REFERENCES

Aimi, N.; Yamanaka, E.; Endo, J.; Sakai, S., and Haginiwa, J. Conversion of oxindole alkaloids into indole alkaloids. Tetrahedron Lett. 11 (1972): 1081-1084.

———— Transformation of indole alkaloids-I. Conversion of oxindole alkaloids into indole alkaloids. Tetrahedron 29 (1973): 2015-2021.

Archongka, U. Physiological pharmacology of indole alkaloids from *Uncaria salaccensis*. Master's Thesis, Department of Physiology, Graduate School, Chulalongkorn University, 1983.

Au, T.Y.; Cheung, H.T., and Sternhell, S. New Corynanthe alkaloids from *Strychnos angustiflora*. J. Chem. Soc. Perkin Transactions I (1973): 13-16.

Badger, G.M.; Cook, J.W., and Ongley, P.A. The chemistry of the *Mitragyna* genus Part I. J. Chem. Soc. (1950): 867-873.

Barger, G.; Dyer, E., and Sargent, L.J. The alkaloids of *Mitragyna rotundifolia* I. J. Org. Chem. 4 (1939): 418-427.

Battersby, A.R.; Brown, R.T.; Kapil, R.S.; Knight, J.A.; Martin, J.A., and Plunkett, A.O. Further evidence

concerning the biosynthesis of indole alkaloids and quinine. Chem. Comm. 23 (1966): 888-890.

Battersby, A.R.; Burnett, A.R., and Parsons, P.G. Partial synthesis and isolation of vincoside and isovincoside: Biosynthesis of the three major classes of indole alkaloids from the β-carboline system. Chem. Comm. 21 (1968): 1282-1284.

———— Alkaloid biosynthesis Part XIV. Secologanin: Its conversion into ipecoside and its role as biological precursor of the indole alkaloids. J. Chem. Soc. Section C (1969a): 1187-1192.

———— Alkaloid biosynthesis Part XV. Partial synthesis and isolation of vincoside and isovincoside: Biosynthesis of the three major classes of indole alkaloids from vincoside. J. Chem. Soc. Section C (1969b): 1193-1200.

Battersby, A.R.; Lewis, N.G., and Tippett, J.M. The basic glucosides related to the biosynthesis of indole and ipecac alkaloids. Tetrahedron Lett. 48 (1978): 4849-4852.

Beckett, A.H.; Dwuma-Badu, D., and Haddock, R.E. Some new *Mitragyna*-type indoles and oxindoles. The influence of stereochemistry on mass spectra. Tetrahedron 25 (1969): 5961-5969.

Beckett, A.H.; Lee, C.M., and Tackie, A.N. The structure of

speciofoline and stipulatine (rotundifoline). Tetrahedron Lett. 25 (1963): 1709-1714.

Beckett, A.H.; Shellard, E.J.; Phillipson, J.D., and Lee, C.M. Alkaloids from *Mitragyna speciosa* Korth. J. Pharm. Pharmac. 17 (1965): 753-755.

——— The *Mitragyna* species of Asia Part VI. Oxindole alkaloids from the leaves of *Mitragyna speciosa* Korth. Planta Med. 14 (1966a): 266-276.

——— The *Mitragyna* species of Asia Part VII. Indole alkaloids from the leaves of *Mitragyna speciosa* Korth. Planta Med. 14 (1966b): 277-288.

——— The isolation and characterization of some alkaloids from the leaves of *Mitragyna speciosa* Korth. In O. Hanc and J. Hubik (eds.), Scientiae Pharmaceuticae. Vol. I, pp. 303-304. Prague: Czechoslovak Medical Press, 1966c.

——— The structure and stereochemistry of some alkaloids from the leaves of *Mitragyna speciosa* Korth. In O. Hanc and J. Hubic (eds.), Scientiae Pharmaceuticae. Vol. I, pp. 321-324. Prague: Czechoslovak Medical Press, 1966d.

Beckett, A.H.; Shellard, E.J., and Tackie, A.N. The *Mitragyna* species of Ghana. The alkaloids of the leaves of *Mitragyna stipulosa* (DC.) O.Ktz. J. Pharm. Pharmc.

15 (1963a), suppl. : 158T-165T.

———— The *Mitragyna* species of Ghana. The alkaloids of the leaves of *Mitragyna ciliata* Aubr.et Pellegr. J. Pharm. Pharmac. 15 (1963b), suppl. : 166T-169T.

———— The *Mitragyna* species of Asia Part IV. The alkaloids of the leaves of *Mitragyna speciosa* Korth. Isolation of mitragynine and speciofoline. Planta Med. 13 (1965): 241-246.

Beckett, A.H. and Tackie, A.N. Structure of rotundifoline and mitragynol (isorotundifoline). Chem. and Ind. 27 (1963a): 1122-1123.

———— The structures of the alkaloids from *Mitragyna* species of Ghana. J. Pharm. Pharmac. 15 (1963b), suppl. : 267T-269T.

Beecham, A.F.; Hart, N.K.; Johns, S.R., and Lamberton, J.A. The stereochemistry of oxindole alkaloids: Uncarines A, B (formosanine), C (pteropodine), D (speciophylline), E (isopteropodine), and F. Aust. J. Chem. 21 (1968): 491-504.

Bindra, J.S. Oxindole alkaloids. In R.H.F. Manske (ed.), The Alkaloids: Chemistry and physiology, pp. 83-121. New York: Academic Press, 1973.

Brown, R.T. and Platt, R. A unigue series of *pseudo* oxindole alkaloids. Chem. Comm. 10 (1976): 357-358.

Budzikiewicz, H.; Djerassi, C., and Williams, D.H. Structure Elucidation of Natural Products by Mass Spectroscopy. Vol. I: Alkaloids. San Francisco: Holden-Day, 1964.

Burkill, I.H. A Dictionary of the Economic Products of the Malay Peninsula. Vol. II. Oxford: University Press, 1935.

Cordell, G.A. Introduction to Alkaloids: A biogenetic approach. New York: A Wiley-Interscience, 1981.

Crabb, T.V. Nuclear magnetic resonance of alkaloids. In G.A. Webb (ed.), Annual Reports on NMR Spectroscopy, pp. 1-198. London: Academic Press, 1978.

Craig, J.C. and Purushothaman, K.K. An improved preparation of tertiary amine N-oxides. J. Org. Chem. 35 (1970): 1721-1722.

Dalton, D.R. The Alkaloids: The foundamental chemistry, a biogenetic approach. New York: Marcel Dekker, 1979.

De Silva, K.T.D.; Smith G.N., and Warren, K.E.H. Stereochemistry of strictosidine. Chem. Comm. 16 (1971): 905-907.

Field, E. Mitrgynine and mitraversine, two new alkaloids from species of *Mitragyna*. J. Chem. Soc. 119 (1921): 887-891.

Finch, N. and Taylor, W.I. The conversion of tetrahydro-β-

carboline alkaloids into oxindoles. The structures and partial syntheses of mitraphylline and rhynchophylline. J. Am. Chem. Soc. 84 (1962a): 1318-1320.

———— Oxidative transformations of indole alkaloids I. The preparation of oxindoles from yohimbine; the structure and partial syntheses of mitraphylline, rhynchophylline, and corynoxeine. J. Am. Chem. Soc. 84 (1962b): 3871-3877.

Grewal, K.S. Observation on the pharmacology of mitragynine. J. Pharmacol. Exp. Ther. 46 (1932): 251-271. Chem. Abstr. 27 (1933): 139.

Harada, M. and Ozaki, Y. Effect of indole alkaloids from *Gardneria* genus and *Uncaria* genus on neuromuscular transmission in the rat limb *in situ*. Chem. Pharm. Bull. 24 (1976): 211-214.

Harada, M.; Ozaki, Y., and Ohno, H. Effects of indole alkaloids from *Gardneria nutans* Sieb.et Zucc. and *Uncaria rhynchophylla* Miq. on a guinea-pig urinary bladder preparation *in situ*. Chem. Pharm. Bull. 27 (1979): 1069-1074.

Harada, M.; Ozaki, Y., and Sato, M. Ganglion blocking effect of indole alkaloids contained in *Uncaria* genus and *Amsonia* genus and related synthetic compounds on the rat superior cervical ganglion

in situ. Chem. Pharm. Bull. 22 (1974): 1372-1377.

Hart, N.K.; Johns, S.R., and Lamberton, J.A. Uncarine C, D (speciophylline), E, and F: C-3 and C-7 epimeric oxindoles related to tetrahydroalstonine. Chem. Comm. 2 (1967): 87-88.

Heckendorf, A.H. and Hutchinson, C.R. Biosynthesis of camptothecin II. Confirmation that isovincoside, not vincoside, is the penultimate biosynthetic precursor of indole alkaloids. Tetrahedron Lett. 48 (1977): 4153-4154.

Hemingway, S.R.; Houghton, P.J.; Phillipson, J.D., and Shellard, E.J. 9-Hydroxyrhynchophylline-type oxindole alkaloids. Phytochemistry 14 (1975): 557-563.

Hemingway, S.R. and Phillipson, J.D. Alkaloids of the Rubiaceae. In J.D. Phillipson and M.H. Zenk (eds.), Indole and Biogenetically Related Alkaloids, pp. 63-90. London: Academic Press, 1980.

Hendrickson, J.B. and Sims, J.J. *Mitragyna* alkaloids: The structure of stipulatine. Tetrahedron Lett. 14 (1963): 929-935.

Hesse, M. Alkaloid Chemistry. New York: A Wiley-interscience, 1978.

Houghton, P.J.; Lala, P.K.; Shellard, E.J., and Sarpong, K. The alkaloids of *Mitragyna stipulosa* (DC.) O. Ktz. J. Pharm. Pharmac. 28 (1976): 664.

Houghton, P.J. and Said, I.M. 3-Dehydromitragynine: An alkaloid from *Mitrgyna speciosa*. Phytochemistry 25 (1986): 2910-2912.

Houghton, P.J. and Shellard, E.J. The *Mitragyna* species of Asia Part XXVIII. The alkaloidal pattern in *Mitragyna rotundifolia* from Burma. Planta Med. 26 (1974): 104-112.

Ing, H.R. and Raison, C.G. The alkaloids of *Mitragyna speciosa* Part I. Mitragynine. J. Chem. Soc. (1939): 986-990.

Jackson, A.H. and Smith, A.E. Electrophilic substitution in indoles-II. The formation of 3,3-spirocyclic indole derivativs from tryptamines and their rearrangement to β-carbolines. Tetrahedron 24 (1968a): 403-413.

Jackson, A.H. and Smith, P. Electrophilic substitution in indoles-III. Rearrangement of 3,3-dialkyl indolenines. Tetrahedron 24 (1968b): 2227-2239.

Jansen, K.L.R. and Prast, C.J. Ethnopharmacology of Kratom and the *Mitragyna* alkaloids. J. Ethnopharmacol. 23 (1988): 115-119.

Kisakurek, M.V.; Leeuwenberg, A.J.M., and Hesse, M. A chemo-taxonomic investigation of the plant families of Apocynaceae, Loganiaceae, and Rubiaceae by their indole alkaloid content. In S.W. Pelletier (ed.), Alkaloids: Chemical and biological perspectives. Vol. I, pp. 211-376. New York: A Wiley-Interscience, 1983.

Kompis, I.; Hesse, M., and Schmid, H. An Approach to the biogenetic classification of indole alkaloids. Lloydia 34 (1971): 269-291.

Likhitwitayawuid, K. A study on pentacyclic triterpenoids of the Mitragyninae (Rubiaceae). Master's Thesis, Department of Pharmaceutical Chemistry, Graduate School, Chiba University, 1986.

Loew, P.; Goeggel, H., and Arigoni, D. A monoterpene precursor in the biosynthesis of indole alkaloids. Chem. Comm. 12 (1966): 347-348.

Lounasmaa, M. and Kan, S.K. A 400 MHz ^{1}H-NMR study of the eight basic heteroyohimbine alkaloids. Tetrahedron 36 (1980): 1607-1611.

Luckner, M. Secondary Metabolism in Plants and Animals. London: Chapman and Hall, 1972.

Macko, E.; Weisbach, J.A., and Douglas, B. Pharmacology of mitragynine. Arch. Int. Pharmacodyn. Ther. 198 (1972): 145-161. Chem. Abstr. 77 (1972): 109440 j.

Manitto, P. Biosynthesis of Natural Products. Chichester: Ellis Horwood, 1981.

Marcan, A. Report of the Government Laboratory of Siam: Kratom eating. Analyst 54 (1929): 475.

———— Report of the Government Laboratory of Siam: Physiological action of Kratom. Analyst 59 (1934): 753-754.

Martin, G.E.; Sanduja, R., and Alam, M. Isolation of isopteropodine from the marine mollusk *Nerita albicilla*: Establishment of the structure via Two Dimensional NMR techniques. J. Nat. Prod. 49 (1986): 406-411.

Mattes, K.C.; Hutchinson, C.R.; Springer, J.P., and Clardy, J. The absolute configuration of vincoside. J. Am. Chem. Soc. 97 (1975): 6270-6271.

Merlini, L.; Nasini, G., and Phillipson, J.D. Structure and synthesis of new natural heteroyohimbine N-oxides. Tetrahedron 28 (1972): 5971-5975.

Millat, L. Is the vegetable hypotensive base mitrinermine identical with rhynchophylline ? Ann. Pharm. Franc. 4 (1946): 27-29. Chem. Abstr. 41 (1947): 1228.

Nagakura, N.; Rueffer, M., and Zenk, M.H. The biosynthesis of monoterpenoid indole alkaloids from strictosidine.

J. Chem. Soc. Perkin Transactions I 9 (1979): 2308-2312.

Nakanishi, N.; Goto, T.; Ito, S.; Natori, S., and Nozoe, S., eds. Natural Products Chemistry. Vol. 3. Oxford: Oxford University Press, 1983.

Pelletier, S.W. Chemistry of the Alkaloids. New York: Van Nostrand Reinhold, 1970.

Perkin Jr., W.H. and Robinson, R. Harmine and harmaline Part III. J. Chem. Soc. 115 (1919): 933-967.

Perrot, E.; Raymond-Hamet, and Millat, L. Hypothermizing action of mitrinermine. Bull. Acad. Med. 116 (1936): 266-268. Chem. Abstr. 31 (1937): 5875.

Pfitzner, U. and Zenk, M.H. Immobilization of strictosidine synthase from *Catharanthus* cell cultures and preparative synthesis of strictosidine. Planta Med. 46 (1982): 10-14.

Phillipson, J.D.; Hemingway, S.R.; Bisset, N.G.; Houghton, P.J., and Shellard, E.J. Angustine and related alkaloids from species of *Mitragyna*, *Nauclea*, *Uncaria*, and *Strychnos*. Phytochemistry 13 (1974): 973-978.

Phillipson, J.D.; Hemingway, S.R., and Ridsdale, C.E. Alkaloids of *Uncaria* Part V. Their occurrence and

chemotaxonomy. Lloydia 41 (1978): 503-570.

——— The chemotaxonomic significance of alkaloids in the Naucleeae S.L. (Rubiaceae). J. Nat. Prod. 45 (1982): 145-162.

Phillipson, J.D.; Rungsiyakul, D., and Shellard, E.J. N-oxides of the oxindole alkaloids, isorhynchophylline, rhynchophylline, rhynchociline, and ciliaphylline. Phytochemistry 12 (1973): 2043-2048.

Phillipson, J.D.; Tantivatana, P.; Tarpo, E., and Shellard, E.J. Hirsuteine and mitrajavine from *Mitragyna hirsuta*. Phytochemistry 12 (1973): 1507.

Ponglux, D.; Supavita, T.; Verpoorte, R., and Phillipson, J.D. Alkaloids of *Uncaria attenuata* from Thailand. Phytochemistry 19 (1980): 2013-2016.

Quisumbing, E. Medicinal Plants of the Philippines. Manila: Manila Bureau of Printing, 1951.

Raymond-Hamet. Some physiological effects of mitraphylline. Compt. rend. Soc. Biol. 114(1933): 692-694. Chem. Abstr. 28 (1934): 830.

——— The effect of mitrinermine on the intestine, the uterus and the isolated seminal vesicle. Arch. Int. Pharmacodyn. 56 (1937): 303-313. Chem. Abstr. 32 (1938): 1327.

———— Action of rhynchophylline and mitrinermine. Arch. Int. Pharmacodyn. 66 (1941): 330-335. Chem. Abstr. 36 (1942): 2917.

Reynolds, J.E.F., ed. Martindale The Extra Pharmacopoeia. 29th ed. London: The Pharmaceutical Press, 1989.

Ridsdale, C.E. A revision of *Mitragyna* and *Uncaria* (Rubiaceae). Blumea 24 (1978a): 43-100.

———— A revision of the tribe Naucleeae s.s. (Rubiaceae). Blumea 24 (1978b): 307-366.

Rueffer, M; Nagakura, N., and Zenk, M.H. Strictosidine, the common precursor for monoterpenoid indole alkaloids with 3α and 3β configuration. Tetrahedron Lett. 18 (1978): 1593-1596.

Rungsiyakul, D. The alkaloids of *Mitragyna tubulosa* Havil. Ph.D. dissertation, Department of Pharmacognosy, Chelsea College, University of London, 1973.

Saxton, J.E. Alkaloids of *Mitragyna* and *Ourouparia* species. In R.H.F. Manske (ed.), The Alkaloids: Chemistry and physiology, pp. 59-91. New York: Academic Press, 1965.

———— Alkaloids of *Mitragyna* and *Ourouparia* species. In R.H.F. Manske (ed.), The Alkaloids: Chemistry and physiology, pp. 521-543. New York: Academic Press,

1968.

———— Alkaloids of *Mitragyna* and related genera. In R.H.F. Manske (ed.), The Alkaloids: Chemistry and physiology, pp. 123-156. New York: Academic Press, 1973.

Scott, A.I. Biosynthesis of indole alkaloids. In D.H. Hey and K.F. Wiesner (eds.), MTP International Review of Science: Organic chemistry series I. Vol. 9 (Alkaloids), pp. 105-141. London: Butterworths University Park Press, 1973.

Scott, A.I.; Lee, S.L.; Capite, P.; Culver, M.G., and Hutchinson, C.R. The role of isovincoside (strictosidine) in the biosynthesis of the indole alkaloids. Heterocycles 7 (1977): 979-984.

Seaton, J.C.; Nair, M.D.; Edwards, O.E., and Marion, L. The structure and stereoisomerism of three *Mitragyna* alkaloids. Can. J. Chem. 38 (1960): 1035-1042.

Shamma, M. and Foley, K.F. Mass spectrometry and the stereochemistry of the pentacyclic oxindole alkaloids. J. Org. Chem. 32 (1967): 4141-4143.

Shamma, M.; Shine, R.J.; Kompis, I.; Sticzay, T; Morsingh, F.; Poisson, J., and Pousset, J.L. The stereochemistry of the pentacyclic oxindole alkaloids. J. Am. Chem. Soc. 89 (1967): 1739-1740.

Shavel Jr., J. and Zinnes, H. Oxindole alkaloids I. Oxidative rearrangement of indole alkaloids to their

oxindole analogs. J. Am. Chem. Soc. 84 (1962): 1320-1321.

Shellard, E.J. The alkaloids of *Mitragyna* with special reference to those of *Mitragyna speciosa* Korth. Bulletin on Narcotics XXVI (1974): 41-55.

Shellard, E.J.; Beckett, A.H.; Tantivatana, P.; Phillipson, J.D., and Lee, C.M. Alkaloids from *Mitragyna javanica* Koord and Valeton and *Mitragyna hirsuta* Havil. J. Pharm. Pharmac. 18 (1966): 553-555.

——— The *Mitragyna* species of Asia Part VIII. The alkaloids of the leaves of *Mitragyna javanica* var. *microphylla* Koord and Valeton. Planta Med. 15 (1967): 245-254.

Shellard, E.J. and Houghton, P.J. The *Mitragyna* species of Asia Part XIX. The alkaloidal pattern in *Mitragyna parvifolia* (Roxb.) Korth. Planta Med. 20 (1971): 82-89.

——— The conversion of *pseudo* heteroyohimbine alkaloids to oxindoles Part II. *In vivo* studies in *Mitragyna parvifolia* (Roxb.) Korth. Planta Med. 21 (1972a): 16-21.

——— The *Mitragyna* species of Asia Part XX. The alkaloidal pattern in *Mitragyna parvifolia* (Roxb.) Korth. from Burma. Planta Med. 21 (1972b): 263-266.

——— The *Mitragyna* species of Asia Part XXI. The

distribution of alkaloids in young plants of *Mitragyna parvifolia* grown from seed obtained from Ceylon. Planta Med. 21 (1972c): 382-392.

———The *Mitragyna* species of Asia Part XXII. The distribution of alkaloids in young plants of *Mitragyna parvifolia* grown from seed obtained from Uttar Pradesh State of India. Planta Med. 22 (1972d): 97-102.

———The *Mitragyna* species of Asia Part XXIV. The isolation of dihydrocorynantheol and corynantheidol from the leaves of *Mitragyna parvifolia* (Roxb.) Korth. from Sri Lanka (Ceylon). Planta Med. 24 (1973a): 13-17.

———The *Mitragyna* species of Asia Part XXV. *In vivo* studies, using ^{14}C-alkaloids, in the alkaloidal pattern in young plants of *Mitragyna parvifolia* grown from seed obtained from Ceylon. Planta Med. 24 (1973b): 341-352.

———The *Mitragyna* species of Asia Part XXVI. Further *in vivo* studies using ^{14}C-alkaloids, in the alkaloidal pattern in young plants of *Mitrgyna parvifolia* (Roxb.) Korth. grown from seed obtained from Sri Lanka (Ceylon). Planta Med. 25 (1974a): 80-87.

———The *Mitragyna* species of Asia Part XXVII. The

alkaloid N-oxides in the leaves of *Mitragyna parvifolia* (Roxb.) Korth. from Sri Lanka. Planta Med. 25 (1974b): 172-174.

Shellard, E.J.; Houghton, P.J., and Lala, P.K. Rotundifoline N-oxides. Phytochemistry 16 (1977): 1427-1429.

Shellard, E.J.; Houghton, P.J., and Resha, M. The *Mitragyna* species of Asia Part XXX. Oxidation products of mitrgynine and speciociliatine. Planta Med. 33 (1978a): 223-227.

———— The *Mitragyna* species of Asia Part XXXI. The alkaloids of *Mitragyna speciosa* Korth. from Thailand. Planta Med. 34 (1978b): 26-36.

———— The *Mitragyna* species of Asia Part XXXII. The distribution of alkaloids in young plants of *Mitragyna speciosa* Korth. grown from seed obtained from Thailand. Planta Med. 34 (1978c): 253-263.

Shellard, E.J. and Lala, P.K. The *Mitragyna* species of Asia Part XXIX. The alkaloidal pattern in the leaves, stem bark, and root bark of *Mitragyna parvifolia* from the Kerala State, India. Planta Med. 31 (1977): 395-399.

———— The alkaloids of *Mitragyna rubrostipulata* (Schum.) Havil. Planta Med. 33 (1978): 63-69.

Shellard, E.J. and Phillipson, J.D. The *Mitragyna* species of Asia Part I. The alkaloids of the leaves of *Mitragyna*

rotundifolia (Roxb.) O.Ktz. Planta Med. 12 (1964a): 27-32.

———— The *Mitragyna* species of Asia Part II. The alkaloids of the leaves of *Mitragyna parvifolia* (Roxb.) Korth. Planta Med. 12 (1964b): 160-165.

Shellard, E.J.; Phillipson, J.D., and Gupta, D. The *Mitragyna* species of Asia Part XI. The alkaloids of the leaves of *Mitragyna parvifolia* (Roxb.) Korth. obtained from the Maharashtra State of India. Planta Med. 16 (1968a): 20-28.

———— The *Mitragyna* species of Asia Part XIII. The alkaloids of the leaves of *Mitragyna parvifolia* (Roxb.) Korth. obtained from India. Planta Med. 16 (1968b): 436-445.

———— The *Mitragyna* species of Asia Part XIV. The alkaloids of the leaves of *Mitragyna parvifolia* obtained from Burma, Cambodia, and Ceylon. Planta Med. 17 (1969a): 51-58.

———— The *Mitragyna* species of Asia Part XV. The alkaloids from the bark of *Mitragyna parvifolia* (Roxb.) Korth. and a possible biogenetic route for the oxindole alkaloids. Planta Med. 17 (1969b): 146-163.

Shellard, E.J.; Phillipson, J.D., and Sarpong, K. rhynchophylline and isorhynchophylline N-oxides from species of *Mitragyna*. Phytochemistry 10 (1971):

2505-2511.

Shellard, E.J. and Rungsiyakul, D. The *Mitragyna* species of Asia Part XXIII. The alkaloids of the leaves of *Mitragyna tubulosa* Havil. Planta Med. 23 (1973): 221-225.

Shellard, E.J. and Sarpong, K. The alkaloids of the leaves of *Mitragyna inermis* (Willd.) O.Ktz. J. Pharm. Pharmac. 21 (1969), suppl. : 113S-117S.

———The alkaloidal pattern in the leaves, stem-bark, and root-bark of *Mitragyna* species from Ghana. J. Pharm. Pharmac. 22 (1970), suppl. : 34S-39S.

———Isolation of speciogynine from the leaves of *Mitragyna inermis* (Willd.) O.Ktz. J. Pharm. Pharmac. 23 (1971a): 559-560.

———The conversion of *pseudo* heteroyohimbine alkaloids to oxindoles Part I. *In vivo* studies. Planta Med. 20 (1971b): 167-171.

———The structure of isomitrajavine. Tetrahedron 27 (1971c): 1725-1729.

Shellard, E.J.; Tantivatana, P., and Beckett, A.H. The *Mitragyna* species of Asia Part X. The alkaloids of the leaves of *Mitragyna hirsuta* Havil. Planta Med. 15 (1967): 366-370.

Smith, G.N. Strictosidine: a key intermediate in the

biogenesis of indole alkaloids. Chem. Comm. 15 (1968): 912-914.

Soontranont, T. Alkaloids of *Mitragyna brunonis* (Wall.ex G.Don) Craib. Master's Thesis, Department of Pharmacognosy, Graduate School, Chulalongkorn University, 1979.

Sroysuwan, G. Antispasmodic activity of indole alkaloids from *Uncaria salaccensis*. Master's Thesis, Department of Physiology, Graduate School, Chulalongkorn University, 1985.

Stockigt, J. and Zenk, M.H. Strictosidine (isovincoside): the key intermediate in the biosynthesis of monoterpenoid indole alkaloids. Chem Comm. 18 (1977): 646-648.

Suwanlert, S. A study of Kratom eaters in Thailand. Bulletin on Narcotics XXVII (1975): 21-27.

Szantay, C.; Blasko, G.; Honty, K., and Dornyei, G. Corynantheine, yohimbine, and related alkaloids. In A. Brossi (ed.), The Alkaloids: Chemistry and pharmacology, pp. 131-268. Orlando, Florida: Academic Press, 1986.

Thomas, R. A possible biosynthetic relationship between the cyclopentanoid monoterpenes and the indole alkaloids. Tetrahedron Lett. 16 (1961): 544-553.

Torssell, K.B.G. Natural Product Chemistry: A mechanistic and biosynthetic approach to secondary metabolism. Chichester: John Wiley & Sons, 1983.

Trager, W.F.; Lee, C.M., and Beckett, A.H. Corynantheidine-type alkaloids-I. Establishment of physical criteria for the *normal*, *pseudo*, *allo*, and *epiallo* configurations by conformational analysis. Tetrahedron 23 (1967): 365-374.

Trager, W.F.; Lee, C.M.; Phillipson, J.D.; Haddock, R.E.; Dwuma-Badu, D., and Beckett, A.H. Configurational analysis of rhynchophylline-type oxindole alkaloids. The absolute configuration of ciliaphylline, rhynchophylline, specionoxeine, isospecionoxeine, rotundifoline, and isorotundifoline. Tetrahedron 24 (1968): 523-543.

Trager, W.F.; Phillipson, J.D., and Beckett, A.H. Chemical comfirmation for the configurations assigned to the indole alkaloids, speciogynine, speciociliatine, mitraciliatine, and hirsutine. Tetrahedron 24 (1968): 2681-2685.

Verpoorte, R.; Ruigrok, C.L.M., and Svendsen, A.B. Medicinal plants of Surinam II. Antimicrobial active alkaloids from *Aspidosperma marcgravianum*. Planta Med. 46 (1982): 149-152.

Weisenborn, F.L. and Diassi, P.A. The reaction of Rauvolfia

alkaloids with mercuric acetate. Conversion of 3-isoreserpine to reserpine. J. Am. Chem. Soc. 78 (1956): 2022-2023.

Wenkert, E. Biosynthesis of indole alkaloids. The Aspidosperma and Iboga bases. J. Am. Chem. Soc. 84 (1962): 98-102.

Wenkert, E.; Chang, C.J.; Chawla, H.P.S.; Cochran, D.W.; Hagaman, E.W.; King, J.C., and Orito, K. General methods of synthesis of indole alkaloids. 14. Short routes of construction of yohimboid and ajmalinoid alkaloid systems and their ^{13}C-nuclear magnetic resonance spectral analysis. J. Am. Chem. Soc. 98 (1976): 3645-3655.

Wenkert, E. and Roychaudhuri, D.K. 3-Dehydro derivatives of some indole alkaloids. J. Org. Chem. 21 (1956): 1315-1317.

Yamanaka, E.; Maruta, E.; Kasamatsu, S.; Aimi, N.; Sakai, S.; Ponglux, D.; Wongseripipatana, S.; Supavita, T., and Phillipson, J.D. A new indole alkaloid, 14α-hydroxy-rauniticine: Structure revision and partial synthesis. Chem. Pharm. Bull. 34 (1986): 3713-3721.

Zarembo, J.E.; Douglas, B.; Valenta, J., and Weisbach, J.A. Metabolites of mitragynine. J. Pharm. Sci. 63 (1974): 1407-1414.

Zinnes, H. and Shavel Jr., J. Yohimbane derivatives III. The oxidative rearrangement of indole alkaloids to their spirooxindole analogs. J. Org. Chem. 31 (1966): 1765-1771.

APPENDIX

Key to the Figures 177-181

1 = DS-1

2 = DS-2

3 = DS-3

4 = DS-4

5 = DS-5

6 = DS-6

7 = DS-7

8 = DS-8

9 = DS-9

10 = DS-10

Cr = Crude alkaloidal extract

Authentic alkaloids

11 = Mitragynine

12 = Speciogynine

13 = Isopteropodine

14 = Isomitraphylline

15 = Mitraphylline

(1) Silica gel 60 F-254/ diethyl ether:ethyl acetate (1:1)

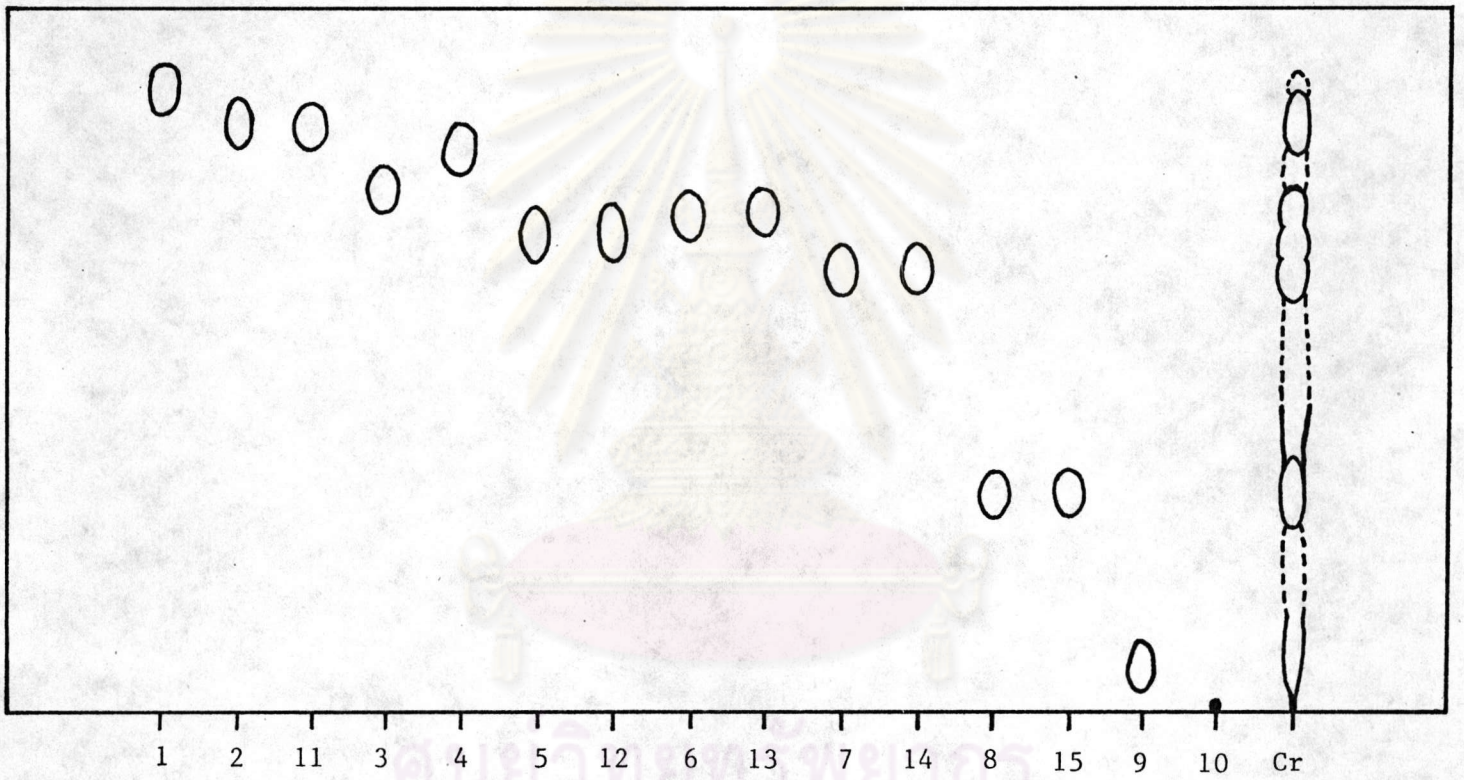

Figure 17 Thin-layer chromatogram of the isolated alkaloids, DS-1 to DS-10

(2) Silica gel 60 F-254/ n-hexane:ethyl acetate:methanol (8:4:1)

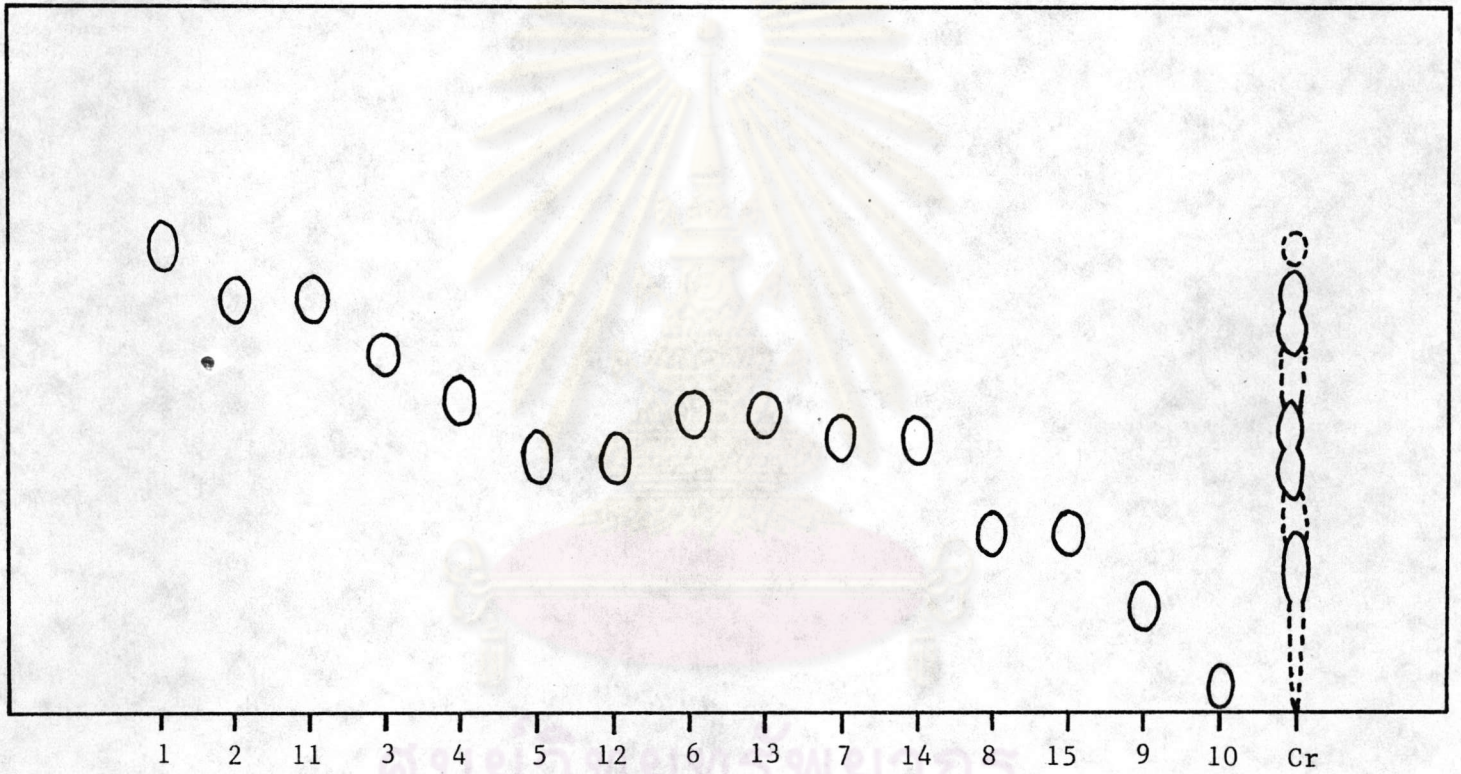

Figure 18 Thin-layer chromatogram of the isolated alkaloids, DS-1 to DS-10

(3) Silica gel 60 F-254/ chloroform:acetone (5:4)

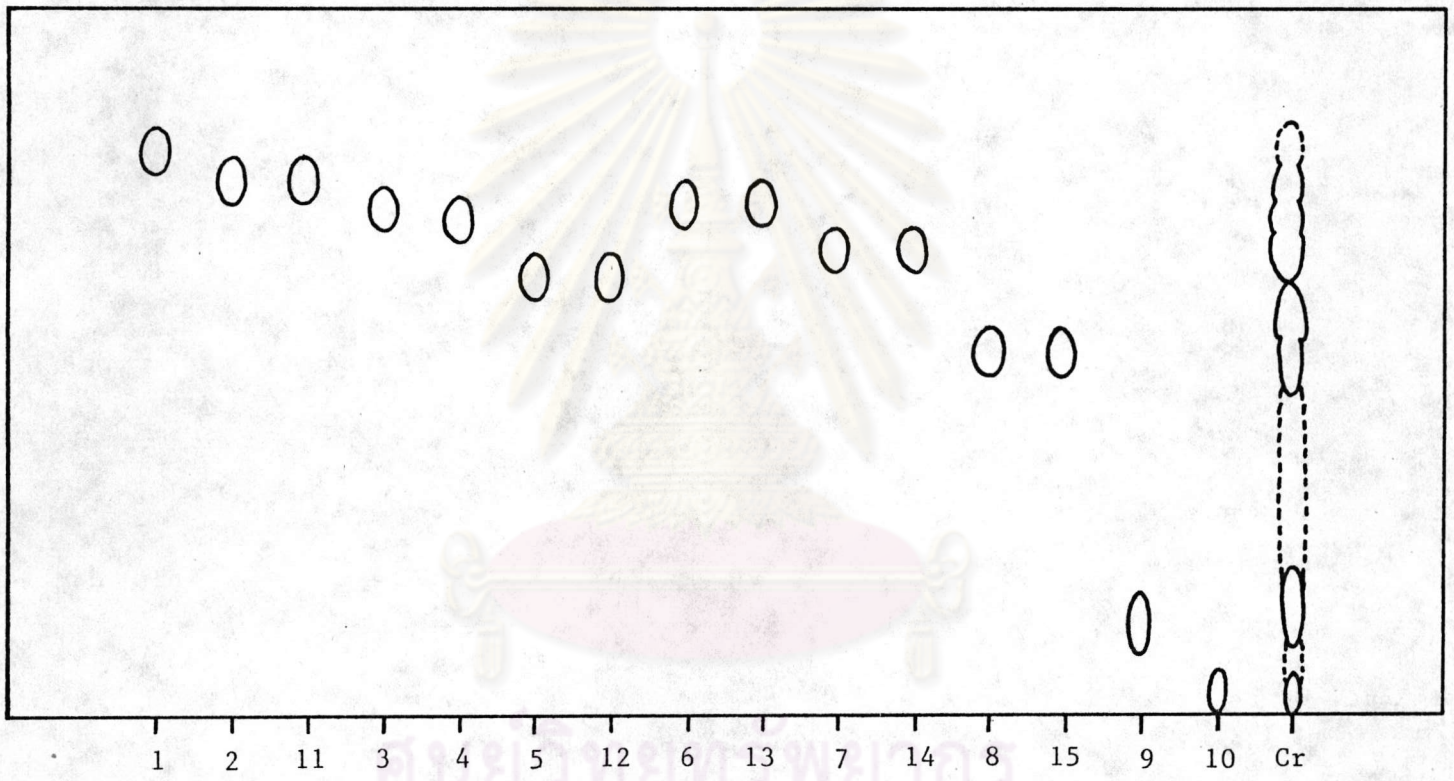

Figure 19 Thin-layer chromatogram of the isolated alkaloids, DS-1 to DS-10

(4) Silica gel 60 F-254/ chloroform:methanol (9:1)

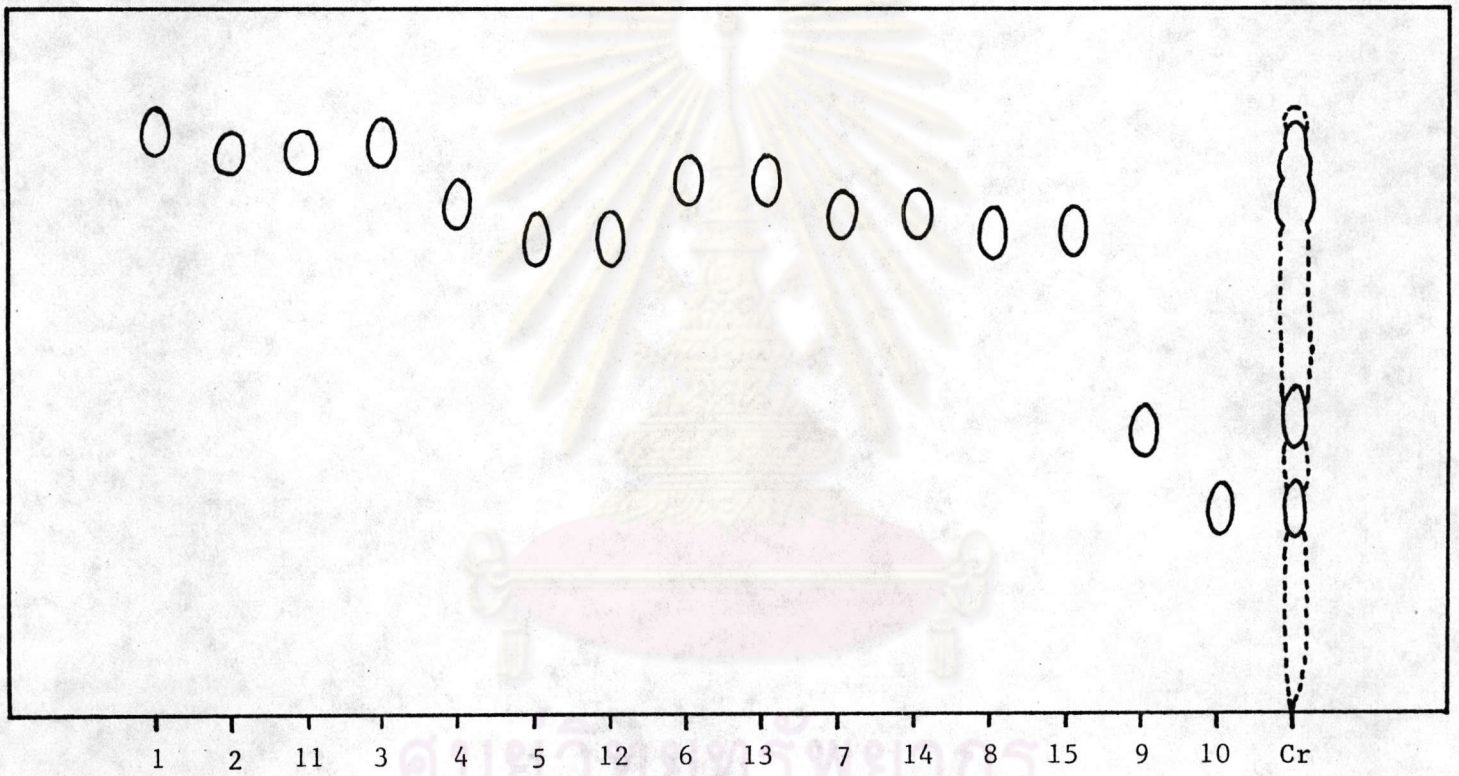

Figure 20 Thin-layer chromatogram of the isolated alkaloids, DS-1 to DS-10

(5) Aluminium oxide F-254 (type E)/ n-hexane:ethyl acetate (5:2)

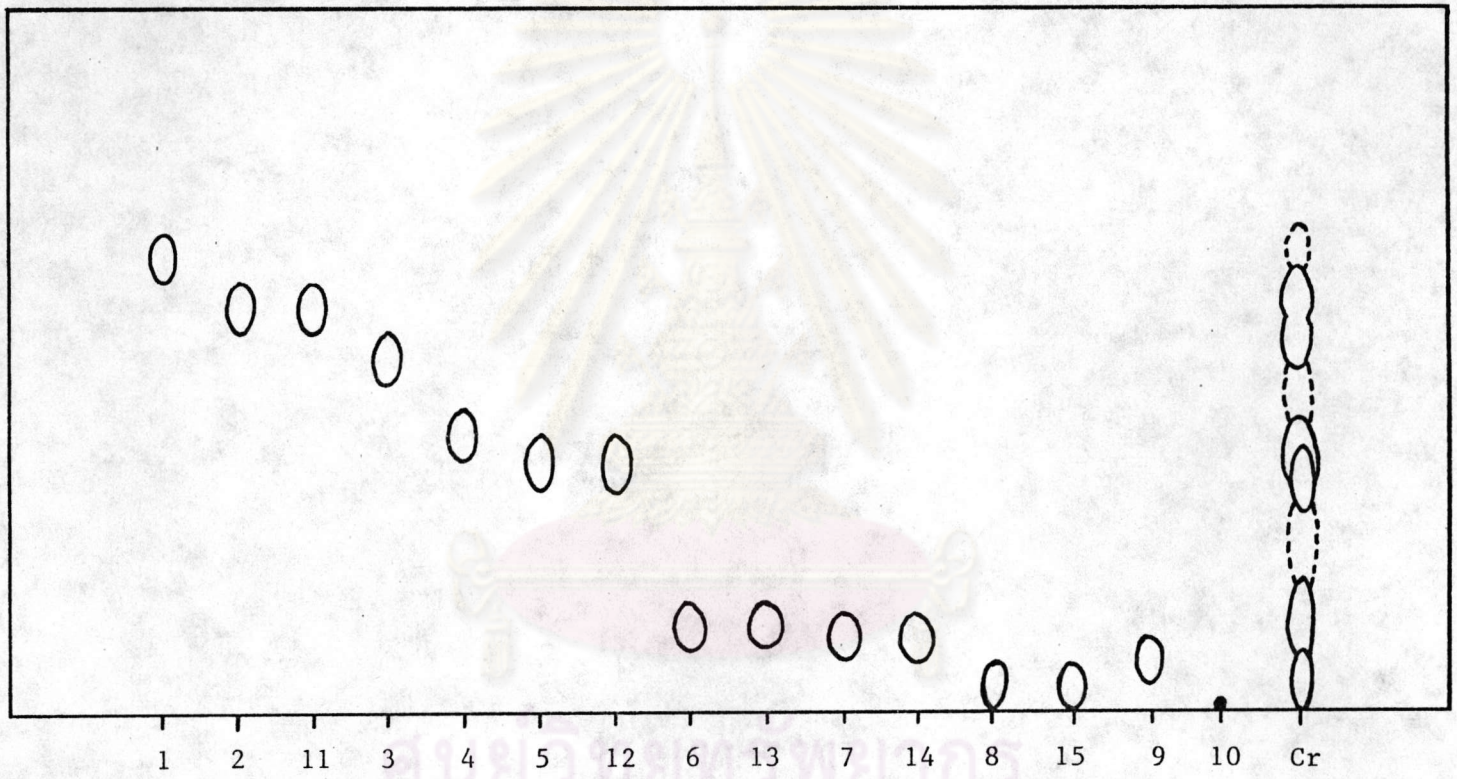

Figure 21 Thin-layer chromatogram of the isolated alkaloids, DS-1 to DS-10

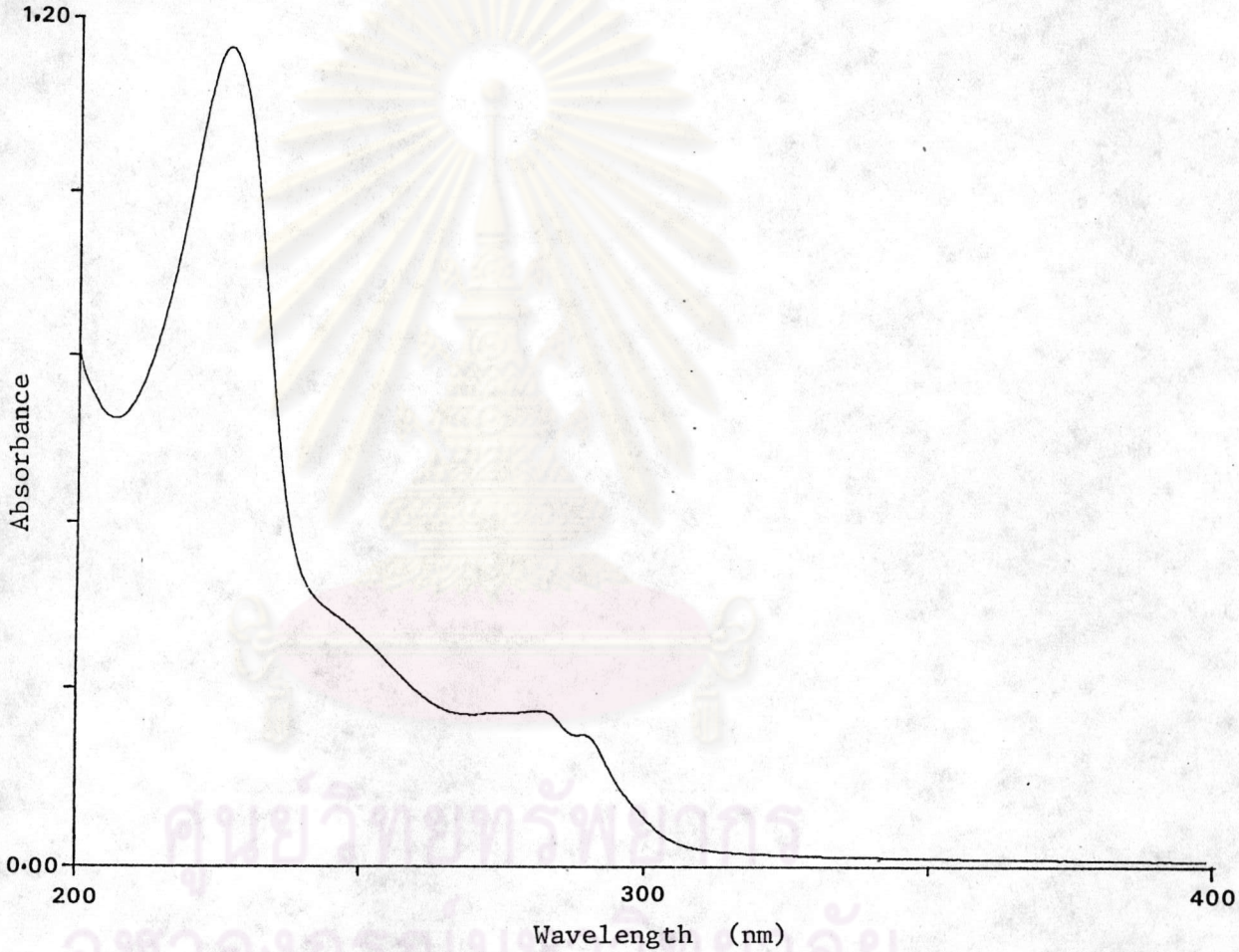

Figure 22 UV absorption spectrum of DS-1 in ethanol

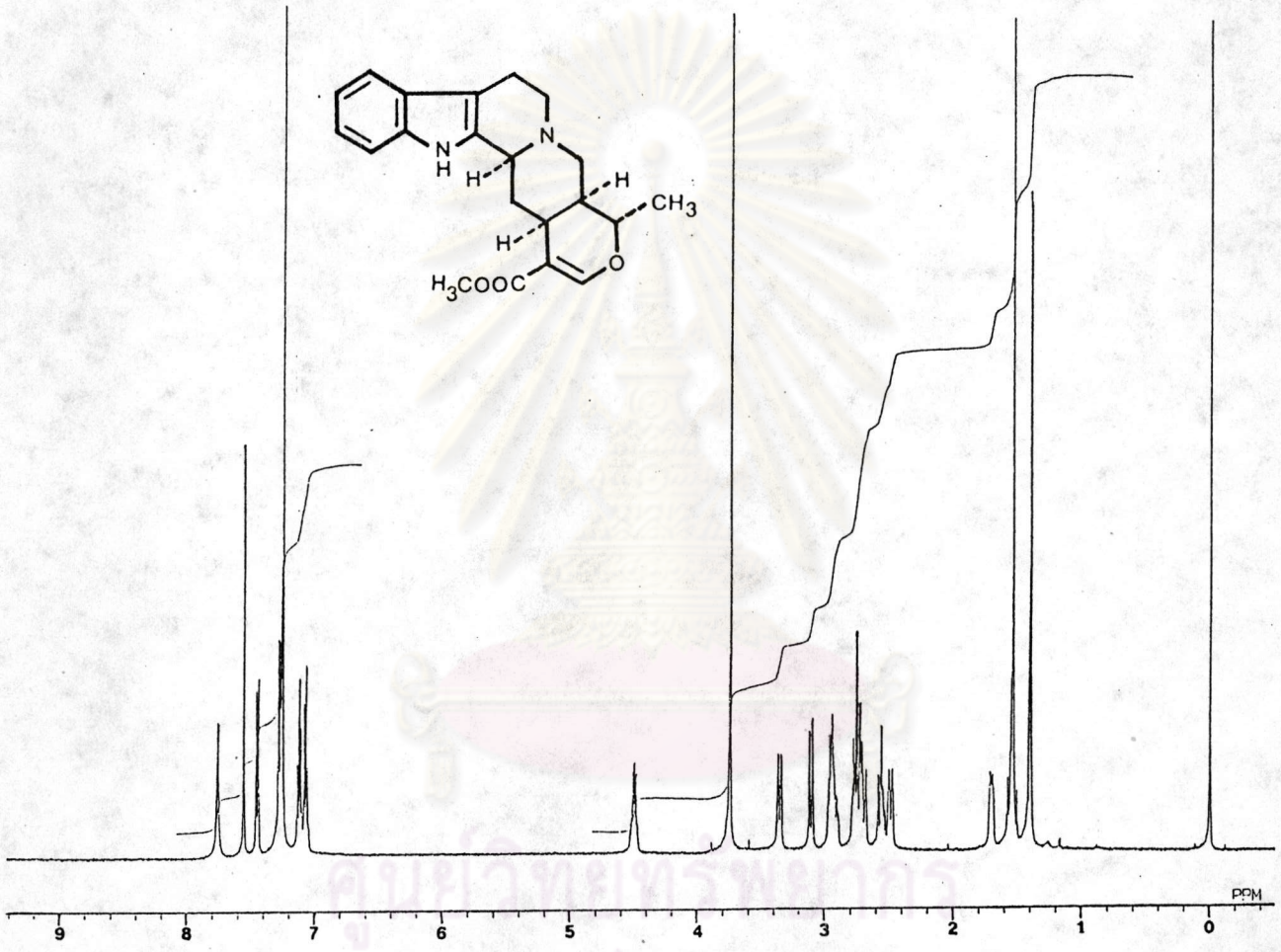

Figure 23 ^{1}H-NMR spectrum of DS-1 in $CDCl_3$

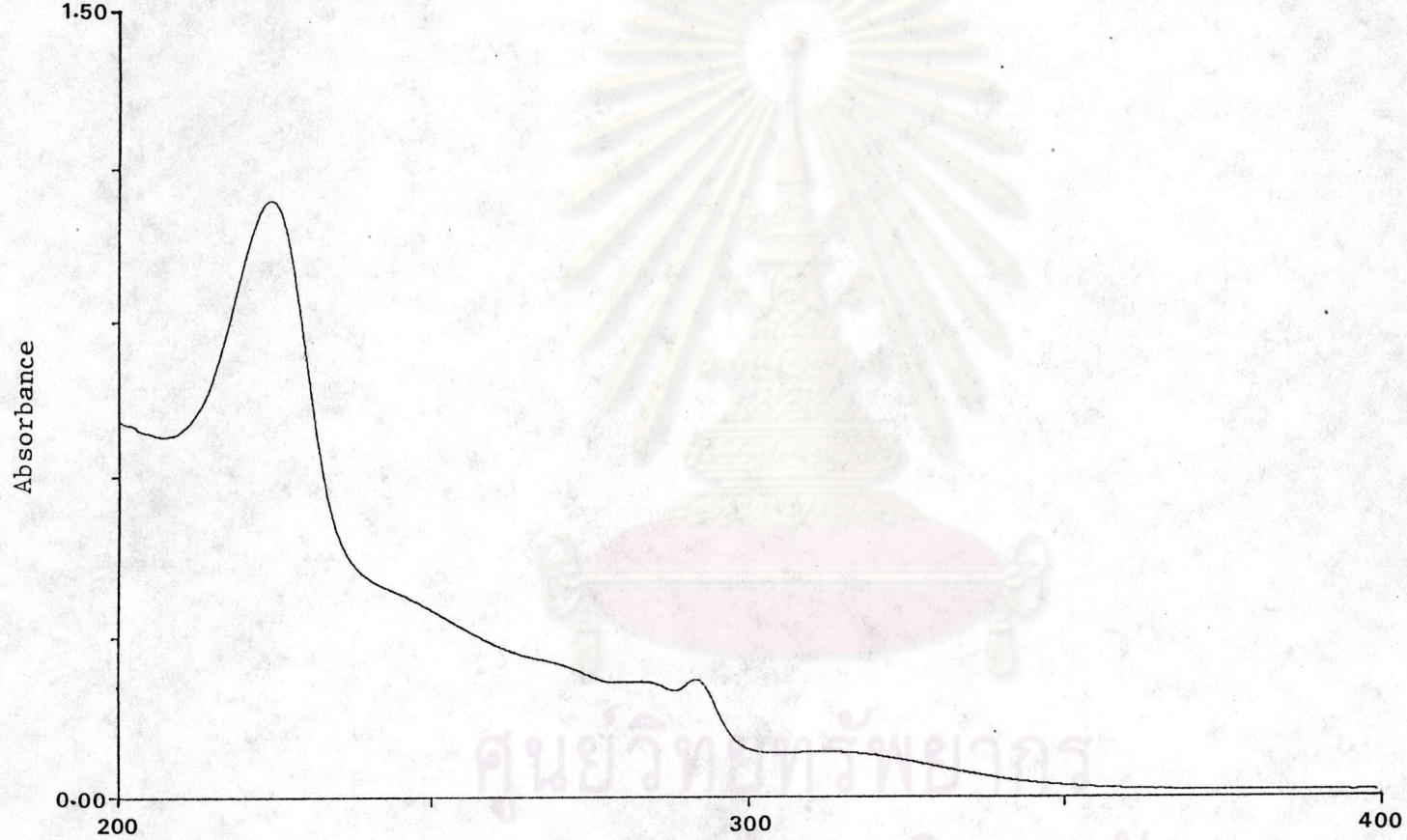

Figure 24 UV absorption spectrum of DS-2 in ethanol

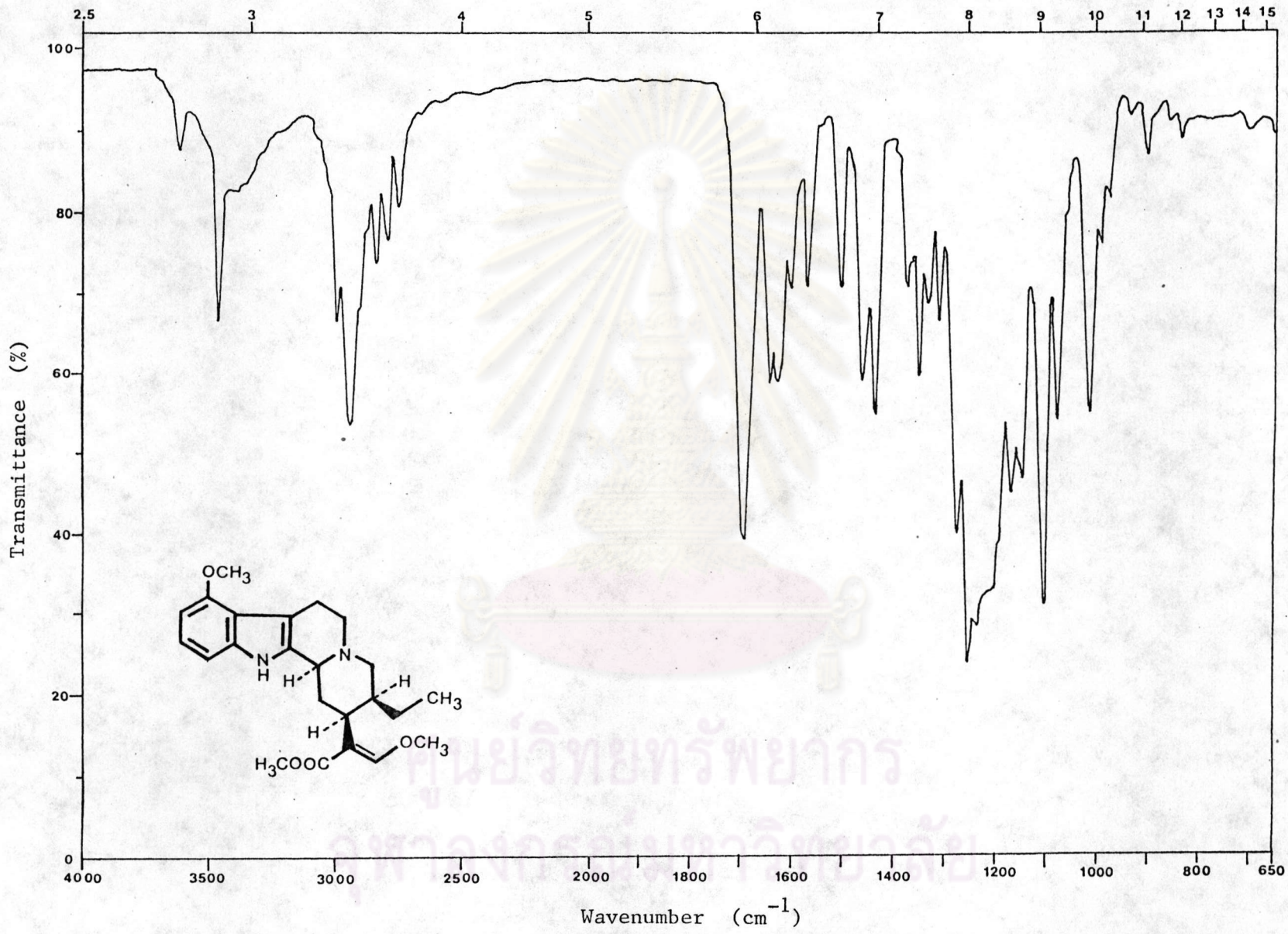

Figure 25 IR absorption spectrum of DS-2 in KBr disc

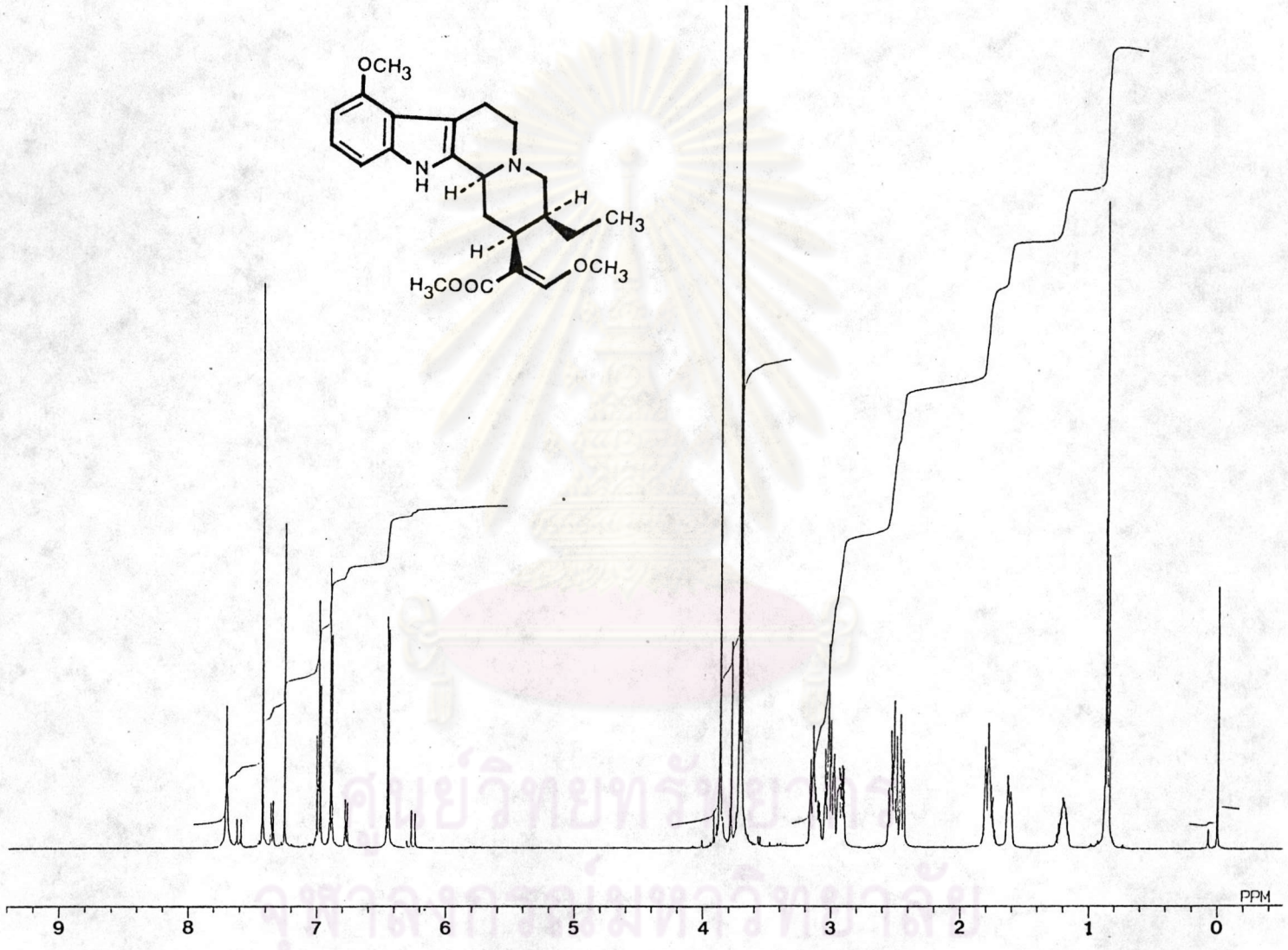

Figure 26 ^{1}H-NMR spectrum of DS-2 in $CDCl_3$

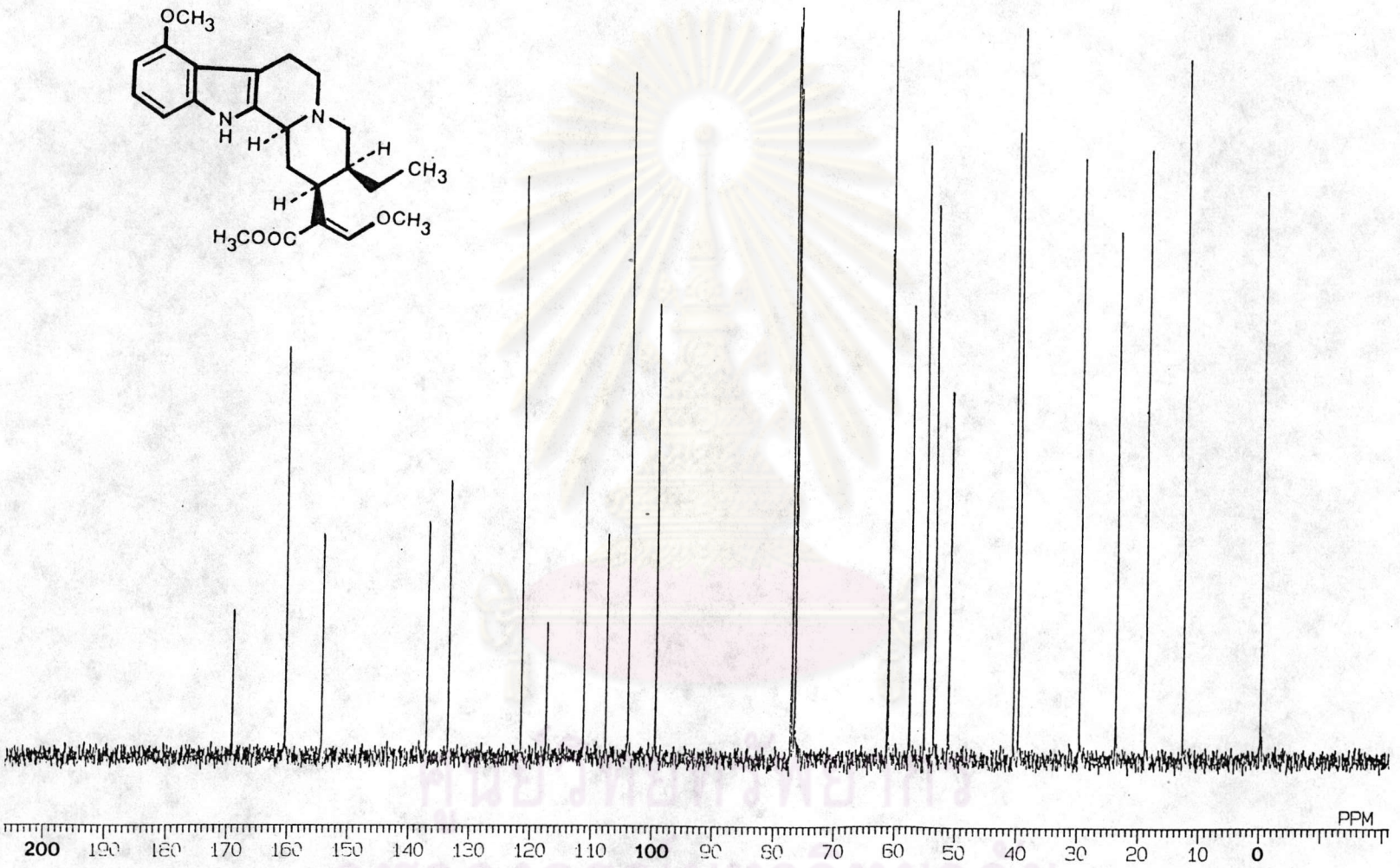

Figure 27 ^{13}C-NMR spectrum of DS-2 in $CDCl_3$

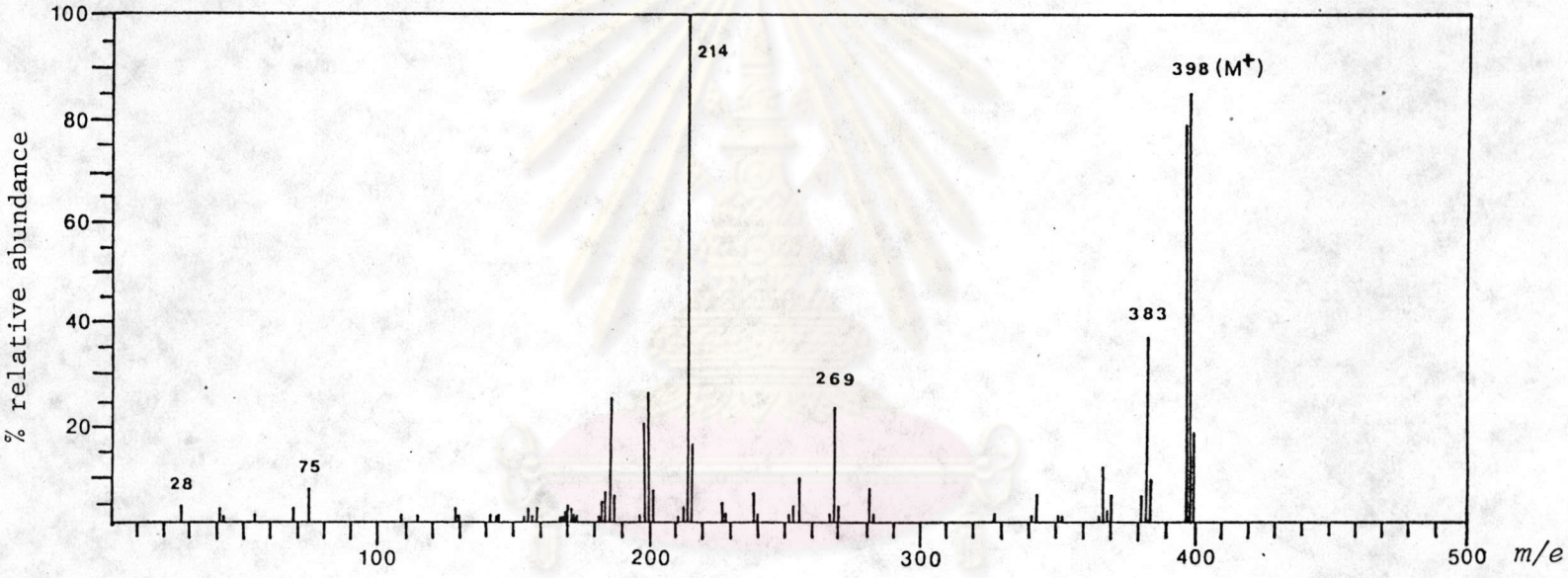

Figure 28 Mass spectrum of DS-2

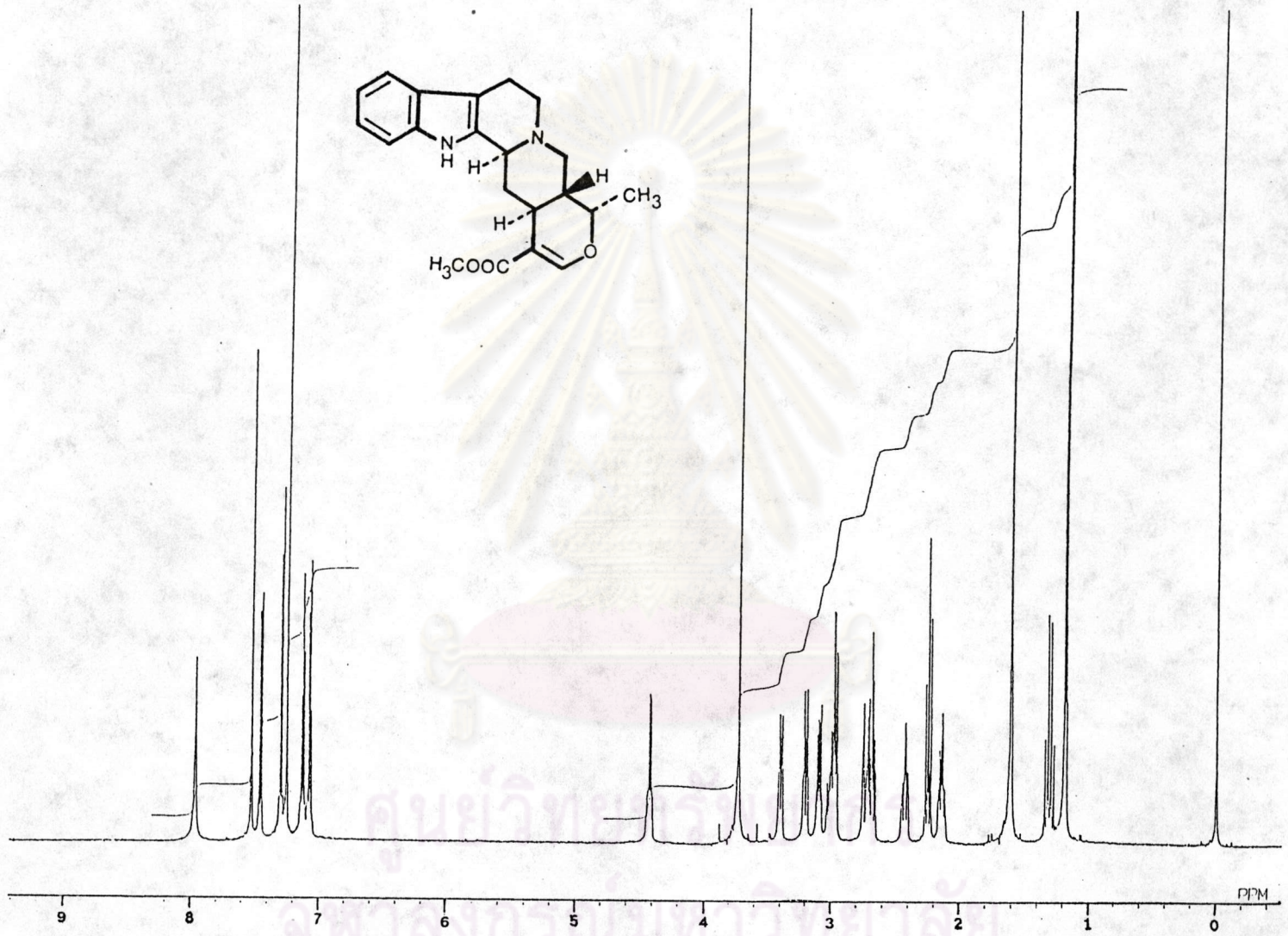

Figure 29 ^{1}H-NMR spectrum of DS-3 in $CDCl_3$

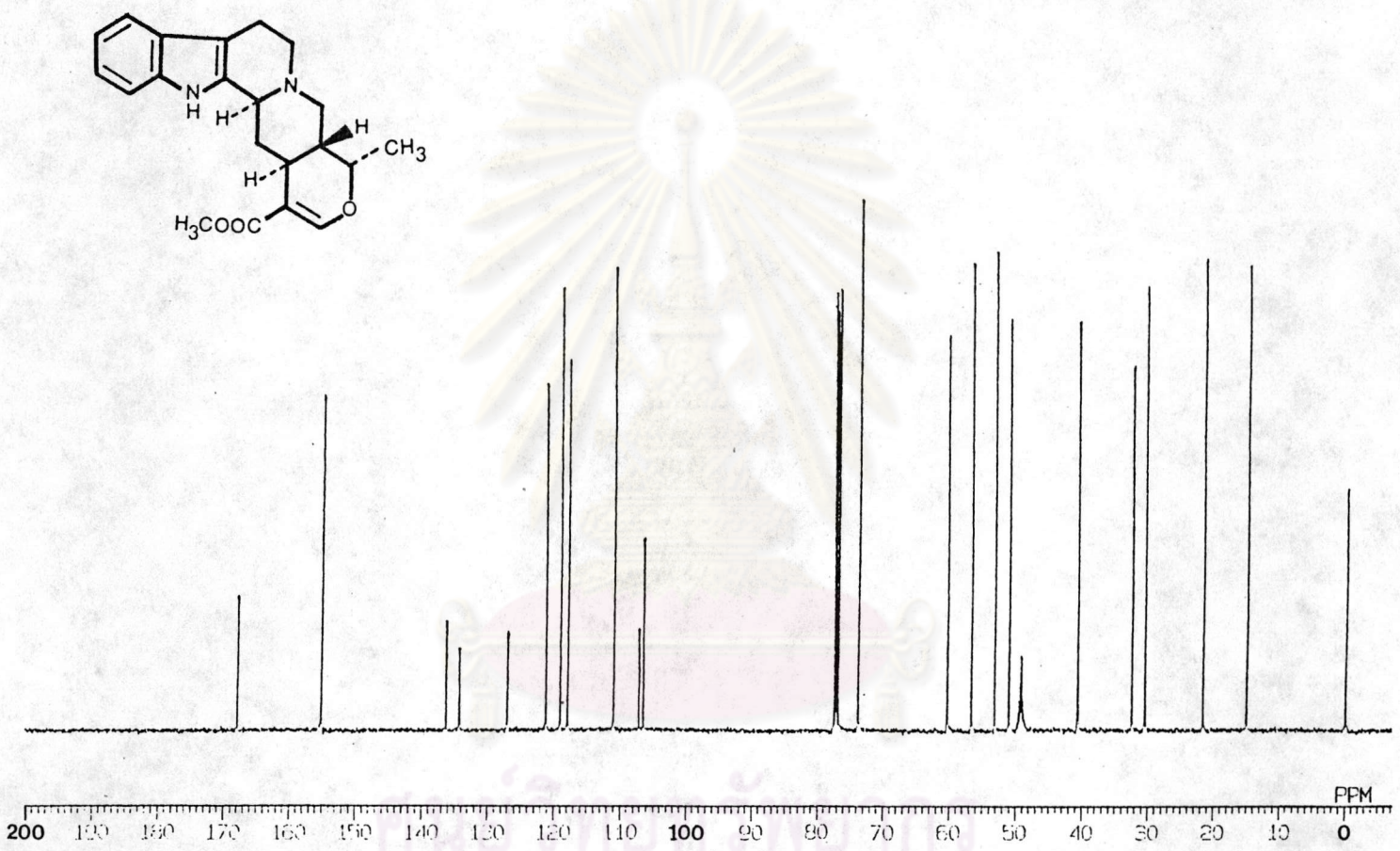

Figure 30 ^{13}C-NMR spectrum of DS-3 in $CDCl_3$

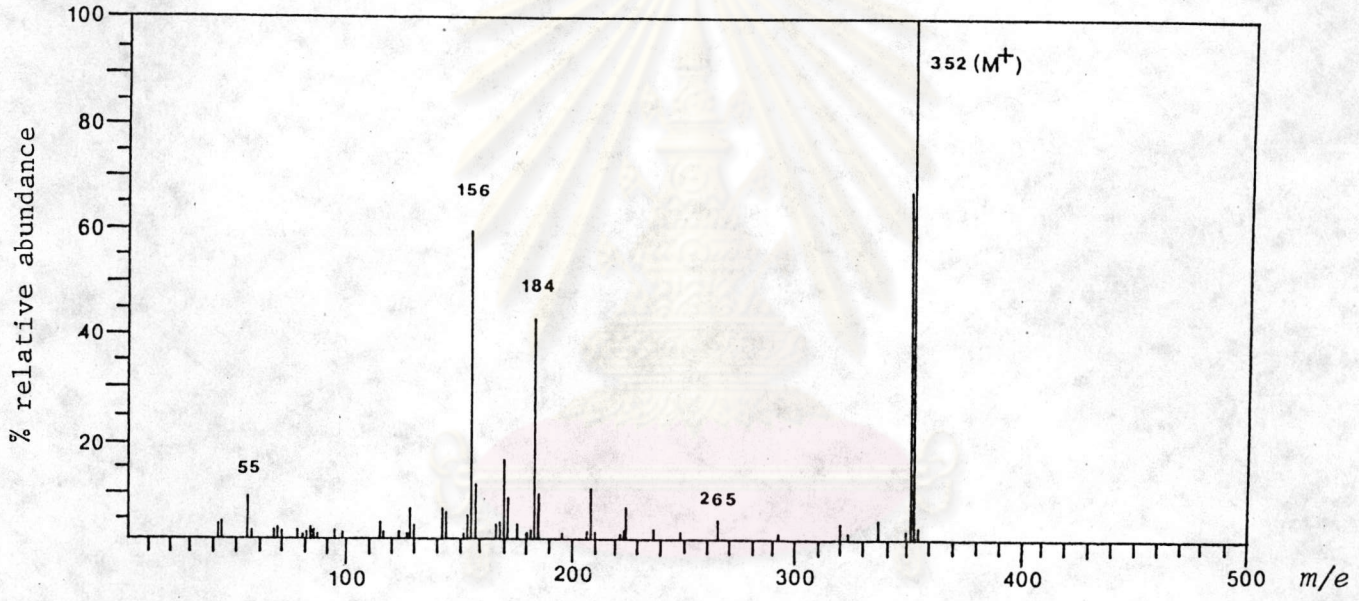

Figure 31 Mass spectrum of DS-3

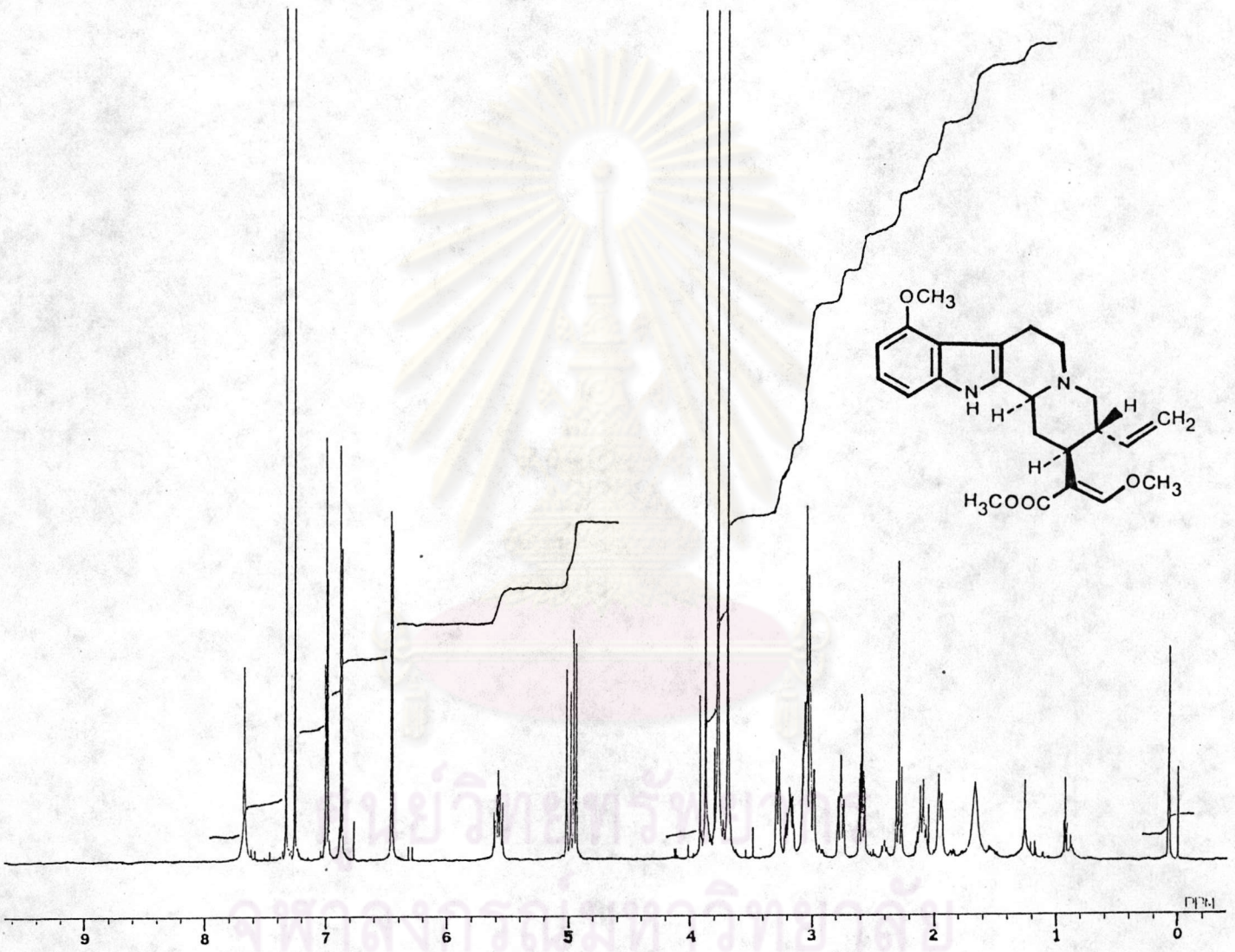

Figure 32 ^{1}H-NMR spectrum of DS-4 in $CDCl_3$

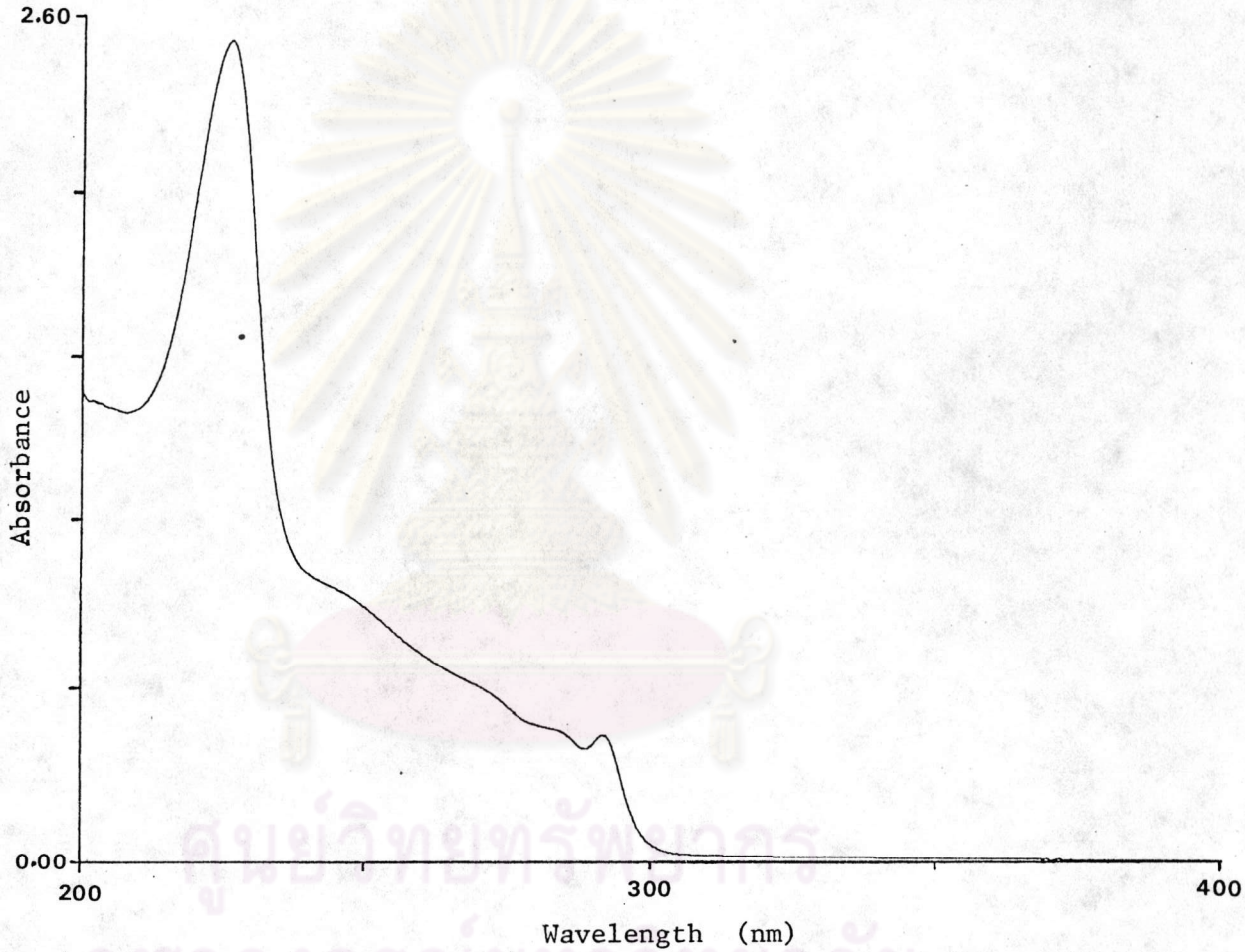

Figure 33 UV absorption spectrum of DS-5 in ethanol

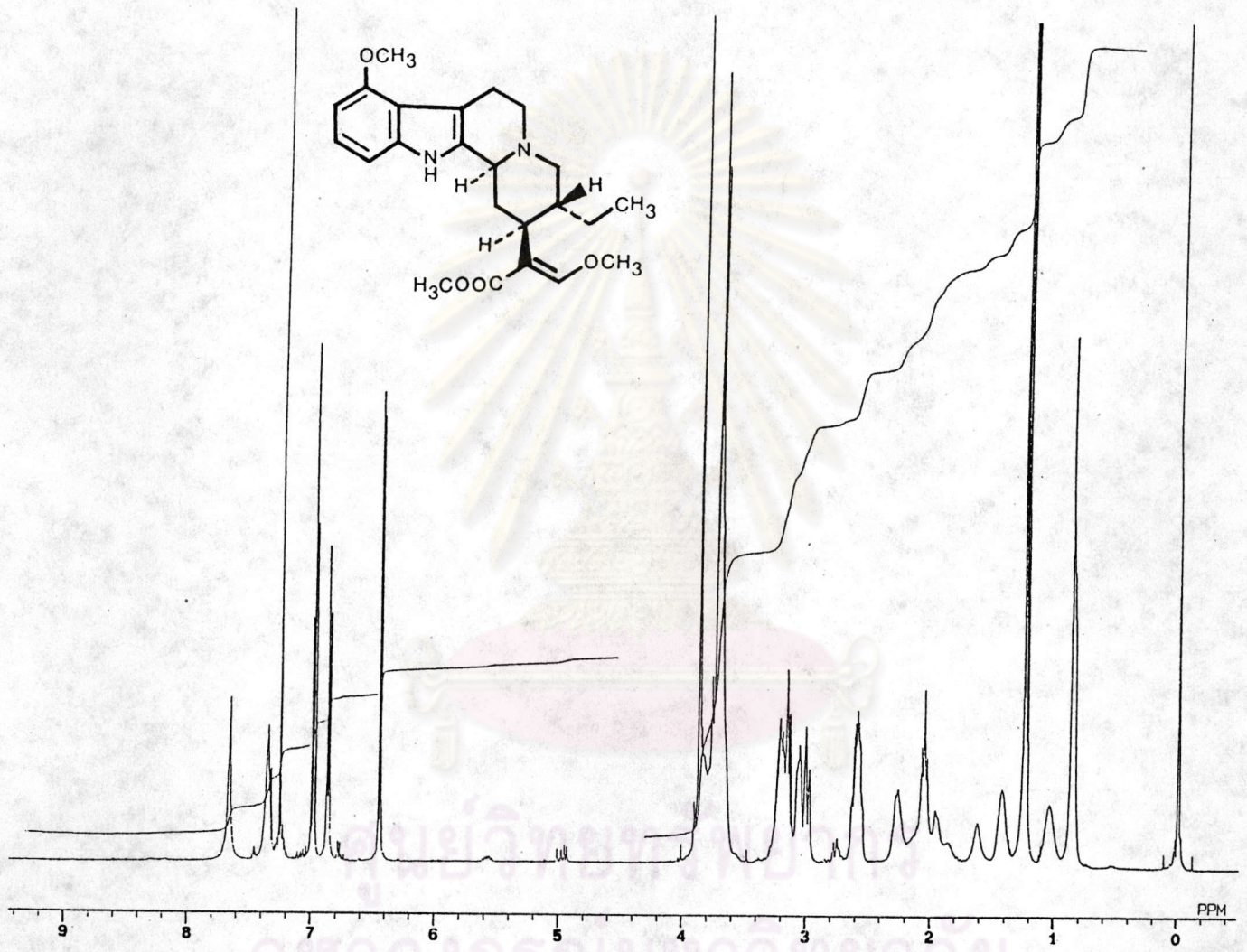

Figure 34 ^{1}H-NMR spectrum of DS-5 in $CDCl_3$

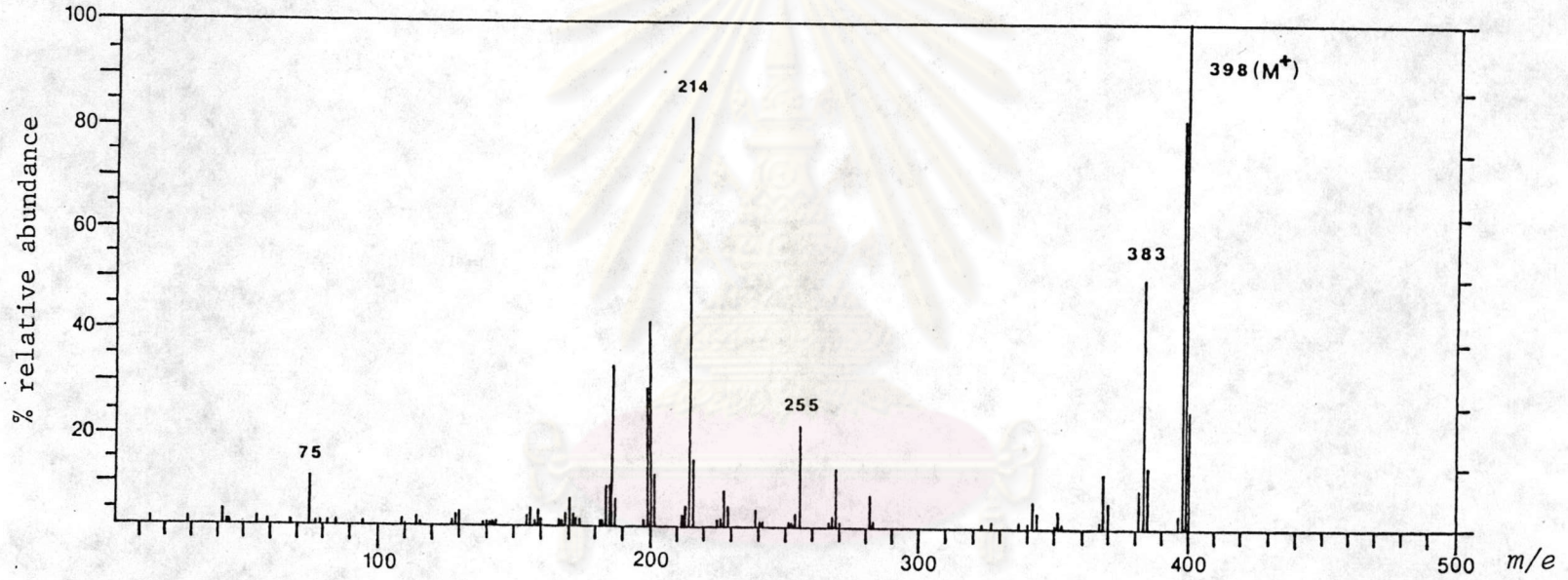

Figure 35 Mass spectrum of DS-5

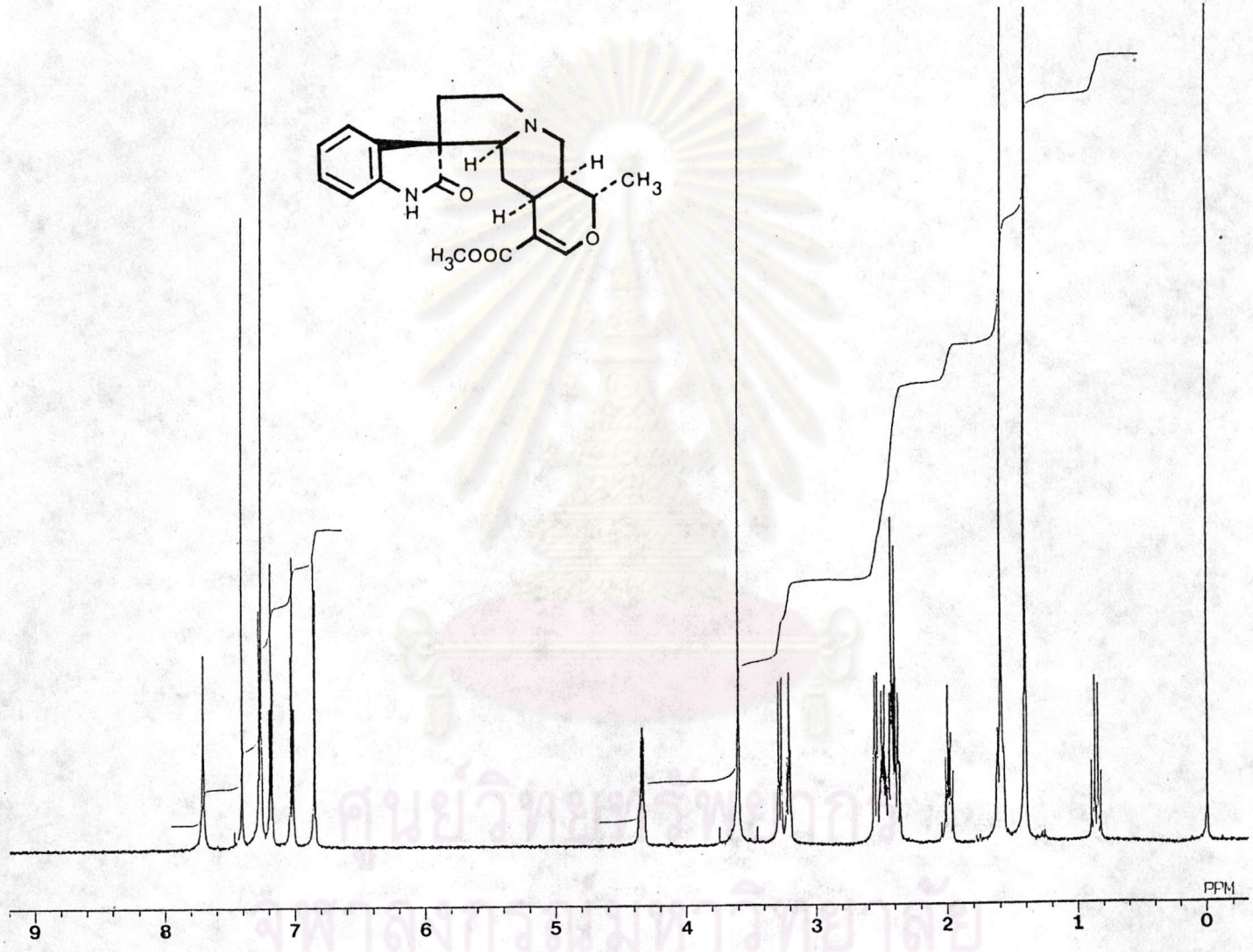

Figure 36 ^{1}H-NMR spectrum of DS-6 in $CDCl_3$

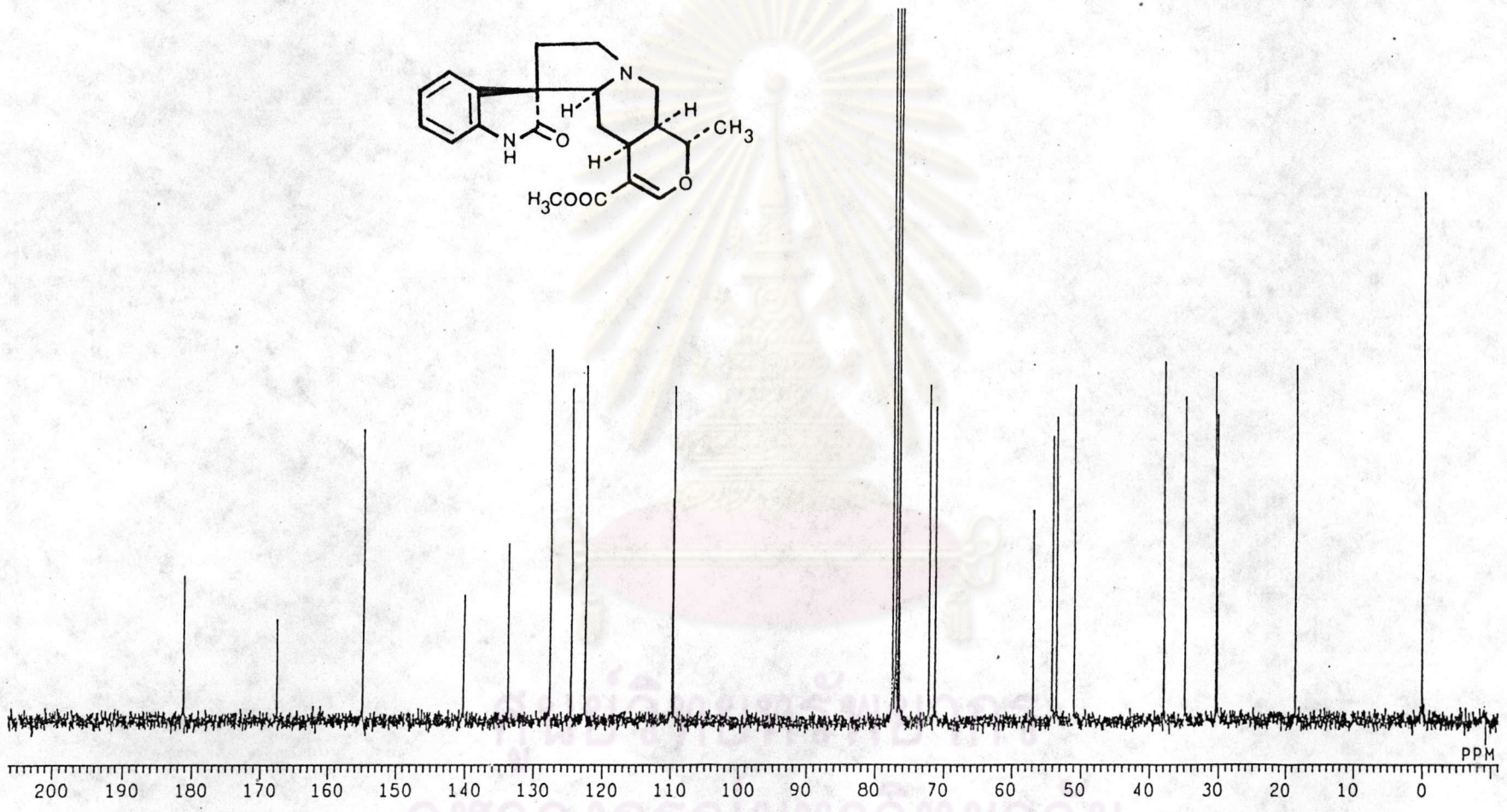

Figure 37 ^{13}C-NMR spectrum of DS-6 in $CDCl_3$

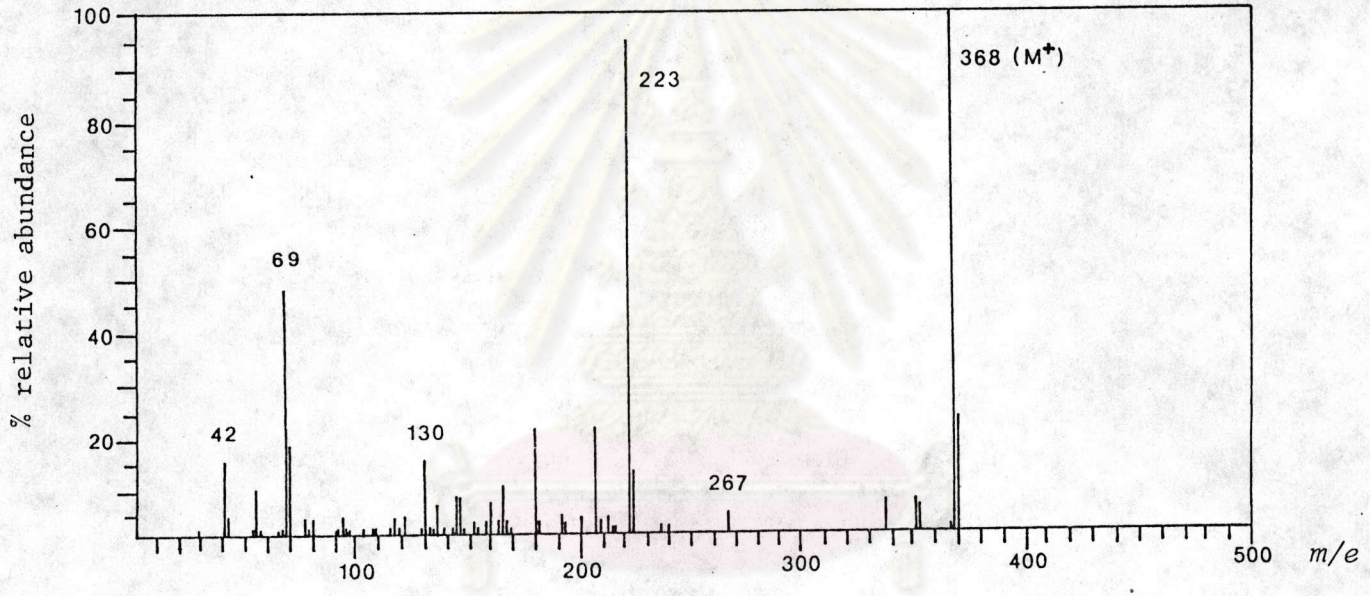

Figure 38 Mass spectrum of DS-6

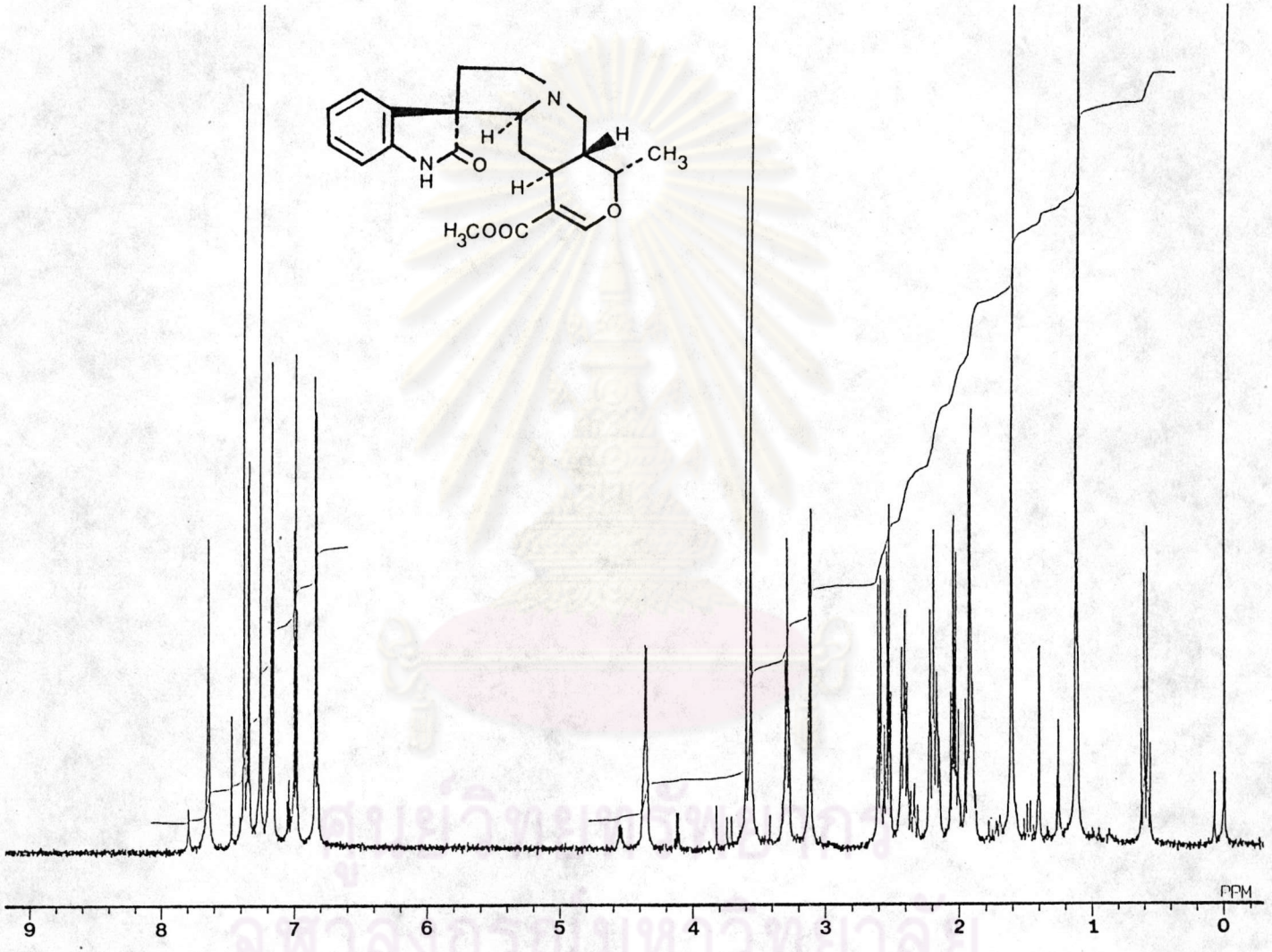

Figure 39 ^{1}H-NMR spectrum of DS-7 in $CDCl_3$

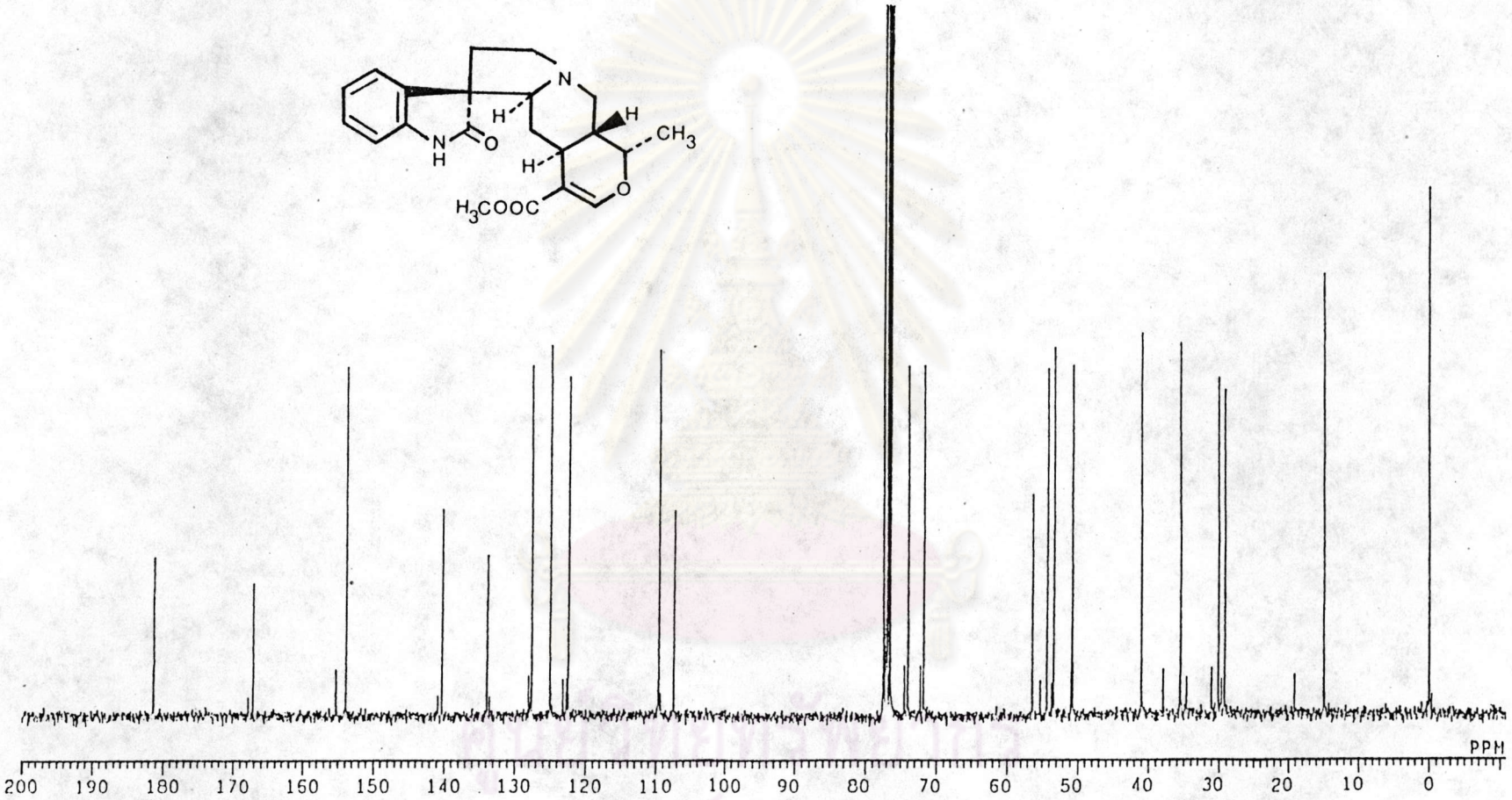

Figure 40 ^{13}C-NMR spectrum of DS-7 in $CDCl_3$

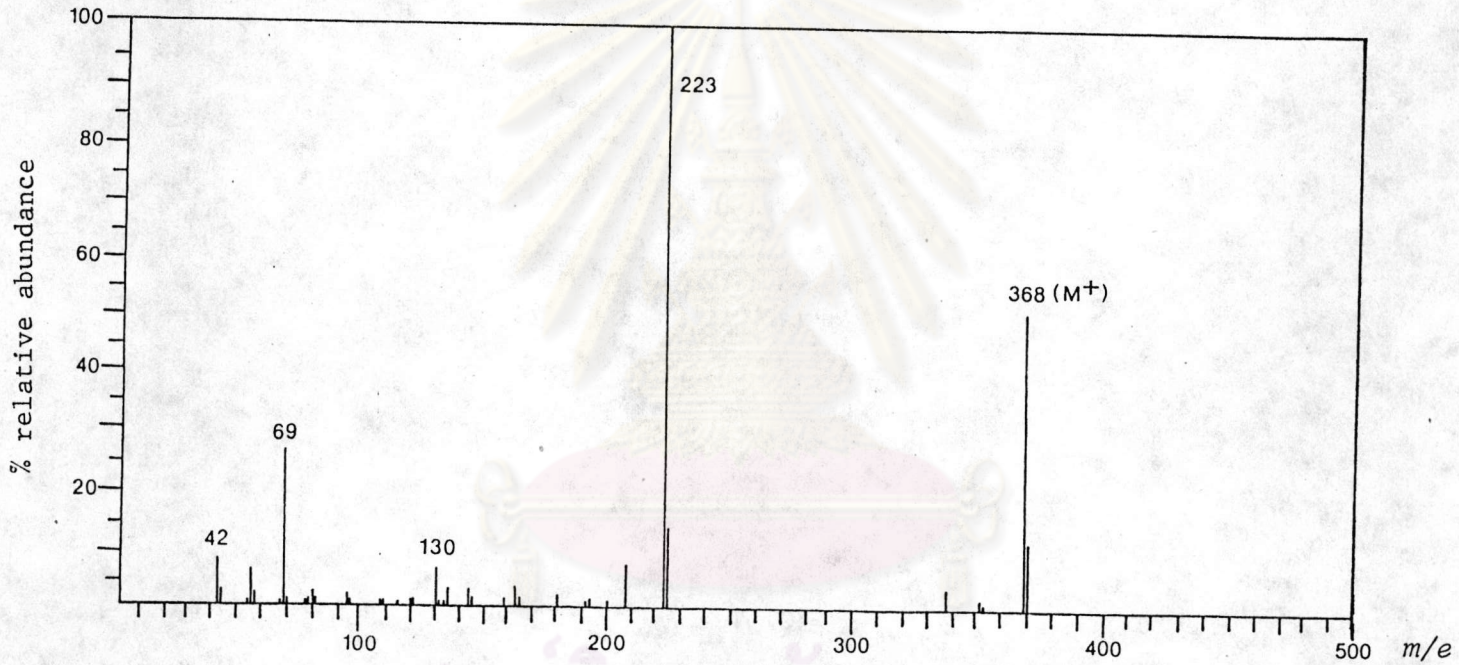

Figure 41 Mass spectrum of DS-7

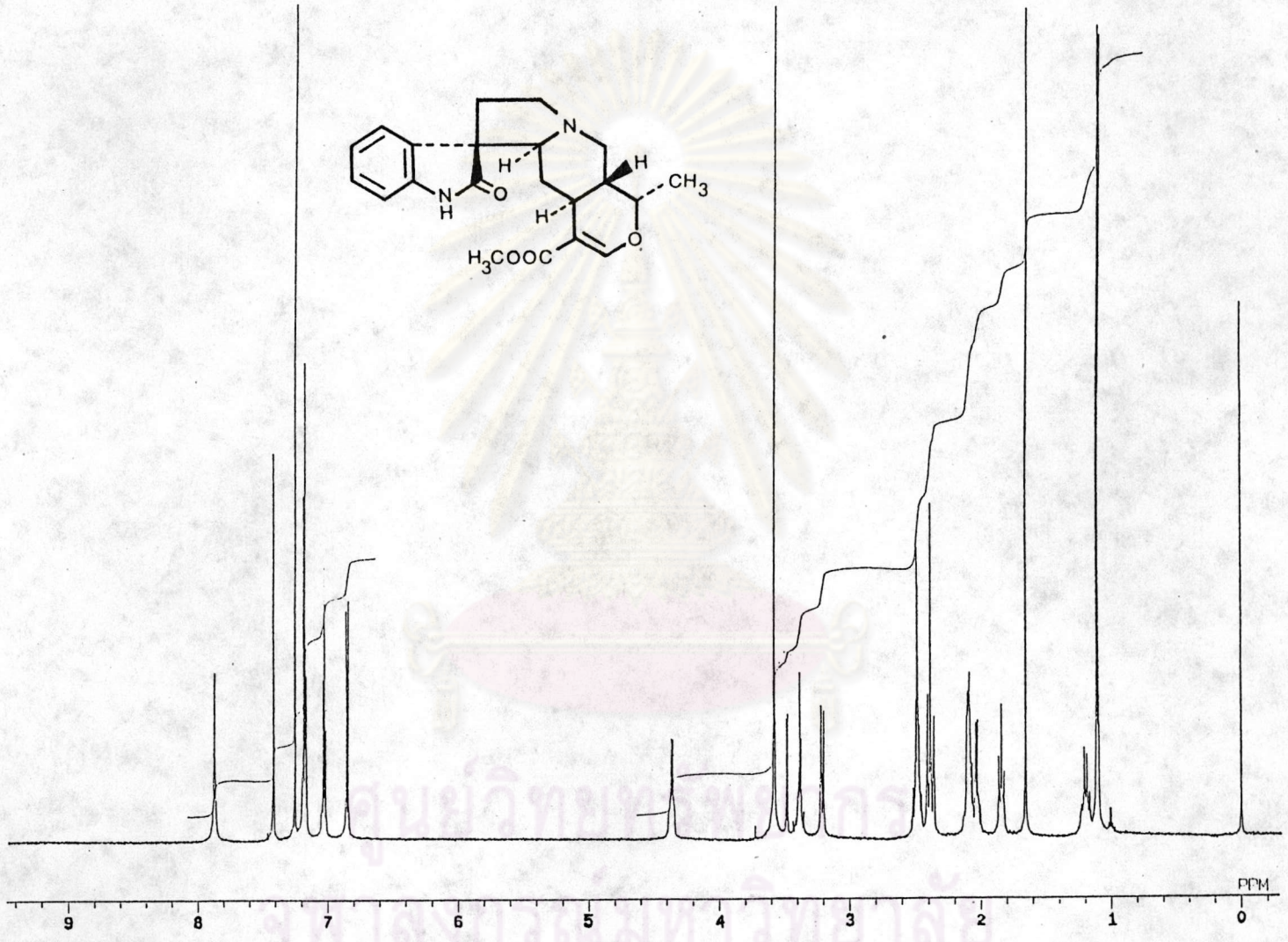

Figure 42 ^{1}H-NMR spectrum of DS-8 in $CDCl_3$

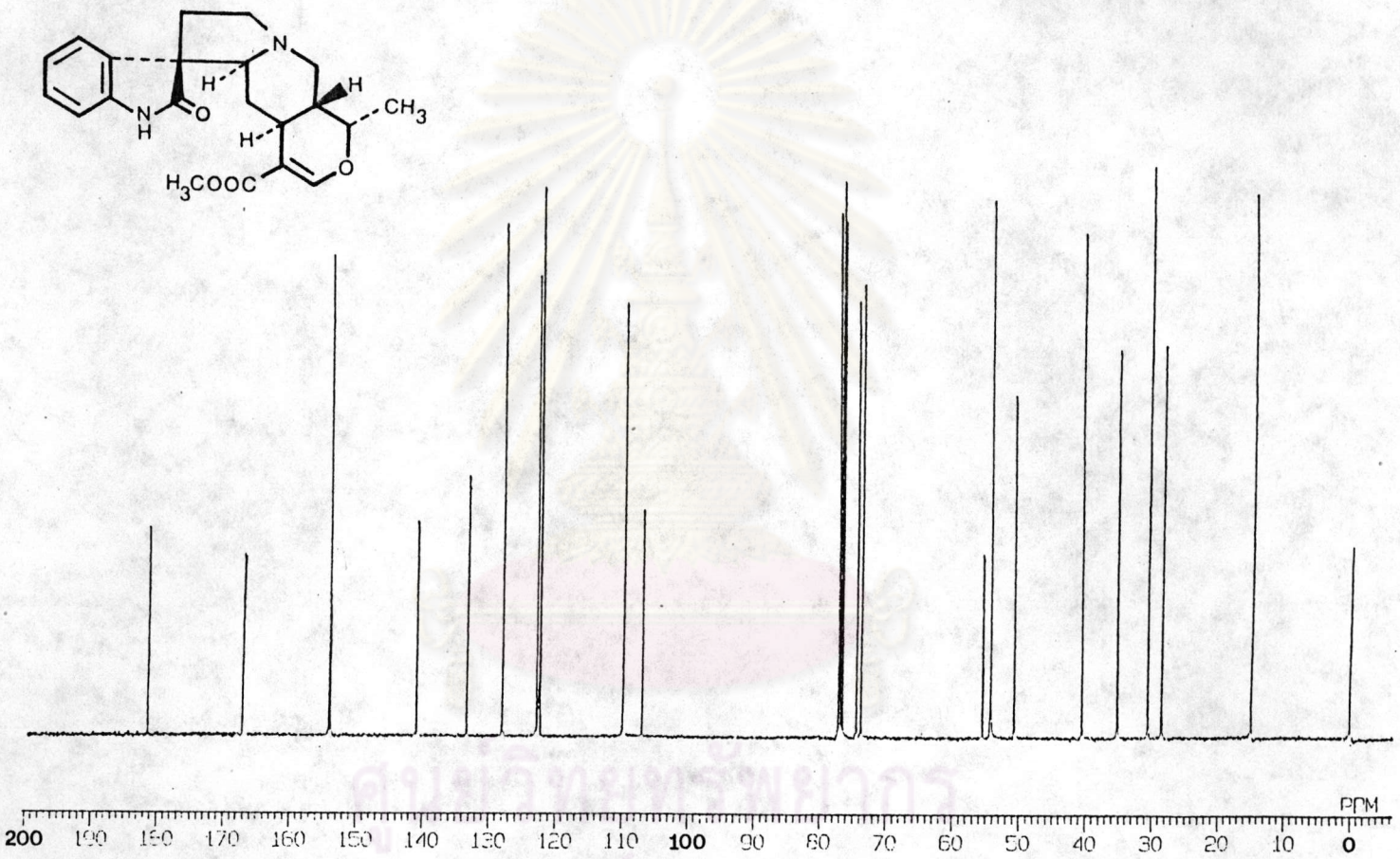

Figure 43 ^{13}C-NMR spectrum of DS-8 in $CDCl_3$

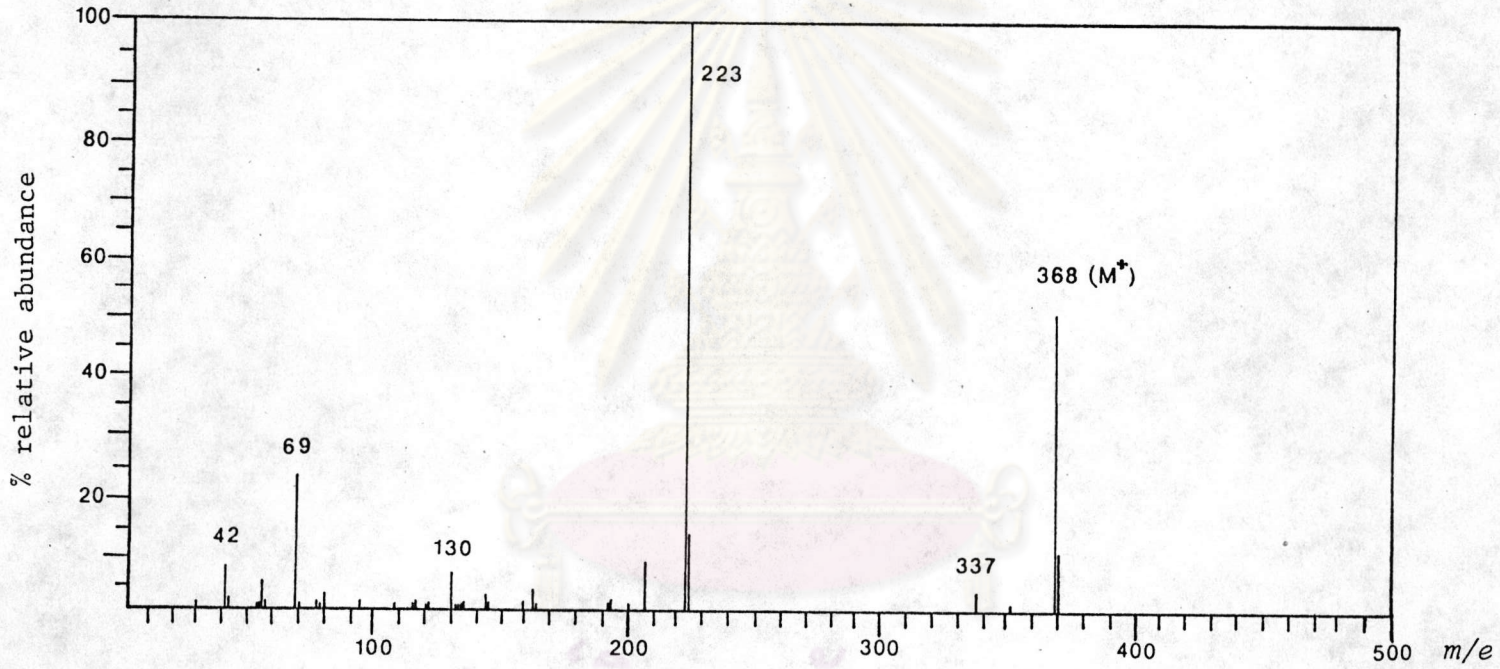

Figure 44 Mass spectrum of DS-8

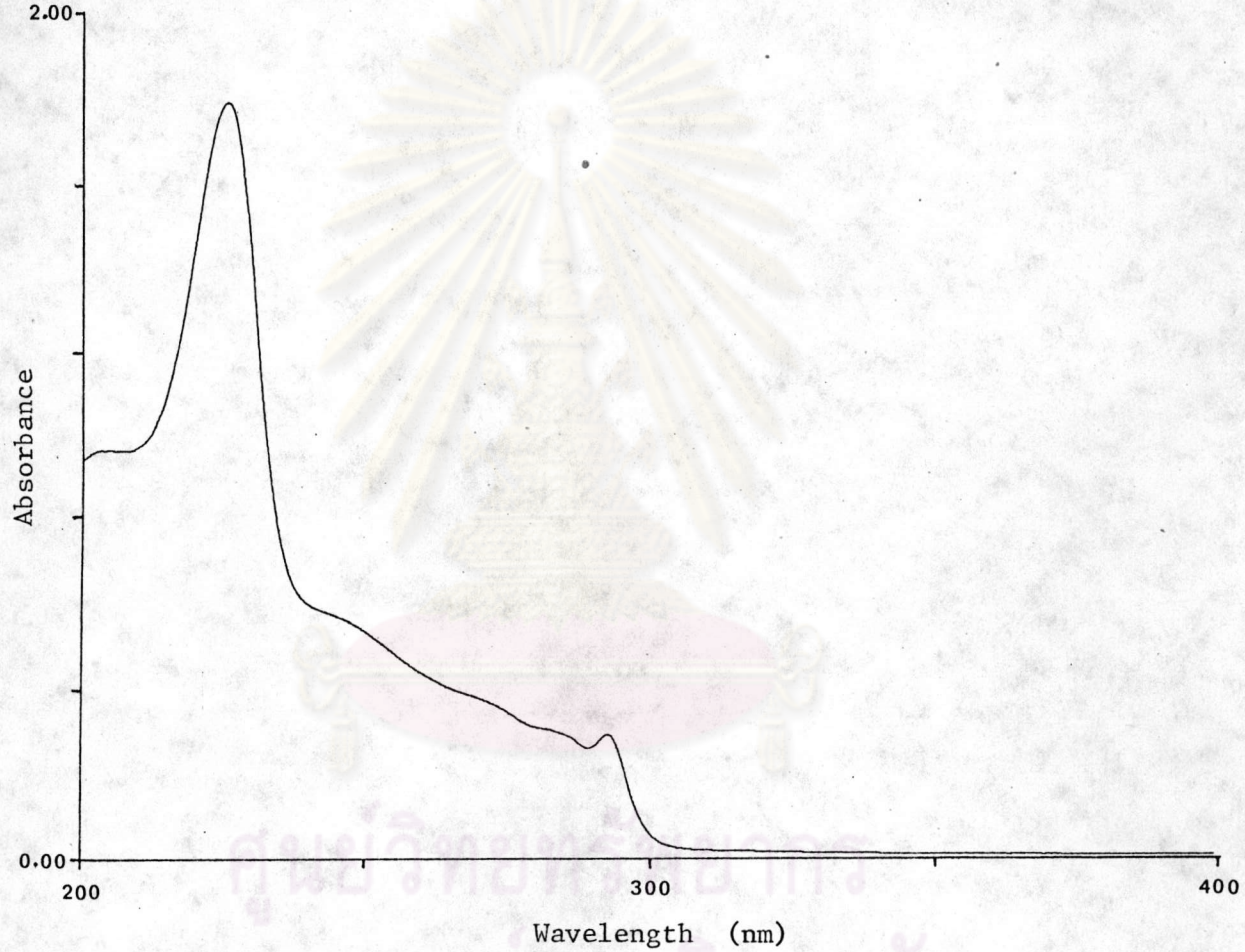

Figure 45 UV absorption spectrum of DS-9 in ethanol

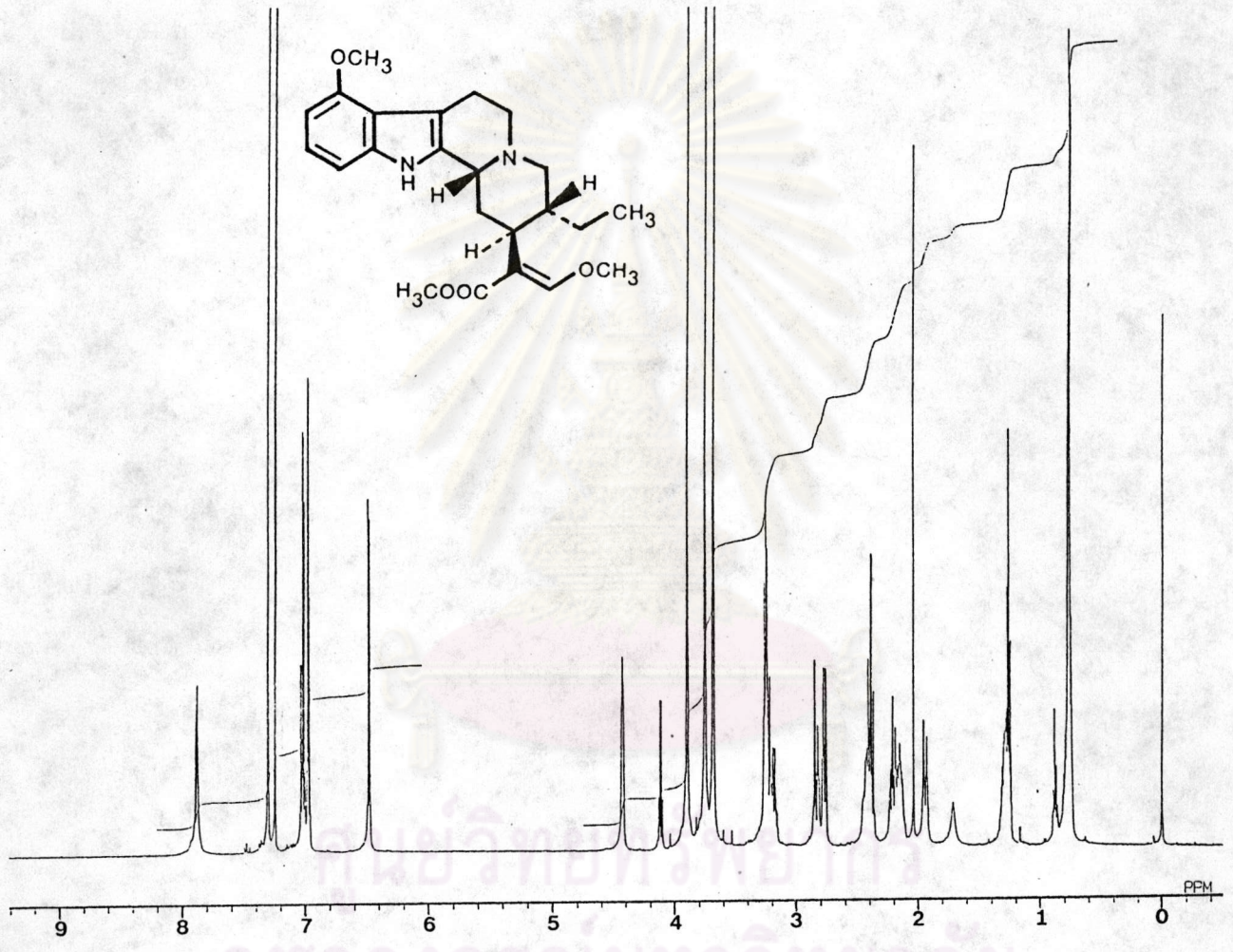

Figure 46 ^{1}H-NMR spectrum of DS-9 in $CDCl_3$

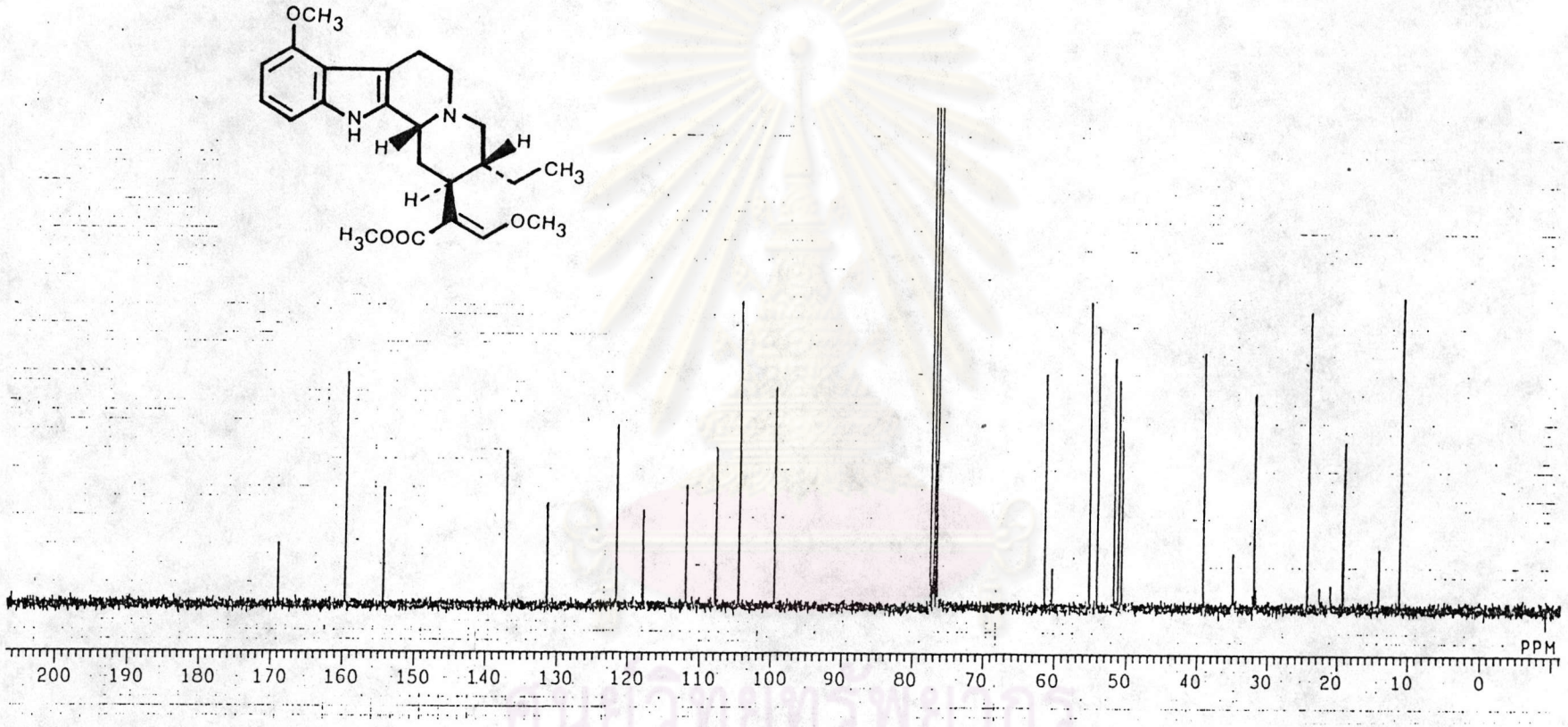

Figure 47 ^{13}C-NMR spectrum of DS-9 in $CDCl_3$

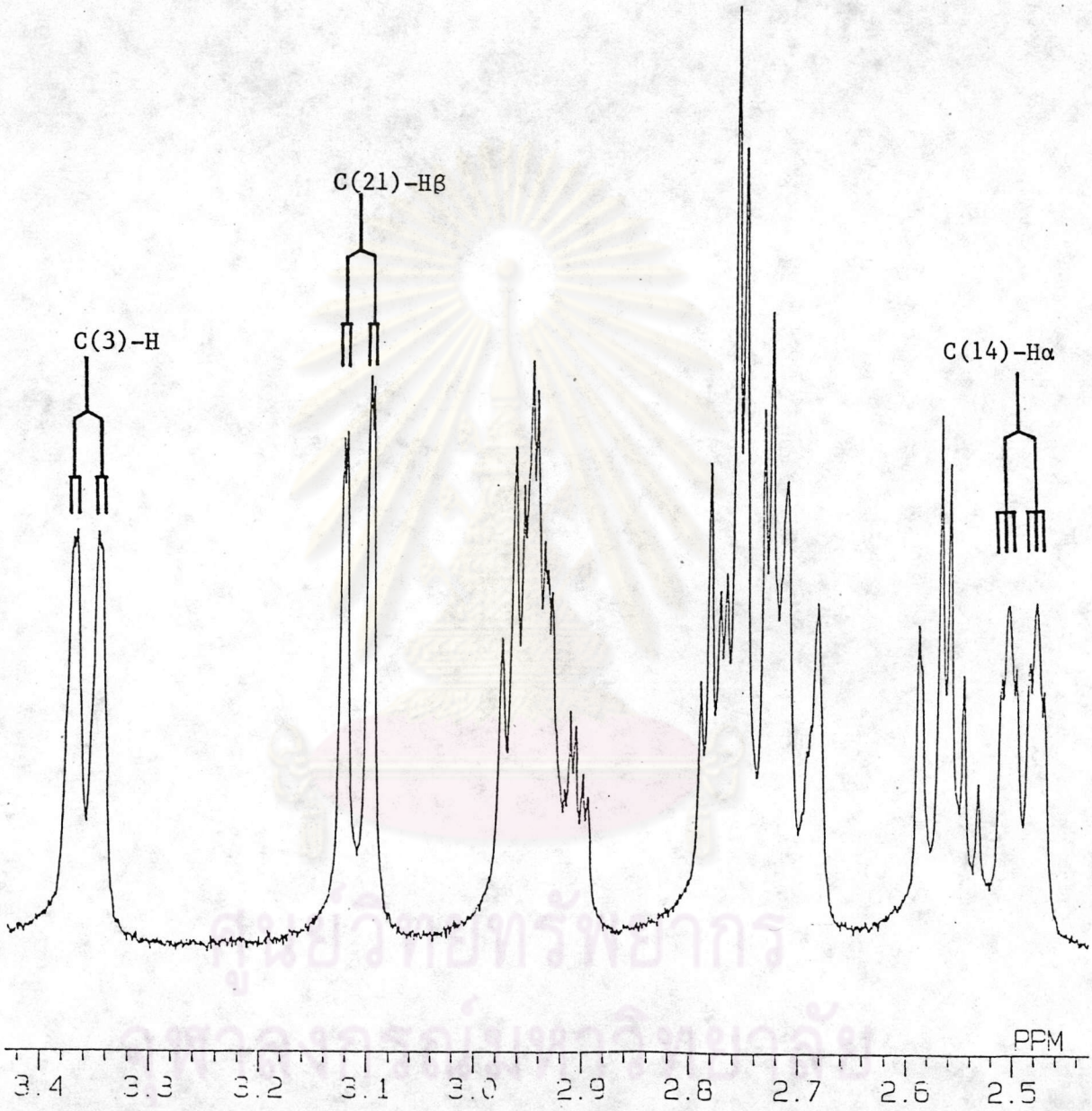

Figure 48 ^{1}H-NMR spectrum of DS-1 in $CDCl_3$

: Expansion of the upfield region

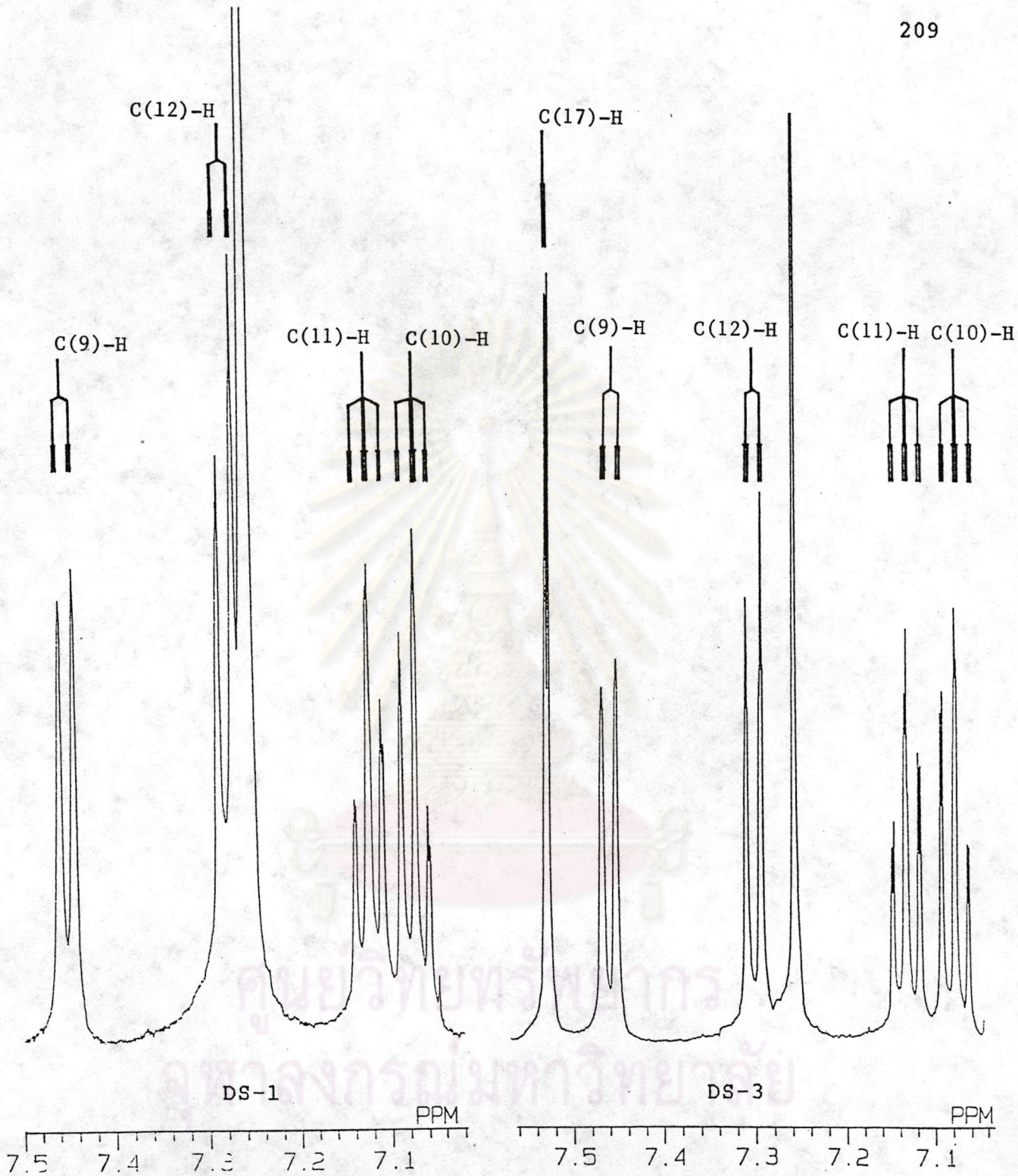

Figure 49 ^{1}H-NMR spectra of DS-1 and DS-3 in $CDCl_3$

: Expansion of the aromatic regions

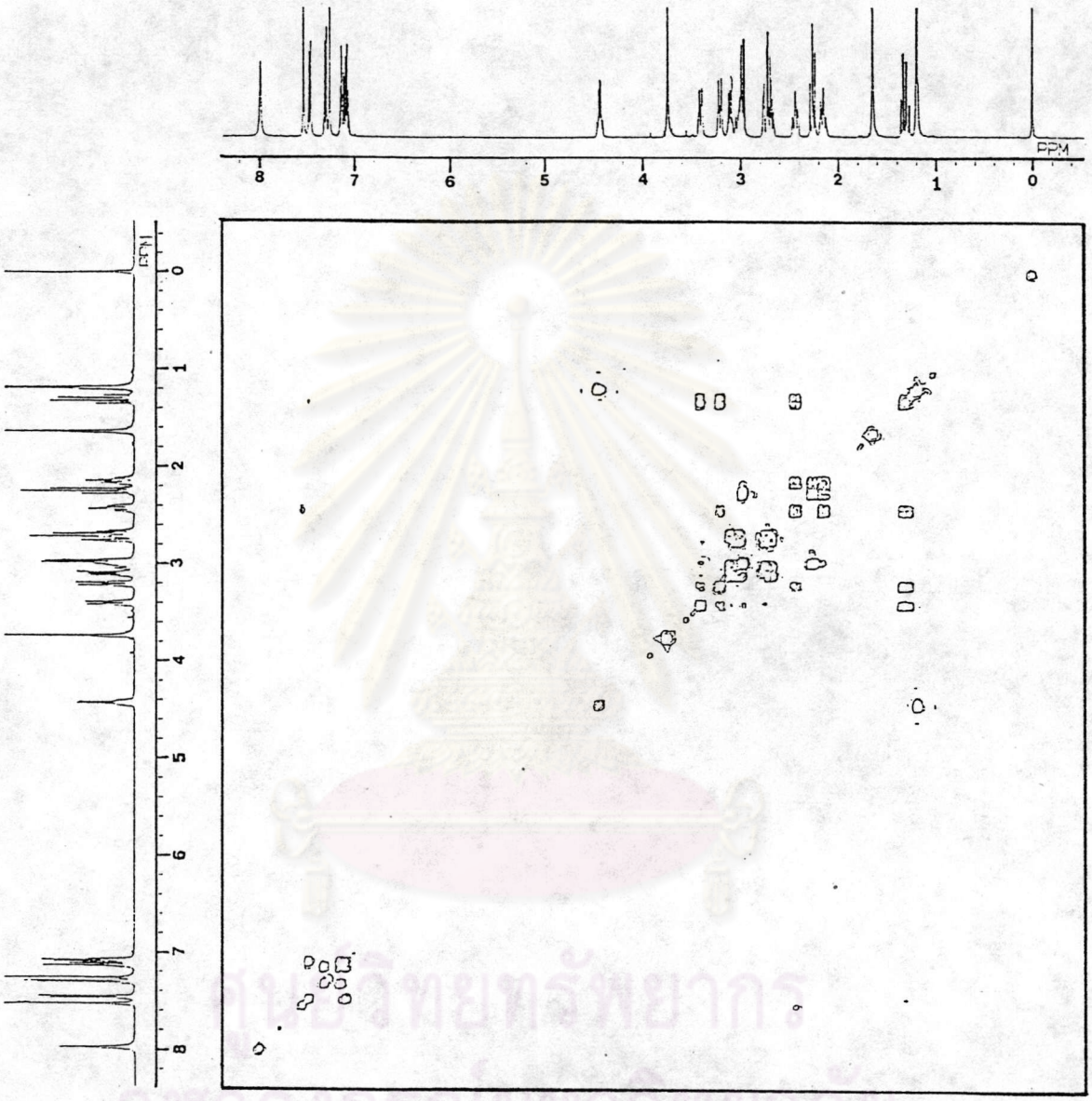

Figure 50 Two dinensional ^{1}H-NMR spectrum (COSY) of DS-3 in C_5D_5N

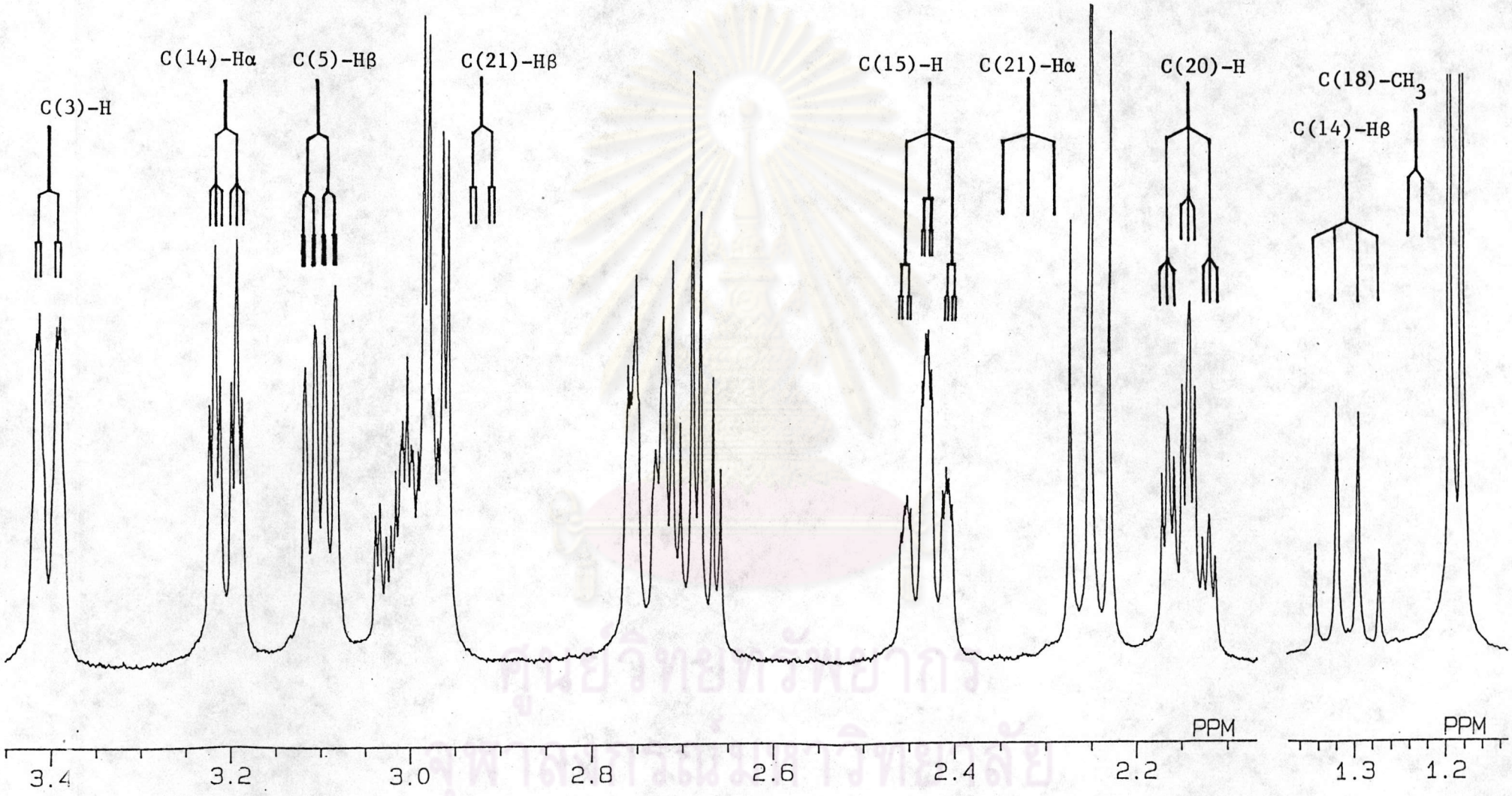

Figure 51 ^{1}H-NMR spectrum of DS-3 in $CDCl_3$

: Expansion of the upfield region

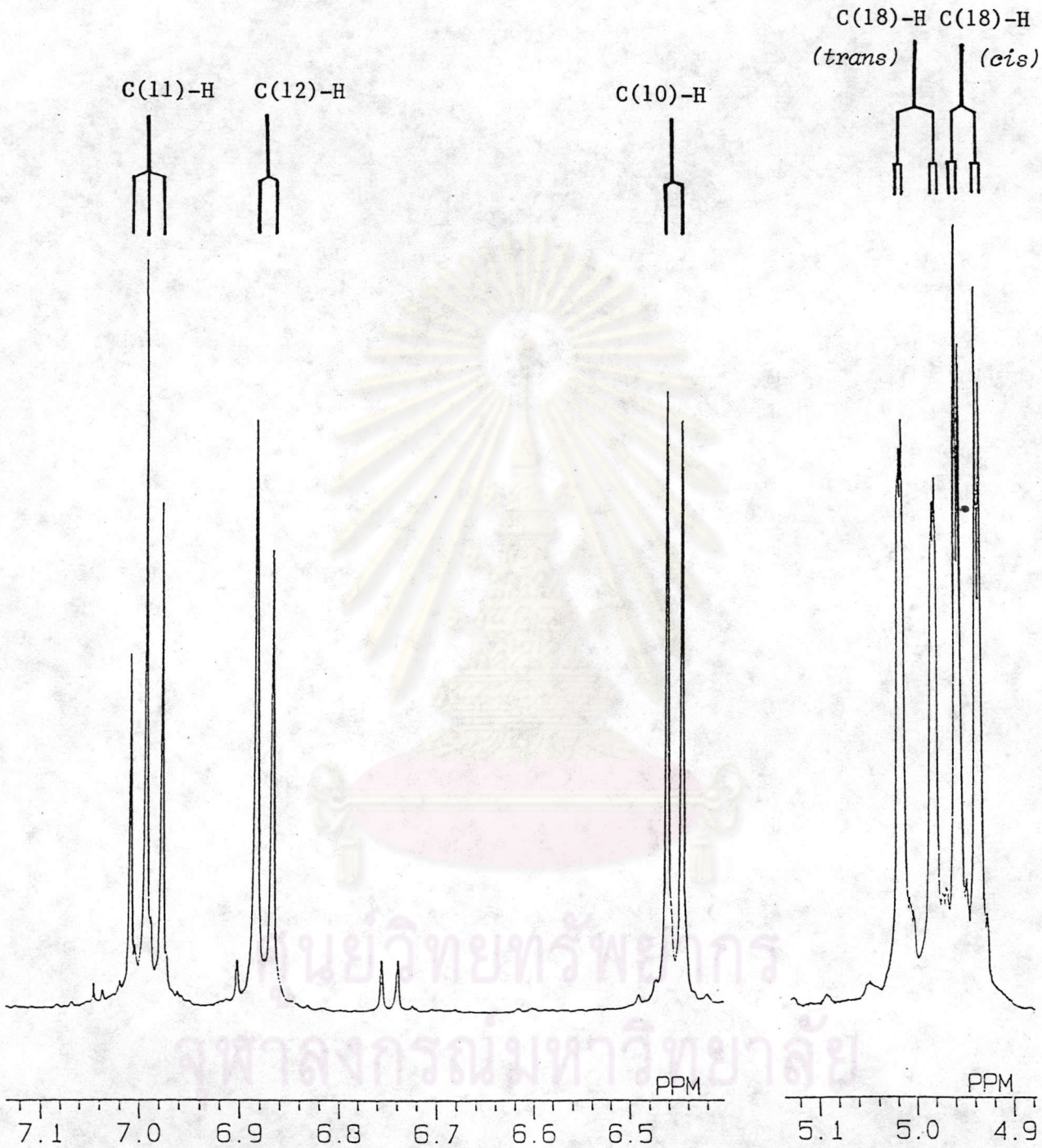

Figure 52 ^{1}H-NMR spectrum of DS-4 in $CDCl_3$

: Expansion of the downfield region

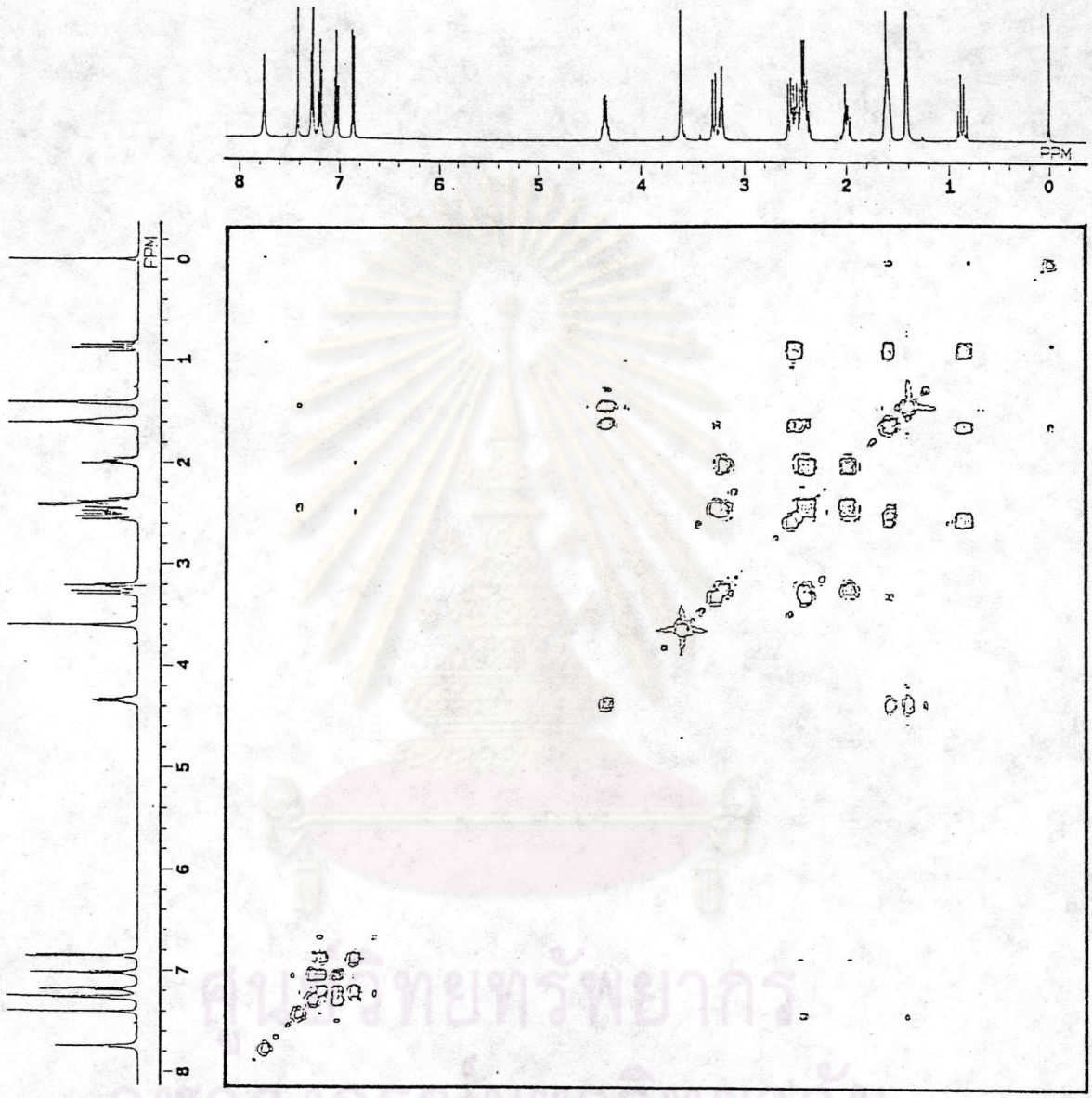

Figure 53 Two dimensional ^{1}H-NMR spectrum (COSY) of DS-6 in C_5D_5N

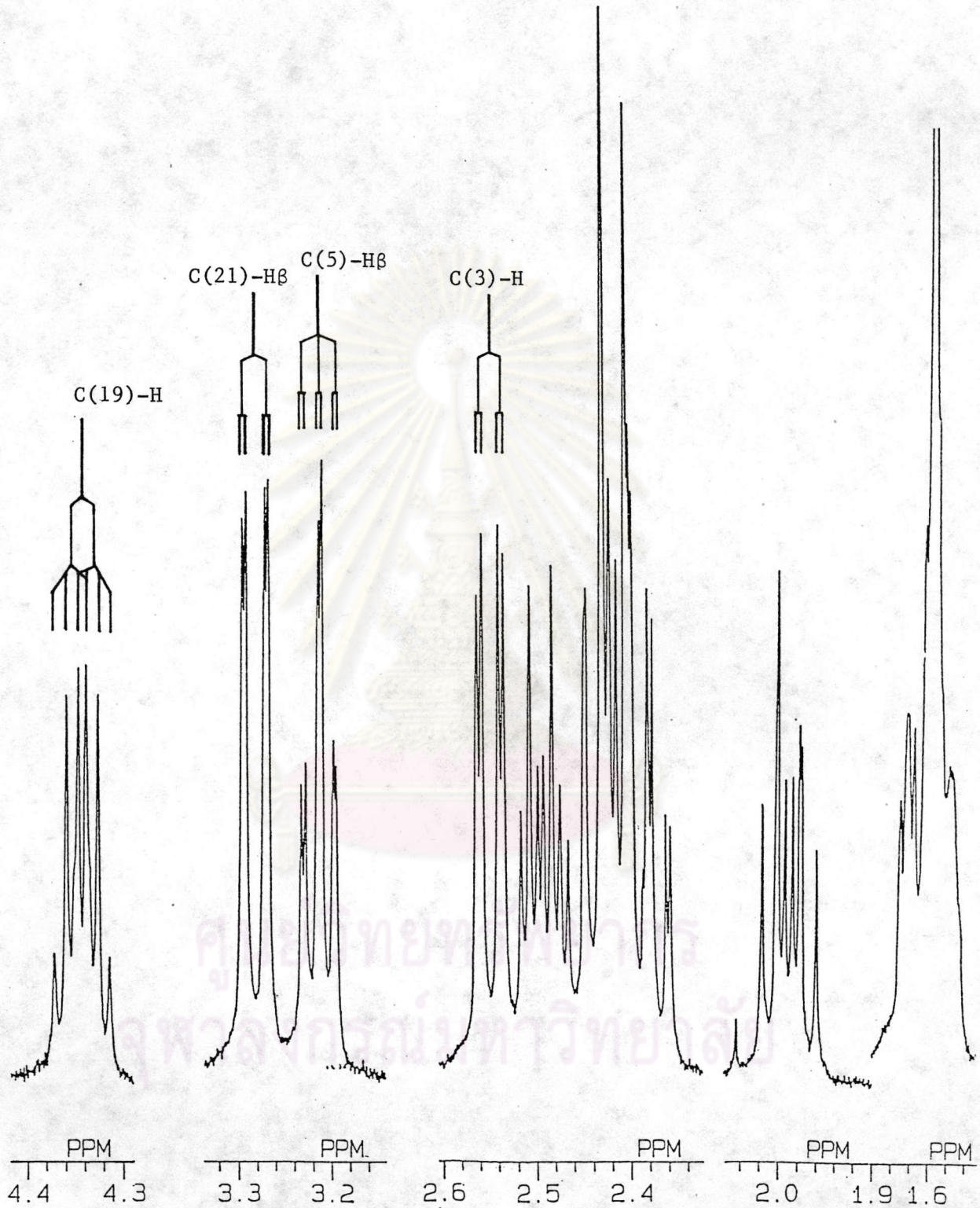

Figure 54 ^{1}H-NMR spectrum of DS-6 in $CDCl_3$

: Expansion of the upfield region

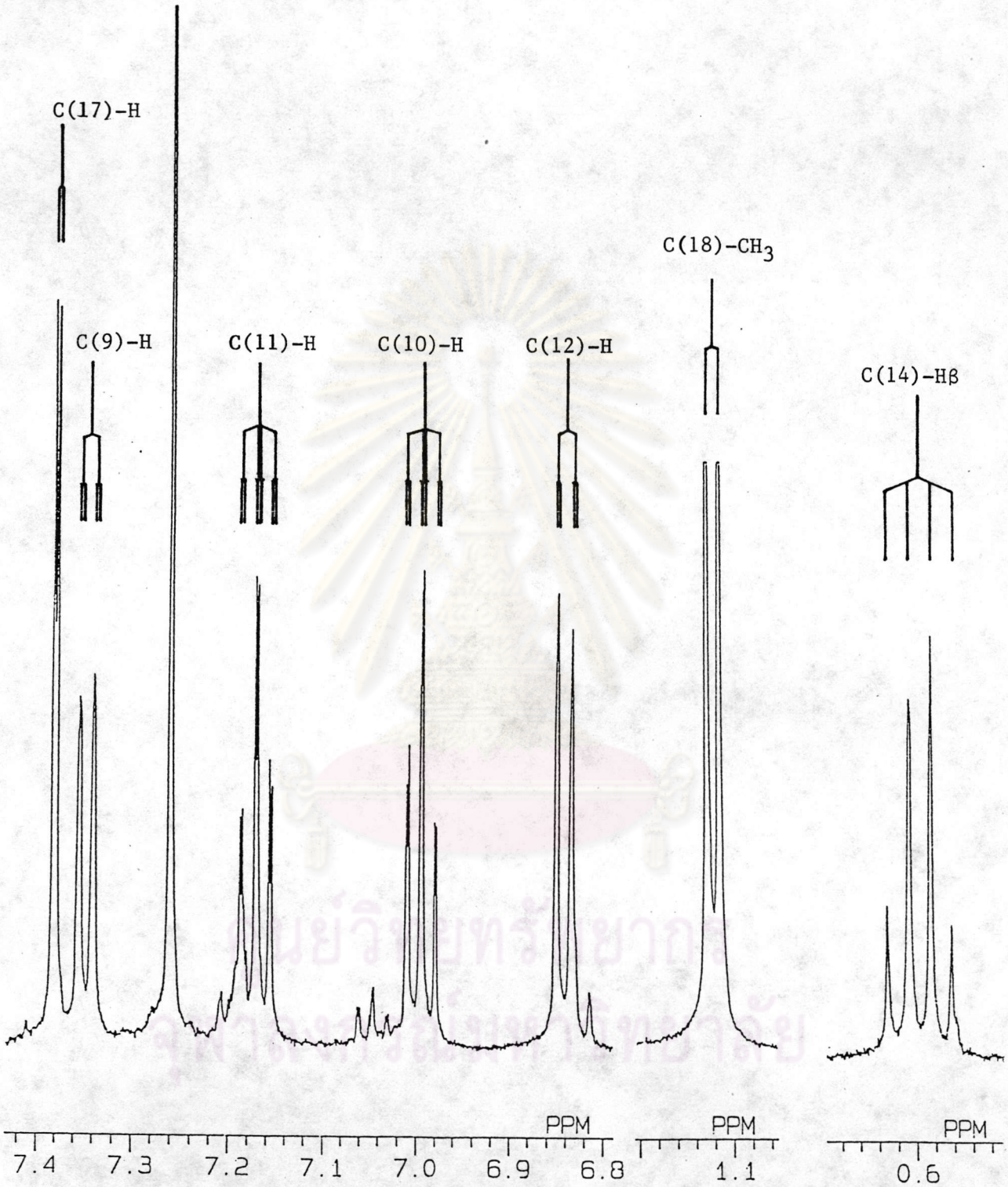

Figure 55 ^{1}H-NMR spectrum of DS-7 in $CDCl_3$

: Expansion of the aromatic region

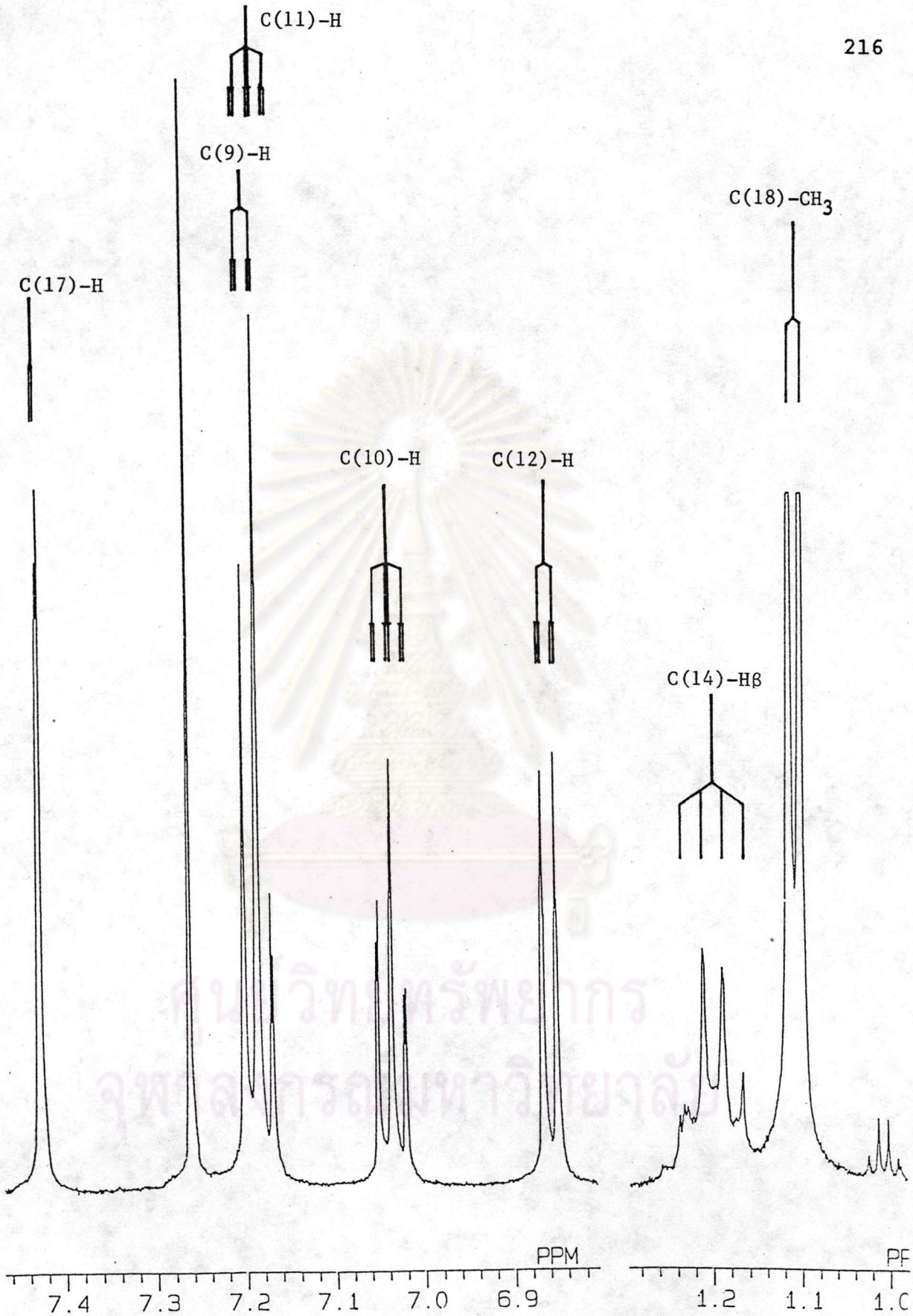

Figure 56 ^{1}H-NMR spectrum of DS-8 in $CDCl_3$

: Expansion of the aromatic region

Figure 57 *Mitragyna speciosa* (Korth.) Havil.

VITA

Mr. Niwat Keawpradub was born on October 29, 1963 in Songkla, Thailand. He received his Bachelor of Science in Pharmacy in 1987 from the Faculty of Pharmacy, Prince of Songkla University, Thailand. Since graduation, he has been appointed as an instructor in the Department of Pharmacognosy and Pharmaceutical Botany, Faculty of Pharmacy, Prince of Songkla University, Songkla, Thailand.