formation of period two is either an equilong symmetry or of a certain new type (equivalent to line symmetry) without a base curve.

Minimal surfaces of unstable ring type: MARSTON MORSE and CHARLES B. TOMPKINS, II. We are concerned with a generalization of theorems concerning minimal surfaces which go back to Newton. Minimal surfaces are surfaces which are locally curved away from the tangent plane in equal degree on both sides. Stable minimal surfaces are those of least area. Soap films assume the shape of minimal surfaces to a very high degree of approximation. Let there be given two circles with distinct parallel planes and with centers on the same axis of rotation. These circles will bound two minimal surfaces of revolution each generated by a segment of catenary, provided the two circles are not too far apart. One of these surfaces will be of minimizing type and stable, and the other non-minimizing and unstable. These surfaces are "ring surfaces"; that is, they are continuous images of a plane circular ring. Our theory includes the following generalization of this classic result. Let the two circles be replaced by two simple closed curves g_1 and g_2 of class C^1. Instead of being planar, suppose g_1 and g_2 have convex projections on suitably chosen planes. Instead of having distinct containing planes suppose g_1 and g_2 are separated by a plane. *If g_1 and g_2 bound a "ring" minimal surface of minimizing type, g_1 and g_2 also bound a ring minimal surface of non-minimizing type.* In developing this theory it was necessary to reinvestigate many portions of the classical theory and in particular to obtain new and stronger theorems concerning the first variation. In general, the work is based on the topological theory of critical points of functionals as developed by Morse. One of the technical details depends upon results recently obtained by Professor A. E. Pitcher concerning "Sum functions on product spaces." An essential characteristic of the methods is the replacing of classic concepts such as that of a critical point by broader topological concepts involving no derivatives. This analysis in the small is combined with the appropriate group theoretic analysis in the large.

(*To be concluded*)

SPECIAL ARTICLES

ALLEGED GONADOTROPIC EFFECT OF ROYAL JELLY

FEMALE larvae of the honeybee (*Apis mellifera* L.) develop into members of the queen or worker caste depending upon the food and care received during larval development. The mature queen is nearly twice as large as the worker and has highly developed ovaries which nearly fill the abdomen.

It is not uncommon for workers to lay unfertilized eggs, although such individuals may have not more than 8–10 ovarioles compared with upward to 340 for the queen. All newly hatched female larvae have rudimentary ovaries capable of developing into the functional organs of the queen caste. However, the number of ovarioles decreases during the late larval and pupal stage of the worker.[1]

Heyl[2] recently suggested that royal jelly, or larval food, secreted by the honeybee "might contain an active principle that would behave like a gonadotropic or growth hormone." In support of this idea he reported that the injection of dilute sodium hydroxide and aqueous pyridine extracts of royal jelly had resulted in a precocious development of the Graafian follicles in immature rats.

In connection with investigations under way on the physiology of reproduction of the honeybee, royal jelly has been assayed for gonadotropic activity, with results that are not in line with those of Heyl. The data from two assays are presented in Table I. Aqueous extracts of acetone-dried royal jelly were used for one assay, and aqueous pyridine extracts for the other. Eight immature female rats, 21 days old, selected from a closely inbred strain, were used as the experimental animals, four for each assay, one of each group serving as a control. The rats in each group were litter mates. The injections were made twice daily for 3 days, and the animals were autopsied 24 hours after the last injection.

TABLE I

ASSAY OF ROYAL JELLY OF THE HONEYBEE FOR GONADOTROPIC EFFECT ON RATS

Rat No.	Equivalents royal jelly injected	Weight of rat		Weight of ovary	Weight of thymus	Weight of adrenal
		Initial weight	Final weight			
	mg	*gm*	*gm*	*mg*	*mg*	*mg*
	Acetone-dried royal jelly					
1	100	38.6	51.0	15.0	182.1	15.2
2	200	38.5	50.0	15.3	144.9	14.5
3	400	36.5	48.5	14.7	172.3	10.8
4	Control	39.5	53.5	18.9	250.9	12.8
	Aqueous pyridine extracts of royal jelly					
5	1000	34.0	41.1	11.4	93.6	16.1
6	2000	31.0	39.8	12.7	86.7	11.0
7	3000	33.0	34.5	11.0	21.5	15.6
8	Control	41.0	54.1	14.6	219.5	13.2

It will be noted that all animals increased in weight during the period of the injection. The ovarian weights of the animals injected with extracts were not greater than those of the controls; furthermore, upon microscopic examination little, if any, follicle stimulation was observed. Histological study of the vagina showed no effects of theelin. The thymus weights of the experimental animals were reduced, whereas the adrenals showed little effect of the injections of royal jelly.

It is concluded from these preliminary assays that

[1] E. Oertel, *Jour. Morph. and Physiol.*, 50: 295, 1930.
[2] H. H. Heyl, SCIENCE, 89: 540, 1939.

a substance which causes follicle stimulation in the white rat is not present in the royal jelly of the honeybee. However, more detailed work may demonstrate the presence of a gonadotropic substance which may or may not be associated with caste production in the honeybee.

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CRYSTALLINE DROSOPHILA EYE-COLOR HORMONE

THE development of eye color in Drosophila is known to be controlled by specific diffusible substances desiginated as v^+ and cn^+ hormones. Khouvine, Ephrussi and Chevais[1] and Tatum and Beadle[2] have shown that these substances are amino acid-like in nature. The former authors in testing various amino-acids for v^+ hormone activity obtained results which indicated that tryptophane, when added to the larval food, was concerned with hormone production. This "tryptophane effect" was found to be due to the production by certain bacteria of a substance with v^+ hormone activity.[3]

This bacterially produced v^+ hormone has now been obtained in a pure crystalline state. The bacteria were grown on an agar medium containing dead yeast, sugar and l-tryptophane. The agar and yeast were precipitated in 80 per cent. alcohol. The hormone was then taken up in a mixture of butyl alcohol, ethyl alcohol and water, and was finally precipitated from absolute butyl alcohol. It was then crystallized from 90 per cent. ethyl alcohol. The crystals are very light yellow, elongated plates, usually forming in rosettes. The elementary analysis (made under the direction of Dr. A. J. Haagen Smit, of the California Institute of Technology) supports the empirical formula $C_{21}H_{34}N_2O_{14}$.

The crystalline hormone has an activity of approximately 20,000,000 v^+ units per gram[4] when a solution is injected into vermilion brown test larvae. Table I shows that within the limits of accuracy of the biological test, repeated recrystallization does not change the activity.

TABLE I

BIOLOGICAL ACTIVITY OF CRYSTALLINE v^+ HORMONE[4] (0.28 γ INJECTED PER LARVA)

Times hormone recrystallized	Maximum eye-color value	v^+ units per fly	v^+ units per gram hormone
1	3.1	6	21,400,000
2	3.1	6	21,400,000
3	3.3	7	25,000,000
4	2.9	5	17,900,000

[1] Y. Khouvine, B. Ephrussi and S. Chevais, *Biol. Bull.*, 75: 425, 1938.
[2] E. L. Tatum and G. W. Beadle, *Jour. Gen. Physiol.*, 22: 239, 1938.
[3] E. L. Tatum, *Proc. Nat. Acad. Sciences*, 25: 486, 1939.

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EFFECT OF EMANATIONS FROM SEVERAL SPECIES OF FUNGI ON RESPIRATION AND COLOR DEVELOPMENT OF CITRUS FRUITS

THE vapors given off by single moldy lemons inoculated from pure cultures were passed at a constant rate through cotton tubes into jars filled with 50 to 60 sound fruits. Respiration was determined by absorbing the CO_2 evolved in a solution of barium hydroxide. During this determination, which consisted of three one-hour tests, the container with the moldy fruit was disconnected from the jar. Hence the respiration values are for the sound fruit only and do not include the carbon dioxide given off by the moldy fruit.

The most pronounced effects were produced by the emanations from fruits inoculated with *Penicillium digitatum* (green mold), as demonstrated by a typical case in Fig. 1. The response was similar in 12 other

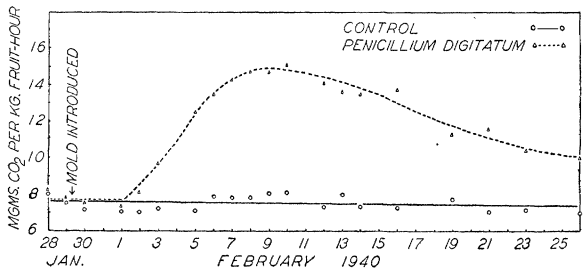

FIG. 1. Respiration of lemons as affected by the vapors of *Penicillium digitatum*.

experiments on lemons and in one test on oranges. The increase in CO_2 evolution by fruit subjected to green mold vapors over the control varied from 50 to 100 per cent. The activity of this fungus is definitely inhibited by low temperatures (2° C.), while higher temperatures (25° C.) do not appear to cause any accelerated effect as compared with 14.5° C. used normally for these experiments. It seems that there are no specific substances present in the fruit which are essential for the production of the active vapor, because *Penicillium digitatum* grown on an agar medium (to which dextrose and potato broth was added) brought about the same results.

Another striking feature of these tests is the very

[4] See reference cited in footnote 2 for significance of eye-color values and units.