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Biology: Its importance in Modern Education

One of the most important and remarkable developments of modern times has been in the study of Biology. Educated men have only very recently recognized the fact that this science is in a large sense the foundation of nearly all forms of human progress.

In the past few years vast advances have been made in all the sciences, and in the realm of the Physical Sciences particularly, investigations and discoveries and their practical application to production have resulted in an immense increase of material wealth. This increase, however, is swallowed up by the drain due to the destructive activities of animals and plants which as parasites, carriers of disease germs, and destroyers of crops, are slowly gaining a dominance in the world. Their activities are a menace which unless checked may lead ultimately to the degeneration of the human race. We are awakening to the fact that human efforts in checking this colossal drain on the wealth of nations can only be successful if undertaken on a national basis. A nation's health and efficiency is the health and efficiency of its citizens, and unless this is of a high standard national wealth and prosperity will suffer.

The first step in this great campaign is the education of the general public in the fundamental principles governing life – the laws of health, the functions of the body in health and disease, the chief types of animals and plants beneficial or dangerous to human health, the role of animals and plants in the spread of disease and the dangers of uncontrolled human reproduction, especially in the undesirable classes of humanity. Mass ignorance in these respects has undermined the health of nations, incapacitated millions and endangered the health of the fit.

The two main channels for the drain of the world's wealth are through human disease and animal and plant pests, and the progress made hitherto by experts has been almost entirely in the field of cure rather than prevention.

In the problem of disease we have left the task to the medical fraternity. It is impossible for medical men and other scientists alone, with all their knowledge, experience and willingness to serve, to combat disease brought about through ignorance. For every individual cured through the corporate knowledge of doctors and other scientists, there are tens of others who contract disease through that arch enemy, ignorance. The need for more doctors and more money to heal the ever-increasing numbers of suffering humanity will obtain scant relief as along as we fail to change our methods of approaching the problem. A nation's knowledge of the means of preventing disease is probably the biggest and most important step in man's warfare with disease.

In the problem of animal and plant pests similar conditions prevail. Crores of rupees are annually lost in India through the devastating depredations of insects alone. Add to this the wealth lost by other animal and plant pests and the figure far outstrips the wealth that can be accumulated through the combined achievements of all modern science.

The world can never be adequately grateful to the workers in the physical sciences whose achievements and discoveries have contributed much to the progress and prosperity of the world. Admirable as the progress and effect of these achievements may be, the world has not yet found an effective check to the drain of human life and wealth. Indeed we owe it as a tribute to these silent workers to specialize and concentrate on a study of the comparatively neglected Biological Sciences; a knowledge of which is absolutely essential for conserving the health and prosperity that the Physical Sciences have won for us.

OPINION

A review of coalbed methane exploration and exploitation

Anirbid Sircar

Methane is an unpleasant explosive contaminant of coal, better known for killing miners than benefiting society. But recent technology developed in the US has allowed the gas to be tapped and sold in commercial quantities. The amount of methane held in coal seam depends on the age, moisture content and depth of the coal.

Coal is a carbon-rich material that has been formed by the chemical and thermal alteration of organic debris. During this process called coalification, a series of by-products are generated, including water and methane. With the progress of coal in rank from peat to anthracite, about 140 m^3 of methane is generated per ton of coal. The amount of methane produced during coalification generally exceeds the capacity of coal to hold the gas. The excess gas migrates into the surrounding rock strata and into the traditional sand reservoirs that may overlie the more deeply buried coals.

Methane can be extracted from the coal seams by the process of desorption according to which the initial reservoir pressure is reduced, by dewatering, to the critical desorption pressure. Thereafter, the coal seams release methane gas as the pressure is reduced. The abandonment pressure is the lowest pressure at which no more methane can be produced. Before an exercise of drilling for the purpose of methane extraction can be undertaken, an estimate of the reserves of coalbed methane gas is made.

Geological set-up in exploration

From the geological mapping and the grade of the coal seams, a preliminary idea can be obtained whether coalbed methane has been formed, and if formed, entrapped in the coal bed. An idea of the cost of drilling for the purpose of extracting coalbed methane gas can also be obtained.

Once the total coal thickness is known by mapping, its multiplication by the area extent gives the volume of coal which when multiplied by density gives the tonnage of coal. The coal tonnage upon multiplication by the gas content of coal, gives the amount of methane absorbed by the coal.

The efficient gas recovery depends upon a large number of factors which in turn influence gas and water production. Of these only three factors, namely permeability, static reservoir pressure and gas desorption pressure are influenced to a greater extent[1].

Geophysical inputs

Remote sensing imagery

Remote sensing data to identify the major lineaments and tectonic set-up may be useful to explore an area of coalbed methane. The details of major fault trends will help in prioritizing the areas available for exploration.

Seismic survey

High resolution seismic survey is helpful to know the basin configuration, its tectonic style, thickness of coal-bearing formation, lateral continuity and approximate depth of different coal seams. The sampling interval, geophone, charge size, charge depth, group interval and shot interval should be carefully chosen through experiments and the full spectrum of recorded frequencies during processing of data should be retained. The geophysical inputs may, however, be required in a virgin field before taking up an area for coalbed methane exploration.

Drilling

The design and procedure for drilling a coalbed methane gas well must achieve the aims of maintaining well control and preventing formation damage[2].

The primary concerns for drilling are overpressure of gas/water kicks, high permeability which leads to loss of circulation fluid, formation damage due to the nature of coal and hole sloughing.

The rigs commonly used are portable, self-propelled and hydraulically-driven, having a top head drive or a kelly drive. A major problem during drilling could be the excessive water flow. Drilling with pressure may be hindered due to escape of large quantities of water through the coal seams.

Worldwide interest

At the moment, almost all of the world's 7.6 bcm/y production of coalbed methane comes from the US[3], where reserves of coalbed methane are conservatively estimated at a third of natural gas reserves. Drilling is concentrated in two areas, Alabama's Black warrior, where the coal seams are particularly gas-rich; and New Mexico's San Juan basin, which is tied into the natural gas grid[4].

Australia is likely to be the next producer of commercial quantities of methane: a couple of pilot projects in Queensland and New South Wales are already well advanced. However, one drawback in such a huge but sparsely populated territory is finding a market for the gas.

China, the world's largest coal producer, is sitting on more than 700 tcf of coalbed methane. The country already has a fairly widespread system of methane drainage and capture, to keep its rather gassy mine safe enough to work in. But although 60% of drained methane is utilized, most of it is too dilute to be used in anything other than local power plants or factory sites.

The smaller coal producers of the world are doing their bit for coalbed methane too. However, the mature industries and crowded territories of most of them will keep developments modest. Interest around the world is quickening, and world coalbed methane output is on the first track.

Coalbed potential of India

India is among the top ten countries in coal resources, having an estimated coal reserve of 160 million metric tons, with an estimated methane resource of 850 BCM.

The Indian coal is mainly confined to the Permian Gondwana basins and the tertiaries. Tertiary coals are widespread in Assam, Meghalaya, Arunachal Pradesh, Tamil Nadu, Rajasthan and Gujarat. Tertiary coals are generally found to be lignitic to sub-bituminous in rank and are generally considered to be unsuitable for coalbed methane target. However, tertiary coals in petroliferous basins of Cambay, Upper Assam and Assam–Arakan may be prospective due to reported higher gas content, which is probably stored in the coal after generation from deeper-lying hydrocarbon source beds or may be of biogenic origin.

Methane emission studies from working mines of India reported most of the degree three gassy mines (> 10 cubic m/ton), are confined in the four Damodar Valley coal fields, viz. Raniganj, Jharia, Bokaro and North Karanpura in Bihar and West Bengal. In these areas, the thickest bituminous coals are extensively developed in the Barakar measurers and in Raniganj measures of Lower and Upper Permian age, respectively.

The Barakar coal seams are superior to Raniganj coal seams as coalbed methane targets. Based on thickness and burial depth, rank and quality of coal has the greatest coalbed methane potential in India.

Media reports have indicated that a few national and multinational companies have shown keen interest in coalbed methane exploration in India.

However, the companies which have already started work in field are Eassar Oil, ONGC, Reliance and CMPDIL.

Summary

Coalbed methane exploration may open up a new energy industry in India. Evaluation of coal properties, construction of adsorption isotherm, and study of geological setting of coal basins should be an integral part of initial research efforts. It is desirable to work out the techno-economic viability of a project after R&D efforts are completed and before exploration and exploitation are taken up.

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SCIENTIFIC CORRESPONDENCE

Usefulness of dipstick test (ParaSight^{TM}F) in high-risk groups for *Plasmodium falciparum* in Central India*

A simplified detection assay that uses a dipstick (ParaSight^{TM}F) developed by Becton Dickinson Advanced Diagnostics (Sparks, MD, USA) was evaluated in the field in forest villages of India[1]. Its simplicity of use suggested it could play an important role in field for the accurate diagnosis of *Plasmodium falciparum* infection. Therefore, we have introduced this technique to people who work in the field and report their experience of using this test in high-risk groups, i.e. infants, children and pregnant women in two districts of Madhya Pradesh (MP; Central India), where malaria is mesoendemic and epidemic prone.

The study was conducted during high transmission season of *P. falciparum* (August–November) in 20 villages of district Jabalpur and Chhindwara (MP) in 1998. The procedure was explained by a Laboratory Technician to one Field Lab Assistant (FLA) who then performed the test under supervision three times. The FLA (A) then explained the test procedure to his colleagues (B and C) who later performed the test in field without supervision. All three FLAs were assigned different study groups, viz. A, infants (1 m to < 12 m), B, children (1 yr to < 5 yrs) and C, pregnant women. Finger-prick samples of blood were collected by the FLAs from all available infants and pregnant women with or without fever. The FLAs then performed the rapid ParaSight^{TM}F test; however, in children only from fever cases. (Infants and pregnant women are highly vulnerable and together they represent the magnitude of malaria in an area. Further, infants are often without symptoms up to 6 months or more because of the mother's immunity and pregnant women generally do not come for blood examination as medicines are harmful to the foetus. Hence all available infants and pregnant women were included.) Verbal consent was obtained from the parents of infants/children and from the woman herself or her husband to carry out the test. Simultaneously, a trained microscopist made thick and thin smears which were re-examined by an independent expert unaware of the previous results for quality control. Parasite density was counted against 200 WBC in thick film and parasitaemia was calculated by taking 8000 as the average WBC count by a standard method (Parasites/μl = No. of parasites × WBC count/no. of WBC counted).

Of the 472 people of all age groups examined by both the methods, 139 were found by microscopy to be parasitaemic, 111 were infected with *P. falciparum*, 23 with *P. vivax* and 5 had mixed infection of *P. vivax* and *P. falciparum*. Mixed infections were analysed with *P. falciparum*. None of the 23 *P. vivax* cases detected by thick blood film examination gave a positive test. Overall, the dipstick was positive in 105 cases, including 5 mixed infections (Table 1) out of 116 cases (sensitivity, 90.5%), and negative in 331 out of 333 cases (specificity, 99.4%), giving a positive and negative predictive value of 98.1 and 96.8%, respectively (efficiency, 97%). Two (A and C) out of the

Table 1. Specificity and sensitivity of the dipstick ParaSight^{TM}F test in diagnosing *P. falciparum* in field as compared to thick smear by a trained microscopist in field laboratory

Dipstick ParaSight^{TM}F test	Microscopy Positive[a]	Negative[b]	Total
Positive	105	2	107
Negative	11	331	342
Total	116	333	449

[a]Including 5 mixed infections of *P. vivax* and *P. falciparum*.
[b]*P. vivax* cases are not included.

*Paper presented in a meeting on 'Informal consultation on Malaria Diagnostics at the Turn of the Century' from 25 to 27 October 1999 in Geneva.