the bond length discrepancy (0.041 Å) is quite large and this is what makes this case unusual, even exotic. It is therefore dangerous to assume as Wesolowski *et al.* seem to have done that simply because the value obtained by high level theory is 'normal', it must be correct. Again, suspecting the X-ray technique is unlikely to lead to a resolution of this dilemma. Chandrasekhar speaks of the 'needle of suspicion', while Schleyer/ Schaefer are more daring and refer to the experimental work as a 'highly suspicious crystal structure', and that too in the title of their paper. Suspicion is warranted only in cases of wrong-doing, and is justified only when the accuser is fully confident as to what is 'right'.

Right and wrong are relative terms even in the cloisters of science, and it would be fairer to both experimentalists and theoreticians if one were to acknowledge that both groups of scientists attempt to extract what is 'right', using the methods available to them, and in the most rigorous ways possible. In rare cases like the present one, what is 'right' with one method appears to be 'wrong' when scrutinized with another. Eventually of course, one progresses a bit towards something that is 'more right' than what one has at present. But then, is not this the ultimate goal of science?

GAUTAM R. DESIRAJU

School of Chemistry,
University of Hyderabad,
Hyderabad 500 046, India

Deep petroleum and the non-organic theory

The recent 'Research News' item published in *Current Science*, summarizing the discovery of hydrocarbons in Archaean rocks[1] rightly highlights the significance of this event. In this letter, I wish to point out that these developments find a natural explanation within the framework of a theory that had been reviewed in the same journal earlier[2].

The discovery of petroleum in source rocks of Archaean age was somewhat unexpected from the viewpoint of the classical organic theory. As per this model, petroleum is of organic origin, being the decomposed remains of plankton. Since life was not abundant in the early periods of the Earth's history, it was thought that there was very little petroleum produced in this manner. Moreover, this petroleum was considered unlikely to have survived the thermal stress which virtually all Pre-Cambrian sediments have undergone. Hence, little prospecting was undertaken in Archaean rocks.

This view persisted despite the discovery of a few Proterozoic oil fields in Oman, China and Siberia. The situation changed when recent work[3] uncovered the existence of oil in sandstone 3000 m.y. old from the Kaapvaal craton in South Africa and the Lake Superior craton in Canada. Source rocks in the form of hydrocarbon-bearing mudstones have been identified, making an organic origin possible. However, within the framework of the non-organic theory this development is entirely expected, for petroleum is seen here as primordial, representing ancient hydrocarbons incorporated into the Earth. It has thus existed since the early days of the Earth, and its occurrence in Archaean rocks is trivially expected in this model.

In recent years, evidence of hydrocarbons in asteroids and comets has continued to accumulate. In the non-organic framework, these petroliferous asteroids/comets are the progenitors of the Earths oil. Hence, the occurrence of primordial petroleum in large quantities is expected. In this light, the recent discoveries of hydrocarbon ice on objects in the Kuiper belt, a band of objects just beyond the orbit of Neptune, is an indication of the substantial amounts of extraterrestrial hydrocarbons[4].

In fact, with these large quantities of hydrocarbon having been dumped on the Earth during its formation, the question is reversed. If the petroleum on the Earth is entirely of an organic origin why has all this primordial hydrocarbon only been a silent spectator?

Although all investigators[1] considered these Archaean petroleum findings to be of ancient biological origin, a non-organic origin is equally plausible. Thus, the petroleum oil occurs in fluid inclusions lying within healed microfractures confined to individual quartz grains. This indicates that the oil was emplaced prior to Archaean metamorphism. This is consistent with the non-organic theory, with the oil being emplaced as a result of upwelling under pressure, with the creation of fractures and the emplacement of oil into the fractures. However, organic petroleum migrating upwards from deep source rocks also provides a plausible explanation.

The Australian occurrence in the Macarthur basin dates to 1400–1700 m.y.[5] coinciding with the appearance of the unicellular organisms called eukaryotes that, as per the organic theory, constitute the major source of oil. However, the discovery of petroleum much older, that is 3.0–2.75 b.y. old[3] pre-dates the origin of such organisms.

The discovery of deep bacteria at depths heretofore unsuspected[6] has come at the same time as the discovery of ancient petroleum. The organic theory views these as representing survivals of organisms entombed since Archaean times. In the non-organic theory, these bacteria were incorporated into the forming Earth, and are ascendng from the depths to the surface. Hence, the non-organic theory can explain most aspects of the recently-discovered Archaean petroleum as well as the deep bacteria as consistently as the organic theory can.

No wonder the non-organic theory is slowly gaining wider acceptance as an alternative to the organic theory. Robert O. Russell, a wellsite geologist at the first well in North America (at Fort McMurray, Alberta, Canada) drilled into crystalline basement granitic shield rocks for the express purpose of commercial hydrocarbon exploration, has pointed out that there are more than 400 wells and fields worldwide, both off-shore and on-shore that produce or have recently produced oil from igneous

rocks[7]. This fact alone indicates that many aspects relating to the origin of petroleum need to be revised. Thomas Gold[8], a distinguished proponent of the non-organic theory, has expanded the application of the non-organic theory to all hydrocarbons, including coal.

In this connection, an international conference on 'Oil in Granite' was held recently in Kazan, Tatarstan, Russia[9]. One of the papers by Kosachev *et al.*[10] from the Institute of Organic Physics and Chemistry, Russian Academy of Sciences, Kazan, concluded that much evidence existed in favour of the theory, and that viable mechanisms for the creation of migration pathways existed.

Recently, C. Warren Hunt, a geologist of the Anhydride Oil Corporation, Calgary, Canada, has proposed a variant of the non-organic theory[11]. This novel theory sets forth the notion that upwelling deep non-organic methane is bacterially modified into petroleum at shallow depths.

In conclusion, although an organic origin of primordial Archaean petroleum is possible, it is far more natural within the non-organic framework. In recent years, the non-organic theory has been gaining wider acceptance. The discovery of the 'Deep Biosphere', the new world of underground bacteria, is another interesting development which may help to shed more light on the origin of petroleum.

1. Sankaran, A., *Curr. Sci.*, 1999, **76**, 868–870.
2. Abbas, S., *Curr. Sci.*, 1996, **71**, 677–684.
3. Dutkiewicz, A., Rasmussen, B. and Buick, R., *Nature*, 1998, **395**, 885–888.
4. Brown, R. H., Dale, P. C., Pendleton, Y. and Veeder, G. J., *Science*, 1997, **276**, 937–939.
5. Jackson, M. J., Powell, T. G., Summons, R. E. and Sweet, I. P., *Nature*, 1986, **322**, 727–729.
6. Sankaran, A., *Curr. Sci.*, 1997, **73**, 495–497.
7. Russell, R. O., *Oil Gas J.*, 1995, p. 34.
8. Gold, T., *Am. Sci.*, 1997, **85**, 408–411.
9. Proceedings of the Conference on Oil in Granite, Kazan, Tatarstan, Russia, 17–19 December 1997, Polar Publishing, Calgary, Canada, 1998.
10. Kosachev, I. P., Romanova, U. G. and Romanov, G. V., in Conference on Oil in Granite, Kazan, Tatarstan, Russia, 17–19 December 1997, Polar Publishing, Calgary, Canada 1998, paper no. 23.
11. Hunt, C. Warren, *Expanding Geospheres: Energy and Mass Transfers from Earth's Interior*. Polar Publishing, Calgary, Canada, 1992.

SAMAR ABBAS

Department of Physics,
Utkal University,
Bhubaneswar 751 004, India

Hybridization in Heteropneustids

A recent report published by Sridhar and Haniffa[1] prompted me to write this letter. The authors claim that '... reports on hybridization among the Heteropneustid species are nil. With the exception of a previous investigation on intergeneric hybridization involving *Clarias batrachus* × *H. fossilis*[2], no work has been attempted on hybridizing Heteropneustid species'. This is a sweeping statement, as we have earlier reported the intergeneric hybridization between *H. fossilis* and *C. batrachus*[3]. Subsequently, we confirmed true hybrid formation, rather than androgenesis or gynaegenesis, by molecular hybridization of isolated genomic DNA using ribosomal RNA gene probe[4]. Lastly, we also reported the *Clarias* dominant physical features of reciprocal hybrids between these two catfishes[5].

1. Sridhar, S. and Haniffa, M. A., *Curr. Sci.*, 1999, **76**, 871–873.
2. Mukhopadhyay, S. M. and Dehadrai, P. V., *Matsya*, 1987, **12–13**, 162–164.
3. Chaudhuri, A. and Mandal, R. K., *Indian J. Exp. Biol.*, 1979, **17**, 1150–1151.
4. Ghosh, B., Datta, U., Roy Choudhury, S. and Mandal, R. K., *J. Genet.*, 1991, **70**, 169–179.
5. Padhi, B. K., Datta, P. and Mandal, R. K., *Indian J. Exp. Biol.*, 1995, **33**, 433–436.

R. K. MANDAL

Department of Biochemistry,
Bose Institute,
P-1/12 CIT Scheme VIIM,
Calcutta 700 054, India

NEWS

A sturdy lead acid car battery using acid gel*

In the traditional car batteries, lead plates are immersed in dilute sulphuric acid. A reputed battery manufacturing company has now designed a new battery, which they think, is much better than the conventional batteries. It also uses the lead–acid mix to generate electricity, but the metal is wound into a tightly cylindrically coiled mesh covered with an acidic gel. The mesh retains the semi-solid acid gel firmly and so unlike in conventional battery technology the acid cannot spill. This battery is called Select Orbital Exide Battery. The price of this battery is stated to be about 50% more than the normal battery. The conventional automotive battery is expected to last about

*Extracted from *Professional Engineering*, 1999, **12**, 14.