NOISE EFFECT ON HUMAN MEMORY

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ABSTRACT

Effect of noise on the temporal cone of human memory has been studied. Calculation of Anderson's Coefficient have been carried out and variation of signal-to-noise ratio discussed.

1. INTRODUCTION

BIOLOGICALLY the nerve cells are responsible for the encoding, transmission and processing of information reaching the brain through the sensory nerves. These cells interact through synaptic junctions. The informations are passed from one element to another through the synapase—a junction cleft of about 20 nm. Pattern recognition, information transmission and memory depend upon the change in functional properties of neurons[2] and its different parts. The physiochemical alterations, change in ion fluxes, protein synthesis[3] and change in the structure or conformation or neuronal macromolecules are implicated in the acquisition and storage of information[4].

The aim of the present work is to find the effect of repeated incidence of informatiors and other factors producing noise in memory. We have calculated the Anderson coefficient[5] (R_A) for different number of information sets incident on the temporal cone and studied its dependence on signal-to-noise power ratio.

2. THEORETICAL

The brain functions are related to the interactions in brain stem and other subsystems such as intrathalamic specific general reciprocal communication[9]. We have developed the concept of the temporal cone[8] generated by the peripheral nervous system (PNS)[6] on the basis of our statistical experimental observations on a large number of healthy persons. The base area of the cone represents the large number of informations stored, which dissipate fast. The height of the temporal cone ($A_p - A_0$) represents memory on the time scale, A_p being the present age of the subject and A_0, the critical age upto which one can remember. In the case of extra sensory perception (ESP), A_0 can be below the birth point. Various temporal factors[7] contribute to the information processing theory of human memory.

The intensity of information from all directions depends upon (i) the age of the individual, (ii) volume strain (v/V) and (iii) the quantum of work (w) Hence,

$$I^t = \frac{CV}{vW}(A_p - A_0)^{-n}, \tag{1}$$

where n is some unknown power and C the constant of proportionality. Taking the biochemical parameters as another factor, one can write

$$I^t = \int_0^x \int_0^y \int_0^z \int_0^{t_p} f(x, y, z, t)\, dx\, dy\, dz\, dt, \tag{2}$$

where function f depends upon the genetic characteristics and the number of DNA and RNA molecules such that

$$f(x, y, z, t) = \sum_{i=1}^{\infty} A_i F_i(x, y, z, t)$$

and

$$A = f(N^{DNA}, N^{tRNA}, N^{mRNA}),$$

F is a branching factor. One can then write the time span (t^s),

$$t^s = (A_p - A_0)$$

$$= \left[\frac{vW}{CV} \int_0^x \int_0^y \int_0^z \int_0^{t_p} \left\{ \sum_{i=0}^{\infty} f_i(N^{DNA}, N^{mRNA}, N^{tRNA}) F_i(x, y, z, t) \right\} dx\, dy\, dz\, dt \right]^n. \tag{3}$$

The Anderson factor can be written in terms of noise-to-singal power ratio P_n/P as

$$R_A = \frac{K}{M} + \frac{P_n}{P}\left(\frac{K+1}{M}\right). \tag{4}$$

where K is the number of information sets. The signal-to-noise ratio $(S/N)_0$ is given by

$$\left(\frac{S}{N}\right)_0 = \frac{(1+Z)^2}{\frac{K}{N} + K^2 Z^2}; \quad Z = \frac{N\mu^2}{P_0}, \tag{5}$$

which is maximum when

$$\mu = \sqrt{\frac{P_0}{N^2 K}}.$$

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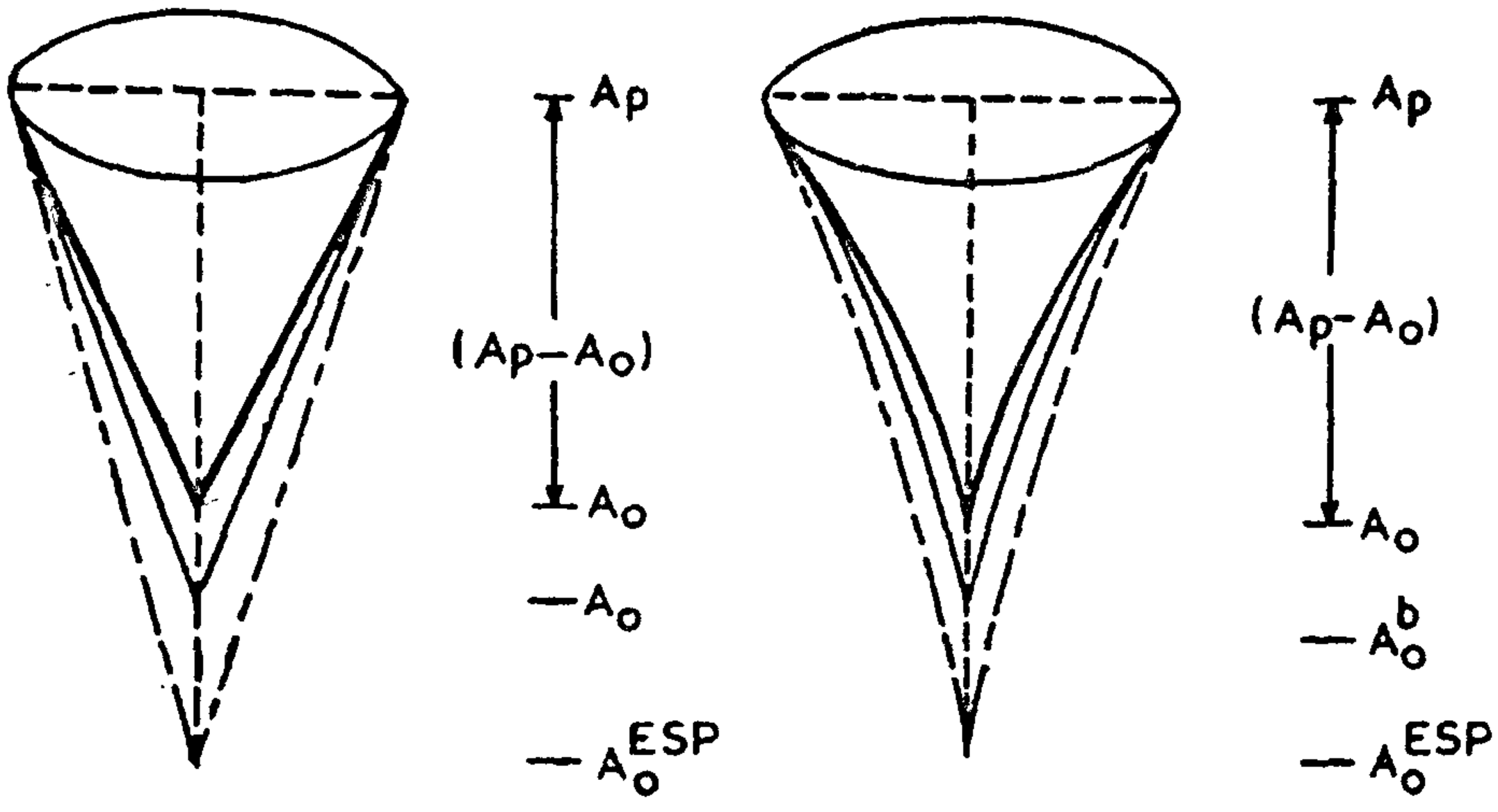

FIG. 1. Possible temporal cones of the long-term human memory (*a*) linear boundaries, (*b*) non-linear boundaries.

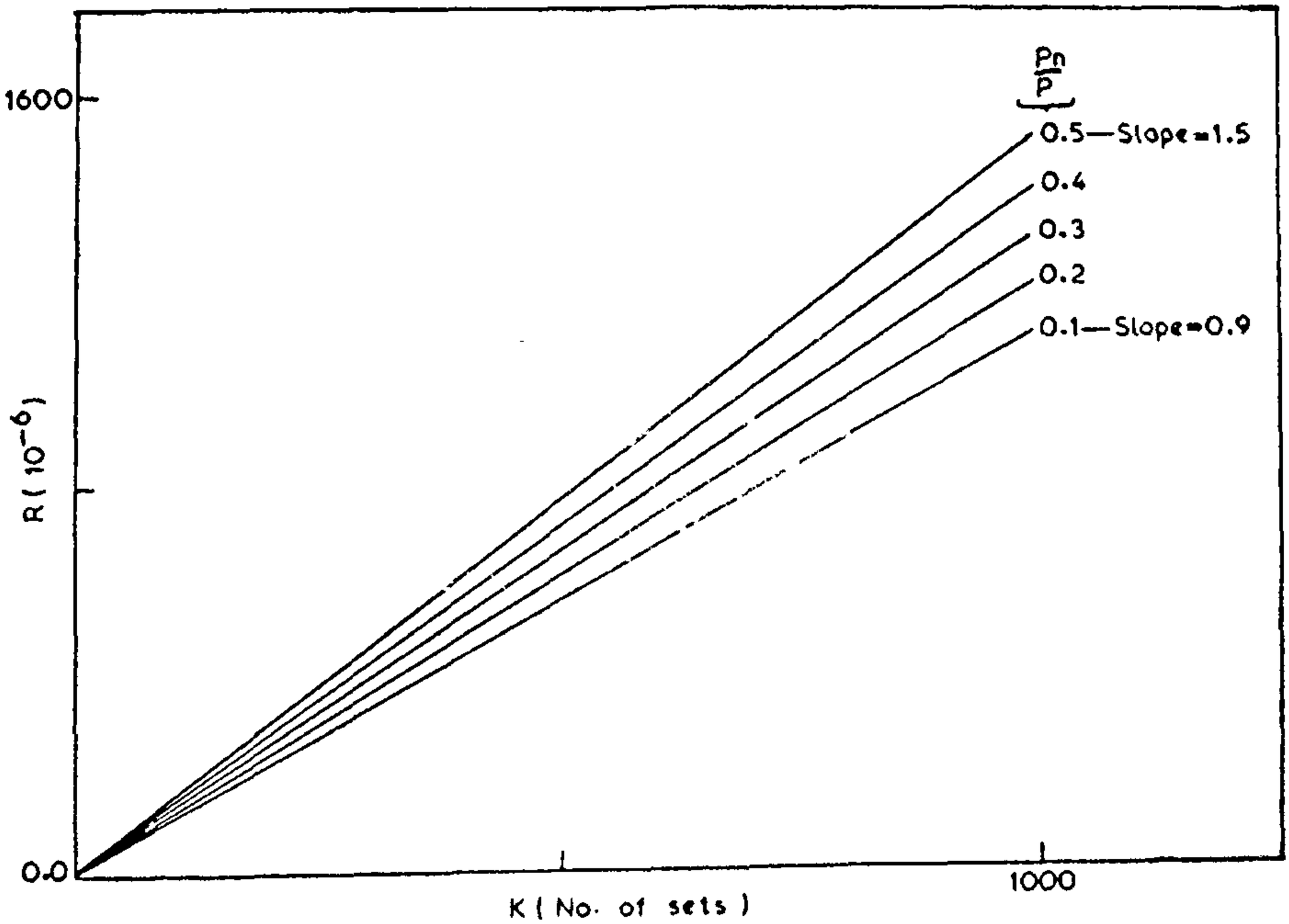

FIG. 2. Variation of the Anderson coefficient, R_A (with the number of information sets when the signal-to-noise power ratio is (*a*) 10%, (*b*) 20%, (*c*) 30%, (*d*) 40% and (*e*) 50%.

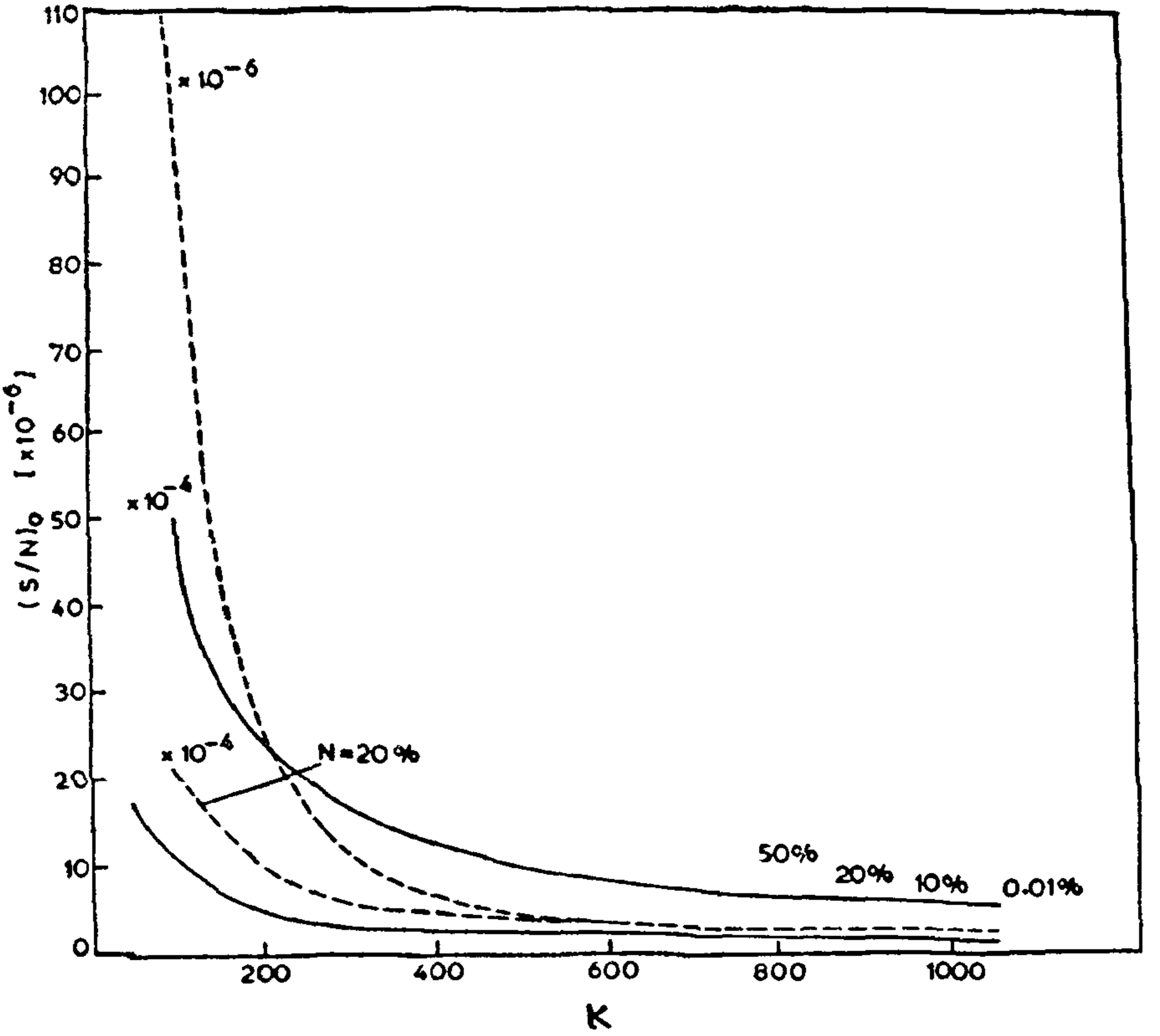

FIG. 3. Variation of the maximum signal-to-noise ratio with the number of sets when the noise is (*a*) 0·01%, (*b*) 10%, (*c*) 20% and (*d*) 50%.

At this value of μ

$$\left(\frac{S}{N}\right)_0 = \frac{N}{K} + \frac{1}{K^2}. \qquad (6)$$

3. DISCUSSION

The effect of (P_0/P) on R_A is shown in Fig. 1. The noise-to-signal ratio increases with the increase in noise-to-signal power ratio. $(S/N)_0$ falls sharply when the number of informations is not very large but falls slowly for relatively large number of informations (Fig. 3). The fall of $(S/N)_0$ with the number of information sets (K) is very fast when noise is 0·01%. Biophysically the curves show that with large number of repetitions of incident information, the signal is more persistant in the brain and decays rather slowly due to the increase in signal-to-power ratio. Information incident once is sometimes masked by the noise and it becomes difficult to recall it easily after a long time. We believe that the noise affects the thalamus, hypothalamus and the temporal lobe[10] as well.

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A CONVENIENT SYNTHESIS OF 6-METHOXY-7-HYDROXY-3',4'-METHYLENEDIOXYISOFLAVONE

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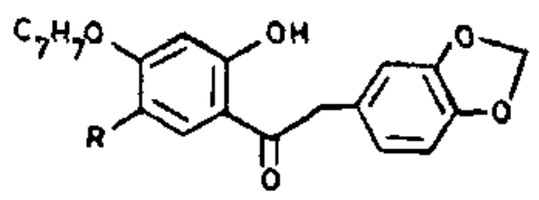
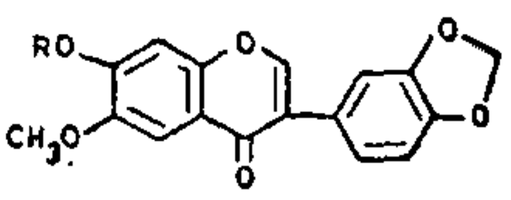
ABSTRACT

Nuclear hydroxylation of 2-hydroxy-4-benzyloxy-3', 4'-methylenedioxydesoxybenzoin(I) with alkaline potassium persulphate gave 2, 5-dihydroxy-4-benzyloxy-3', 4'-methylenedioxydesoxybenzoin (II) which was used to obtain 6-methoxy-7-hydroxy-3', 4'-methylenedioxyisoflavone(V).

NUCLEAR hydroxylation of 2-hydroxyacetophenones using alkaline potassium persulphate are commonly employed to prepare 2, 5-dihydroxyacetophenones needed to obtain 6-hydroxy (alkoxy) flavones. Similar synthesis of 6-hydroxy (alkoxy) isoflavones could not be effected as the nuclear hydroxylations of 2-hydroxydesoxybenzoins to obtain the corresponding 2, 5-dihydroxydesoxybenzoins did not give satisfactory results. The 6-oxygenated isoflavones were thus obtained by using either chalkones[1,2] or 2, 5-dihydroxydesoxybenzoins obtained directly from 1, 3, 4-trioxygenated phenols which are usually difficult to prepare[3,4]. This paper now reports the results of the nuclear hydroxylation of 2-hydroxydesoxybenzoins to obtain 2, 5-dihydroxydesoxybenzoins as well as provide a convenient synthesis of naturally occurring[5–8] 6-methoxy-7-hydroxy-3', 4'-methylenedioxyisoflavone (V). In this connection 2-hydroxy-4-benzyloxy-3', 4'-methylenedioxydesoxybenzoin[9] (I) when subjected to nuclear oxidation using alkaline potassium persulphate, gave 2, 5-dihydroxy-4-benzyloxy-3' 4'-methylenedioxydesoxybenzoin (II) obtained earlier by a cumbersome procedure[4]. Selective methylation of the desoxybenzoin(II) followed by cyclisation of the resulting methyl ether(III) using ethyl formate[10] and sodium instead of ethyl orthoformate[11] and pyridine-piperidine gave 6-methoxy-7-benzyloxy-3', 4'-methylenedioxyisoflavone(IV) in good yields. Debenzylation of IV using aluminium chloride in acetonitrile yielded 6-methoxy-7-hydroxy-3', 4'-methylenedioxyisoflavone(V) identical with the authentic sample. Aluminium chloride in acetonitrile is known to bring about debenzylation as well as demethylations of chelated C_5-methoxyls[12, 13]. In the present case, IV underwent debenzylation with this reagent giving better results, as debenzylation using catalytic hydrogenolysis, sometimes gave isoflavononones[14] instead of isoflavones whereas debenzylations using hydrochloric acid–acetic acid yielded resinous compounds also.



I, R = H
II, R = OH
III, R = OCH_3



IV, R = C_7H_7
V, R = H

EXPERIMENTAL

2, 5-Dihydroxy-4-benzyloxy-3', 4'-methylenedioxydesoxybenzoin(II)

To a solution of 2-hydroxy-4-benzyloxy-3', 4'-methylenedioxydesoxybenzoin(I) (12 g) in aqueous sodium hydroxide (10 g in 100 ml) cooled to 5°, was added in aqueous solution of potassium persulphate (15 g in 200 ml) dropwise with stirring during the course of 4 hr. The reaction mixture was allowed to stand for 24 hr at room temperature. The