reported values of rate constants at 0° C are the result of (perhaps unwise) extrapolations from higher temperatures.

There is therefore, in our opinion, a need to explore more thoroughly the rates of reactions involving water over smaller intervals of temperature and especially at temperatures lower than 15° C. A fuller description of the present measurements will appear elsewhere.

GRAHAM HILLS
CESAR A. N. VIANA

Department of Chemistry,
University of Southampton

Received August 27, 1970.

1 Laidler, K. J., *Theories of Chemical Reaction Rates*, 59 (McGraw-Hill, New York, 1969).
2 Bell, R. P., Fendley, J. A., and Hulett, J. R., *Proc. Roy. Soc.*, A,**235**, 453 (1956).
3 Hulett, J. R., *Proc. Roy. Soc.*, A,**251**, 274 (1959).
4 Caldin, E. F., Kasparian, M., and Tomalin, G., *Trans. Faraday Soc.*, **64**, 2802 (1968).
5 Caldin, E. F., and Tomalin, G., *Trans. Faraday Soc.*, **64**, 2814 and 2823 (1968).

BIOLOGICAL SCIENCES

Handedness and Birth Order

IN spite of much speculation on the matter, the aetiology of left-handedness remains elusive. Investigators have considered heredity, neurological pathology, imitation and negative personality, but the evidence in support of any particular hypothesis is inconclusive. There are, however, some suggestive facts. The frequency of left-handedness is greater in males and in twin births, both of which are also associated with greater birth and infant mortality and, in the case of males, a higher rate of spontaneous abortion. The pre-natal and peri-natal periods seem to be more stressful for these groups. Left-handedness is also associated with language disorders such as stuttering, dyslexia, and mental retardation, conditions where central nervous system pathology may be implicated[1]. This suggests that the incidence of left-handedness might be correlated with stressful pre-natal and birth conditions. Such difficulties are most characteristic of primiparous births (longer labour and more use of instruments) and births to older mothers. Thus high risk birth orders would be the first born and the late-born (defined here as fourth or later birth).

The relationship between left-handedness and birth order was studied for a sample of ninety-five left-handed university students, fifty-four male and forty-one female. Handedness was classified by asking each subject, "Which hand do you usually use for writing ?". Previous work has shown that the reply (right or left) is as good a behavioural criterion as any other. A group of 553 right-handed students (262 male and 291 female) served as a control group.

Table 1 Handedness and Birth Order

Birth order	All Ss R	All Ss L	Group male handedness R	Group male handedness L	Female R	Female L
1, 4+ (high risk)	250	56	117	34	133	22
2, 3 (low risk)	303	39	145	20	158	19
	$\chi^2=6.16$		$\chi^2=5.71$		$\chi^2=0.91$	
	$P=0.02$		$P=0.02$		$P=0.50$	

Table 1 shows the relationship between handedness and the two categories of birth order, high risk (first birth or fourth and later births) and low risk (second and third births). For the group as a whole (male and female) there are more left-handed people in the high risk birth order category. The chi-square value, based on analysis of a 2×2 contingency table, birth order and handedness, is 6.16 (d.f.$=1$, $P<0.02$). The fifty-six left-handed cases in the high risk group are thus significantly more than the forty-five cases that would be expected by chance. For the incidence of left-handedness in high-risk male subjects alone, $P<0.02$ (chi-square$=5.71$, d.f.$=1$). For the female subjects alone, there is a nonsignificant trend in the same direction.

These results support the hypothesis that there is a relationship between handedness and birth order, which suggests a relationship between left-handedness and neurological insult associated with pre-natal or delivery factors.

PAUL BAKAN

Department of Psychology,
Simon Fraser University,
Burnaby 2,
British Columbia

Received July 13, 1970.

1 Hecaen, H., and De Ajuriaguerra, J., *Left-handedness: Manual Superiority and Cerebral Dominance* (Grune and Stratton, New York and London, 1964).

Patterned Response to Song in Cricket Central Auditory Neurone

THE acoustic behaviour of many Orthopterans is familiar and well documented[1]. The evidence suggests that females are phonotactic to the calling song of the conspecific male[2], that phonotaxis occurs with greater probability when the calling song is that of a conspecific rather than a heterospecific male[3], that males as well as females exhibit phonotaxis[4] and that males respond to each others' song by stridulating in turn[5] and by synchronizing their chirps[6].

In order to find sensory neurophysiological correlates of acoustic behaviour, the activity of central auditory neurones in the neck connectives of several species of crickets has been recorded. One central auditory neurone of an East African field cricket tentatively identified as a *Liogryllus* sp. responds to recorded song with trains of action potentials which conform to the temporal pattern and the intensity of the song (Fig. 1*A* and *B*). For the purpose of brevity, this neurone will be called the φ neurone.

The φ neurone is the first unit recorded from an Orthopteran to be shown to have the properties of a song-responding unit. A number of other central auditory neurones have been characterized in Gryllid, Acridid and Tettigonid nervous systems, but most are highly phasic and/or rapidly habituating units of large diameter which seem to be suited for warning functions; they lack the proper qualifications for a song-responding fibre: the T fibre of the Tettigonid Homorocoryphus is inhibited by song and another smaller central fibre of this animal responds to song with no regular pattern[7]. The T fibre of *Gampsocleis buergeri*, another Tettigonid, shows habituation in response to its species song[8]. Several central auditory neurones of other cricket species and other central fibres of *Liogryllus* sp. have been tested and do not show patterned response to song (M. D. Z., in preparation) (Fig. 1*C*).

The φ neurone responds to song with a train of action potentials for each sound pulse of the song (Fig. 1*A*, *B*). The number of action potentials in each train is proportional to the logarithm of the energy of each sound pulse which is given approximately by the product of the maximum intensity and the duration of the pulse (Fig. 2). The first action potential of each train is delayed by 15–20 ms from the start of the sound pulse, the delay varying inversely with the initial rate of increase of the sound intensity. The last action potential occurs with a