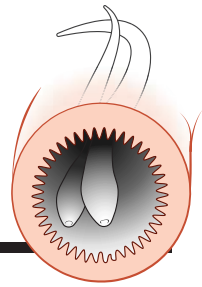
Oxides that conduct hydride anions *p. 1262*

Intestinal tuft cells provide protective immunity *p. 1264* ▸



PERSPECTIVES

SCIENCE DIPLOMACY

Reboot Gitmo for U.S.-Cuba research diplomacy

Transform Guantánamo into a peace park and ecological research center

By **Joe Roman**[1] *and* **James Kraska**[2]

Cuba has about 5000 km of coastline, including coral reefs, mangrove wetlands, seagrass beds, and tropical wet forests. Long stretches of coast remain undeveloped, with relatively high levels of fish biomass and marine biodiversity in marine parks that are unparalleled in the Caribbean (*1*, *2*). But on the eve of President Obama's visit to Cuba, we must consider whether normalization of relations between the United States and Cuba, with anticipated expansion of coastal development and return of industrial agriculture, might reverse Cuba's advances in ecological conservation. We propose an approach to protect Cuba's coastal ecosystems and enhance conservation and ecological research throughout the Caribbean. The United States should deliver on President Obama's recent plan to close the military prison at U.S. Naval Station Guantánamo Bay and repurpose the facilities into a state-of-the-art marine research institution and peace park, a conservation zone to help resolve conflicts between the two countries. This model, designed to attract both sides [similarly, see (*3*)], could unite Cuba and the United States in joint management, rather than serve as a wedge between them, while helping meet the challenges of climate change, mass extinction, and declining coral reefs.

POLICY

The U.S. presence at Guantánamo dates back more than a hundred years. The United States helped Cuba fight for independence from Spain in the 1890s and then occupied the island in 1898. As part of the Cuban-American Treaty, Cuba was granted independence in 1902, but the U.S. Platt Amendment required Cuba to rent Guan-

Final approach? Mangroves dot Guantánamo Bay with the U.S. naval base airstrip seen in the distance. Might the contentious base become a research and diplomatic centerpiece in U.S.-Cuba relations?

PHOTO: LUKE FRAZZA/AFP/GETTY IMAGES

tánamo Bay to the United States as a coaling and naval station, a perpetual lease that could be broken only by mutual consent. Since the 1960s, the Cuban government has regarded the U.S. presence as illegal, refusing to cash the annual $4085 rent check. The Community of Latin American and Caribbean States recently called for returning the base to Cuba.

The Obama Administration has made it clear that diplomatic relations with Cuba and the transfer of detainees do not mean that it is willing to discuss the return of the 117 km^2 Guantánamo base to Cuba anytime soon (*4*, *5*). Although we believe that eventually giving the land back to Cuba would be a good outcome, we take the Administration at its word and propose a third path that would benefit Cuba, the United States, and beyond. The November 2015 agreement between the United States and Cuba on sister sanctuaries, including the Florida Keys National Marine Sanctuary and Guanahacabibes National Park on the west coast of Cuba, illustrates the current goodwill between the countries and could help foster dialogue to consider our proposal.

"WOODS HOLE" OF THE CARIBBEAN. Why would Cuba accept anything short of an immediate return of the base? A park that commemorates the history of the area and uses existing infrastructure for a research center would give global recognition to the country's conservation efforts. It would provide financial support, up-to-date facilities for ecological and environmental work, and an opportunity to build capacity and train Cuban scientists and students, especially those from the surrounding eastern provinces. A parcel of the land, perhaps on the developed southeastern side of the base, could become a "Woods Hole of the Caribbean," housing research and educational facilities dedicated to addressing climate change, ocean conservation, and biodiversity loss. With genetics laboratories, geographic information systems laboratories, videoconference rooms—even art, music, and design studios—scientists, scholars, and artists from Cuba, the United States, and around the world could gather and study. The new facilities could strive to be carbon neutral, with four 80-meter wind turbines having been installed on the base in 2005, and designed to minimize ecological damage to the surrounding marine and terrestrial ecosystems.

With a reduced U.S. footprint at Guantánamo, most of the land and sea could be returned to native wildlife. The area provides habitat for many endemic species, such as the vulnerable Cuban iguana (*Cyclura nubila*), and it may be a critical refuge for the West Indian manatee (*Trichechus manatus*) (*6*). It is an important nesting area for the endangered green turtle (*Chelonia mydas*) and critically endangered hawksbill turtle (*Eretmochelys imbricata*). The tropical dry forests on the base are relatively rare in Cuba, and the station hosts important Caribbean coastal habitats, such as sandy beaches, mangroves, coral reefs, and seagrass beds. The granadillo tree (*Brya ebenus*), spiny lobster (*Panulirus argus*), and several reef fishes have been overharvested and require better management. The two countries could work together to restore native species and fight noxious invasives, such as lionfish (*Pterois* spp.), African catfish (*Clarius gariepinus*), and marabou (*Dichrostachys cinerea*).

There are signs of progress in protecting Caribbean coastal ecosystems. Islands like Bermuda and Bonaire have moved forward on coral reef conservation, largely by protecting their reef fishes (*7*). After the 1992 Earth Summit in Rio de Janeiro, Cuba developed a strong tradition of environmental protection. More than an "accidental Eden" (*8*), Cuba has extensive protected areas, a constitution with strong environmental provisions, and an aggressive stance on climate change, putting it at the center of Caribbean conservation efforts. It has established the largest marine park in the Caribbean, the Jardines de la Reina (Gardens of the Queen), with abundant sharks and groupers (*9*).

CONVERSION AND REDEMPTION. The Guantánamo Naval Base serves the U.S. Fourth Fleet and is a hub for law enforcement and mass migration operations. Yet, as early as the 1970s, the base has been proposed as a bargaining chip to help normalize U.S. relations with Havana (*10*). By the end of the Cold War, the U.S. Department of Defense considered closing the base (*11*). As U.S. involvement in wars in Afghanistan and Iraq winds down and detainees are released or subject to criminal trial, perhaps the most compelling reason for the Pentagon to possess the base disappears. Although the station supports other missions, including regional counterdrug operations, maritime migration interdiction, search and rescue, and humanitarian assistance, Naval Air Station Key West, only 90 miles away, can meet most of these needs. Because Guantánamo is not in any U.S. congressional district, there would not be a fight over jobs at risk of being lost.

"...the name Guantánamo could become associated with...efforts to preserve and repair...the planet."

The move would extend a long tradition of U.S. naval support of marine scientific research and operational oceanography. More important, opening up Guantánamo would facilitate exchange, the two countries learning from each other. The peace park and research center would enhance capacity, technological transfer, and scientific facilities for Cuban researchers.

The world's first peace park is the Waterton-Glacier International Peace Park on the border of Canada and the United States, a symbol of goodwill between the countries (*12*). There have been successful transitions from military bases and conflict zones in other countries. After the United States left Fort Clayton to Panama, for example, part of the base was transformed into Ciudad de Saber (City of Knowledge), a government-sponsored complex that has attracted international scholars and the United Nations Development Program. Although the future of land along the corridor of the former Iron Curtain is uncertain, the European Green Belt initiative could transform the continent and help species such as lynx,

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brown bears, and imperial eagles recover (*13*). Such international parks are signs that humans can respect each other, even after conflicts, and protect other species that share our planet. In transforming the base, we should not forget the past. Efforts such as the Guantánamo Public Memory Project (gitmomemory.org), which seeks to build awareness of U.S. history in the area, should be supported.

We hope that Pope Francis, who played an essential role in restoring relations between Cuba and the United States, will contribute to advancing a peaceful future for Guantánamo, in which both countries benefit. In the first papal encyclical on the environment, *Laudato Si'*, he called for an ecological conversion and the widespread protection of biodiversity, remarking on the decline of coral reefs, "Who turned the wonderworld of the seas into underwater cemeteries bereft of colour and life?" (*14*). Humans did, of course, through overfishing, deforestation, pollution, and burning fossil fuels (*15*). And humans can turn it around.

A first step in returning the land to Cuba, the Guantánamo peace park and research center would encourage nations to convert military bases and conflict zones into areas of creativity, cooperation, and biodiversity conservation. For the next generation, the name Guantánamo could become associated with redemption and efforts to preserve and repair international relations and the planet. ■

REFERENCES AND NOTES

1. D. J. Whittle, O. Rey Santos, *Cuban Stud.* **37**, 73 (2006).
2. M. J. H. Newman, G. Paredes, E. Sala, J. B. C. Jackson, *Ecol. Lett.* **9**, 1216 (2006).
3. J. E. Schweig, *Cuba: What Everyone Needs to Know* (Oxford Univ. Press, New York, 2009).
4. M. Crowley, *Time*, 30 May 2013.
5. A. Holpuch, *The Guardian*, 4 February 2015.
6. G. Sedaghatkish, E. Roca, Eds., *U.S. Naval Station Guantánamo Bay Cuba: Rapid Ecological Assessment* (The Nature Conservancy, Arlington, VA, 1999).
7. J. Jackson, M. Donovan, K. Cramer, V. Lam, *Status and Trends of Caribbean Coral Reefs: 1970–2012* (Global Coral Reef Monitoring Network, IUCN, Gland, Switzerland, 2014).
8. D. Whittle, *MEDICC Rev.* **17**, 49 (2015).
9. F. Pina-Amargós, G. González-Sansón, F. Martín-Blanco, A. Valdivia, *Peer J.*, **2**, e274 (2014).
10. D. Binder, *The New York Times*, 30 August 1977.
11. M. Moore, *The Washington Post*, 25 April 1990.
12. S. H. Ali, Ed., *Peace Parks: Conservation and Conflict Resolution* (MIT Press, Cambridge, MA, 2007).
13. A. Terry, K. Ullrich, U. Riecken, *The Green Belt of Europe—From Vision to Reality* (IUCN, Gland, Switzerland, 2006).
14. Pope Francis, *Laudato Si', On Care for Our Common Home*, [encyclical] (2015); m.vatican.va.
15. J. M. Pandolfi *et al.*, *Science* **301**, 955 (2003).

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PHYSICS

Squeezing into superconductivity

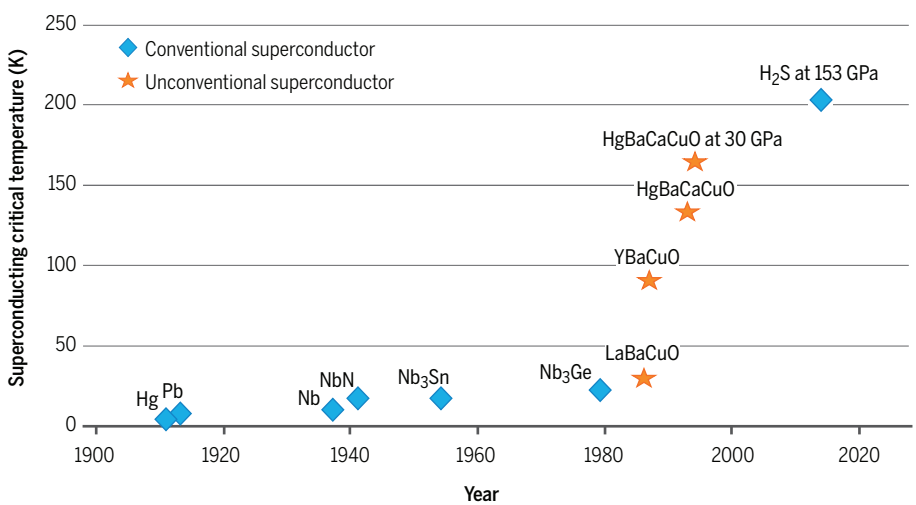
Synchrotron light sources can be used to probe superconductivity at extreme pressures

By **Viktor Struzhkin**

The recent report of superconductivity in hydrogen sulfide (H_2S) by Drozdov *et al.* (*1*) at a record high superconducting critical temperature T_c of 203 K and at high pressure (153 GPa) triggered excitement from both a fundamental and technological perspective. On page 1303 of this issue, Troyan *et al.* (*2*) confirm the finding by using an elegant and unexpected implementation of the Mössbauer technique at the third-generation synchrotron facility in Grenoble, France. They measured the Meissner effect (*3*)—the expulsion of magnetic field from the sample—thereby unequivocally confirming the existence of superconductivity. The new superconductor is believed to have a simple chemical formula, H_3S. The superconductivity in H_3S was predicted theoretically by Duan *et al.* (*4*) before the first experimental findings were reported. The technique has great potential for future studies of tiny samples squeezed to extremely high pressure. This experimental advance paves the road to probing superconductivity in metallic hydrogen, which is expected to be a room-temperature superconductor above 500 GPa (*5*).

To understand the impact of the report by Troyan *et al.*, we should look deeper into the decades-long quest for a room-temperature superconductor. The most exciting development in superconductivity since its discovery by Kamerlingh Onnes in 1911 (see the figure) happened in 1987, when Bednorz and Müller found high-temperature superconductivity in materials based on copper-oxygen (CuO_2) layers, the layered structure being a necessary structural property of this new "unconventional" family of superconductors. The discovery of these so-called high-T_c cuprate materials led to a stunning T_c = 165 K at 30 GPa in a mercury-based cuprate material (*6*), which is higher than in a previous record-holding material (Nb_3Ge) by almost a factor of 7. The superconductivity mechanism in cuprates still defies theoretical understanding and remains the focus of intense research efforts by scientists around the world. This absence of theoretical understanding is a handicap preventing a guided search for new superconductors with even higher critical temperatures.

In contrast to the cuprate situation, there is a wealth of conventional superconducting



Raising the critical temperature. The highest-T_c materials over the years since the discovery of superconductivity in mercury by Kamerlingh Onnes in 1911. The unconventional cuprate superconductors are marked by orange stars, the conventional ones by blue diamonds. Note that the highest T_c values are observed in a compressed state at very high pressures. For useful applications, the effect of pressure must be understood theoretically, and this understanding should be used to design new materials with favorable parameters close to ambient conditions.

GRAPHIC: N. CARY/*SCIENCE*