In this series, the dihydroxy compound is not an exception to the regularity, and it is assumed to be due to the fact that only one carbonyl group of anthraquinone ring forms a hydrogen bond with the hydroxyl group.

The author expresses his gratitude to Prof. S. Takagi of the Universtiy of Kyoto for his helpful guidance throughout the work, and to Messrs. K. Ōya, Y. Yamaguchi, H. Yamura, S. Yoshida, and H. Yoshida of this Company for their kind encouragements. He is also indebted to Messrs. I. Nakanome, M. Suyama, T. Akamatsu, and their associates for preparation of standard substances.

Experimental

The infrared spectra were recorded on a Perkin-Elmer Model 21 spectrophotometer, using a sodium chloride prism. The spectra of all substances were obtained as mulls in mineral oil.

Most of the compounds studied were either commercially available or were supplied by members of this Research Department. These compounds were used without further purification unless doubt exsisted as to their purity. If purification was necessary, standard methods of recrystallization from suitable solvents and sublimation were used.

Summary

The infrared spectra of 10 monosubstituted and 23 disubstituted anthraquinones were determined in the region of 650～900 cm^{-1}, and the strong characteristic absorption bands obtained were found to be correlated to their structures.

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5—2

25. **Naofumi Ōi** : The Infrared Characteristic Absorption Bands of Monosubstituted Naphthalenes in the Region of 1650～2000 cm^{-1}.

(*Research Department, Osaka Works, Sumitomo Chemical Company**)

Normally, the spectral region of 1650～2000 cm^{-1} is not very interesting unless carbonyl groups or triple bonds are present, but this region has been used by Young, DuVall, and Wright(1) for the characterization of substituted benzene compounds, and its usefulness in the analysis has been confirmed by Bellamy.(2) Whiffen(3) presented evidence that the stronger infrared absorption bands from 1650～2000 cm^{-1} in benzene derivatives normally arise from summation tones of the out-of-plane CH bending vibrations.

In substituted naphthalene compounds, such investigation has not yet been shown, but it is well known that they have strong characteristic bands in the region of 650～900 cm^{-1} as in benzene ring originating in the out-of-plane deformation vibration of the ring hydrogen, so it is supposed that monosubstituted naphthalenes will show characteristic absorption bands in the region of 1650～2000 cm^{-1}.

As was expected, these substances showed strong characteristic absorption bands in this region and the pattern of these bands of ten monosubstituted naphthalenes is shown in Fig. 1. These patterns are more complex than monosubstituted benzenes, but it is known that these bands can be correlated with their structure.

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* Kasugade-cho, Konohana-ku, Osaka (大井尙文).

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2) L.J. Bellamy : "The Infrared Spectra of Complex Molecules," Methuen & Co., London (1954).

3) D.H. Whiffen : Spectrochim. Acta, **7**, 253(1955).

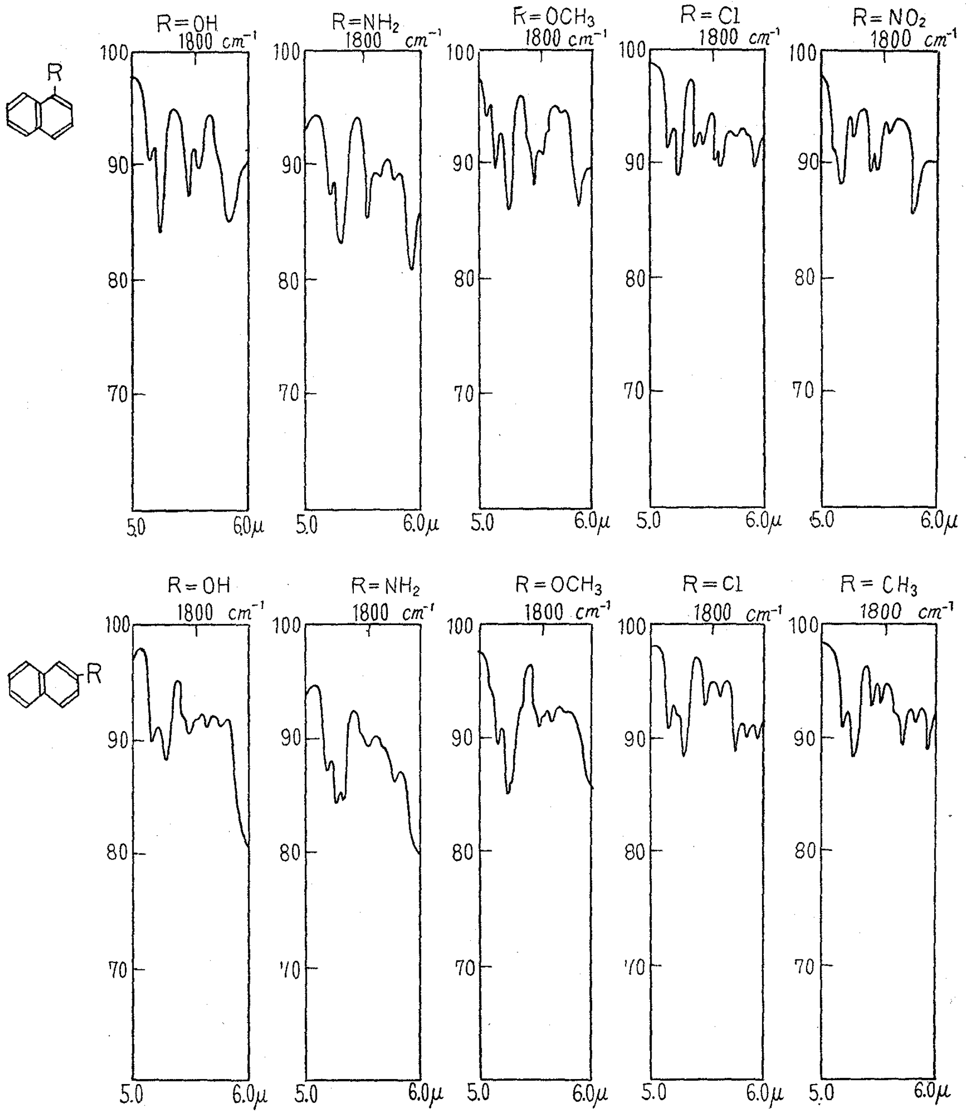

Fig. 1. Infrared Spectra of Monsubstituted Naphthalenes (1650~1000 cm^{-1})

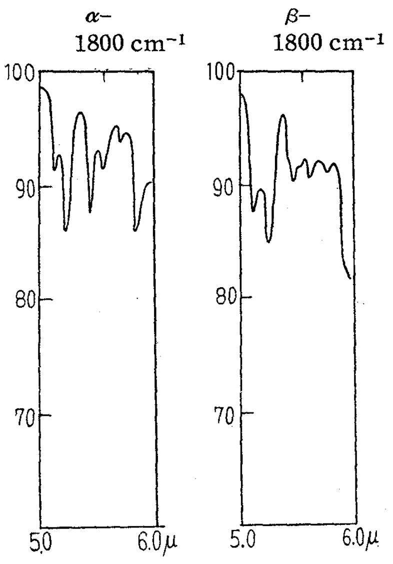

Fig. 2.

From this investigation, two typical patterns of characteristic absorption bands are obtained as shown in Fig. 2. These patterns will be available for use in the qualitative analysis of such compounds.

The origin of these characteristic absorption bands in the region of $1650\sim2000\,\text{cm}^{-1}$ is not known, but it is presumed that they perhaps arise from the summation tones of the out-of-plane CH bending vibrations. If it is true, the out-of-plane CH bending vibrations of substituted naphthalenes are generally more complex than those of substituted benzenes, and it is natural that their summation bands should also be more complex. As theoretical studies on the naphthalene ring is insufficient to date, these problems will become more clear in future.

The author expresses his gratitude to Prof. S. Takagi of the University of Kyoto for his helpful guidance throughout the work, and to Messrs. K. Ōya, Y. Yamaguchi, H. Yamura, S. Yoshida, and H. Yoshida of this Company for their kind encouragements.

Experimental

Method—The spectra were obtained with a Perkin-Elmer Model 21 recording infrared spectrophotometer, using a sodium chloride prism. The spectra of all standard substances were determined in 0.1 mol./L. solution with sodium chloride sealed cells of 1.0 mm. thickness. CS_2 was used as a solvent.

Materials—All of the compounds studied were commercially available. These compounds were used without further purification unless doubt existed as to their purity. If purification was necessary, standard methods of recrystallization were used.

Summary

In monosubstituted naphthalene compounds, the charateristic absorption bands in the region of $1650\sim2000\,\text{cm}^{-1}$ could be correlated with their structure.

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26. Kazuo Miyatake, Atsuji Okano, Kazuhiko Hoji, and Tōsaku Miki :

Studies on the Constituents of *Digitalis purpurea* L. II.[1] Paper Partition Chromatography of Cardioglycosides from Digitalis Seeds.

(*Yanagishima Research Laboratory, Daiichi Seiyaku Co., Ltd.**)

Studies on the cardioglycosides of digitalis have made a tremendous advance in recent years and the majority of glycosides contained in the plants have been isolated and their structure clarified. Naturally, these advances owe much to the progress of isolation technique but the establishment of paper partition chromatography had much to do with that.

Studies on cardioglycosides contained in the seeds of *Digitalis purpurea* are being made but they are insufficient compared to those in the leaves, reports published to date being on the isolation of digitalinum verum,[2,3] gitoxin,[4] strospeside,[4] and struc-

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* Hirakawabashi, Sumida-ku, Tokyo (宮武一夫, 岡野淳二, 傍士和彦, 三木藤作).

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