Chemical study of Cenozoic woods from Kashmir, India

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Acetylbromide chemical treatment of fossil woods recovered from various Pliocene and Pleistocene strata in the Karewa Formation of Kashmir has been carried out to evaluate their degree of humification.

Key-words—Chemistry, Fossil woods, Cenozoic, Kashmir (India).

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साराँश

भारत में काश्मीर से नूतनजीवी काष्ठों का रासायनिक अध्ययन

फ़ारूख ए० लोन, मकसूदा खान एवं जी० ऍम० बट

काश्मीर के करेवा शैल-समूह में अतिनूतन एवं नवनूतन कालीन विभिन्न स्तरों से उपलब्ध अश्मित काष्ठों में ह्यूमसभवन का मान अन्वेषित करने के लिए एसिटाइलब्रोमाइड़ की रासायनिक क्रिया की गई तथा अध्ययन किया गया।

THE valley of Kashmir provides a unique opportunity for Quaternary palaeoclimatic and palaeoenvironmental studies of almost 1,000 m thick Karewa sediments of a primeval lake which later got drained off as a result of the emergence of Jhelum River. Fission-track dating and magnetic-polarity stratigraphy of these sediments has revealed that sedimentation has been in progress for the last four million years or so (Burbank & Johnson, 1982; Agrawal *et al.*, 1985). During the course of field work some fossil woods from various localities in the Karewa Series were collected.

Earlier, the studies on the chemical composition of fossil woods have been carried out by Komatsu and Ueda (1923), Waksman and Stevens (1929), Mitchell and Ritter (1934), Gortner (1938), Jahn and Harlow (1942), Cundy (1946), Skrigam *et al.* (1957a, 1957b), Chowdhury *et al.* (1957), Kohara (1958) Brasch and Jones (1959) and Chowdhury *et al.* (1967). These studies deal with the difference between major components (cellulose, hemicellulose and lignin) of fossil and modern woods. But it has been overlooked that humic substances exist in fossil wood (Kagemori, 1973). Therefore, the present work has been conducted to know the degree of humification in the woods from various Quaternary strata. For this purpose, the methods proposed by Itihara *et al.* (1966), Kagemori and Itihara (1967) and Kagemori (1973) are followed.

RESULTS

The results of the study are summarized in Table 1 and depicted in Text-figures 1-3. In this study four wood samples from archaeological excavations and two samples from living trees (one each from hard and soft wood) are also included for comparison. To know the decompositional differences between fossil hard and soft woods, their behaviour on chemical treatment is shown in Text-figures 2 and 3, respectively.

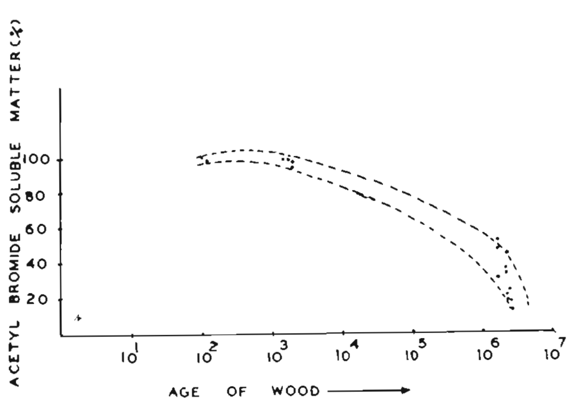
DISCUSSION

Treatment with acetylbromide proposed by Itihara *et al.* (1966) is a useful method for examining the degree of humification of fossil woods, because the main constituents of wood, i.e., cellulose, hemicellulose and lignin are completely soluble in

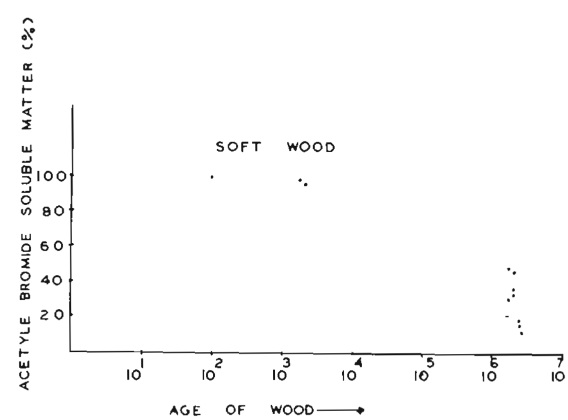
Table 1—Showing horizons, localities of samples analyzed, approximate age of the samples, kind and identity of wood, percentage of acetylbromide soluble matter and humin

Sample No.	Horizon	Locality	Assumed average age × 10⁴ years	Kind of wood	Botanical identity	% Cellulose + hemicellulose + lignin = Acetyl-bromide soluble matter %	% Humin
1	Fluvio-lacustrine Lower Karewa sediments	Dubjan	400	Soft	*Abies pindrow*	12.22	87.78
2.	Lower Karewa	Dubjan	400	Soft	*Pinus*	16.95	83.05
3	Lower Karewa	Dubjan	390	Hard	*Juglans*	23.27	76.73
4.	Lower Karewa	Dubjan	380	Soft	*Pinus*	18.31	81.69
5.	Lower Karewa	Dubjan	380	Hard	*Juglans*	21.38	78.62
6.	Lower Karewa	Hirpur Loc. III	313 (247-380)	Soft	*Pinus*	46.44	53.56
7	Lower Karewa	Hirpur Loc III	313 (247-380)	Soft	*Pinus*	36.21	63.79
8.	Lower Karewa	Hirpur	313 (247-380)	Soft	*Pinus*	33.95	66.05
9.	Lower Karewa	Khaigam	240	Soft	*Picea*	31.08	68.92
10.	Lower Karewa	Khaigam	240	Hard	*Populus*	32.91	47.09
11	Lower Karewa	Khaigam	240	Soft	*Pinus*	48.41	51.59
12.	Archaeological deposit	Burzahom	0.43	Hard	*Betula*	96.00	4.00
13	Archaeological deposit	Burzahom	0.43	Soft	*Pinus*	97.50	2.50
14.	Archaeological deposit	Semthan	0.35	Hard	*Celtis*	99.00	1.00
15.	Archaeological deposit	Semthan	0.35	Soft	*Cedrus*	98.5	1.50
16	Living wood	Srinagar	0.005	Hard	*Platanus*	100.00	0.00
17	Living wood	Srinagar	0.003	Soft	*Pinus*	100.00	0.00

acetylbromide (Karrer & Winder, 1921; Karrer & Bodding-Wieger, 1923), whereas humin in fossil wood is insoluble in the reagent (Tokuoka & Matuo, 1942). Hence, the percentage of acetylbromide soluble matter is supposed to correspond to the total contents of cellulose, hemicellulose, lignin, etc. and the acetylbromide insoluble matter to the amount of humin present.

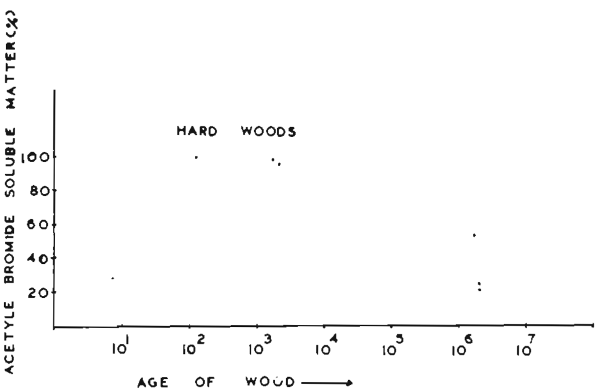


Text-figure 1—Percentage of acetylbromide soluble matter of fossil woods and assumed ages of strata bearing them.



Text-figure 2—Percentage of acetylbromide soluble matter of soft woods.

The present study reveals that the living woods are totally soluble in acetylbromide indicating that these are entirely made up of cellulose, hemicellulose, lignin, etc. and no humin is present. The percentage of acetylbromide soluble matter of samples decreases depending on the age of the fossil. The wood from the archaeological site are almost soluble in the reagent (96 to 99%). The



Text-figure 3—Percentage of acetylbromide soluble matter of hard woods.

woods from Pleistocene deposits show solubility of 31 per cent to 52 per cent and those from Pliocene levels 12 per cent to 46 per cent. Evidently, the fossil wood has been gradually humified in the course of about four million years since it was laid down in the sediments. It could be concluded that during five thousand years of the wood burried in the sediments, zero to 5 per cent of humin is formed within the fossil wood. In about two-and-a half-million years, about 50 per cent of wood is transformed into humin, and by about four million years almost all of the wood (87 per cent) is transformed into humin. It is also deducible that the soft woods are slightly more changeable into humin than hard woods (Text-figs. 2, 3) indicating that the process and degree of humification is dependent on the nature and composition of wood also.

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