pronounced RAY) County, where there are some 130 churches for

"We sing praises to a great God and Savior," says 81-year-old Tommy Burdett (center) of the Thursday night McDonald's Singers. "So far we haven't had any complaints."

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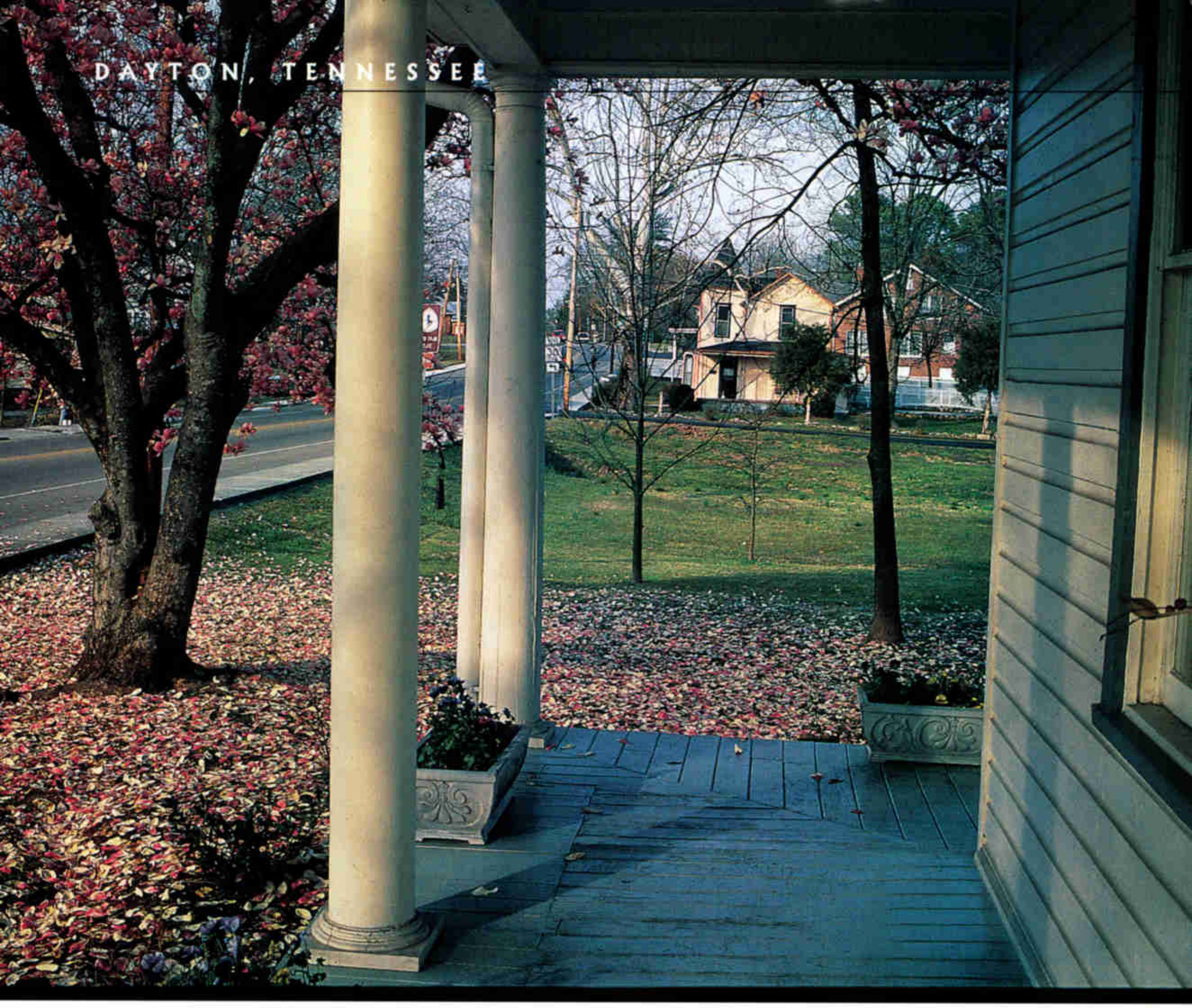

John Scopes slept here, at the Bailey House, during his 1925 trial. The Tennessee law banning evolution from school curricula held until 1967.

28,000 people, from small rural wood frames to the mainstream big brick First Baptist downtown.

There's a lot to give thanks for. First, the setting. Dayton snuggles in the Tennessee River Valley between the Smoky Mountains and the long slow roll of the Cumberland Plateau. Then the salt-of-the-earth people—about 6,000 of them—who work and pray hard. There's a healthy economy, based on manufacturing plants like La-Z-Boy, which assembles 3,000 recliners a day, and a near-record low unemployment rate of 4.4 percent. Last, but far from least, is the Rhea County High School football team. To bear witness to a victory of the Golden Eagles is the closest thing to heaven on earth.

The town itself is a tidy gridwork centered on a courthouse square. Gossip Central is the Dayton Coffee Shoppe, where biscuits, not bagels, rule. A topping of gravy, while not obligatory, is the local taste. "*Brown* gravy, not that wallpaper-paste-like *white* gravy," one regular explained.

Dayton also is the town made famous by the 1925 Scopes "Monkey" trial that matched the flamboyant lawyer William Jennings Bryan against the equally showy Clarence Darrow over whether or not John Scopes, a high school science teacher, had violated House Bill No. 185, which made it "unlawful . . . to teach . . . that man has descended from a lower order of animals." Scopes, acting as a guinea pig to test the law, lost.

Everyone loves Dr. Gavioli's recipe for pi.

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The Good Neighbor Teacher Award was developed in cooperation with the National Council of Teachers of Mathematics.

Scopes taught at the old county high school, on a hill overlooking the town. The present-day high school is a low brick building that sits in farmland ten miles away. There is an after-school Bible Club and, once upon a time not too long ago, prayers at graduation. When I asked if evolution was part of the curriculum, Pat Conner, the principal, replied, "We teach—no, we 'present'—everything in the biology textbook, with a little less emphasis on the controversial parts." He spoke carefully and would say no more. Evolution was being taught, albeit grudgingly.

"The thing that is most difficult for us to accept here is that there are different religious beliefs," sighed Conner.

I asked him about a man, a lawyer, who had recently moved to Dayton from a northern city. When his child reported there were Bible readings in school, he pointed out the violation of federal law, and the school superintendent stopped the readings. An uproar ensued. Rumors flew that the school district was being sued; citizens suggested starting a legal defense fund. "He didn't understand the community," Conner said.

"Suppose you had taken the man aside beforehand," I said. "What advice would you have offered?"

Conner, a local, thought awhile. "I would have tried to alert him," he replied. "I'd have said: 'Look, do you want to cause your family trouble? This is a rural, conservative place, and very emotional about religion. Attack religion and the Crusades begin. But you need to follow your own convictions.'"

Dayton has endured 75 years of outsider scorn because of Scopes. If it circles the wagons against outsiders, it is not hard to see why. There's a sense here that people who have not walked in your shoes don't have a clue. Often, they don't.

On the way to interview Conner, I'd crossed an elevated walkway linking the gymnasium to the main building. Through the windows you can spot a thread of stream that spills down from the mountain and slips under the walkway. Quotes from people like Alexander Pope and Thomas Edison decorate the walls. They are inspirational, as befits an institution of learning, and there was one I particularly liked.

"It takes two to speak the truth,—one to speak, and another to hear."

—HENRY DAVID THOREAU

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At the "liars' table" in the Dayton Coffee Shoppe, locals fork up tall tales along with biscuits and gravy atop a community portrait under glass.

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Brief Summary of Prescribing Information
(Nos. 1541, 3046)
03-5073-R15-Brf., Rev. November, 2000

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(prē'-va-sid)
(lansoprazole)
Delayed-Release Capsules

INDICATIONS AND USAGE

PREVACID Delayed-Release Capsules are indicated for: 1. Short-Term Treatment of Active Duodenal Ulcer 2. *H. pylori* Eradication to Reduce the Risk of Duodenal Ulcer Recurrence 3. Maintenance of Healed Duodenal Ulcers 4. Short-Term Treatment of Active Benign Gastric Ulcer 5. Healing of NSAID-Associated Gastric Ulcer 6. Risk Reduction of NSAID-Associated Gastric Ulcer 7. Treatment of Heartburn and Other Symptoms Associated with GERD (Gastroesophageal Reflux Disease) 8. Short-Term Treatment of Erosive Esophagitis 9. Maintenance of Healing of Erosive Esophagitis 10. Pathological Hypersecretory Conditions Including Zollinger-Ellison Syndrome

CONTRAINDICATIONS

PREVACID Delayed-Release Capsules are contraindicated in patients with known hypersensitivity to any component of the formulation.

Amoxicillin is contraindicated in patients with a known hypersensitivity to any penicillin. (Please refer to full prescribing information for amoxicillin before prescribing.)

Clarithromycin is contraindicated in patients with a known hypersensitivity to any macrolide antibiotic, and in patients receiving terfenadine therapy who have preexisting cardiac abnormalities or electrolyte disturbances. (Please refer to full prescribing information for clarithromycin before prescribing.)

WARNINGS

CLARITHROMYCIN SHOULD NOT BE USED IN PREGNANT WOMEN EXCEPT IN CLINICAL CIRCUMSTANCES WHERE NO ALTERNATIVE THERAPY IS APPROPRIATE. IF PREGNANCY OCCURS WHILE TAKING CLARITHROMYCIN, THE PATIENT SHOULD BE APPRISED OF THE POTENTIAL HAZARD TO THE FETUS. (SEE **WARNINGS** IN PRESCRIBING INFORMATION FOR CLARITHROMYCIN.)

Pseudomembranous colitis has been reported with nearly all antibacterial agents, including clarithromycin and amoxicillin, and may range in severity from mild to life threatening. Therefore, it is important to consider this diagnosis in patients who present with diarrhea subsequent to the administration of antibacterial agents.

Treatment with antibacterial agents alters the normal flora of the colon and may permit overgrowth of clostridia. Studies indicate that a toxin produced by *Clostridium difficile* is a primary cause of "antibiotic-associated colitis."

After the diagnosis of pseudomembranous colitis has been established, therapeutic measures should be initiated. Mild cases of pseudomembranous colitis usually respond to discontinuation of the drug alone. In moderate to severe cases, consideration should be given to management with fluids and electrolytes, protein supplementation, and treatment with an antibacterial drug clinically effective against *Clostridium difficile* colitis.

Serious and occasionally fatal hypersensitivity (anaphylactic) reactions have been reported in patients on penicillin therapy. These reactions are more apt to occur in individuals with a history of penicillin hypersensitivity and/or a history of sensitivity to multiple allergens.

There have been well-documented reports of individuals with a history of penicillin hypersensitivity reactions who have experienced severe hypersensitivity reactions when treated with a cephalosporin. Before initiating therapy with any penicillin, careful inquiry should be made concerning previous hypersensitivity reactions to penicillins, cephalosporins, and other allergens. If an allergic reaction occurs, amoxicillin should be discontinued and the appropriate therapy instituted.

SERIOUS ANAPHYLACTIC REACTIONS REQUIRE IMMEDIATE EMERGENCY TREATMENT WITH EPINEPHRINE. OXYGEN, INTRAVENOUS STEROIDS, AND AIRWAY MANAGEMENT, INCLUDING INTUBATION, SHOULD ALSO BE ADMINISTERED AS INDICATED.

PRECAUTIONS

General

Symptomatic response to therapy with lansoprazole does not preclude the presence of gastric malignancy.

Information for Patients

PREVACID Delayed-Release Capsules should be taken before eating.

Alternative Administration Options

For patients who have difficulty swallowing capsules, PREVACID Delayed-Release Capsules can be opened, and the intact granules contained within can be sprinkled on one tablespoon of either applesauce, ENSURE® pudding, cottage cheese, yogurt, or strained pears and swallowed immediately. The granules should not be chewed or crushed. Alternatively, PREVACID Delayed-Release Capsules may be emptied into a small volume of either orange juice or tomato juice (60 mL – approximately 2 ounces), mixed briefly and swallowed immediately. To insure complete delivery of the dose, the glass should be rinsed with two or more volumes of juice and the contents swallowed immediately. The granules have also been shown *in vitro* to remain intact when exposed to apple, cranberry, grape, orange, pineapple, prune, tomato, and V-8® vegetable juice and stored for up to 30 minutes.

For patients who have a nasogastric tube in place, PREVACID Delayed-Release Capsules can be opened and the intact granules mixed in 40 mL of apple juice and injected through the nasogastric tube into the stomach. After administering the granules, the nasogastric tube should be flushed with additional apple juice to clear the tube.

Drug Interactions

Lansoprazole is metabolized through the cytochrome P_{450} system, specifically through the CYP3A and CYP2C19 isozymes. Studies have shown that lansoprazole does not have clinically significant interactions with other drugs metabolized by the cytochrome P_{450} system, such as warfarin, antipyrine, indomethacin, ibuprofen, phenytoin, propranolol, prednisone, diazepam, clarithromycin, or terfenadine in healthy subjects. These compounds are metabolized through various cytochrome P_{450} isozymes including CYP1A2, CYP2C9, CYP2C19, CYP2D6, and CYP3A. When lansoprazole was administered concomitantly with theophylline (CYP1A2, CYP3A), a minor increase (10%) in the clearance of theophylline was seen. Because of the small magnitude and the direction of the effect on theophylline clearance, this interaction is unlikely to be of clinical concern. Nonetheless, individual patients may require additional titration of their theophylline dosage when lansoprazole is started or stopped to ensure clinically effective blood levels.

Lansoprazole has also been shown to have no clinically significant interaction with amoxicillin.

In a single-dose crossover study examining lansoprazole 30 mg and omeprazole 20 mg each administered alone and concomitantly with sucralfate 1 gram, absorption of the proton pump inhibitors was delayed and their bioavailability was reduced by 17% and 16%, respectively, when administered concomitantly with sucralfate. Therefore, proton pump inhibitors should be taken at least 30 minutes prior to sucralfate. In clinical trials, antacids were administered concomitantly with PREVACID Delayed-Release Capsules; this did not interfere with its effect.

Lansoprazole causes a profound and long-lasting inhibition of gastric acid secretion; therefore, it is theoretically possible that lansoprazole may interfere with the absorption of drugs where gastric pH is an important determinant of bioavailability (eg, ketoconazole, ampicillin esters, iron salts, digoxin).

Carcinogenesis, Mutagenesis, Impairment of Fertility

In two 24-month carcinogenicity studies, Sprague-Dawley rats were treated orally with doses of 5 to 150 mg/kg/day, about 1 to 40 times the exposure on a body surface (mg/m^2) basis, of a 50-kg person of average height (1.46 m^2 body surface area) given the recommended human dose of 30 mg/day (22.2 mg/m^2). Lansoprazole produced dose-related gastric enterochromaffin-like (ECL) cell hyperplasia and ECL cell carcinoids in both male and female rats. It also increased the incidence of intestinal metaplasia of the gastric epithelium in both sexes. In male rats, lansoprazole produced a dose-related increase of testicular interstitial cell adenomas. The incidence of these adenomas in rats receiving doses of 15 to 150 mg/kg/day (4 to 40 times the recommended human dose based on body surface area) exceeded the low background incidence (range = 1.4 to 10%) for this strain of rat. Testicular interstitial cell adenoma also occurred in 1 of 30 rats treated with 50 mg/kg/day (13 times the recommended human dose based on body surface area) in a 1-year toxicity study.

In a 24-month carcinogenicity study, CD-1 mice were treated orally with doses of 15 to 600 mg/kg/day, 2 to 80 times the recommended human dose based on body surface area. Lansoprazole produced a dose-related increased incidence of gastric ECL cell hyperplasia. It also produced an increased incidence of liver tumors (hepatocellular adenoma plus carcinoma). The tumor incidences in male mice treated with 300 and 600 mg/kg/day (40 to 80 times the recommended human dose based on body surface area) and female mice treated with 150 to 600 mg/kg/day (20 to 80 times the recommended human dose based on body surface area) exceeded the ranges of background incidences in historical controls for this strain of mice. Lansoprazole treatment produced adenoma of rete testis in male mice receiving 75 to 600 mg/kg/day (10 to 80 times the recommended human dose based on body surface area).

Lansoprazole was not genotoxic in the Ames test, the *ex vivo* rat hepatocyte unscheduled DNA synthesis (UDS) test, the *in vivo* mouse micronucleus test or the rat bone marrow cell chromosomal aberration test. It was positive in *in vitro* human lymphocyte chromosomal aberration assays.

Lansoprazole at oral doses up to 150 mg/kg/day (40 times the recommended human dose based on body surface area) was found to have no effect on fertility and reproductive performance of male and female rats.

Pregnancy: Teratogenic Effects.

Pregnancy Category B

Lansoprazole

Teratology studies have been performed in pregnant rats at oral doses up to 150 mg/kg/day (40 times the recommended human dose based on body surface area) and pregnant rabbits at oral doses up to 30 mg/kg/day (16 times the recommended human dose based on body surface area) and have revealed no evidence of impaired fertility or harm to the fetus due to lansoprazole.

There are, however, no adequate or well-controlled studies in pregnant women. Because animal reproduction studies are not always predictive of human response, this drug should be used during pregnancy only if clearly needed.

Pregnancy Category C

Clarithromycin

See **WARNINGS** (above) and full prescribing information for clarithromycin before using in pregnant women.

Nursing Mothers

Lansoprazole or its metabolites are excreted in the milk of rats. It is not known whether lansoprazole is excreted in human milk. Because many drugs are excreted in human milk, because of the potential for serious adverse reactions in nursing infants from lansoprazole, and because of the potential for tumorigenicity shown for lansoprazole in rat carcinogenicity studies, a decision should be made whether to discontinue nursing or to discontinue the drug, taking into account the importance of the drug to the mother.

Pediatric Use

Safety and effectiveness in pediatric patients have not been established.

Use in Women

Over 800 women were treated with lansoprazole. Ulcer healing rates in females were similar to those in males. The incidence rates of adverse events were also similar to those seen in males.

Use in Geriatric Patients

Ulcer healing rates in elderly patients are similar to those in a younger age group. The incidence rates of adverse events and laboratory test abnormalities are also similar to those seen in younger patients. For elderly patients, dosage and administration of lansoprazole need not be altered for a particular indication.

ADVERSE REACTIONS

Clinical

Worldwide, over 6100 patients have been treated with lansoprazole in Phase 2-3 clinical trials involving various dosages and durations of treatment. In general, lansoprazole treatment has been well-tolerated in both short-term and long-term trials.

The following adverse events were reported by the treating physician to have a possible or probable relationship to drug in 1% or more of PREVACID-treated patients and occurred at a greater rate in PREVACID-treated patients than placebo-treated patients:

Incidence of Possibly or Probably Treatment-Related Adverse Events in Short-Term, Placebo-Controlled Studies

Body System/Adverse Event	PREVACID (N=1457) %	Placebo (N=467) %
Body as a Whole		
Abdominal Pain	1.8	1.3
Digestive System		
Diarrhea	3.6	2.6
Nausea	1.4	1.3

Headache was also seen at greater than 1% incidence but was more common on placebo. The incidence of diarrhea was similar between patients who received placebo and patients who received lansoprazole 15 mg and 30 mg, but higher in the patients who received lansoprazole 60 mg (2.9%, 1.4%, 4.2%, and 7.4%, respectively).

The most commonly reported possibly or probably treatment-related adverse event during maintenance therapy was diarrhea.

In the risk reduction study of PREVACID for NSAID-associated gastric ulcers, the incidence of diarrhea for patients treated with PREVACID was 5%, misoprostol 22%, and placebo 3%.

Additional adverse experiences occurring in <1% of patients or subjects in domestic trials are shown below. Refer to **Postmarketing** for adverse reactions occurring since the drug was marketed.

Body as a Whole - asthenia, candidiasis, chest pain (not otherwise specified), edema, fever, flu syndrome, halitosis, infection (not otherwise specified), malaise; *Cardiovascular System* - angina, cerebrovascular accident, hypertension/hypotension, myocardial infarction, palpitations, shock (circulatory failure), vasodilation; *Digestive System* - anorexia, bezoar, cardiospasm, cholelithiasis, constipation, dry mouth/thirst, dyspepsia, dysphagia, eructation, esophageal stenosis, esophageal ulcer, esophagitis, fecal discoloration, flatulence, gastric nodules/fundic gland polyps, gastroenteritis, gastrointestinal hemorrhage, hematemesis, increased appetite, increased salivation, melena, rectal hemorrhage, stomatitis, tenesmus, ulcerative colitis; *Endocrine System* - diabetes mellitus, goiter, hyperglycemia/hypoglycemia; *Hemic and Lymphatic System* - anemia, hemolysis; *Metabolic and Nutritional Disorders* - gout, weight gain/loss; *Musculoskeletal System* - arthritis/arthralgia, musculoskeletal pain, myalgia; *Nervous System* - agitation, amnesia, anxiety, apathy, confusion, depression, dizziness/syncope, hallucinations, hemiplegia, hostility aggravated, libido decreased, nervousness, paresthesia, thinking abnormality; *Respiratory System* - asthma, bronchitis, cough increased, dyspnea, epistaxis, hemoptysis, hiccup, pneumonia, upper respiratory inflammation/infection; *Skin and Appendages* - acne, alopecia, pruritus, rash, urticaria; *Special Senses* - blurred vision, deafness, eye pain, otitis media, taste perversion, tinnitus, visual field defect; *Urogenital System* - abnormal menses, albuminuria, breast enlargement/gynecomastia, breast tenderness, glycosuria, hematuria, impotence, kidney calculus.

Postmarketing

On-going Safety Surveillance: Additional adverse experiences have been reported since lansoprazole has been marketed. The majority of these cases are foreign-sourced and a relationship to lansoprazole has not been established. Because these events were reported voluntarily from a population of unknown size, estimates of frequency cannot be made. These events are listed below by COSTART body system.

Body as a Whole - anaphylactoid-like reaction; *Digestive System* - hepatotoxicity, vomiting; *Hemic and Lymphatic System* - agranulocytosis, aplastic anemia, hemolytic anemia, leukopenia, neutropenia, pancytopenia, thrombocytopenia, and thrombotic thrombocytopenic purpura; *Special Senses* - speech disorder; *Urogenital System* - urinary retention.

Combination Therapy with Amoxicillin and Clarithromycin

In clinical trials using combination therapy with PREVACID plus amoxicillin and clarithromycin, and PREVACID plus amoxicillin, no adverse reactions peculiar to these drug combinations were observed. Adverse reactions that have occurred have been limited to those that had been previously reported with PREVACID, amoxicillin, or clarithromycin.

Triple Therapy: PREVACID/amoxicillin/clarithromycin

The most frequently reported adverse events for patients who received triple therapy for 14 days were diarrhea (7%), headache (6%), and taste perversion (5%). There were no statistically significant differences in the frequency of reported adverse events between the 10- and 14-day triple therapy regimens. No treatment-emergent adverse events were observed at significantly higher rates with triple therapy than with any dual therapy regimen.

Dual Therapy: PREVACID/amoxicillin

The most frequently reported adverse events for patients who received PREVACID t.i.d. plus amoxicillin t.i.d. dual therapy were diarrhea (8%) and headache (7%). No treatment-emergent adverse events were observed at significantly higher rates with PREVACID t.i.d. plus amoxicillin t.i.d. dual therapy than with PREVACID alone.

For more information on adverse reactions with amoxicillin or clarithromycin, refer to their package inserts, **ADVERSE REACTIONS** sections.

Laboratory Values

The following changes in laboratory parameters for lansoprazole were reported as adverse events:

Abnormal liver function tests, increased SGOT (AST), increased SGPT (ALT), increased creatinine, increased alkaline phosphatase, increased globulins, increased GGTP, increased/decreased/abnormal WBC, abnormal AG ratio, abnormal RBC, bilirubinemia, eosinophilia, hyperlipemia, increased/decreased electrolytes, increased/decreased cholesterol, increased glucocorticoids, increased LDH, increased/decreased/abnormal platelets, and increased gastrin levels. Additional isolated laboratory abnormalities were reported.

In the placebo controlled studies, when SGOT (AST) and SGPT (ALT) were evaluated, 0.4% (1/250) placebo patients and 0.3% (2/795) lansoprazole patients had enzyme elevations greater than three times the upper limit of normal range at the final treatment visit. None of these patients reported jaundice at any time during the study.

In clinical trials using combination therapy with PREVACID plus amoxicillin and clarithromycin, and PREVACID plus amoxicillin, no increased laboratory abnormalities particular to these drug combinations were observed.

For more information on laboratory value changes with amoxicillin or clarithromycin, refer to their package inserts, **ADVERSE REACTIONS** section.

OVERDOSAGE

Oral doses up to 5000 mg/kg in rats (approximately 1300 times the recommended human dose based on body surface area) and mice (about 675.7 times the recommended human dose based on body surface area) did not produce deaths or any clinical signs.

Lansoprazole is not removed from the circulation by hemodialysis. In one reported case of overdose, the patient consumed 600 mg of lansoprazole with no adverse reaction.

Manufactured for
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Lake Forest, IL 60045

Ref. 03-5073-R15, Rev. November, 2000

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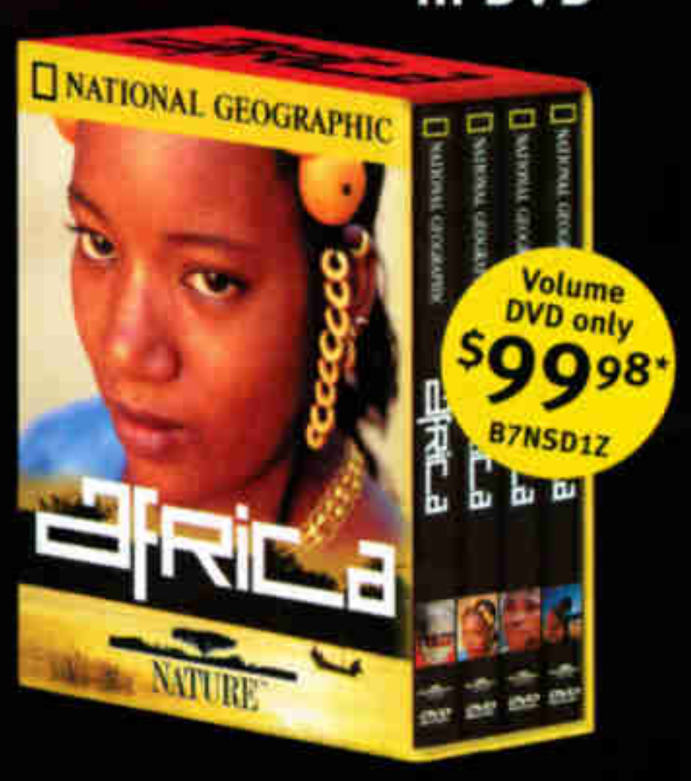

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Flight of Fancy

You'd think that decades spent working with the world's best nature photography would leave an editor pretty much unimpressible. But Chris Johns's shot of pastel flamingos flocking over the plush green of Mozambique's coastal mangrove swamps captivated Editor Bill Allen in a way he just couldn't shake off. "The simple truth is that I couldn't stand *not* to run this picture in the magazine," Allen says. "It's one of those images that's simply too good to leave out." Beauty doesn't always secure an image a place in a feature layout: "We're a geographic magazine, rather than a photographic magazine. That means making tough choices about which images do the best journalistic job," says Allen. "But sometimes being the boss is fun. In this case it gave me the chance to get one more stunning photograph in the magazine."

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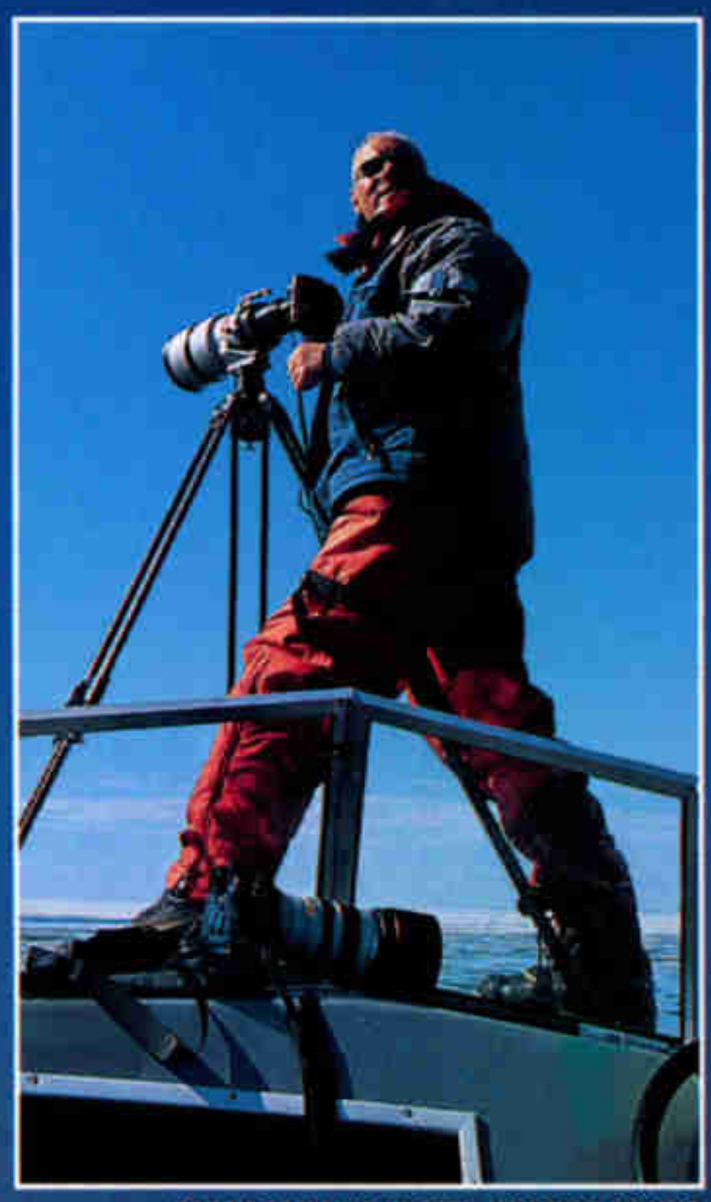
CANADIAN ARCTIC

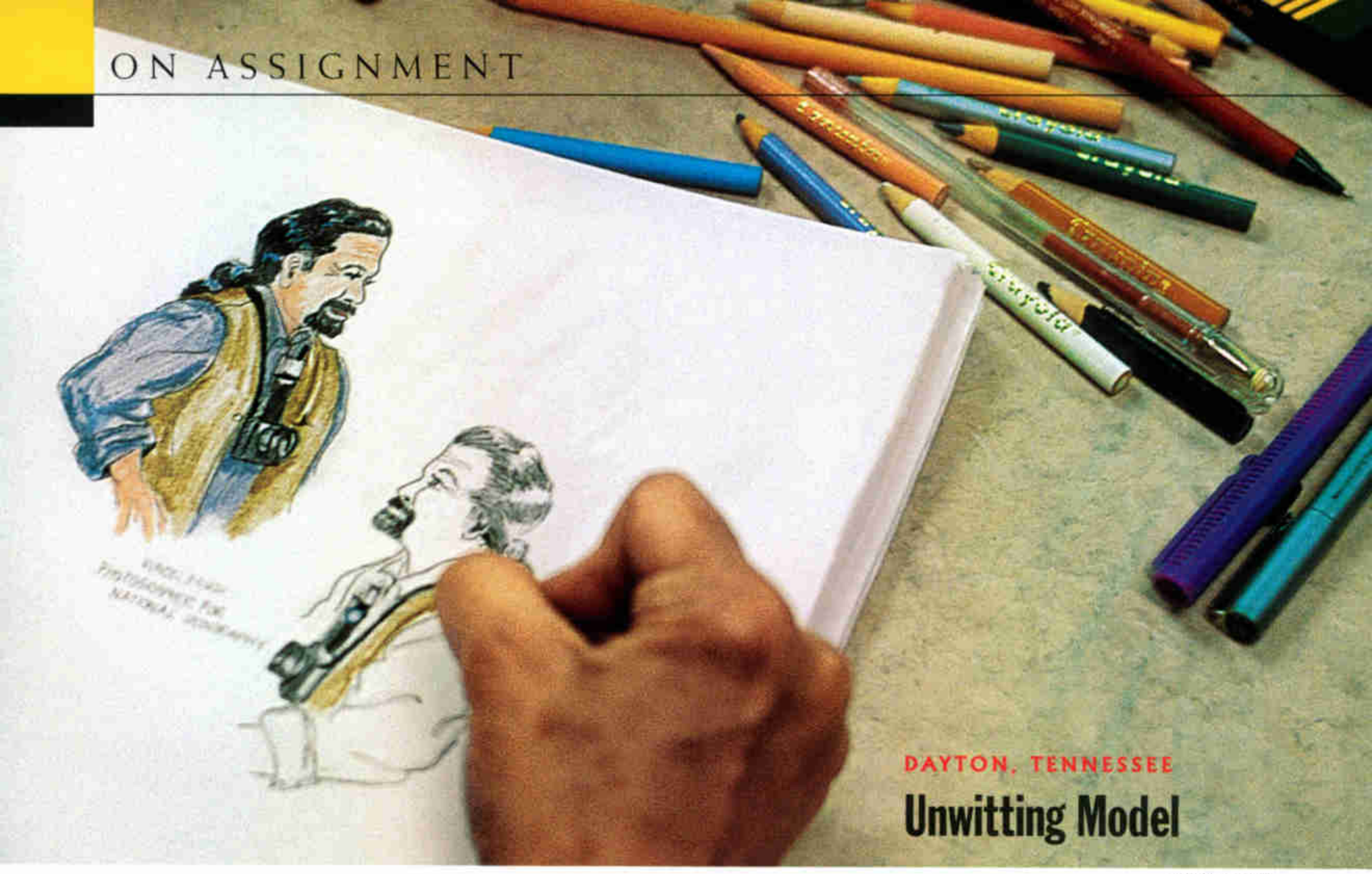
Partners in Photography

A marriage thrives in the frozen north

When Eleonore Rosing accompanies her photographer-husband, **Norbert Rosing**, on his assignments, it's no day at the beach. Eleonore (below left, with Inuit guide Pakak Qamaniq) has traveled with Norbert to frigid, ice-filled regions for the past decade as he photographed polar bears, and she joined him again as he "hunted" walruses in Canada's Foxe Basin. "She loads cameras, changes lenses, holds the underwater camera, puts the sleeping bags away," he says. Norbert (right) also pays tribute to Pakak, "the best guide in Igloolik," on the Melville Peninsula. "He was absolutely perfect," Norbert says. "Having good guides like Pakak and his assistant Adam Qanatsiaq leaves your mind free to concentrate on what you want to see. You only have to worry that the equipment works."



PAKAK QAMANIQ (INSET); NORBERT ROSING



DAYTON, TENNESSEE

Unwitting Model

VINCENT J. MUSI

As he photographed the weekly gospel sing at the McDonald's in Dayton, Tennessee, for this issue's zip code feature, **Vince Musi** wondered why people were laughing. It didn't take him long to learn it was because local art teacher Denise Wilson was sketching him (above) as he worked. "I took it as a gesture of warmth and friendliness on the part of the community, which welcomed me with open arms," Vince says. It wasn't his first modeling experience: An artist had drawn him at work on assignment in Spain. "I try to be low-key," says Vince, "but I guess I stick out like a sore thumb: a guy with a ponytail, a goatee, and a camera."

WORLDWIDE

For both photographer **Chris Johns** and author **Peter Godwin** an interview with South Africa's former president Nelson Mandela was an occasion to treasure. "I don't know that I've ever met a more gracious, charismatic person in my life," says Chris (below, at left). "And his passionate commitment to Africa's peace parks was overwhelming." "This wasn't just another charity where he had his name on the masthead," says Peter, at right, who covered South Africa as a newspaper correspondent in the 1980s. "He knew exactly what it was about." (Hear the full interview at *national geographic.com/ngm/0109*.)

Visiting "a magical place" along Central America's Caribbean coast, photographer **Susie Post Rust** became enamored of the Garífuna people's spirit of joy. "A spontaneous party can break out anywhere. Someone starts drumming, others join in, and all of a sudden everybody is dancing," says Susie.

Author **Carl Zimmer** found his first assignment for the magazine, learning how science puzzles out questions of age, "kind of intimidating: I had to deal with time scales from the origins of life to the origins of the universe." Carl calls science writing "a good way to get a good education from the experts. You ask them questions, and they seem happy to talk to you about their work." For the record he's 35 years old.

DAVE HAMMAN

MORE ON OUR WEBSITE

Find more stories about life on assignment from our authors and photographers, including their best, worst, and *quirkiest experiences, at* **nationalgeographic.com/ngm/0109**.

For people with type 2 diabetes

"Taking care of my diabetes takes real commitment. Always."

"I do want to be stronger than diabetes. I want to do this for myself, and for Eileen — my wife and best friend.

"So, I will always take care of myself. It was tough at first, but I got into a good diet and exercise routine. That still wasn't enough, so my doctor added *Avandia* for my type 2 diabetes. It helps my body use its own natural insulin more effectively.

"It's been a year now, and I've kept my blood sugar down — with the help of *Avandia*. Your results may vary."

Strengthen your body's own ability to help control blood sugar.

Avandia, along with diet and exercise, helps improve blood sugar control. It may be prescribed alone, with Glucophage® (metformin HCl tablets) or with sulfonylureas. When taking *Avandia* with a sulfonylurea, you may be at risk for low blood sugar. Ask your doctor whether you have to lower your sulfonylurea dosage.

Avandia is not indicated for use with insulin. In some people, *Avandia* may cause fluid retention, or swelling. This could lead to or worsen congestive heart failure, so tell your doctor if you have a history of these conditions. *Avandia* is not for everyone. If you have severe heart failure or active liver disease, *Avandia* is not recommended. If you experience an unusually rapid increase in weight, swelling or shortness of breath while taking *Avandia*, talk to your doctor immediately.

Also, blood tests to check for serious liver problems should be conducted before and during *Avandia* therapy. Tell your doctor if you have liver disease, or if you experience unexplained tiredness, stomach problems, dark urine or yellowing of the skin while taking *Avandia*. See important patient information on the following page.

If you are nursing, pregnant or thinking about becoming pregnant, talk to your doctor before taking *Avandia*.

Talk to your doctor, or for more information call 1-800-AVANDIA (1-800-282-6342) or visit www.avandia.com

GlaxoSmithKline

Bristol-Myers Squibb Company

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Glucophage is a registered trademark of LIPHA s.a.
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Please see important patient information on the following page.

Avandia®
rosiglitazone maleate

You can be stronger than diabetes

Patient Information about AVANDIA® (rosiglitazone maleate) 2 mg, 4 mg, and 8 mg Tablets

What is *Avandia*?
Avandia is one product in a class of prescription drugs called thiazolidinediones (thigh-a-zoe-lid-een-die-owns) or TZDs. It is used to treat type 2 diabetes by helping the body use the insulin that it is already making. *Avandia* comes as pills that can be taken either once a day or twice a day to help improve blood sugar levels.

How does *Avandia* treat type 2 diabetes?
If you have type 2 diabetes, your body probably still produces insulin but it is not able to use the insulin efficiently. Insulin is needed to allow sugar to be carried from the bloodstream into many cells of the body for energy. If insulin is not being used correctly, sugar does not enter the cells very well and builds up in the blood. If not controlled, the high blood sugar level can lead to serious medical problems, including kidney damage, blindness and amputation.

Avandia helps your body use insulin by making the cells more sensitive to insulin so that the sugar can enter the cell.

How quickly will *Avandia* begin to work?
Avandia begins to reduce blood sugar levels within 2 weeks. However, since *Avandia* works to address an important underlying cause of type 2 diabetes, insulin resistance, it may take 8 to 12 weeks to see the full effect. If you do not respond adequately to your starting dose of *Avandia*, your physician may increase your daily dose to improve your blood sugar control.

How should I take *Avandia*?
Your doctor may tell you to take *Avandia* once a day or twice a day (in the morning and evening). It can be taken with or without meals. Food does not affect how *Avandia* works. To help you remember to take *Avandia*, you may want to take it at the same time every day.

What if I miss a dose?
<u>If your doctor has prescribed *Avandia* for use once a day:</u>

- As soon as you remember your missed dose, take one tablet anytime during the day.
- If you forget and go a whole day without taking a dose, don't try to make it up by adding another dose on the following day. Forget about the missed dose and simply follow your normal schedule.

<u>If your doctor has prescribed *Avandia* for use twice a day:</u>

- As soon as you remember the missed dose, take one tablet.
- Take the next dose at the normal time on the same day.
- Don't try to make up a missed dose from the day before.
- You should never take three doses on any single day in order to make up for a missed dose the day before.

Do I need to test my blood for sugar while using *Avandia*?
Yes, you should follow your doctor's instructions about your at-home testing schedule.

Does *Avandia* cure type 2 diabetes?
Currently there is no cure for diabetes. The only way to avoid the effects of the disease is to maintain good blood sugar control by following your doctor's advice for diet, exercise, weight control, and medication. *Avandia*, alone or in combination with other antidiabetic drugs (i.e., sulfonylureas or metformin), may improve these other efforts by helping your body make better use of the insulin it already produces.

Can I take *Avandia* with other medications?
Avandia has been taken safely by people using other medications, including other antidiabetic medications, birth control pills, warfarin (a blood thinner), Zantac® (ranitidine, an antiulcer product from GlaxoSmithKline), certain heart medications, and some cholesterol-lowering products. You should discuss with your doctor the most appropriate plan for you. If you are taking prescription or over-the-counter products for your diabetes or for conditions other than diabetes, be sure to tell your doctor. Sometimes a patient who is taking two antidiabetic medications each day can become irritable, lightheaded or excessively tired. Tell your doctor if this occurs; your blood sugar levels may be dropping too low, and the dose of your medication may need to be reduced.

What should I discuss with my doctor before taking *Avandia*?
Avandia, like other TZDs, may cause fluid retention or swelling in some people. This could lead to or worsen congestive heart failure, particularly in people taking insulin. *Avandia* is not indicated for use with insulin. Talk to your doctor if you have a history of heart failure or swelling. You should also talk to your doctor if you have liver problems, or if you are nursing, pregnant or thinking of becoming pregnant. If you are a premenopausal woman who is not ovulating, you should know that *Avandia* therapy may result in the resumption of ovulation, which may increase your chances of becoming pregnant. Therefore, you may need to consider birth control options.

What are the possible side effects of *Avandia*?
Avandia was generally well tolerated in clinical trials. The most common side effects reported by people taking *Avandia* were upper respiratory infection and headache. As with most other diabetes medications, you may experience an increase in weight. You may also experience edema (swelling) and/or anemia. If you experience any swelling of your extremities (e.g., legs, ankles) or tiredness, notify your doctor. Talk to your doctor immediately if you experience edema, shortness of breath, an unusually rapid increase in weight, or other symptoms of heart failure.

Who should not use *Avandia*?
You should not take *Avandia* if you are in the later stages of heart failure or if you have active liver disease. The following people should also not take *Avandia*: People with type 1 diabetes, people who experienced yellowing of the skin with Rezulin® (troglitazone, Parke-Davis), people who are allergic to *Avandia* or any of its components and people with diabetic ketoacidosis.

Why are laboratory tests recommended?
Your doctor may conduct blood tests to measure your blood sugar control. Blood tests to check for serious liver problems should be conducted before starting *Avandia*, every 2 months during the first year, and periodically thereafter.

It is important that you call your doctor immediately if you experience unexplained symptoms of nausea, vomiting, stomach pain, tiredness, anorexia, dark urine, or yellowing of the skin.

How should I store *Avandia*?
Avandia should be stored at room temperature in a child-proof container out of the reach of children. Store *Avandia* in its original container.

gsk GlaxoSmithKline

Flashbacks

U.S. BUREAU OF EDUCATION

IMMIGRATION

Cooking With Fresh Verbs

An Italian immigrant makes an American breakfast aided by instructional materials from the YMCA. In the early decades of the 20th century such newcomers to the United States were encouraged to take "Americanization" classes to speed their assimilation. Day and evening school sessions offered adults subjects including child care, hygiene, housekeeping, English—and courses in eliminating accents once English was learned. This photograph was first published in the April 1918 article "What Is It to Be an American?"

MORE ON OUR WEBSITE

You can send this month's Flashback as an electronic greeting card and access the Flashback photo archives at **nationalgeographic.com/ngm/flashback/0109.**

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ATTRACTION

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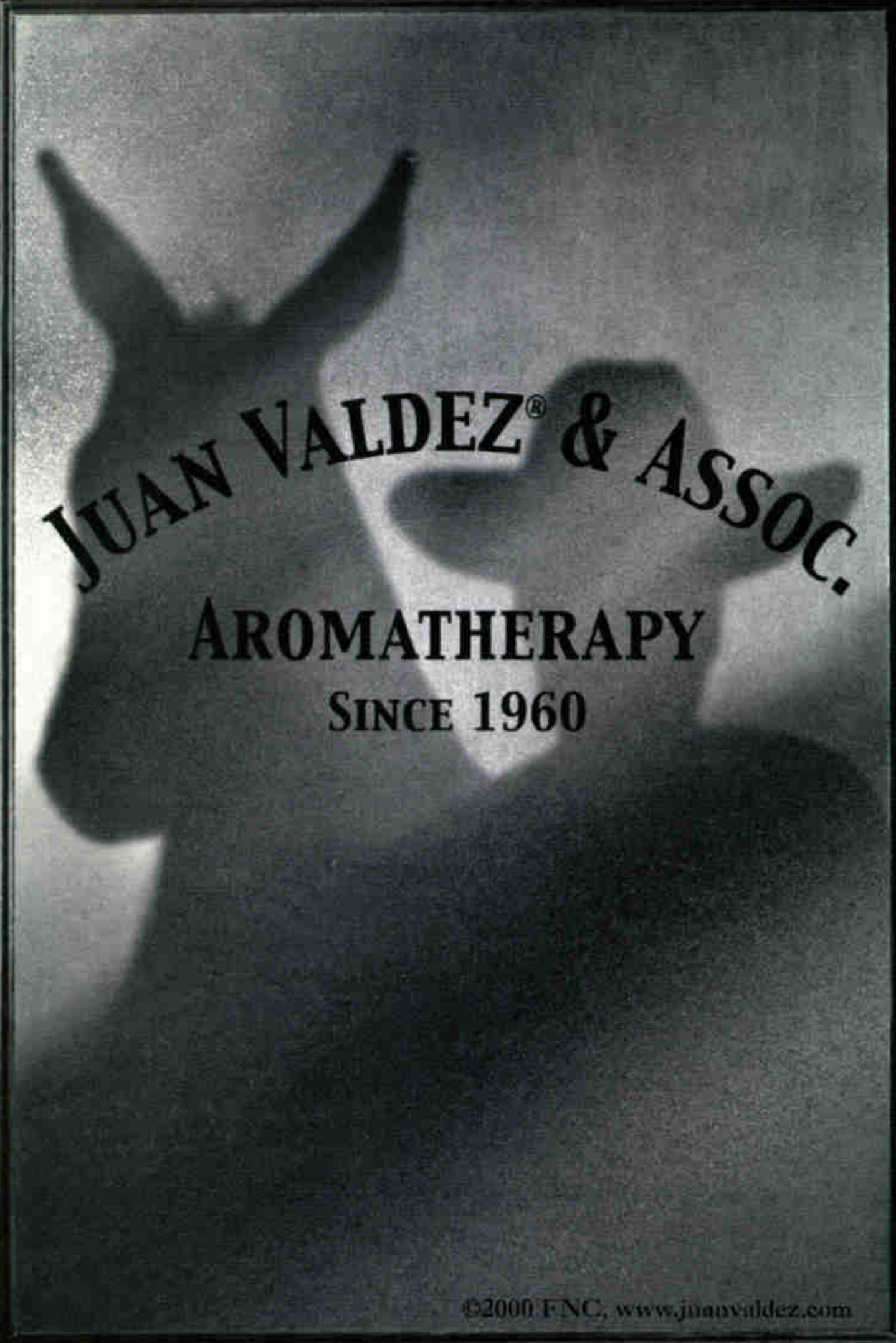
JENN-AIR



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