three plants were also extra-axillary and trifid at the apex but one of the three branches had a female flower attached to it. The female flowers remained either attached to the tendril along the entire length of the corolla tube (figure 1B) or were free (figure 1C). These plants were named 'flower on tendril' (FOT).

The male and female flowers of FOT plants were significantly larger than those of the control plants. In FOT plants (24.45%) cells of the tendril tips had $2n = 22$ (figure 1D) and 75.55%, cells had $2n = 44$ (figure 1E). In comparison to normal meiosis (11, II, figure 1F) in the control, the FOT plants were characterized by the presence of both diploid and tetraploid pollen mother cells. The tetraploid pollen mother cells had a mixture of quadri- (5.66/cell), tri-(1.16/cell), bi-(8.33/cell) and univalents (1.16/cell, figure 1G). The pollen grain sterility (20.03%) as well as the polar axis (95.02 μm) of fertile pollen grains were significantly higher in FOT than in the control (2.27%, 61.49 μm). The average yield of seed per fruit (3.50) and single seed weight (248 mg) were low as compared to the control. The plants raised from seeds collected from FOT plants had normal tendrils. However, crosses between FOT and control plants were abortive. Thin layer chromatography of phenolic compounds in young leaves, following the method of Mukherjee *et al*[2], revealed no difference in the distribution of spots for phenolic compounds, colour reaction to flavone (diphenyl boric acid ethanolamine complex) and hR_f values in FOT and control plants. Both FOT and control plants showed 10 spots in their chromatograms having the same colour reaction and hR_f values.

FOT due to polysomatic tissues in the plants is not warranted because many plants recovered from the C_0 plants show mixoploid nature of the somatic cells, without any change in the position of emergence of female flower. Mixoploidy may be one of the factors leading to the production of such tendrils.

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A TIME-TEMPERATURE SCHEDULE FOR TERMINATING DIAPAUSE IN PREPUPAE OF *COTESIA KAZAK*

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THIS paper deals with a time-temperature schedule (TTS), a new technique developed for breaking diapause in the prepupae of the exotic parasitoid, *Cotesia kazak* Telenga (Hymenoptera: Braconidae). This exotic parasitoid was imported into India in November 1985 from the Commonwealth Institute of Biological Control, Switzerland for conducting biocontrol trials against *Heliothis armigera* (Hubner) (Lepidoptera: Noctuidae), a serious polyphagous pest, attacking various crops of economic importance.

C. kazak has been reported to be a major parasitoid of *H. armigera* on tomato, cotton, etc. in various Russian provinces[1,2]. *H. armigera* larvae reared on artificial diet[3] were used as host culture for multiplying *C. kazak*.

During December 1985 and January 1986 the prepupae of *C. kazak* lodged inside the cocoons entered into diapause. Diapause in *C. kazak* has also been observed earlier[4,5]. Normally, *C. kazak* adults emerge in 7–9 days from the date of cocoon formation. In the present study, even after a month from the date of cocoon formation, no adults emerged. The cocoons were then dissected and the presence of viable purpupae inside the cocoons confirmed diapause. In February 1986, one more consignment of *C. kazak* was obtained and their progeny did not enter into diapause (henceforth called the non-diapausing population or NDP).

The TTS was formulated by combining and modifying the chilling[5] and acclimatization techniques[6]. This was followed by various laboratory trials. The cocoons were retained at room temperature (25 ± 2°C) and at relative humidity of 60 ± 2% for a month. To break diapause they were passed through the following temperatures (figure 1) 15°C (5 days) → 10°C (5 days) → 5°C (21 days) → 0°C (21 days) and reversed back through the same series to room temperature. To avoid any possible interference by light, the cocoons were kept in the BOD incubator under dark conditions.

Using TTS, the diapause was broken and *C. kazak* adults emerged (henceforth called the diapausing population or DP) from 50 to 83% of the treated cocoons in different replications in 13 ± 2

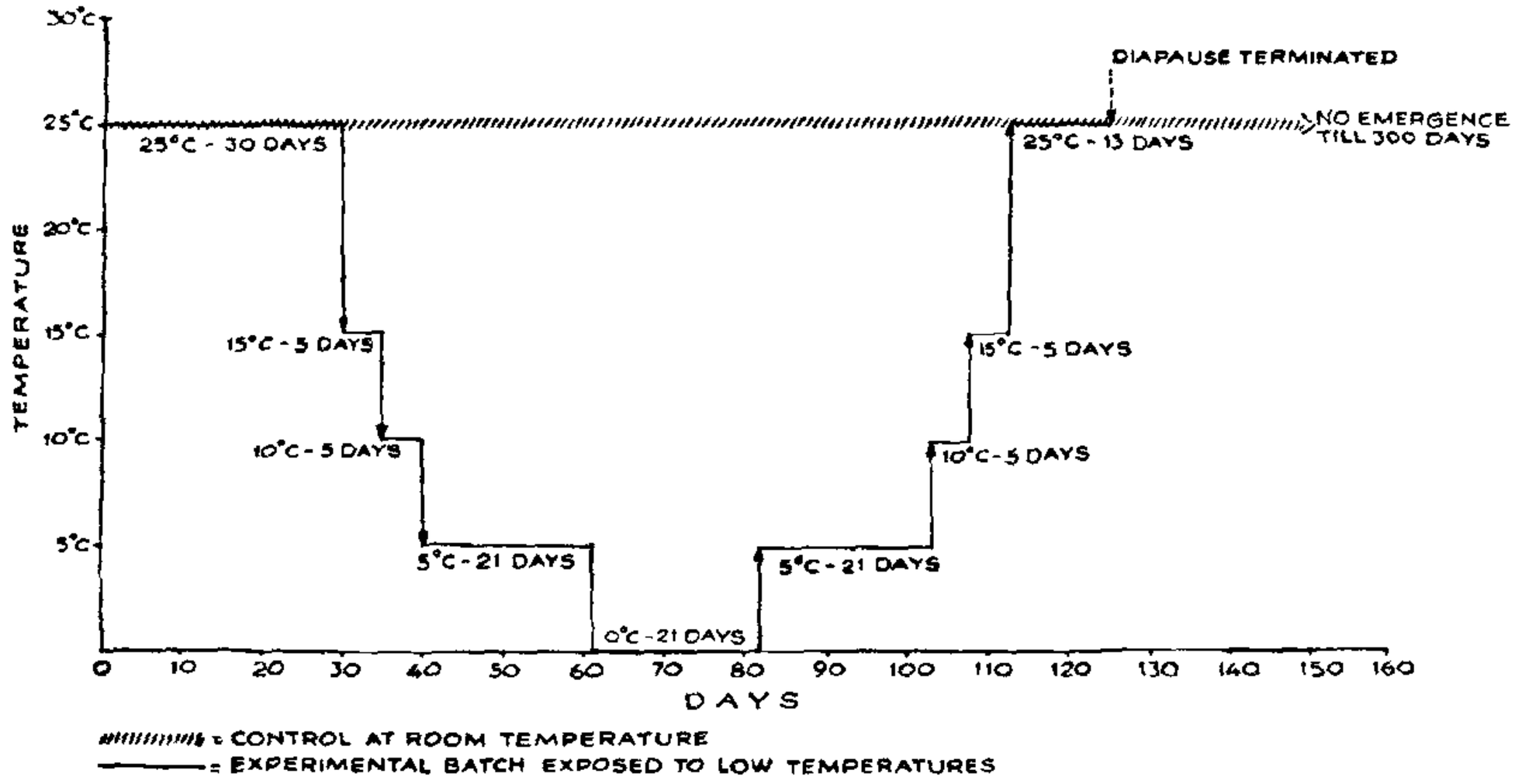

Figure 1. Schematic representation of the technique (TTS) developed to terminate diapause in prepupae *C. kazak*.

days after they were shifted to room temperature. About 126 days from the date of cocoon formation were required for the adults to emerge from the treated cocoons (figure 1). When there was no adult emergence from the treated cocoons even after a month at room temperature, they were dissected and only dried and shrivelled prepupae were observed. A set of untreated cocoons containing the diapausing prepupae were kept at room temperature as control, in which there was no emergence even after 300 days (figure 1).

The DP was compared with NDP for differences in morphological characters, longevity, fecundity and per cent adjut emergence from cocoons formed. The females of NDP lived longer and produced more cocoons, but with regard to other parameters, there was no significant difference (table 1). However, when a natural breaking of diapause in *C. kazak* does not occur there are chances of losing the laboratory culture of this important exotic parasitoid. At this juncture, the TTS will be an extremely useful technique for breaking the diapause by using just the minimum refrigeration facilities in the laboratory.

The authors are grateful to Dr K. P. Carl, CIBC, European Station, Switzerland for the supply of *C. kazak*.

18 August 1987; Revised 19 February 1988

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Table 1 *Comparison between diapausing population (DP) and non-diapausing population (NDP) of C. kazak*

	Longevity in days		Progeny development		
	Male	Female	No. of cocoons obtained per female	Per cent adult emergence	Sex Ratio (♂:♀)
DP	7.8 ± 1.9^a	5.7 ± 0.6^a	12.7 ± 3.5^a	61.4 ± 6.7^a	$1:0.7^a$
NDP	5.9 ± 1.4^a	10.2 ± 0.7^b	$24\ 7 \pm 3.8^b$	64.4 ± 6.8^a	$1:0.5^b$
C.D. at 5%	n.s.	1.5126	8.2333	n.s.	0.1308
C.D. at 1%	n.s.	1.5087	n.s.	n.s.	n.s.

Treatments followed by the same alphabet are not statistically different; n.s. not significant.

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UNUSUAL HATCHING IN SILKWORM *BOMBYX MORI* (L)

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WHEN eggs 'black boxed' are exposed to light, hatching normally takes place almost instantaneously and is completed within 30 to 60 min. The fully developed embryo complete as a larva in all respects, wriggles and pushes the micropylar region. A small hole is created around which the larva nibble the egg chorion, making the hole large enough for wriggling out. In this process, the head comes out first and after anchoring on the substratum with thoracic legs, the whole body is pulled out (figure 1a).

However, an unusual hatching was accidentally seen in the silkworm *Bombyx mori* where instead of the head, the caudal and then the abdominal part of the larva came out of the egg shell. A close examination showed that all such larvae were entangled with their heads inside the shell and only the abdominal part was free (figure 1b). The chances of the hatched larvae getting entangled in the way seen were ruled out, since efforts to get the same by mixing empty shells and newly hatched larvae failed. The possibility of mutants was also ruled out, since such larvae released artificially by breaking the shells when reared for more than 2 generation failed to reproduce the same effect even at a very low frequency.

Further observations on hatching indicated that this behaviour, though not normal, is also not rare. In 'sheet eggs' since the eggs are fixed to a substratum, even if the larvae come out in a reverse direction can anchor firmly to either the next egg or the substratum and pull themselves out of the egg shell. This is not possible when the eggs are in loose form and spread in a thin layer on smooth paraffin paper for hatching and brushing. In the case of loose eggs, a rough substratum is, therefore, desirable during hatching and brushing.

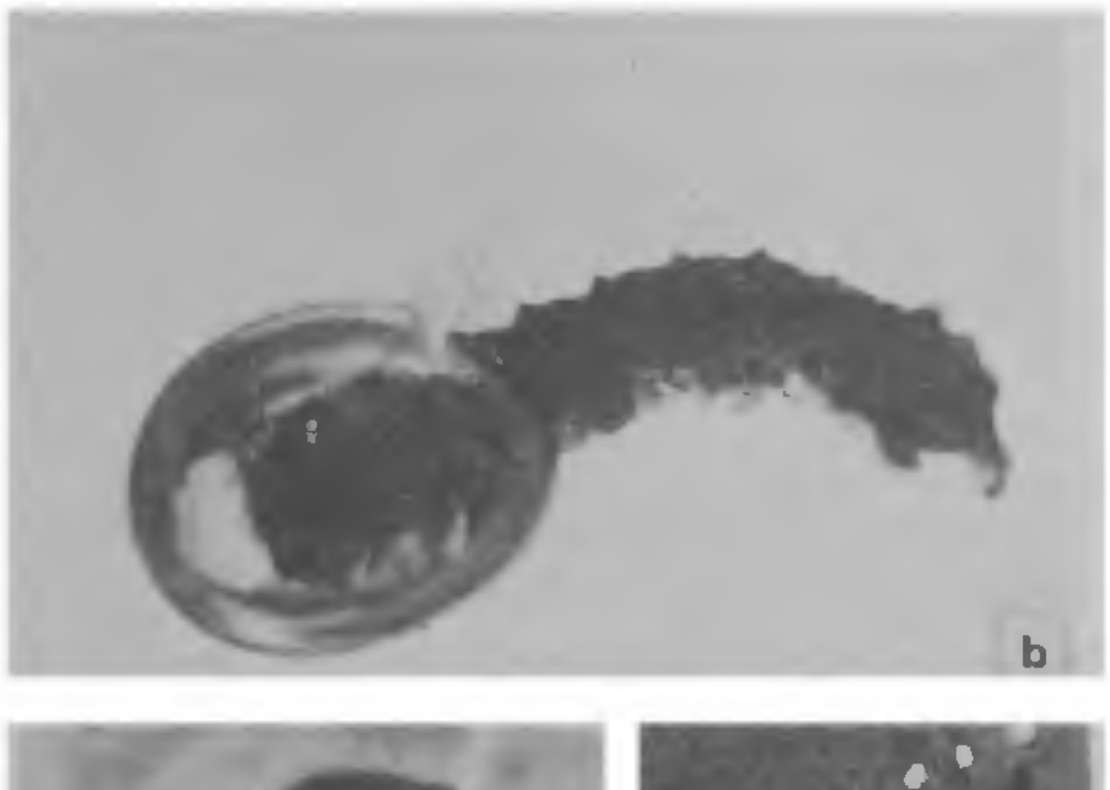

Figure 1a–c. a. Normal hatching in silkworm eggs with the head portion coming first; **b, c.** Abnormal hatching with the abdominal part of the body coming first.

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