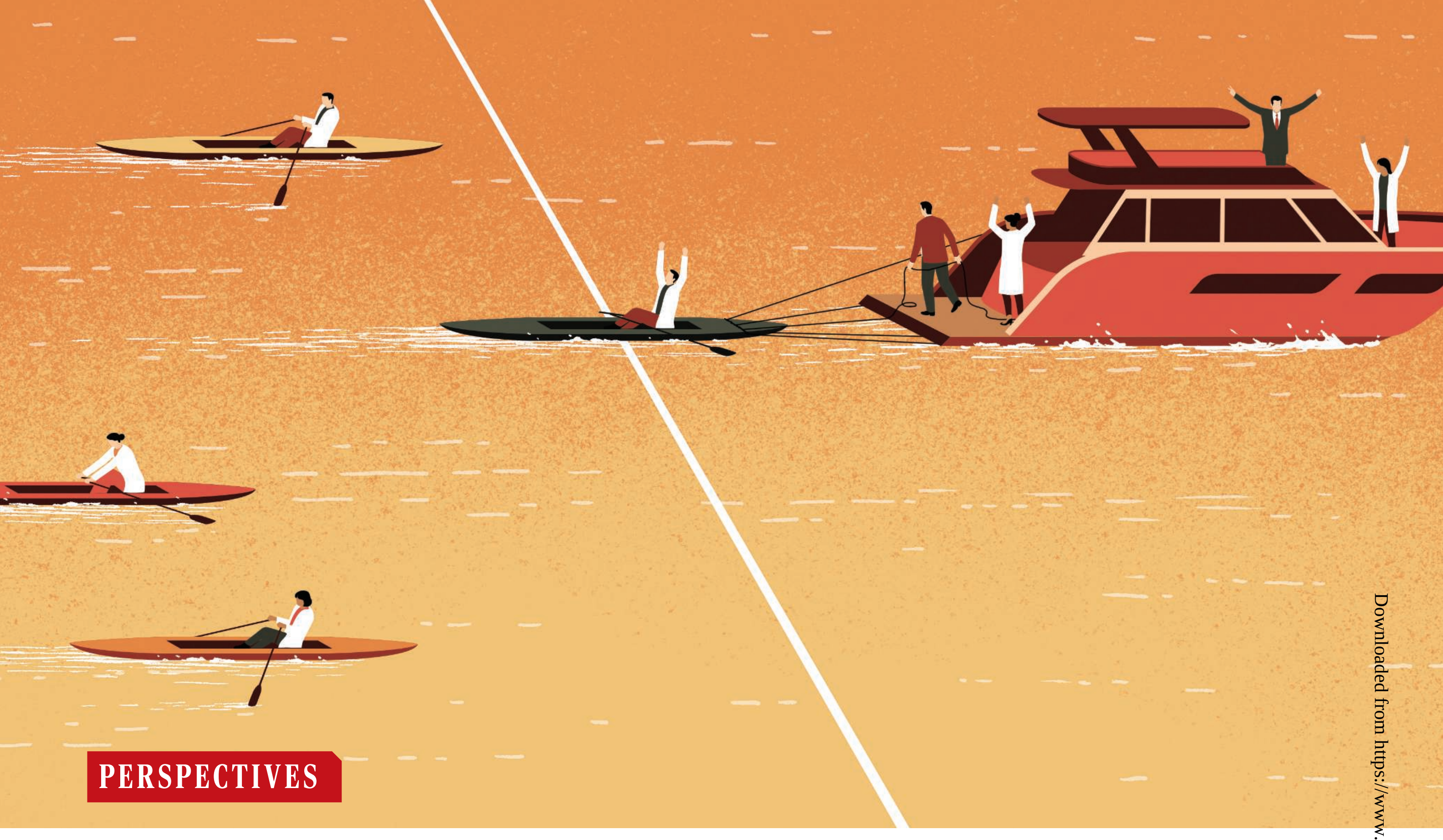

PERSPECTIVES

SCIENTIFIC COMMUNITY

It's whom you know that counts

Hometown ties help Chinese scientists get ahead

By **Y. Xie**[1,2]

Universalism—the evaluation of scientists' achievements based on merit alone rather than on functionally irrelevant factors (*1*–*3*)—has long been an unquestioned norm in science. Its existence is best illustrated by the reactions of outrage whenever a violation of universalism in science is exposed. For example, a study by Moss-Racusin *et al.* received a lot of attention in the scientific community because it found that when assessing application materials, science faculty rated students with male names as more competent than students who were otherwise identical but had been given female names (*4*). In a recent study, Fisman *et al.* (*5*) find evidence for favoritism in Chinese science: The election of membership to the two most prestigious scientific organizations, the Chinese Academy of Sciences (CAS) and the Chinese Academy of Engineering (CAE), appears to be influenced by "guanxi," or social network, as measured by hometown ties between candidates and selection committee members.

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The authors' focus on guanxi in CAS and CAE membership elections is judicious, given guanxi's well-documented centrality as a value "pervasive and dominant in the entire [Chinese] society throughout much of its historical, political, and economic contexts" [p. 159 in (*6*)]. They also use a culturally appropriate measure of guanxi, hometown ties, because common place of origin ("lao xiang") is an important social identifier that binds Chinese migrants together (*7*).

Fisman *et al.* find that sharing the same place of origin with selection committee members boosts a candidate's probability of election success by ~40%. Among scientists who were successfully elected to the CAS and CAE, those sharing hometown ties with committee members were less accomplished, as measured by high-impact publications, than their peers. The focus on Chinese science is timely, as China has been growing rapidly in its scientific capacity, productivity, and research funding (*8*, *9*). Because membership in CAS or CAE is associated with generous government research funding (*5*), the violation of universalism identified by Fisman *et al.* is tantamount to misallocation of public resources and thus may be detrimental to Chinese science (*9*).

These empirical findings are in agreement with previous research on scientists. More than six decades of sociological research has confirmed that despite laudable norms, such as universalism and disinterestedness (*1*), scientists do not behave differently from other people. They are motivated by desire for money, success, and recognition (*2*, *3*); compete for resources (*2*, *3*, *9*); argue over priorities (*10*); and sometimes even cheat to get ahead (*8*). Indeed, inequality in both resource distribution and rewards is extremely high among scientists (*2*, *11*).

To date, the most comprehensive study of CAS members is Cao's book on *China's Scientific Elite* (*12*). Inspired by Zuckerman's landmark study on Nobel laureates in the United States (*11*), Cao systematically documented the social determinants of becoming a CAS member, including place of birth, family background, education, mentor's influence, institutional affiliation, scientific achievements, and political factors. He found that various network factors, particularly mentoring relationships, significantly influence CAS election outcomes.

It would be naïve to infer from these studies that Chinese science is hopelessly corrupt. Science is a social institution embedded within, rather than isolated from,

ILLUSTRATION: DAVIDE BONAZZI/@SALZMANART a larger society. Scientists themselves are members of a society, and their behaviors reflect their milieu. Guanxi helps top Chinese scientists become CAS/CAE members largely because guanxi is important in today's China. However, reliance on guanxi is not unique to Chinese science. In American science, social networks, especially those developed in graduate programs, affect attainment of academic positions and achievement recognition. Long *et al.* found that the prestige of a graduate program and mentor is highly predictive of first academic employment, whereas preemployment productivity is not (*13*). Zuckerman reported that mentoring relationships matter even for the most coveted reward in science—the Nobel Prize (*13*)—because mentors who have won the prize are well positioned to nominate their former students.

Recognition of scientists' accomplishments, such as membership in prestigious societies and top prizes, appropriately rewards scientists for their contributions to humanity (*2*, *3*, *11*). However, evaluation of scientific merit is never easy. Quantifiable criteria—such as publication and citation counts—can be misleading. In China, where the state's influence is strong and pervasive, bureaucracy could easily lead to more corruption (*9*). Therefore, evaluation by peer scientists in the same field remains the best and the most feasible option. Peers, however, are not infallible; their evaluations can be subjective. Adding to established literature in sociology, Fisman *et al.* remind us that science is ultimately a social institution affecting, and affected by, human behavior. ■

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OPTICAL METAMATERIALS

Metamaterials for perpetual cooling at large scales

A glass-polymer film can cool structures by radiating heat, even under direct sunlight

By **Xiang Zhang**

The cold universe is a vast but freely available heat sink that has been largely neglected in the past and has a great potential to store and dissipate the enormous waste heat we generate every day on Earth. On page 1062 of this issue, Zhai *et al.* develop a metamaterial—a class of engineered material with exotic properties not found in nature—to cool room-temperature objects perpetually by dumping heat to outer space through infrared (IR) thermal radiation (*1*).

Thermal radiation in the form of electromagnetic waves is the primary way for Earth to dissipate ~170 pW of the incoming solar irradiation (*2*). At room temperature, thermal radiation peaks at ~10 µm IR wavelength, which lies in the so-called atmospheric window (*3*). The radiation within this spectral window passes directly through the atmosphere layer to the cold, outer space with little absorption and reemission. This is why we feel chilly when standing outside on a clear and calm night.

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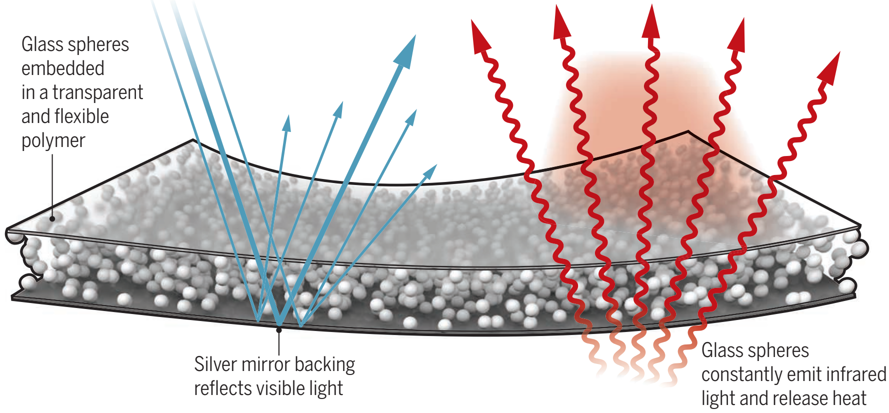
Nocturnal radiative cooling has been exploited in warm climates for building cooling (*4*). Daytime radiative cooling, however, is fundamentally limited because most naturally available IR-emissive materials also absorb sunlight at visible and near-IR wavelengths and heat up rapidly under the Sun. The solar power density overwhelms the room-temperature radiation spectrum for the wavelengths that are shorter than 4 µm; effective daytime radiative cooling demands a material that reflects all of the light at wavelengths shorter than 4 µm while being fully emissive for longer wavelengths. Recently, nanophotonic structures with tailored spectral responses were designed for passive daytime radiative cooling (*5*, *6*). They can reflect most of the sunlight but remain highly emissive in the IR. When facing toward the sky, the photonic structures cool themselves below the ambient temperature under direct sunlight through the net outgoing energy flux.

Passive radiative cooling consumes no electricity nor refrigerant. Once deployed, the cooling effect is perpetual as long as the object temperature is higher than that of the outer space. The primary challenge with passive radiative cooling, however, is to produce these photonic structures in a simple, scalable, and yet cost-effective way

A flexible route to coolness

In previous approaches, intricate crystalline nanostructures emitted thermal infared light. Zhai *et al*. use larger glass spheres (~10 µm diameter) in a flexible polymer to create a scalable, thin-film cooling material.



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