forty trials. In the drug state (1·5 and 3·5 h after ingestion for all doses), they made forty-eight errors in thirty-five trials. This difference between the total number of drug and non-drug errors was significant (Mann–Whitney Test).

In the non-drug state, all nineteen errors involved the omission of a given digit or the insertion of one not given. In the drug state, there were thirty-seven errors of this type. In the drug state only, there were also eleven errors in which the subject did not carry out instructions given a few seconds before: for example, he would reorder from low to high rather than follow the instructions to reorder from high to low.

Our observations, like those of others[4], indicate that impairments in immediate memory from marijuana intoxication do not follow a smooth time-function but, rather, are episodic, brief in duration and not always under volitional control. These episodes often interrupted the speech patterns of our subjects and seemed to be associated with the intrusion of extraneous perceptions and thoughts (compare ref. 5). One subject commented: "Well, I just felt very confident and able to remember the numbers . . . then when it came time to give them back, I'd see and hear, mostly see, I think, all kinds of numbers. And I wouldn't know which ones were the right ones." Another subject commented: "I can understand what I'm thinking, but I can't understand what I'm saying. . . . Because there are so many thoughts in between what I'm saying . . .".

The cognitive impairments induced by THC also involve intermittent lapses in attention. One subject stated: "Everything's pretty mixed up . . . I lose track of what's been happening. And it sometimes even seems like a long time has passed, but I know it hasn't, because I'm generally still in the middle of a word or sentence". Because we exhorted our subjects to try as hard as possible, we feel that they were able considerably to mitigate the influence of impaired attention on their cognitive performance. Usually the cognitive changes abated in 3 to 5 h, although some subjects described residual impairment up to 24 h later.

Similar intermittent defects in remembering relevant events may contribute to various types of behavioural disorders, including acute psychoses[6,7]. Elsewhere, we discuss correlations between THC-induced impairments in immediate memory and other behavioural changes[8].

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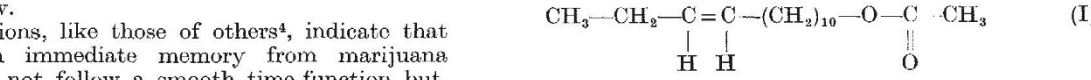
1 Weil, A. T., and Zinberg, N. E., *Nature*, **222**, 434 (1969).
2 Isbell, H., Gorodetsky, C. W., Jasinski, D., Claussen, U., Spulak, F. V., and Korte, F., *Psychopharmacologia*, **11**, 184 (1967).
3 Hollister, L. E., Richards, R. K., and Gillespie, H. K., *Clin. Pharmacol. Ther.*, **9**, 783 (1968).
4 Clark, L. D., and Nakashima, E. N., *Amer. J. Psychiat.*, **125**, 379 (1968).
5 Posner, M. I., *Psycho. Bull.*, **60**, 333 (1963).
6 Pribram, K. H., in *The Pathology of Memory* (edit. by Talland, G. A., and Waugh, M.), 127 (Academic Press, New York, 1969).
7 McGhie, A., Chapman, J., and Lawson, J. S., *Brit. J. Psychiat.*, **111**, 383 (1965).
8 Melges, F. T., Tinklenberg, J. R., Hollister, L. E., and Gillespie, H. K., *Science*, **168**, 1118 (1970).

Sex Pheromone of the Oblique-banded Leaf Roller Moth

Although at least ten pheromone compounds have been reported for lepidopterous species, only three[1–3] have proved to be true sex attractants in natural field conditions. We now report that the structure of the sex attractant of the oblique-banded leaf roller *Choristoneura rosaceana* (Lepidoptera, Tortricidae), one of the most widely distributed North American tortricids, is *cis*-11-tetradecenyl acetate (I).



(I)

Two years ago, after identifying the sex attractant of the red-banded leaf roller moth (*Argyrotaenia velutinana*) as (I), we trapped many oblique-banded leaf roller males along with red-banded leaf roller males in orchard traps baited with this compound. We established a laboratory rearing programme for oblique-banded leaf rollers and processed 20,000 female abdominal tips as before[2,3]. At least a hundred-fold increase in free attractant was obtained by saponification of the crude extract followed by acetylation. Identification of the active component was accomplished by the usual techniques[2,3] of column, gas and thin-layer chromatography, ozonolysis and mass spectrometry.

Synthetic compound (I) was very stimulatory to males in the laboratory and has attracted hundreds of oblique-banded leaf roller males in field trapping experiments in the past two years. The *trans* isomer also elicited a response in laboratory bioassays until it was fractionated twice on silver nitrate-impregnated silica gel thin-layer plates to remove traces of the *cis* isomer (I), as was the case for the false codling moth[4]. The *trans* isomer had no inhibitory or masking effects in the laboratory bioassay, but was found to be a very potent inhibitor to male response in the field when added in low percentages to the attractant (I). This emphasizes the importance of field bioassays for biological activities which are not evident in the laboratory.

Because both oblique-banded and red-banded leaf roller males are attracted to the same compound in the field, it is not clear how specificity is effected. The two species have overlapping seasonal and diurnal cycles and share the same host plants. The addition of dodecyl acetate to (I) does effect partial reproductive isolation by drastically increasing attractancy for red-banded leaf roller males[5] and decreasing it for oblique-banded leaf roller males. Preliminary studies indicate that other compounds can give the opposite effect when added to (I) in enhancing oblique-banded leaf roller attractancy and inhibiting red-banded leaf roller response. The emission of different secondary compounds by females of each species along with the sex attractant (I) could effect reproductive isolation in the field for these two species.

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1 Berger, R. S., *Ann. Entomol., Soc. Amer.*, **59**, 767 (1966).
2 Roelofs, W. L., and Arn, H., *Nature*, **219**, 513 (1968).
3 Roelofs, W. L., Comeau, A., and Selle, R., *Nature*, **224**, 723 (1969).
4 Read, J. S., Warren, F. L., and Hewitt, P. H., *Chem. Commun.*, 792 (1968).
5 Roelofs, W. L., and Comeau, A., *Nature*, **220**, 600 (1968).