had no effect on survival of the mice.

In the dosages used by us, both DOPA and dopamine produced increased motor activity and piloerection in mice; both are intermediary metabolites in the synthesis of norepinephrine and epinephrine:

phenylalanine → tyrosine → DOPA → dopamine → norepinephrine → epinephrine.

In addition to being a precursor of norepinephrine, dopamine apparently has physiologic actions of its own; its importance in brain function has recently been extensively reviewed (*7*). Thus endogenous dopamine may also be important to an animal's defense mechanisms against radiation damage.

The mode of action of dopamine in protecting against injury by radiation is obscure. Since norepinephrine, the precursor of epinephrine, is not a radioprotective agent, it is unlikely that the dopamine effect is by conversion to epinephrine. Our results in splenectomized mice also support the conclusion that it was dopamine itself, and not the metabolite epinephrine, that was the active agent in our experiments.

KEDAR N. PRASAD
MELVIN H. VAN WOERT
Department of Radiation Biology and Biophysics, University of Rochester School of Medicine and Dentistry, Rochester, New York, and *Medical Research Center, Brookhaven National Laboratory, Upton, New York*

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Hexagonal Pattern in Cell Walls of Escherichia coli B

Abstract. *Cell walls, isolated from* Escherichia coli *B, as examined by electron microscopy and optical diffraction contain a hexagonal lattice structure, the (1,0) planes of which are separated by 140 ± 8 angstroms. Unless the walls are briefly heated (10 minutes, 90°C) early in the isolation, the hexagonal array cannot always be observed. Enzymatic digestion with pancreatin and amylase improves visualization of the lattice; subsequent treatment with pepsin and sodium dodecylsulfate removes the hexagonal pattern. Protein or lipoprotein globular units within the wall may thus be arranged in a hexagonal array upon the mucopeptide layer.*

Hexagonal packing of subunits in cell walls of gram-negative bacteria has been observed in *Spirillum sp.*, *Rhodospirillum rubrum*, *Halobacterium halobium*, and *Lampropedia hyalina* (*1*). Although several investigators have studied the structure of the cell wall of *Escherichia coli* (*2*), there has been no evidence of periodic packing of constituent subunits (*3*). We now present electron micrographs and an optical diffraction pattern indicating a hexagonal structure in the wall of *E. coli*; the apparent lability of this structure may account for its not having been detected previously.

Escherichia coli B (*4*) was grown on synthetic medium (*5*); the cells were harvested in the late logarithmic growth phase. The intact cells were ruptured with glass beads (0.2 mm diameter) (*6*), and the cell envelopes (*7*) were separated by differential centrifugation and washed ten times with freshly distilled water. To preserve the hexagonal structure within the cell walls so that it may be observed, it is necessary to heat the suspension of cell envelopes for 10 minutes at 90°C; after this procedure the preparation can be examined directly by electron microscopy (Figs. 1 and 2) or subjected to enzymatic digestion prior to ultrastructural analysis (Figs. 3, 4, 5, and 6). For electron microscopy, preparations of cell envelopes, fixed in formalin and unfixed, were negatively stained with 1 percent aqueous potassium phosphotungstate (PTA) at *p*H 7.4. Fixed and unfixed preparations yielded identical results, and the same result was obtained after negative staining with 2 percent uranyl acetate.

Therefore only material stained with PTA is presented. Droplets of the envelope suspensions in PTA were placed on copper grids (200 mesh) covered with parlodion; the grids were dried and examined with an AEI EM6B electron microscope operating at 60 kv with double condensor alignment at a 50-μ objective aperture. The magnification was calibrated by including tobacco mosaic virus (outside diameter 180 Å) in some of the cell envelope suspensions (*8*).

Freshly isolated cell envelopes of *E. coli* B that were not heated, when examined in the electron microscope, show no reproducible hexagonal pattern (Fig. 1). In contrast, many of the heated envelopes show areas of the cell wall with small granules in a hexagonal distribution (Fig. 2). The cell membrane retracts from the cell wall in most of these preparations and forms the dark mass in the central region of the cell.

To improve the demonstration of this periodic structure associated with the cell wall, the heated envelopes were digested with pancreatin and amylase (*9*). As seen in Figs. 3, 4, and 6a, the hexagonal lattice structure is clarified considerably; it is present over the complete cell wall, and moire patterns (*10*) are produced by the overlay of two cell-wall surfaces. The measured distance between the (1,0) lattice planes is 140 ± 8 Å.

After digestion with pancreatin and amylase, the regular pattern associated with the cell wall can be removed by incubation of the cell envelopes in pepsin and subsequent treatment with sodium dodecylsulfate (SDS) (*11*). In such a preparation (Fig. 5) all hexagonal regularity has been lost, and the walls appear similar to the protein-free rigid substructure obtained by Weidel, Frank, and Martin (*2*) after SDS, phenol, and trypsin treatment.

An optical diffraction pattern (*12*) substantiates the hexagonal symmetry in the envelopes treated by heat and by pancreatin and amylase (Fig. 6b).

Our results demonstrate that a hexagonal structure is associated with the cell walls of *E. coli* B, and that the structure can be consistently observed if the walls are heated during their isolation. That the hexagonal pattern is a labile structure, preserved by heat treatment, rather than an artifact produced by high temperatures, is suggested by the fact that in a few cases a hexagonal array has been seen in walls which were not heated during isolation but which were subsequently treated with pancreatin and amylase. Although such observations are uncommon, the presence of the hexagon-

al pattern in any unheated cell walls strongly suggests that this arrangement is present in vivo and is stabilized in some way by the heat treatment. It remains to be seen whether elevated temperatures inactivate a degradative enzyme associated with the cell envelope or stabilize a structural protein required for the hexagonal array. In thin sections of intact *E. coli*, spherical subunits of 120 to 140 Å diameter have been noted (*13*) beneath the outer trilaminar layer of the cell wall and superficial to a pale-staining region presumed to be the mucopeptide layer. We have made similar observations (unpublished).

Our results support the interpreta-

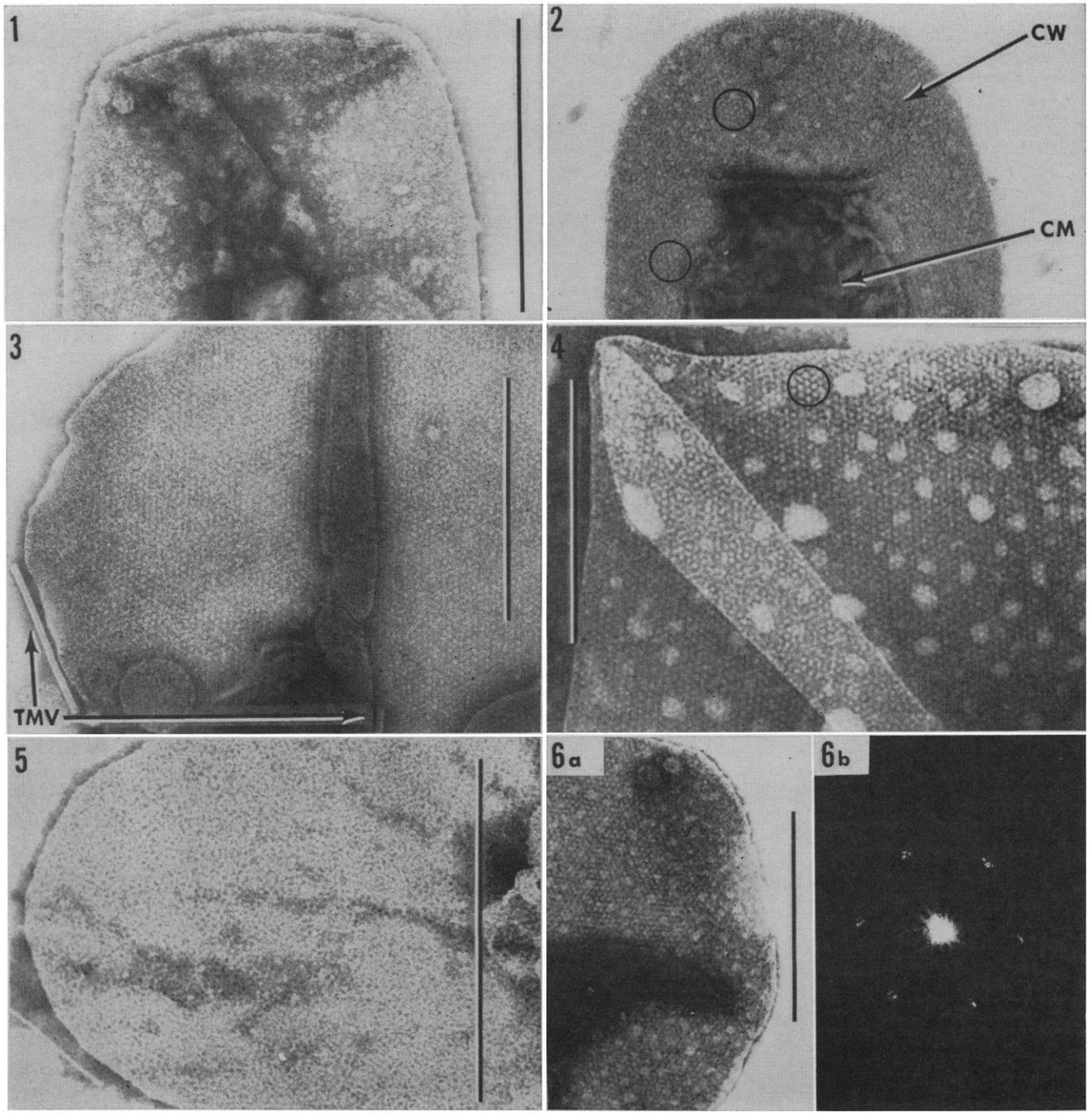

Fig. 1. Negatively stained cell envelope from *Escherichia coli* B. This preparation was not heated during isolation. No hexagonal pattern is seen. Bar measures 0.5 μ. Fig. 2. Cell envelope from a preparation identical to that in Fig. 1, except that the cell envelopes were heated to 90°C for 10 minutes during isolation. Hexagonal patterning can be seen in the cell wall (*CW*) and have been circled. The central dark mass is the retracted cell membrane (*CM*). Magnification as in Fig. 1. Fig. 3. Same preparation as in Fig. 2 but in this case the heated envelopes were subsequently treated with pancreatin and amylase. The hexagonal array can be seen over the whole cell wall. Tobacco mosaic virus (*TMV*) has been included as an internal calibration standard. Bar measures 0.5 μ. Fig. 4. Hexagonal array after pancreatin and amylase treatment of heated cell envelopes. A clearly defined region of this lattice has been circled. Bar is 0.5 μ. Fig. 5. Same preparation as in Figs. 3 and 4 but after pancreatin and amylase digestion the cell walls were treated with pepsin and SDS. The hexagonal array is removed, and a thin amorphous layer remains. Bar is 0.5 μ. Fig. 6. (a) Same preparation as in Figs. 3 and 4. The hexagonal array is clearly evident. Bar is 0.5 μ. (b) Hexagonal symmetry in the optical diffraction pattern obtained from the electron micrograph negative plate of Fig. 6a.

tion that these globular subunits within the wall are hexagonally and uniformly distributed upon a mucopeptide substrate and may be composed of protein or lipoprotein.

DONALD A. FISCHMAN*
Department of Zoology, University of Chicago, Chicago, Illinois
GEORGE WEINBAUM
Department of Biochemistry, Albert Einstein Medical Center, Philadelphia, Pennsylvania 19141

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* Present address: Armed Forces Institute of Pathology, Washington, D.C. 20305.

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The Ecological Significance of Sexual Dimorphism in Size in the Lizard Anolis conspersus

Abstract. *Adult males of* Anolis conspersus *capture prey of significantly larger size and occupy perches of significantly greater diameter and height than do adult females; similarly, these three dimensions of the niche are significantly larger for adult females than for juveniles. Adult males on the average eat a smaller number of prey, and the range in size of prey is larger. The relationship between the average length of the prey and that of the predator is linear when the predator size is above 36 millimeters, but becomes asymptotic when it is below that value. Subadult males as long as adult females eat significantly larger food than do the latter, but only in the larger lizards is this correlated with a relatively larger head.* Anolis conspersus *selects prey from a wide range of taxa and shows no obvious intraspecific specialization not connected to differences in microhabitat and prey size. The efficiency of this system for solitary species is pointed out.*

Anoline lizards make up the most conspicuous and diversified vertebrate genus in the West Indies. There are many very small islands with at least one species, and the greatest numbers occur on the large islands of Cuba, with 22 species, and Hispaniola, with 20 species. Most species of *Anolis* which occur without congeners are about the same absolute size from island to island, the heads of adult males measuring 17 to 21 mm and the snout-vent lengths being 65 to 75 mm. Furthermore, the sexes are highly dimorphic in size, the head length of adult males averaging 1.3 to 1.5 times that of females (*1*). This striking convergence from at least seven different stocks (*1*) implies that on islands where an anoline lizard occurs without congeners, natural selection has favored an optimum size and sexual dimorphism, either because unsuitably proportioned colonists are eliminated, or because later there is an increase in size dimorphism between the sexes. Presumably this latter process, at least, is a reflection of the phenomenon of "ecological release," in which one species, in the absence of closely related species, increases the breadth of certain critical dimensions of its ecological niche.

Two nonexclusive hypotheses concerning the adaptive significance of sexual dimorphism in size were tested for one of the convergent solitary species, *Anolis conspersus* of Grand Cayman Island. The first, that size differences might reflect differences in structural habitat (*2*) such as perch size, I tested by noting the height above ground and the diameter of perches of 474 lizards in several habitats. The second, that such differences reflect a difference in the distribution of prey size, I examined by analyzing the stomachs and intestinal contents of 166 lizards collected in the same areas (*3*).

Differences in both prey size and microhabitat have previously been reported for age and sex classes of different sizes within other species of lizards. A greater proportion of large insects were found in larger adult males than in adult females of *Anolis lineatopus* and *Agama agama* (*4, 5*); similarly, juveniles take smaller food than adults (*5–7*). Sexual differences in preferred microhabitat have been found in *Anolis lineatopus, A. cybotes,* and *A. sagrei* (*4, 8*), and juvenile-adult stratification has been observed (*4, 7–9*).

Grand Cayman is a flat, relatively dry island about 32 km long with a maximum width of a little over 6 km. Most of the vegetation consists of several types of mangrove associations or xeric scrub forest, some growing directly on top of bare coral rock.

Table 1. Frequency of perch height and perch diameter combinations for male and female adults, subadult males, and juveniles. Results are percentages observed. Five adult males, 17 adult females, 3 subadult males, and 14 juveniles were found on the ground.

Perch height (feet)	Perch diameter in inches (1 inch = 2.54 cm) for											
	Adult males $N = 133$			Adult females $N = 222$			Subadult males $N = 43$			Juveniles $N = 37$		
	3	3–½	½	3	3–½	½	3	3–½	½	3	3–½	½
>10	5	1	0	0	0	0	2	0	0	0	0	0
6–10	21	8	0	4	6	3	14	0	2	3	0	8
3–5	32	16	2	16	32	2	23	33	0	3	16	10
1–2	10	7	0	15	20	2	9	16	0	10	25	25