slow EEG activity might indicate particularly severe deterioration of the brains of these individuals. Thus whatever damage has occurred to cause the appearance of these slow waves also seems to affect sleep quality.

4. Rhythmic aspects of sleep. In contrast to the great abnormalities in other sleep parameters, the NREM-REM cycles, on average and particularly in the males, did not show great deviation from the normal pattern. Although there was wide variation in individual NREM-REM cycle duration, this ultradian rhythm seems to be maintained in patients whose brain is no longer capable of producing synchronized alpha activity. Sleep, as might be expected, was severely fragmented in most patients (fig. 9), with numerous shorter and longer sleep episodes occurring during the day. However, the day-night cycle of wakefulness and sleep could still be recognized in the group of patients as a whole (fig. 10).

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Short Communications

Degraded monoterpenes from the opisthobranch mollusc *Melibe leonina*[1]

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Summary. 2,6-dimethyl-5-heptenal (**1**) and 2,6-dimethyl-5-heptonic acid (**2**) were isolated from skin extracts of the nudibranch *Melibe leonina*. The aldehyde **1** is responsible for the pleasant odour of the animals.

The dendronotid nudibranch *Melibe leonia* (Gould, 1852) has one of the most unusual feeding behaviors of any member of the phylum mollusca. Unlike other nudibranchs, *M. leonina* is not a predator of sessile bottom dwelling animals, rather, it feeds upon zooplankton by majestically sweeping the sea with its large oral hood[3].

Our chemical studies[4] on *M. leonina* were prompted by a report that the nudibranch's primary defense is an odifer-

ous substance that is repugnant to potential predators[5]. Agersborg[6] likened the odour to that of oil of bergamot, and described in detail the glands from which the substance is secreted.

Specimens of *M. leonina* were collected during a reproductive congregation of the nudibranchs in a shallow kelp bed (−1 to −5 M) at Cates Park, Vancouver, B.C. The number of nudibranchs was extremely high (≈ 50 animals/m^2) and their odour could be detected in-situ by self contained underwater breathing apparatus (SCUBA) divers. Freshly collected whole specimens were immediately immersed in chloroform.

Silica gel column chromatography (hexane/chloroform) of the chloroform extracts yielded 2 pure metabolites. Mass spectrometry indicated that the least polar compound **1** had a molecular formula of $C_9H_{16}O$ (M^+, m/z, 140). An ^1H NMR-spectrum of this substance displayed resonances appropriate for 3 methyl groups at δ 1.70 (bs, 3 H), 1.61 (bs, 3H) and 1.11 (d, J = 7.1 Hz, 3H), for a single olefinic proton at 5.10 (m), and for an aldehyde proton at 9.62 (d, J = 1.9 Hz). The aldehyde functionality also displays an IR-absorption at 1723 cm^{-1} and a ^{13}C NMR-resonance at δ 205.0 (d). In the mass spectrum compound **1** undergoes a McLafferty rearrangement to give a base peak at m/z 82. All the spectral evidence[7] suggested that the non polar compound **1** was the degraded monoterpene 2,6-dimethyl-5-heptenal which had been previously reported as a component of one of the pheromones of the ant *Lasius carniolicus*[8] and which is used as the synthetic racemate in the perfume industry[9].

The more polar compound from *M. leonia* extracts had a molecular formula of $C_9H_{16}O_2$ (HRMS: M^+, m/z 156.1151, calc'd 156.1151) and its ^1H NMR-spectrum indicated that it was closely related to **1**[10]. IR-absorption bands (3500 → 2200 and 1700 cm^{-1}) characteristic of a carboxylic acid and the absence of an aldehyde proton in the ^1H NMR-spectrum suggested that the polar metabolite was 2,6-dimethyl-5-heptenoic acid (**2**). This was confirmed by preparing the methyl ester **3**. We have not been able to find any previous report of carboxylic acid **2** as a natural product[11].

In view of the postulated defensive role for the odiferous compound, we tested **1** and **2** for antifeedent activity in a standard goldfish bioassay[12]. The carboxylic acid **2** showed no activity at 100 µg/mg, while the aldehyde **1** was too volatile for reliable testing.

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Semi-synthesis of A23187 (calcimycin) analogs[1]

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Summary. The cleavage of A23187 to give a synthon (**4**) and the semi-synthesis from (**4**) of 2 Des-N-methylamino A23187 isomers (**7a, b**) are described. The antibiotic activities of the acids analogous to A23187 (**1**), (**2**), (**7a**), (**7b**) are compared.

A23187 (calcimycin) (**1**) has been isolated from a strain of *Streptomyces chartreusis* NRRL 3882[3]. It belongs to a large and growing class of natural carboxylic ionophores and presents a structure which is specifically adapted for the complexation of divalent cations in solution[4] and allows their transport through a membrane phase[5]. Extensive work has been done on the application of this ionophore to investigations of the involvement of Ca^{++} in the control of numerous physiological processes[6]. However, its mechanism of action as an antibacterial agent is not yet clearly understood[7].

In this communication, we report the first example of a semi-synthetic method for obtaining analogs with a modified benzoxazole ring which may be of interest for structure-activity studies, since benzoxazole appears to interact at 2 sites with Ca^{++}[8] or Mg^{++}[9] judging by X-ray structures of 2:1 complexes.

The N-methyl derivative (**2**) was prepared by a conventional method and has the following physical parameters: m.p. 113–115 °C, $(\alpha)^{25}_{578}$: −26° (c: 0.01, $CHCl_3$), mass spectrum ($M^+ = 537$), ^{13}C-NMR (15 MHz, $CDCl_3$) δ: 32.5 (C_9), 45.9 ($-N(CH_3)_2$), 98.7 (C_{14}), 165.3 (C_8), 168.3 (C_1), 194.6 (C_{20})[10].

We observed that this compound, unlike calcimycin, is rapidly cleaved in a proton-containing medium like DMF. The oxazole ring is opened to give the corresponding amide-phenol (**3**) (64% yield). m.p. 114 °C, $(\alpha)^{25}_{578}$: +79° (c: 0.01, $CHCl_3$) mass spectrum ($M^+ = 555$), ^{13}C NMR (15 MHz, $CDCl_3$) δ: 42.3 (C_9), 45.6 ($-N(CH_3)_2$), 98.4 (C_{14}), 170.5, 173.5 (C_1, C_8), 194.3 (C_{20}).