

It is also interesting to include the effect of lens-film combination on the diffraction images. It can be done by cascading the Film's MTF with the system MTF's provided the linear processes would be involved. However, complexity arises due to some non-linear phenomena involved during the exposure and development of the film.

We have considered in our calculation unit contrast truncated targets so that object contrast bears a linear relationship with image contrast. It is interesting to estimate the error caused by truncation by varying the modulation. For modulation less than unity there is non-linear relationship²⁰ between object and image contrast.

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CHEMICAL COMPONENTS OF *ASPLENIUM LACINIATUM*

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ABSTRACT

Asplenium laciniatum has been found to contain octatriacontane, stearic acid, vitamin-K₂, phthiocol, β -sitosterol and β -sitosterol D-O-glucoside. The free sugars identified are sucrose (large amount), glucose, galactose and arabinose. This is the first report of the isolation of vitamin-K₂ and phthiocol from a plant source.

A *SPLENIUM laciniatum* is a fern belonging to the group of highly advanced cryptogens. Its alcoholic or acetone extract has a burning effect on the skin and produce a wound which takes about ten days to heal. Investigation of the chemical components was taken up in order to find out the active principles present in it.

The dried plant (4 Kg) obtained from Kalimpong (West Bengal) was exhaustively extracted with acetone and alcohol successively. Acetone from the acetone extract was removed under reduced pressure and the residue adsorbed on silica gel and chromatographed over a column of silica gel where-by the following compounds were obtained.

Compound A, eluted with petroleum ether, m.p. 68–70° (200 mg, from ethyl acetate). Its I.R. spectrum showed it to be aliphatic in nature. It did not answer Liebermann-Burchard test and moved along the solvent front on TLC in *n*-hexane. The mass spectrum showed a mass peak at *m/e* 534 and a cluster of peaks at 14 units ($-\text{CH}_2$) apart. The highest peak in each cluster represented $\text{C}_n\text{H}_{2n+1}$ fragment which was accompanied by C_nH_{2n} and $\text{C}_n\text{H}_{2n-1}$ peaks. Intense peaks were for C-4 and C-5 units and fragment intensity decreased in a smooth curve down to ($\text{M}^+-\text{C}_2\text{H}_5$). The (M^+-CH_3) peak was very weak. It was identified as octatriacontane.

Compound B, eluted with petroleum ether-benzene (1 : 3), m.p. 69–70° (60 mg, from methanol). Its methyl ester had m.p. 38–39°. Mass spectrum of the parent compound showed a parent peak at m/e 284. It was identified as stearic acid (octadecanoic acid).

Compound C, eluted with benzene, m.p. 104–105° (120 mg, yellow needles from petroleum ether). It gave positive test for a quinone. Its I.R. (1670 cm^{-1} for $>C=O$) and U.V. ($\lambda_{\text{max}}^{\text{EtOH}}$ 246, 261 and 332 nm) spectra confirmed it to be a quinone. N.M.R. spectrum showed a doublet at δ 2.15 due to the presence of a quinonoid methyl group having an ortho H atom. A quartet at δ 6.8 integrating for one proton may be due to the ortho hydrogen. A multiplet at δ 7.8–8.15 integrated for four aromatic protons. In the mass spectrum it showed a parent peak at m/e 172 (100%). Appearance of abundant ions at m/e 144 (M^+-CO), 116 (M^+-2CO) and at m/e 104 and its decomposition products at m/e 76 and 50 showed it to be a naphthoquinone with no benzenoid substituents^{1,2}. From the above data the structure of the compound—C, could be given as 2-methyl 1 : 4-naphthoquinone which was confirmed by direct comparison with its synthetic sample (Co-TLC, m.m.p.).

2-Methyl 1 : 4-naphthoquinone (menadione or Vit. $-K_3$) is known to occur among mammals³. Exhaustive survey of literature showed that it has not been isolated from nature. Vitamin K_3 has now been isolated for the first time from a plant source.

Compound D, eluted with benzene-chloroform (3 : 1), m.p. 173–74° (150 mg, yellow prisms from methanol). It gave positive test for a quinone. It also gave positive ferric chloride test indicating it to be phenolic in nature. Its I.R. ($1660, 3410\text{ cm}^{-1}$ for $>C=O$ and chelated $-OH$) and U.V. ($\lambda_{\text{max}}^{\text{CHCl}_3}$ 250, 280 and 335 nm) spectra confirmed it to be a hydroxy quinone. N.M.R. spectrum showed signals at δ 2.05 (3 H, $-CH_3$), δ 7.35 (1 H, $-OH$) and at δ 7.85–8.10 (m, 4 H, aromatic protons). Mass spectrum gave a parent peak at m/e 188 (100%). Presence of fragments at m/e 160 and 132 are due to the losses of one and two carbonyl groups respectively of the quinone. From the appearance of peaks at m/e 105 and 77 it could be concluded that the hydroxyl group in the naphthoquinone is at position two with no benzenoid substituents¹. From the above data the structure of compound D, could be given as 2-hydroxy 3-methyl 1 : 4 naphthoquinone (phthiocol).

For further confirmation compound D was methylated by the dimethyl sulphate, potassium carbonate and acetone method and the methyl ether crystallised from methanol as light yellow needles, m.p. 93–94° (lit. 93°, from methanol). N.M.R. spectrum of the methyl ether showed an additional peak at δ 4.15 for the methoxyl group. I.R. spectrum lacks a peak at 3410 cm^{-1} (for the chelated hydroxyl). Its mass spectrum showed a parent peak as the base peak at m/e 202 along with normal fragmentation peaks for a naphthoquinone¹. The structure of the compound D was confirmed by its synthesis⁴ and its direct comparison with the synthetic sample (Co-TLC and m.m.p.).

Phthiocol is known to be a degradative product of the K-vitamins⁵⁻⁸. It is elaborated by bacteria⁹⁻¹¹ (micro-organism, unicellular) but its isolation has now been reported for the first time from a plant source (multicellular). The presence of vitamin- K_3 and phthiocol was also detected (TLC) in the fresh solvent extract of the fern and so they are not artefacts but exist as such in the plant.

Compound E, eluted with chloroform, had m.p. 136–38° (250 mg, from methanol), $[\alpha]_D^{20}$ -40° . It gave positive Liebermann-Burchard and TNM tests, and ν_{max} $3,500\text{ cm}^{-1}$ (OH). It formed an acetate, m.p. 125–26° (from methanol). The compound was identified as β -sitosterol which was further confirmed by its direct comparison with an authentic sample (Co-TLC and m.m.p.).

Compound F, eluted with chloroform-methanol (95 : 5), m.p. above 300° and was almost insoluble in common organic solvents (100 mg). $[\alpha]_D^{20}$ 50° (pyridine). Acid hydrolysis gave β -sitosterol and D-glucose. Permethylation of Compound F, by Hakomori's method¹² and subsequent hydrolysis by Kiliani's reagent ($HCl : AcOH : H_2O : 1 : 3.5 : 5.5$) gave β -sitosterol and 2, 3, 4, 6-tetra-O-methyl D-glucose identified by paper chromatography. Enzymatic hydrolysis with emulsion showed β -linkage. The compound was identified as β -sitosterol-D-O-glucoside.

Alcohol extract on concentration deposited a white solid, m.p. 182–84° (30 g). It answered Molisch's test and gave an acetate, m.p. 68–69° (from methanol). The compound was identified as sucrose (Co-I.R.). Paper chromatography of the alcohol extract in butanol : pyridine : water ; 6 : 4 : 3 indicated the presence of glucose, galactose and arabinose (when sprayed with aniline hydrogen phthalate) as free sugars and confirmed by direct comparison with their respective authentic samples.

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PALAEOMAGNETISM OF THE CENOZOIC VOLCANIC ROCKS FROM EAST AFRICA

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ABSTRACT

Palaeomagnetic results from 269 sites in the East African Cenozoic volcanics are presented. The post-Miocene volcanics were divided into three age groups, 0-1.8, 1.8-7.0 and 13-11 my. and their pole positions calculated. Along with the Miocene pole from Turkana, the Eocene-Oligocene pole from Ethiopia, the pre-Miocene post Karroo pole from Tororo and the mean Mesozoic pole from the rest of Africa, a polar wander path for Africa from Mesozoic to present is suggested.

The small pole displacements of the late Tertiary volcanics are both "far-sided and right-handed". Whereas this could be explained on the basis of Wilson's off-set dipole hypothesis, the much larger displacements shown by the older rocks must be attributed either to polar wander or to the drift of the African plate or to both.

DURING the last ten years the palaeomagnetic research group at the University of Nairobi has carried out detailed studies of a very wide spectrum of Cenozoic volcanics of East Africa. Results of a palaeomagnetic study of the Miocene lavas from Turkana, West of Rudolf form part of an unpublished thesis by Raja¹. A detailed account of the palaeomagnetism of the volcanics of Central East Africa is given by Reilly², in his unpublished thesis. Patel and Gacii³, have presented the results of their study on the Kapiti phonolites of Kenya. The palaeomagnetism of the Ethiopian flood basalts, believed to be Eocene-Oligocene in age has been reported by Brock *et al.*⁴. Recently Raja and Visé⁵, have presented the results of their study on the Carbonatite volcanics of Tororo, S. E. Uganda, which are believed to be "pre-Miocene, post-Karroo" by Davies⁶.

This paper presents a summary of the above results.

Rocks of age in the range 13-0 my., were divided into three groups A, B and C. The groups C/B boundary was chosen as 1.8 my.

which corresponds to the Plio-Pleistocene boundary of the scale suggested by Berggren⁷. The relatively quiet period of volcanism 11-7 my. enabled the division between groups A and B. The Turkana lavas range in age from 32-13 my.⁸. But most of the basalts showed ages between 23 and 14 my. with a concentration at about 17 my.⁹. Hence the approximate age of 17 my. is assigned to the Turkana lavas considered as one unit.

Table I gives the mean directions and poles for all the groups mentioned above. Along with the mean Mesozoic pole for Africa at 261° E, 65° N¹⁰, it is possible to suggest a polar wander path for Africa from Mesozoic to present. Such a path is shown in Fig. 1. It can be seen that the pole from the Tororo ring complex (TU) fills a wide gap between the Mesozoic pole and the East African Tertiary poles. The close similarity between the Australian polar wander curve for the Cenozoic and the African polar wander curve for the same period enabled McElhinny *et al.*¹¹, to suggest the existence of a common polar wandering component.