

# CURRENT SCIENCE

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## CORRESPONDENCE

### Need to integrate science communication initiatives

Creating public understanding of science in an era when science and technology are permeating every fabric of society needs no emphasis. Despite some encouraging trends in recent years<sup>1</sup>, various ongoing science communication initiatives and programmes at the national level need to be integrated under a single accountable authority to avoid duplication of efforts by multiple government agencies.

At the national level, for instance, the renaming and rededication of the New Delhi-based Publications & Information Directorate of the Council of Scientific & Industrial Research (CSIR) as the National Institute of Science Communication (NISCOM) on 25 September 1996 assumes a lot of significance<sup>2</sup>. Interestingly, within the CSIR family, two more New Delhi-based institutes, viz. the Indian National Scientific Documentation Centre and National Institute of Science, Technology & Development Studies are also involved directly or indirectly in science communication.

On the other hand, the Union Ministry of Science & Technology has the popular science wing – the National Council for Science & Technology Communication

(NCSTC). In the recent past, two more outfits have emerged: the NCSTC-Network (a government-cum-voluntary-cum-nongovernmental body) and an autonomous organization, the *Vigyan Prasar*. Interestingly, one individual heads these three bodies. The NISSAT – National Information System for Science & Technology – also falls under the Science & Technology Ministry. Needless to say, the main objective of these set ups in one way or the other is science communication.

Specifically, for health education, the Union Ministry of Health & Family Welfare has a full-fledged institute – the Central Health Education Bureau which is located in New Delhi. And for environment awareness, the Union Ministry of Environment & Forests supports two centres of excellence. These are the Centre for Environment Education, Ahmedabad and the Madras-based CPR Environment Education Centre. The Delhi-based Defence Scientific Information & Documentation Centre of the Defence Research & Development Organization and the Ahmedabad-based Development and Educational Communication Unit of the Indian Space Research Organization are

also major players. Similarly the National Centre for Science Information (established in Indian Institute of Science, Bangalore in 1984) has been active in accessing and disseminating results of worldwide scientific and technological research to the faculty and researchers in universities and other research institutes in the country. Added to all this, the other major S&T agencies have their own Publication(s) and Information Division/Directorate. Even a large number of professional bodies such as the Society for Information Science, Indian Science Writers' Association, Health Media Centre – India and Energy Environment Group are painting a positive picture of science communication.

With this backdrop, there is an urgent need to integrate science communication initiatives.

1. Jain, N. C., *Curr. Sci.*, 1993, **65**, 441–442.
2. Anonymous, *CSIR News*, 1996, **46**, 277.

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## NEWS

### Light and the future

Since global environmental and energy problems have reached an alarming situation, 21st century will be the 'age of

\*A Satellite Symposium on Current Trends in Photophysics and Photochemistry was organized in Madurai Kamaraj University, Madurai, during August 5 and 6, 1996.

light' – particularly a period of exploitation of solar energy. Use of solar energy to combat pollution, to generate chemical energy (by water splitting) and to generate electricity (solar cells) has been reported extensively. Recently, in a two-day meeting, scientists from abroad and India assembled in Madurai to discuss current

trends in photophysics and photochemistry and solar energy conversion.\*

As buckyballs are available for the scientists to play, J. P. Mittal (BARC, Mumbai) in his talk highlighted the very unique and interesting photochemistry and photobiology of fullerenes. Using modern laser techniques, the molecular processes

taking place in fullerenes within picoseconds following the absorption of light energy were studied. Surprisingly, fullerenes were found to be the most efficient compounds to produce singlet oxygen, a form of oxygen possessing high energy. Coupled with this ability and the selective absorption of fullerenes encapsulated in  $\gamma$ -cyclodextrin by cancer cells (compared to normal cells), the feasibility of application of fullerenes in photodynamic therapy, a technique where light energy is used to selectively kill cancer cells, was pointed out.

N. Alonso-Vante (Hahn Meitner Institute, Berlin, Germany) discussed the important role of the surface of semiconductors used in splitting water to  $H_2$  and  $O_2$ , a process where solar energy is harnessed to chemical energy. The results indicate that to tailor semiconductor materials for efficient solar energy conversion, the semiconductor surface is of vital importance besides the photophysics and photochemistry of the semiconductor. Using surface probing techniques such as scanning tunneling microscopy, the role of humidity and the surface structure stability in air were investigated for  $RuS_2$ .

M. Chowdhury (IACS, Calcutta) spoke on the effect of magnetic field on the reaction of transient radicals (unstable intermediate products) produced. The magnetic field can also influence the transient species by bringing them together to form recombined product or to lead them to separate and form new products. The recombination of the photogenerated radical pair has been followed by luminescence from the recombined product (exciplex) and measurement of absorption of the transient radicals by laser flash photolysis. The magnetic field effect (MFE) on exciplex emission varies with the nature of the medium and this change is attributed to the change in the diffusive

motion. The role of polarity and ionic strength of the medium on the magnetic field effect was also highlighted.

Well-known inorganic complexes and organic dyes were incorporated into several synthetic polymers to produce light-absorbing macromolecules. Measurement of the lifetime of the light emission states of these macromolecules was used to map the environment around the light-absorbing antenna molecules. On the basis of these established facts, P. Natarajan (CSMCRI, Bhavnagar) discussed how to devise materials that can mimic photosynthetic biological systems for the production of value-added products from solar energy.

E. Pelizzetti (Univ. of Torino, Italy) focussed on how solar energy could be used to detoxify organic pollutants using the magic chemical titanium dioxide (Figure 1). When semiconductor particulates are irradiated by light, very reactive radical species are produced. Chlorinated organic compounds and some nitrogen compounds which get into the ecosystem by the use of pesticides, coolants, etc. are oxidized by the hydroxyl radicals and mineralized. He also explained how a model waste water treatment plant was in commission in Europe and how the operation of such a plant could be optimized by selecting proper supported photocatalytic semiconductors such as titanium dioxide, suitable light flux and efficient reactor design. For a country like India which has plenty of sunlight throughout the year, such a technique holds a great potential.

H. Tributsch (Hahn Meitner Institute, Berlin) discussed the new concept of proton transport (opposite to the movement of electron) in biomembrane followed by light absorption. Proton exchange with semiconductors such as  $ZrSe_2$ ,  $TiO_2$ ,  $FeS_2$  and  $InSe$  and its

implications in solar energy conversion was explained. The photophysical processes in bacterial rhodopsin could be explained in terms of proton transfer model based on autocatalytic mechanism.

Photo-induced electron transfer is a key process in biological systems. The distance between molecules involved in the electron transfer is a critical factor for designing molecular electronic devices based on photochemical/photophysical properties. M. Kaneko (Ibaraki Univ., Japan) discussed the use of polymer membranes incorporating photoredox molecules to study electron transfer distances in model systems to understand whether the electron transfer is through chemical bonds or through space or via other mediator molecules.

One of the most promising techniques for solar energy utilization is the design of suitable photoelectrochemical cells. K. Kalyanasundaram (Swiss Federal Institute of Technology, Switzerland) discussed how solar cells can be designed to deliver conversion efficiency of nearly 10%. This efficiency is achieved by judicious choice of materials and appropriate molecular engineering of various components in the solar cell (Figure 2). For maximum light absorption polypyridyl complexes of transition metals were used as photosensitizers. The redox properties of these dyes were tuned to obtain sufficient driving force to convert absorbed light energy to the charge carriers in the semiconductor. Other factors such as solubility and long-term photostability of the sensitizers, good communication between the dyes and the semiconductor surface are also of critical importance to obtain a sustainable technology. Kalyanasundaram exhibited solar cells developed on these principles.

P. Ramamurthy (Univ. of Madras) discussed how radical intermediates formed by light absorption could be used for

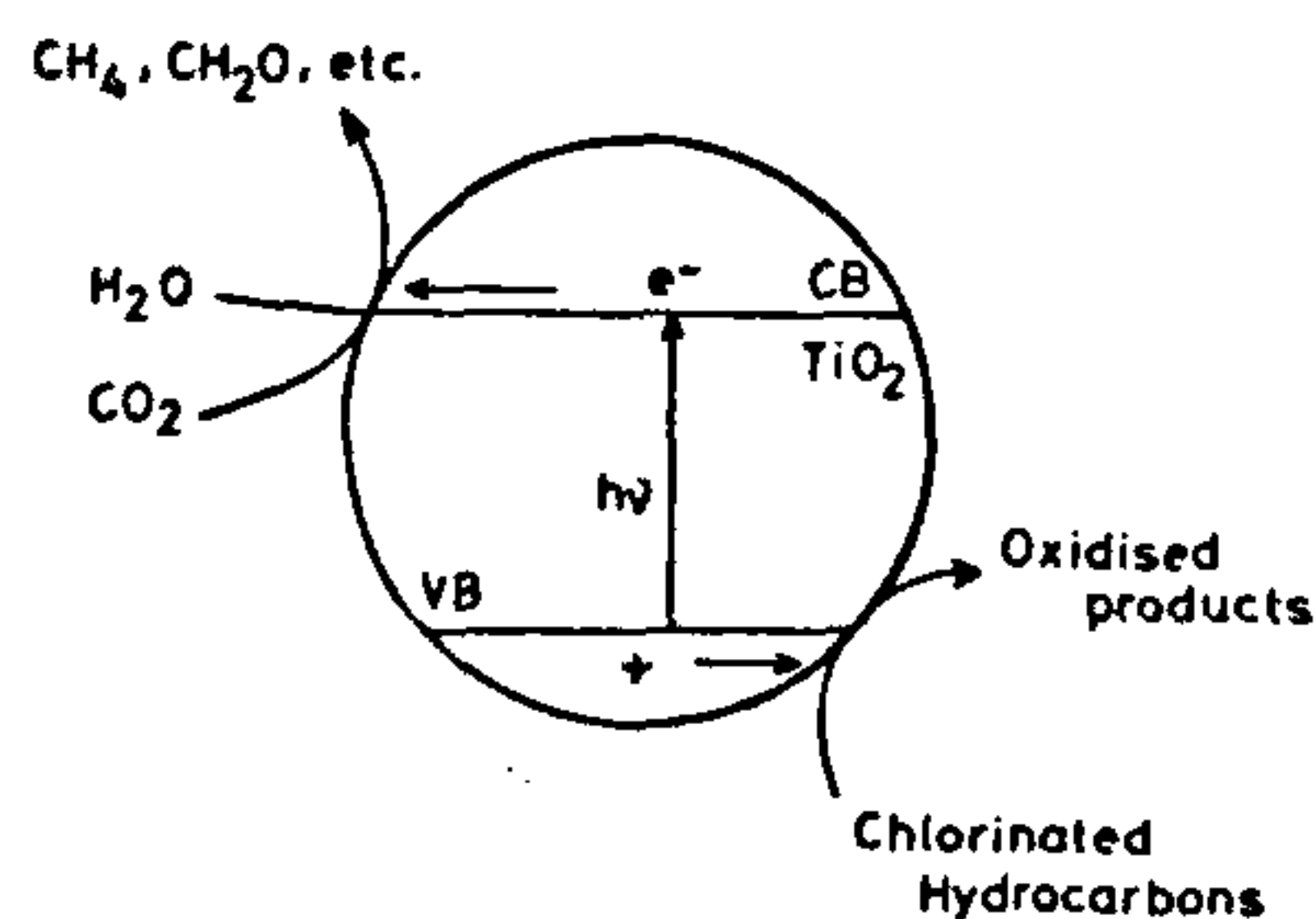


Figure 1. Detoxification of organic pollutants using  $TiO_2$ .

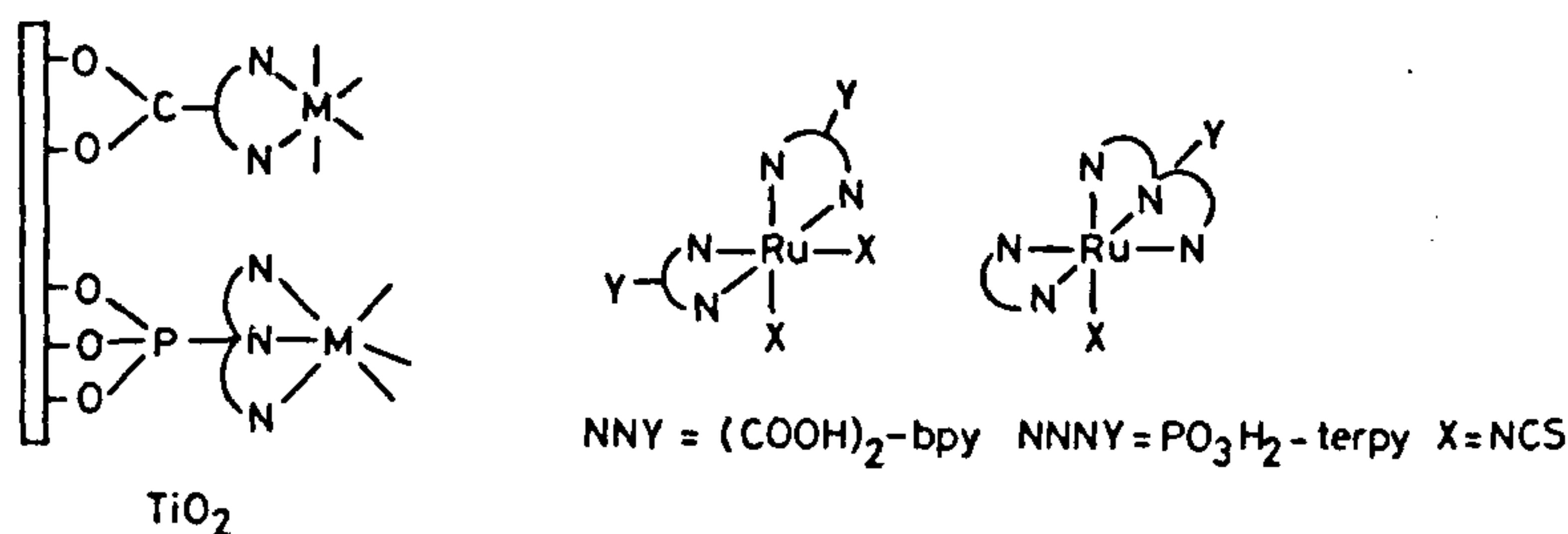


Figure 2. Materials and molecular engineering in photoelectrochemical cells.

production of polymers by taking triphenylpyrylium ion (TPP<sup>+</sup>) as the sensitizer. Using time-resolved light emission studies of the sensitizer, he explained the *in situ* generation of cationic initiators from iodobenzene (PhI). To understand the mechanistic details of the interaction between PhI and triplet state of TPP<sup>+</sup>, electron transfer quenching reaction was studied with a series of electron donors and the theories of electron transfer applied.

Because of their extensive use in tannery, the chromium complexes attract wide interest. T. Ramasami (CLRI, Chennai) explained the photochemistry of cobalt and chromium complexes. He explained how changes in electronic structures, geometries and solvents could influence the photochemistry of these complexes. The role of charge transfer excited states leading to different types of photoredox reactions was highlighted by taking some typical model systems.

S. Mazumdar (TIFR, Mumbai) illustrated the use of picosecond time-resolved fluorescence and anisotropy decay of natural porphyrins and their zinc complexes in anionic, cationic and neutral

micelles. The spectral data are consistent with the model, suggesting that the fluorescence depolarization occurs by both rotational and translational diffusion of the porphyrin inside the micelle along with the tumbling motion of the micelle as a whole.

From the surface photovoltage (SPV) studies, the reversal of the photocurrent in a liquid junction solar cell from n- to p-type characteristics was reported. This reversal is explained by preferential trapping of photoelectrons which supports the widely-held belief that charge transfer across a semiconductor-liquid interface occurs via trapped carriers. Based on SPV studies, the effect of humidity and film thickness on the ability of intrinsic semiconductors to generate photocurrent, the effect of etching on surface change and charge carrier sites have been investigated in the Weizmann Institute, Israel. G. Hodes gave a graphic account of the role of surface states in the photoelectrochemical properties of nanocrystalline CdSe films.

G. Prabhakara Rao (CECRI, Karaikudi) discussed the impact of chemically modified electrodes on many electrochemical

phenomena involved in photoelectrochemical cells. When potassium hexacyanoferrate was used as the chemical modifier, a large enhancement in photocurrent was noticed. However, dark current also increased owing to the formation of reactive intermediates, thereby restricting long-term stability of these electrodes.

P. Velusamy (Gifu Univ., Japan) elaborated the technology of obtaining thin lead oxide films and their interesting semiconducting properties. The photoelectrochemical and spectral responses and solar energy conversion efficiency of films grown using different electrolytes were analysed in the light of surface morphologies of the films.

The diversified topics covered in the meeting have been successful in channeling thoughts and experiments to harness and utilize solar energy and understand several photochemical and photobiological processes.

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## RESEARCH NEWS

### Anomalous diamonds

Some recent reports of diamonds in rocks of crustal origin have added to the plethora of diamond finds outside the long established kimberlite (diatremes) source. These have shaken conventional notions that diamonds are solely mantle-derived, formed under high pressure and temperature (40 kilobars and 950°C), conditions not available in the crustal environment. Porous aggregates of micrometer-sized diamond crystals – carbonados – are examples<sup>1</sup> of non-kimberlite source showing attributes for a crustal origin. They are considered to be products of either transformed carbon subducted into the mantle or generated during impact metamorphism of carbon in rocks. Irradiation of organic carbon by fission fragments is found capable of inducing structural re-arrangement of carbon to diamond during the

radioactive decay of uranium in uraniumiferous sediments. Such nanometer-sized diamonds have been reported<sup>2</sup> from Precambrian carburanium – a fine-grained coal-like assemblage containing hydrous, carbonaceous material (with 5% uranium oxide) – occurring as brittle hygroscopic oval inclusions in pegmatite veins from North Karelia, Russia. These 40 nm sized diamonds were retrieved from the acid leached residues of the rock and their identity established by high resolution transmission electron microscopy. The find proves that 'carbonaceous material, catastrophically disrupted by energetic particles, can crystallize as diamond'<sup>2</sup>, a process that will shortly be verified experimentally in a linear accelerator.

Diamonds of extra-terrestrial source<sup>3,4</sup>, generated in the inter-stellar space, have

been found in iron meteorites and urelites and they are believed to have formed by vapour condensation. Clay beds from the impact crater site along the Cretaceous-Tertiary boundary (K-T boundary)<sup>5</sup> were found to contain minute crystals of diamond. They are not considered extra-terrestrial but are supposed to be meteorite-impact induced as they show chemical and isotopic constituents typical of earthly materials. Another example of impact-related diamond has been reported<sup>6</sup> from the 15 million-year-old Ries Crater in Germany. This is considered to have formed 'by chemical vapour deposition from the ejected plume of the impact crater' when carbon-bearing rocks vapourized during the impact.

Among the few other recent non-kimberlite diamond finds, is one from meta-