suffer from climate-related noise. The authors averaged several AIM events to reduce noise, but although obtaining an average delay is informative, the question remains as to what extent individual DO–AIM pairs might vary in timing.

Studies of other Antarctic ice cores[8] reveal that the variation of temperature with time during AIM events has geographic variability, and that two phases are typically visible in the AIM profile during warming. They are accompanied by variations in other climate tracers that point to atmospheric-circulation changes that are not synchronous with Greenland events. Buizert *et al.* looked at atmospheric changes, and observed sea-salt variations during AIM that indicate synchronous changes in sea ice and temperature. Such variations may provide insight into changes in southern freshwater forcing and ocean feedbacks that affect the bipolar see-saw.

Establishing the relative timing between see-saw events in the two hemispheres is a big step forward, but the full extent of changes revealed by Antarctic ice cores, including the timing of changes in carbon dioxide level, remains under-exploited. An integrated understanding of hemispheric climate coupling therefore awaits. Nevertheless, Buizert and colleagues' findings are particularly compelling in the light of recent indications[9] of a contemporary slowing of the AMOC, which has been anticipated. Predicting the global effects of such a change will pivot on our understanding of how the hemispheres communicate. ■

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MATERIALS SCIENCE

Semiconductors grown large and thin

Atomically thin layers of semiconductors called transition-metal dichalcogenides have been grown uniformly on the square-centimetre scale — paving the way for the ultimate miniaturization of electronic applications. SEE LETTER P.656

TOBIN J. MARKS & MARK C. HERSAM

The ubiquity of electronic devices today derives from the development of semiconductor wafers that have exceptional spatial uniformity. These wafers enable the production of highly integrated circuits, because each of the billions of constituent transistors behaves predictably, with differences between individual devices being among the smallest of any manufactured technology. Meanwhile, the miniaturization of transistors over the years has led researchers to consider the ultimate size limit: atomic-scale electronic devices. This limit has been reached in research laboratories with the fabrication of prototypes from atomically thin semiconducting materials[1]. But integrated circuits can be made from such devices only if atomically thin materials can be grown uniformly over large areas. On page 656 of this issue, Kang *et al.*[2] report a crucial step in this direction. They have achieved such uniformity on the wafer-scale — several square centimetres — for one of the most promising classes of two-dimensional semiconductor.

Transition-metal dichalcogenides (TMDs) have the general formula MX_2, in which M is a metal such as molybdenum (Mo) or tungsten (W), and X can be sulfur, selenium or tellurium. They are semiconducting materials with 2D structures consisting of stacked, three-atom-thick X–M–X monolayers bound largely by interlayer van der Waals forces, roughly analogous to the structure of graphite. The appeal of TMDs has conventionally centred on their bulk forms[3], for applications as lubricants, energy-storage materials and catalysts. However, intense interest in the properties of atomically thin, 2D electronic materials such as graphene has extended to MX_2 materials, because they offer the possibility of high-performance and mechanically flexible transistors, light detectors, solar cells and light-emitting devices.

Most studies that have attempted to fabricate devices from atomically thin TMDs have used mechanically exfoliated forms (samples

50 Years Ago

In an article in a recent issue of *Minerva* … on "The President's Science Advisers", Dr. P. H. Abelson discusses the use which the Presidents of the United States have made of the service of a 'Science Adviser' since 1957. Dr. Abelson is concerned with the part which the Science Adviser and his staff have actually played, including his relation to the Office of Science and Technology created in March 1962, and more particularly he directs attention to some of the limitations of the system … Dr. Abelson goes so far as to maintain that the Science Adviser and his staff have failed to address themselves to many major problems which might be expected to fall within the Science Adviser's responsibility. Instead he believes they have been occupied with many relatively trivial problems, and the consequent exclusion of such questions as whether in the United States the present allocations of money and manpower has led to some discontent with the advisory system.
From *Nature* 1 May 1965

100 Years Ago

The great consumption of petrol as a motor fuel, which last year, in spite of the disturbing element of war, rose to the enormous volume of 120 million gallons in England, and to nearly ten times that amount in America, has led to the attempt being made to add to the natural supply by the so called "cracking" of the heavy residual oils left after the petrol and the lamp oil have been distilled off from the crude oil … The term "cracking" is one of those delightful Americanisms which express so exactly the meaning we wish to impart that it has been adopted universally.
From *Nature* 29April 1915