li[10,11]. Among the skin glands of mammals, sweat glands are known to be influenced by catecholamines.

There are species-specific differences in adrenergic receptor sites, for example, β-receptor agonists cause sweating in bovides, whereas α-receptor agonists are effective in equides[12]. From the results (table), it becomes clearly evident that the extrusion of preformed secretion from the preputial gland can be effectively brought about by α-adrenergic agonist-phenylephrine, while the β-adrenergic agonist (isoproterenol) is ineffective in eliciting a positive response. Thus it is clear that the extrusion of preformed sebum from the preputial glands of rats may be regulated through the α-adrenergic receptors.

Further, it was observed that the glands preincubated with α-receptor blocking agents did not respond to added adrenaline while those preincubated with β-receptor blocking agent still showed a positive response. This suggests that α-blocking agents are effective in blocking the response of the glands to adrenaline, while β-blocking agents are without such effect. This can be said to confirm the contention that extrusion of sebum from the preputial glands of rat is mediated via α-adrenergic receptors.

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2 P.M. Ambadkar and D.M. Vyas, unpublished observations.
3 B. Serrati, Riv. Patol. nerv. *52*, 377 (1938).
4 A. Savill, The hair and scalp. Williams and Wilkins, Baltimore 1944.
5 P.H. Nexmand, Acta derm.-vener. Stockh. *25*, 275 (1944).
6 I.S. Hodgson-Jones, R.M.B. Mackenna and V.R. Wheatley, Acta derm. vener. Stockh. *32*, suppl. 29, 155 (1952).
7 E.H. Starling, Human physiology. Churchill, London 1936.
8 A.M. Kligman and W.B. Shelley, J. invest. Derm. *30*, 99 (1958).
9 B.J. Benson and M.E. Hadley, Comp. biochem. physiol. *30*, 857 (1969).
10 C.W. Hoffman and J.N. Dent, J. exp. Zool. *202*, 155 (1977).
11 B. Thomas Pool, J.N. Dent and K. Kemphues, J. exp. Zool. *201*, 203 (1977).
12 D. Robertshaw, J. invest. Derm. *63*, 160 (1974).

Cannibalism in *Anopheles pharoensis* Theo.[1]

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Summary. A single 4th instar larva of *Anopheles pharoensis* could consume within 24 h an average number of 5.3–11.6 larvae of the 1st instar. The number consumed differed according to crowdedness and the presence of other mature larvae. Dissection of the midgut of these larvae revealed the presence of various undigested parts of young larvae.

The cannibalistic behaviour of the 4th and 3rd instar larvae of *Anopheles pharoensis* was early noticed by the present author[2]. In a recent study on the genetic control of *A. pharoensis*[3], close observations of laboratory reared larvae revealed some unexpected mortality in the late larval instars which was probably a result of such cannibalistic behaviour. Larvae were observed trying to seize each other, which would probably result in injury of the body wall, allowing microorganisms to invade the hemocoel and probably causing death or inactivation of the injured larvae. These inactive larvae then become an easy prey to other predaceous ones, and partially eaten larvae were commonly seen in the breeding pans. Old skins from moulting larvae could be observed in the breeding pans only for a short time after moulting, and then were most probably eaten by the other larvae.

Cannibalism was early recorded in *Aedes aegypti*[4] and *Anopheles stephensi*[5] but was not considered to be a usual feature in mosquitoes[6] until it was recently investigated in *Anopheles stephensi*[7]. The present paper provides some quantitative studies of this cannibalistic behaviour in *A. pharoensis*.

Material and methods. Larvae of *A. pharoensis* used in the present investigation were obtained from the standard colony maintained in the Institute of Genetics, Mainz University, FRG.[3]. Larvae were reared at a normal density of 0.6 L/cm^2 during the first 2 instars and reaching 0.4 L/cm^2 during the latter instars. Small plastic cups 7 cm in diameter and 5 cm in height were used in the present investigation. Laboratory temperature was kept constant at 27 °C. 1, 10 and 20 4th instar larvae were confined with 10, 20 and 40 larvae of the 1st instar. 3 replicates of each combination were carried out. Larvae were kept in fresh tap water and given no food. The number of larvae of the 1st instar consumed, and the number of the 4th pupating, were recorded after 24 and 48 h. Some of the remaining 4th instar larvae were dissected and the contents of the midgut were examined.

Results and discussions. Results shown in the table indicate that 1 single 4th instar larva could consume 5.3–11.6 young larvae in 24 h when they were present together at a density from 0.3 to 1.1 L/cm^2. With the presence of more mature larvae (10 or 20), the consumption rate also increased with crowdedness but not at such high rates. Competition between mature larvae would reduce their predaceous capacity and give the young larvae a chance to escape. With a

Cannibalism in *Anopheles pharoensis*

Larval density (L/cm)	Density of 4th: 1st at:			Average No. of consumed 1st instar larvae after:	
	0 h	24 h	48 h	24 h	48 h
0.3	1:10	0.3: 2.3	0.3:2.3	5.3	1.0
0.6	1:20	0.3:11.0	0.0:10.0	9.0	3.0
1.1	1:40	0.0:28.3	-	11.6	-
0.5	10:10	6.3: 0.0	-	1.5	-
0.8	10:20	6.3: 0.0	-	3.1	-
1.3	10:40	5.3: 1.6	3.6:0.0	7.2	0.4
0.8	20:10	12.3: 0.0	-	0.8	-
1.1	20:20	13.3: 1.0	13.0*:0.6	1.4	0.1
1.6	20:40	13.6: 2.3	13.3*:2.0	2.8	0.1

* Reduction in 4th instar density was due to mortality not pupation.

density of 10:20 (0.8 L/cm^2) all 1st instar larvae were consumed in 24 h, while at higher densities i.e. 10:40 or 20:40 (1.3 and 1.6 L/cm^2) some young larvae were still present after 24 or 48 h. In a similar study with *A. stephensi*[7] the authors concluded that all the 1st instar larvae were consumed by the 4th instar ones when present together at densities of 0.8 and 1.6 L/cm^2. They also showed that the consumption rate varied significantly with the 4th and 1st instar larval densities. The authors also added that 3-day-old larvae were less readily consumed due to their larger size and/or more vigorous escape attempts. This was not the same with *A. pharoensis* as repeating the previous experiments with the 2nd instar larvae as prey revealed almost the same degree of consumption as observed in the 1st instar, with slight differences. In the case of the 2nd instar larvae, some mortalities were observed among the 4th instar larvae which did not appear with the 1st instar larvae.

Dissection of the predaceous 4th instar larvae showed the presence of some undigested bristles, scales, food brushes and sometimes a semi-complete head capsule in the midgut. It would be interesting for further studies to clarify how these parts are eaten and later on digested, and the effect of such behaviour on the biology of the insects. It is possible that one day we might consider some mosquito larvae as carnivorous insects.

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2 A. Shoukry, Thesis, Ain Shams University, Cairo, 1965.
3 A. Shoukry, in press.
4 M.E. Mac Gregor, J. trop. Med. *18*, 193 (1915).
5 D.N. Roy, Indian J. med. Res. *19*, 635 (1931).
6 S.R. Christophers, *Aedes aegypti*, the yellow fever mosquito. Cambridge Univ. Press, 1960.
7 W.K. Reisen and R.W. Emory, Mosquito News *36*, 198 (1976).

Power frequency electric field induces biological changes in successive generations of mice[1]

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Summary. Electromagnetic fields arising from the electrical power system are pervasively present in the environment. To help evaluate their public-health risk we raised 3 successive generations of mice in a low-strength, 60-Hz electric field. We found that the field caused an increased mortality in each generation, and, altered body weights in the 3rd generation.

Electric and magnetic fields emanating from components of the electric power system - a frequency of 60 Hz in the United States and 50 Hz in Europe - are pervasively present in the environment. With the development of increasingly larger overhead high-voltage transmission lines, the public-health consequences of chronic exposure to such fields has come into sharper focus. Well over 50 groups of investigators have reported biological effects in organisms ranging from amoeba to man following laboratory exposure to an electrical environment similar to that created by a typical high-voltage transmission line[2]. A question consequently arose concerning the degree of risk experienced by individuals who come within the zone of influence of such lines[3] - up to several 100 m[4].

Until the mechanisms of interaction between electromagnetic radiation and biological systems are elucidated, it will be necessary to base human exposure standards for power-frequency fields on an assessment of risk as distilled from appropriate animal studies. This work was intended as one such study.

Methods. Initially, mature male and female Ha/ICR mice were purchased commercially and split into 4 groups - horizontal-exposure, vertical-exposure, horizontal-control, and vertical-control. Mice in the horizontal-exposure group were allowed to mate, gestate, deliver, and rear their offspring in a horizontal 60-Hz field of 3.5 kV/m. At maturity, randomly selected individuals from the 1st generation were similarly allowed to produce and rear their offspring while being continuously exposed. Randomly selected individuals from the 2nd generation then produced the 3rd generation. A parallel procedure was followed for each of the other 3 groups. The vertical-exposure group consisted of 3 generations raised in a 60-Hz field of 3.5 kV/m. The horizontal-control group was raised in the ambient electric field and the vertical-control group was raised in the complete absence of electric fields - otherwise the environment for each group was identical to that of the corresponding exposed group.

The mice were housed in 15 × 30 cm non-metallic cages contained in 1 of 3 specially constructed units. The horizontal unit held both the exposed and control mice of the horizontal-field study, whereas separate units were built for each of the vertical groups.

Each vertical unit consisted of 3 pairs of shelves; each shelf was a plate of aluminum sandwiched between 2 sheets of wood. The cages were supported between each pair of plates by 2.5 cm thick closed-cell foam rubber - glued directly to the wood insulation of each bottom plate - to negate the possibility of artifacts arising from field-induced vibration. Using this technique we found previously that any interference from vibration can be eliminated, even at much stronger fields than employed here[5]. The cages were centered on the shelves - which were 2.4 m long - with their long axes directed along the 0.6 m shelf width. The metal plate extended to within 2 cm of each shelf edge. In the vertical exposure unit, 1120 V were applied to each pair of plates, thereby producing 3.5 kV/m in the intra-plate region. The plates in the vertical-control unit were grounded.

The mice in this study were housed in a single windowless room of our accredited animal care facility. In this room we measured a 60-Hz field of 2-12 V/m from the lighting and air conditioning systems as well as from other sources. To establish a well-defined baseline for the vertical exposure, we wrapped the cage-containing region with grounded aluminum screening, thereby creating Faraday conditions (zero electric field) for the vertical-control group. This in turn slightly reduced the measured ambient light levels