nature, there are previous reports which suggest that other plants may actually undergo the same process as well. Bell (*8*) and Mehra and Singh (*9*), for example, reported almost identical details of sporogenesis in the filmy fern *Trichomanes proliferum* forma B. Also Verma (*10*) reported instances of equational divisions and formation of diplospores in sporogenesis in species of *Ophioglossum* and *Isoëtes*. In none of these earlier reports, however, was the complete life cycle, including the gametophyte and formation of the sporophyte described.

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11. I thank W. H. Wagner, Jr., for his guidance throughout this project; Mrs. Katherine Chen for help in preparing the sporogenesis slides; R. Long, Olga Lakela, E. S. Ford, C. E. Delchamps, F. C. Craighead, and J. Beckner for help in field work in Florida; and the University of Michigan Rackham Graduate School for funds for field work. Part of this research was made possible through National Science Foundation grant G-10846.

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Sleep Tendencies: Effects of Barometric Pressure

Abstract. *For two samples of naval aviation cadets, curvilinear relationships were obtained between barometric pressure readings and the occurrence of signs of the onset of sleep on electroencephalograms obtained during routine EEG examinations. High and low barometric pressures relative to the prevailing average pressures were associated with increased proportions of subjects showing signs of onset of sleep.*

Raboutet, Lesèvre, and Rémond (*1*) reported a statistically significant relationship between barometric pressure and the occurrence of signs of the onset of sleep on electroencephalograms obtained during routine EEG examinations of aviation personnel. Because of the practical and theoretical implications of this finding we undertook a further study of this relationship.

Since 1961, routine EEG recordings have been made on naval aviation trainees in the Division of Neurological Sciences of the U.S. Naval School of Aviation Medicine at Pensacola, Florida. The records of 1012 examinations made between 1 April 1961 and 30 December 1961 were obtained. Each record had been scored for the sleep signs. Two groups were identified: one group showing no signs of the onset of sleep, ($N = 641$); the other showing signs that ranged from those which were brief and occasional to those which were persistent ($N = 371$). The hour and date of examinations were available for each record.

From hourly weather records maintained by the Naval Air Station, the barometric pressure reading at the time of the examination of each subject was collated with the EEG data.

In brief, the EEG scoring criteria were as follows: The appearance of any signs of drowsiness or sleep were grouped for purposes of the study. These signs were those which have been classically associated with the onset and presence of sleep, such as a slowing of the basic resting rhythm with a desynchronizing tendency, irregular high-amplitude slow activity, or 14 cy/sec spindling. The three categories, "brief, occasional," "persistent," and "dominant," were based on the increasing appearance of these indices in a subject's record during the recording sessions of approximately ½ hour. The category "brief, occasional" included those records in which minimal sleep tendencies appeared at random for periods of less than 10 seconds, separated by much longer records showing that the subjects were unmistakably awake. The "persistent" category included records of subjects who had to be stimulated frequently by noise signals and oral prompting to stay awake so that records of wakefulness of appreciable duration could be obtained, and who lapsed into sleep again within less than 1 minute if such stimulation was delayed. The "dominant" sleep category denoted the type of subject who, despite repeated stimulation, could not be kept awake for more than a few seconds at a time. Scoring for sleep was done only on those parts of the recordings which were obtained during periods when it was intended that the subjects should be awake, as distinguished from periods when sleep was deliberately allowed or encouraged.

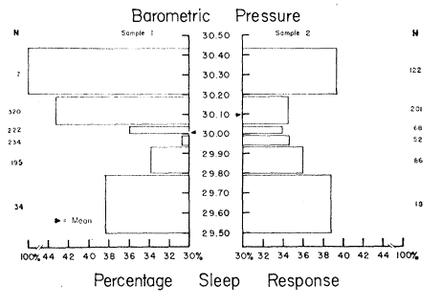

Fig. 1. Percentage of subjects showing signs of the onset of sleep, in relation to barometric pressure. N is the total number of subjects.

The results obtained from the first sample deviated considerably from those of Raboutet, Lesèvre, and Rémond, and a second sample was obtained. The EEG records from 3 January 1962 through 30 June 1962 were matched against the barometric weather records for that period ($N = 547$). Because these records were scored subsequent to the findings of the first sample, and because the scorers were more sensitive to the signs of the onset of sleep, there was a significant increase in the records scored as "brief, occasional" signs of sleep and a decrease in the records scored as "no sleep." Combining these categories in sample 2 resulted in approximately the same proportion (64.2 percent) of subjects as those classified under the "no sleep" category in sample 1 (68.2 percent). A decision was made to group the data into two categories for both samples: (i) Definite signs of sleep ("brief, occasional," "persistent," and "dominant" in sample 1; "persistent" and "dominant" in sample 2) and (ii) none or limited signs of sleep ("no sleep" signs in sample 1 and "no sleep" signs and "brief, occasional" in sample 2). In both samples, scoring was done prior to collation with the data on barometric pressure.

The results of samples 1 and 2 are shown in Fig. 1. This figure presents the percentage of subjects whose records were scored and categorized as showing definite signs of sleep in relation to the barometric pressure readings at the hour of recording. The number of subjects (N) recorded for each pressure reading is shown, as well as the mean pressure for the two samples. The relationships between barometric pressure and percentage of subjects showing definite signs of sleep are the same for both samples—that is, an in-

creasing percentage of such signs is associated with increasingly high or low pressure readings. The lowest percentage of subjects showing signs of the onset of sleep in sample 2 has a higher barometric pressure reading than the lowest percentage in sample 1. Furthermore, the mean barometric pressure is higher for sample 2 than for sample 1.

The simplest interpretation of these data would appear to be that changes in barometric pressure away from the prevailing pressure are associated with sleep tendencies. This is to say that the occurrence of either high or low barometric pressures relative to the usual (average) pressure results in an increased tendency to sleep. This interpretation has its strongest support from the shift of the lowest sleep response with a shift of prevailing pressure in the two samples.

The results are quite different from those of Raboutet, Lesèvre, and Rémond who report a decreased tendency to sleep with increasing barometric pressure. The results were as follows (milibars of mercury, percentage showing signs of sleep, number in each group, respectively): 970 to 999 milibars = 27 percent (121); 1000 to 1019 milibars = 17 percent (467); 1020 to 1030 milibars = 5 percent (54). It should be pointed out that their study was based upon the relationship between signs of sleep on an EEG and a single barometric pressure reading taken at noon of the examination date.

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Children's Language: Word-Phrase Relationship

Abstract. *Unsystematic observations indicated that small children who could reverse the order of certain two-unit utterances had difficulty reversing utterances that formed common English sequences. Findings of this study indicate that the following factors are sources of difficulty in reversing pairs: (i) inability to separate English sequences into word units, and (ii) semantic absurdity of reversed pairs.*

A recent discussion of children's speech asserts that "the child's first two-word utterances are usually predicative statements painfully pieced together, with the words juxtaposed rather than connected" (*1*). This view suggests that the acquisition of language involves progressive addition of separate words into phrases and sentences. An opposing view suggests that the first multiple word utterances are learned as single units and only later differentiated into separate words. It has generally been assumed that children of 4 or 5 years of age who speak fluently can differentiate single words from multiple-word utterances. The demonstration that children have a tendency to define a single unknown word in terms of the entire context in which it occurs suggests, however, that each word is not endowed with a distinct meaning (*2*). A recent Russian study cited by Ervin and Miller (*3*) reports that children who are asked to indicate the words in a sentence pick units longer than single words. The results of the experiment described here provide more direct evidence that preschool children have difficulty in dividing common word sequences into separate words.

The experiment was designed to determine the reliability of the following observation and to investigate its sources: pairs of digits were read to children and they were taught to say them in reverse order. This skill, easily acquired by most children between 4 and 5 years of age, could be transferred to pairs of letters and pairs of nouns. But when commonly encountered "grammatical pairs" for example, ("he went" or "pretty doll") were presented, these children had great difficulty in reversing them.

A group of children was set the task of reversing pairs in each of five different categories. Difficulty of two types of "nongrammatical pairs"—(i) letters and numbers, and (ii) like parts of speech—was compared with that of three types of grammatical pairs: (iii) commonly encountered pairs that did not form a grammatical sequence when reversed, (iv) commonly encountered pairs that did form a grammatical sequence when reversed, and (v) anomalous pairs not commonly encountered (Table 1). Grammatical pairs were divided into these separate categories to permit further specification of sources of difficulty. Comparison of categories iii and iv made it possible to determine whether absurdity of solutions was a source of difficulty. Comparison of category v with categories iii and iv made it possible to determine whether all grammatical pairs were difficult, or only common English sequences.

The ability to separate the items making up a pair is prerequisite for reversing their order. That is, if one did not know where the first item ended and the second began, it would not be possible to say the second one first. In order to determine the extent to which difficulty of reversal results from inability to separate items, a second group of subjects was included. These subjects dealt with the same 15 pairs as the first group. Their task, rather than reversing the order of items in a pair, was to repeat the first item and await a tap before giving the second item (*4*).

Sixty-six children between the ages of 4½ and 5 years were included in the experiment, 33 in each group. Children were randomly assigned to one of the two groups. The 15 pairs of items were randomly ordered for each subject. Each subject was tested alone. A pair was presented, and, if the correct response was given, the experimenter said "fine" and continued with the next pair. If there was an incorrect response or no response in 20 seconds, the experimenter gave the answer: for group 1, saying the items in reverse order; for group 2, saying the first item, tapping, and then saying the final item.

Thirteen children in group 1 and ten children in group 2 were unable to do any pairs; three children in group 1 and four children in group 2 could do all

Table 1. Pairs of items in each of the five categories described in the text.

Category	Pairs
i	5–2; D–S; 3–7
ii	black–white; child–lady; foot–hand
iii	man–runs; red–apple; she–went
iv	I–do; you–are; it–is
v	table–goes; house–did; orange–cow