'plain-living and high thinking'. Saha did most of his scientific and organizational work during the pre-independence era. He supported the independence movement and believed that there had to be a complete reorganization of society and the economy after independence.

While Saha and Raman differed on many aspects of development of science in the country, their views on nuclear weapons are almost identical. If anything, Saha is more vocal in expressing his views: 'the logical pursuit (of utilizing nuclear fission for military purposes) by rival power groups will mean the destruction of the present form of civilization ...' (*Sci. and Cult.*, 1947, **13**, 86).

Quite early he realized that nuclear warfare should be banned—'Though the possession of atomic weapons appears to constitute great military strength, actually it is not so. Its use constitutes a great moral sin against humanity. Its production involves immense organization and cost, which only the big nations are capable of undertaking. It is effective only against great centers of population and industry, whose destruction would be an unpardonable crime against civilization.' Commenting on a decision made on 18 December 1954 by the NATO Council to base its military strategy on the use of nuclear weapons, he said, 'The decision is immoral because the very persons in whose interest atomic weapons are proposed to be used would be its first victims. History teaches that "wars to end wars", "violence to end violence" have never accomplished their objective. The consequence of the decision will be to intensify the race for nuclear armaments and endanger the peace of the world. If the conflagration spreads, as it is sure to do, it will lead to sheer mass destruction.' He believed that the NATO decision made the destruction of modern civilization a technological possibility.

On the attitude of scientists, intellectuals and artists towards the nuclear danger he has this to say: 'Apart from the fire-eating generals, admirals and politicians of the McCarthy type (and, we might add, scientists of the Teller type), the world opinion of scientists, artists and intellectuals is definitely against the manufacture and use of atomic weapons.'

Note how this logical, reasoning scientist clearly always holds the larger good of humanity in mind: 'Those who are indulging in the testing of thermonuclear bombs, even in distant areas, cannot avoid the moral responsibility of committing a crime against humanity.' 'The atomic logic has been used since 1946 to frighten nations. The "atomic war-mongering" is chiefly the work of ill-informed generals, admirals and politicians' (*Sci. and Cult.*, 1955, **21**, 70).

Conclusion

It is not coincidental that the best of scientists, the men and women who have dramatically altered our view of nature, have been opposed to the destructive aspects of science. The pursuit of truth as one perceives science to be, also entrusts scientists with a responsibility to put it to humane uses. This aspect of science has as much to do with the blossoming of a science culture in India as with having creative scientists and well-equipped labs.

In a letter addressed to many scientists around the world including Saha, Einstein had this to say: '... Through the release of atomic energy, our generation has brought into the world the most revolutionary force since prehistoric man's discovery of fire. This basic power of the universe cannot be fitted into the outmoded concept of narrow nationalisms. For there is no secret and there is no defence; there is no possibility of control except through the aroused understanding and insistence of the peoples of the world.' 'We scientists recognize our inescapable responsibility to carry to our fellow citizens an understanding of the simple facts of atomic energy and their implications for society. In this lie our only security and our only hope—we believe that an informed citizenry will act for life and not for death.'

It is about time that the humanist tradition of science, so eloquently expressed by Raman and Saha, asserted itself in the collective consciousness of our community.

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SCIENTIFIC CORRESPONDENCE

Algal flora in the cave soils

Caves although are one of the stressed environments, they are inhabited by a number of species of vertebrates[1], invertebrates[2], and microorganisms such as bacteria and fungi[3]. Apart from these, algae are one among the smaller organisms which inhabit only the light-receiving entrance zone of the cave[4]. Diatoms were often collected from subterranean waters, but they cannot be kept alive under total darkness, while those collected from dark zone of subterranean rivers were always found dead[5]. The present study describes the algae cultured from the soils of six different caves in South India.

Soil samples were collected from six caves: Samanar (C1), Pannian (C2), KKB I (C3), and KKB II (C4). The Samanar cave faces southeast, whereas the other caves face the northwest within a radius of about 10 km from the Madurai Kamaraj University campus (9°58′ N, 78°10′ E). The other two caves Ramanathapuram (C5) and Veerasihamani (C6) are located at a distance of about 140 km in the north from Tirunelveli (8°44′ N, 77°42′ E). The temperature and humidity were recorded continuously inside the first four caves for a period of one year[6–8]. The geophysical characteristics of the caves are given in Table 1. Based upon penetration of light, all caves are arbitrarily divided into three parts, namely entrance, twilight and dark zones. Cave 3 is well illuminated and hence shows

the absence of dark zone in it. The soil samples were collected in 1.5 ml eppendorf tubes from three different places in each zone and from each cave (a total of 51 samples). Composite samples were prepared by mixing one g of the samples from the three samples of each zone, reducing the total number of samples to 17. One g of each composite sample was dispersed in 10 ml of Reimann *et al.* and Bold's basal media separately in test tubes for the growth of diatoms and green algae, respectively. The cultures were reared in a thermostatically-controlled room (24 ± 1°C), illuminated with cool white fluorescent lamps at an intensity of 50 $\mu E/m^2/s$ (equivalent to 2500–3000 lux), and exposed to 12 h : 12 h light–dark condition. Counting and identification were on the basis of their respective keys[9–11].

Table 1. Geophysical characteristics of the six caves

Cave	Zone	Distance from entry point (m)	Temperature (°C)	Humidity (%)	Maximum light intensity (lux)	Seasonality
C1	EZ	0–5	Max. 29.2 ± 1.5 Min. 22.8 ± 0.7	Max. 56.9 ± 7.5 Min. 28.8 ± 0.8	1144	Slight
	TZ	5–15	Max. 26.3 ± 1.15 Min. 22.5 ± 0.6	Max. 91 ± 1.0 Min. 71.13 ± 5.54	7.5	Minimal
	DZ	> 15	27 constant	95 constant	Constant darkness	Absent
C2	EZ	0–5	Fluctuates	Fluctuates	110469	Slight
	TZ	5–10	Fluctuates	Fluctuates	8.14	Minimal
	DZ	> 10	Relatively constant 27	Relatively constant 95	Constant darkness	Absent
C3	EZ	0–4	Fluctuates	Fluctuates	Fluctuates	Slight
	TZ	> 4	Fluctuates	Fluctuates	Fluctuates	Minimal
C4	EZ	0–3	Fluctuates	Fluctuates	Fluctuates	Slight
	TZ	3–8	Fluctuates	Fluctuates	Fluctuates	Minimal
	DZ	> 8	Relatively constant 27	Relatively constant 95	Constant darkness	Absent
C5	EZ	0–2	Fluctuates	Fluctuates	Fluctuates	Slight
	TZ	2–5	Fluctuates	Fluctuates	Fluctuates	Minimal
	DZ	> 5	Relatively constant	Relatively constant	Constant darkness	Absent
C6	EZ	0–3	Fluctuates	Fluctuates	Fluctuates	Slight
	TZ	3–5	Fluctuates	Fluctuates	Fluctuates	Minimal
	DZ	> 5	Relatively constant	Relatively constant	Constant darkness	Absent

EZ–Entrance zone, TZ–Twilight zone, DZ–Dark zone;
Each cave (C) is numbered as given in the text;
Food sources: Bat guano (water flows and air currents also carry food materials).

Table 2. Distributional pattern of algae in different zones of caves

	Entrance zone						Twilight zone						Dark zone				
Genera recorded	C1	C2	C3	C4	C5	C6	C1	C2	C3	C4	C5	C6	C1	C2	C4	C5	C6
Chlorophyceae																	
Chlorella sp.	–	+	–	+	+	–	–	+	–	–	–	–	–	–	–	–	–
Chlorococcum sp.	+	+	+	+	+	+	+	+	+	–	–	+	–	–	–	–	–
Scenedesmus sp.	+	+	–	–	+	+	–	–	–	–	+	–	–	–	–	–	–
Bacillariophyceae																	
Cyclotella sp.	+	+	+	+	–	–	–	–	+	–	–	–	–	–	–	–	–
Navicula sp.	+	+	+	+	+	+	+	+	–	–	–	–	–	–	–	–	–
Nitzschia sp.	+	+	–	+	+	–	–	–	–	–	–	+	–	–	–	–	–
Surirella sp.	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Each cave is numbered as given in the text.

It took 3–7 days for the algae to grow in the media. A total of seven species of algae, belonging to Bacillariophyceae (four species) and Chlorophyceae (three species) (Table 2) grew on the soil samples. One way completely randomized ANOVA showed that the representation of different species of algae was significantly higher ($F_{1,82} = 18.7$, $P < 0.0001$) in the samples from the entrance zone (73.68%) compared to twilight zone (26.32%) of all the caves. No green algae or diatoms were found in the culture of samples collected from the dark zone of any of the caves. Among the green algae, *Chlorococcum* sp. and among the diatoms *Navicula* sp. were more dominant at the entrance zone of all the caves.

While the Pannian cave (C2) had all seven species of algae at its entrance zone, only three to five species of algae were found at the entrance zone of other caves. The soil samples taken from the twilight zone of various caves had less number of species: three in cave 2; two in caves 1, 3 and 6; one in cave 5; and none in cave 4.

The presence of seven species of algae in Pannian cave (C2) is presumably because the entrance of this cave faces the zenith and thereby receives more light compared to other caves (Table 1). Some genera like *Chlorella*, *Scenedesmus* and *Chlamydomonas* can grow also chemorganotrophically in dim light, using simple substrates[12]. The present study confirms the earlier reports with regard to the distribution of algae in caves[4], in response to light as the limiting factor.

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In vitro studies on some non-coniferous gymnosperms

Gymnosperms, comprising conifers and non-conifers, are generally evergreen trees and shrubs. A number of reports are available on the application of tissue culture technology for multiplication of coniferous plants[1] unlike the case with non-conifers[2]. The non-conifers, such as cycads and *Ephedra*, differ strikingly from conifers in their habit, structure, and habitat. They are important in terms of evolutionary, scientific, ornamental and medicinal values. The presence of ciliate sperm (primitive feature) in cycads, and double fertilization (advanced feature) in *Ephedra* adds further to their distinct identity. Cycads which were once common in mid-Mesozoic, are now present only as relics of the past and are aptly referred to as 'Dinosaurs of the Plant Kingdom'[3]. Cycads propagate themselves either through seeds or asexually by means of adventitious shoots. Further, all cycads are slow growing. The plants are dioecious and the seed set is very poor. Even the few seeds that mature, rapidly lose their viability. Disturbances in their ecosystem have led to a steady decline in the population size of cycads, thereby causing serious concern.

Cycads are notorious for their recalcitrance to tissue culture[2]; and thus are a challenge to investigators. The generally used explants in cycads are from embryo or endosperm[4]. Paucity of seeds and a single massive shoot apex (pachycaulous) are additional disadvantages for their propagation by tissue culture technique. Some workers have used leaf explants[5–8].

The present report deals with responses obtained from different explants of *Cycas*, *Zamia*, and *Ephedra foliata* cultured on Murashige and Skoog medium (MS) with various plant growth regulators (PGRs) added to the medium individually as well as in combination. Regeneration using nodal segments has been reported in a few species of *Ephedra*[9], and from haploid tissues of *E. foliata*[10]. Micropropagation of *E. foliata* using embryo explants is also described here.

Segments of petiole and rachis (1.0–1.5 cm long portions split lengthwise) of unfolding leaves of cycads and seeds of *E. foliata* were obtained from the Botanical Garden, Department of Botany, University of Delhi. Embryos and portions of endosperms of *C. circinalis* were excised from seeds collected from Nagamangala, Karnataka State. Explants were sterilized with 0.1 to 0.2% $HgCl_2$ solution for 2 min in a laminar flow cabinet prior to inoculation. MS medium[11] with different concentrations of auxins (2,4-D, NAA) and cytokinins (BAP, Kn) singly or in combinations was used. Embryos of *E. foliata* were excised from mature seeds, and medianly-cut half portions were cultured on the MS medium with 2% sucrose and 10% coconut water (CW) + PGRs. For each experiment a minimum of 24 cultures were raised and the experiments were repeated at least twice. Cultures were maintained at 25 ± 2°C under 16 h light photoperiod provided by cool fluorescent light (15 $mE/m^2/s$).