et al.,[12] reported substantially lower values for yeast and liver than those found by Jukes with chick assay method. Thus, when the comparison is made with values obtained by the microbiological method the ratio of pantothenic acid in royal jelly to that of yeast is approximately 6 to 1.

Of the vitamins studied in royal jelly pantothenic acid is the only one in which it is unusually rich. Whether or not pantothenic acid is in any way responsible for the development of female larvae into queen bees remains to be studied. The presence of pantothenic acid in such relatively large amounts does suggest that it might be one of the factors responsible for the development into queens of the female larvae which continue to receive royal jelly.

Summary. It has been found that royal jelly is the richest known source of pantothenic acid. On a dry basis it contains an average of 511 μg per g which is between 2.5 and 6 times as much pantothenic acid as is present in yeast or liver.

13339 P

Influence of Age on Survival of Respiration, Spinal Reflexes, Pupillary Responses and Heart Action.

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Despite the many observations reported on survival of tissues and organs, little information is available concerning the influence of age on survival time. Several observers[1-5] have reported that young animals are more resistant to anoxia and asphyxia than are adults, and Selle and Witten[6] found that the primitive respiratory mechanism

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2 Avery, R. C., and Johlin, J. M., PROC. SOC. EXP. BIOL. AND MED., 1932, **29**, 1184.

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5 Himwich, N. E., Alexander, F. A. D., and Fazekas, J. F., *Proc. Am. Physiol. Soc.*, 1941, **53**, 193.

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(gasping) itself survives much longer in young animals than in old. Thus, the head of a new-born rat or dog gasps 40 to 80 times during a period of 30 to 60 minutes following ligation of the cerebral vessels or decapitation; the head of a half-grown or adult animal ceases gasping within a few seconds.

The present studies were undertaken to determine whether the anoxic survivals of other physiological processes, such as pupillary responses, trunk reflexes and heart action, parallel that of the respiratory mechanism.

Survival of the gasping mechanism was determined as described previously.[6] Maximal dilatation of the pupil was taken to be a satisfactory indication of cessation of pupillary activity. Following the onset of anoxia the pupils constrict to pin point size. Later they dilate and for a time only respond to bright light. The duration of trunk reflexes (movement of tail or foot) was determined by the application of painful induction shocks to cutaneous areas of the abdomen and foot. To follow cardiac beats, the heart was exposed by a midline incision of the chest within 2 minutes after spinal transection or after thoracic respiration had ceased.

Results on 3 series of animals are given in the accompanying table.

TABLE I.
Age Factor in Survival of Respiration, Pupillary Responses, Spinal Reflexes and Heart Beat.

Age, days	No. animals	Gasping ceased, sec.	Max. dilation of pupil, sec.	Trunk reflexes abolished, sec.	Heart beat ceased: Ventr., min.	Heart beat ceased: Aur., min.
Rats						
Premature	6	1885	—	1530	111	146
1	15	1765	—	1215	88	103
3	17	1667	—	835	85	96
4	12	1420	—	628	85	102
7	10	970	256	460	90	99
14	14	305	140	122	72	78
21	10	121	82	67	28	36
42	10	45	52	43	12	17
100	10	15	47	37	13	16
Rabbits						
1	10	1465		1320	103	113
3	9	1280		1080	72	84
7	6	452		252	51	58
14	3	67		38	15	18
90	2	15		20	14	19
Dogs						
1	3	2100		920	47	58
3	2	1652		840	38	42
7	3	530		420	25	31
14	3	352		270	8	11
35	2	94		74	6	8
65	1	35		45	7	9

The remarkable survival of the respiratory mechanism in young animals is obviously not unique; other physiological processes survive similarly.

In early age groups the survival of trunk reflexes is about two-thirds that of gasping; in the older age groups there is no clear difference. The survival of pupillary responses in the 7-day-old rat is about 3 times that of the adult. Heart action for all species studied is approximately 7 times longer in 1-day-old animals than in adults.

13340

Body Size and Metabolism of Liver Slices *in vitro.*

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Grafe, Reinwein and Singer[1] concluded from micro respiration trials that the metabolic rate of animal tissues *in vivo* was restricted by a central regulator to a fraction of the rate of oxidation of the tissues *in vitro.* The summated *in vitro* metabolism[†] of the rat according to Grafe is twice as great as the metabolic rate *in vivo* and the tissues of a steer respire *in vitro* 20 times as fast as they do in the living animal. Based on similar work Terroine and Roche[2] derived their rule: The metabolic rate *in vitro* per unit weight of homologous tissues of large and small animals is the same even though the metabolic rate per unit weight of the tissues in the living animals decreases systematically with increasing body size.

In contrast to Grafe's conclusion, Field, Belding and Martin[3] demonstrated that the summated metabolic rate of rat tissues *in vitro* amounted to 89% of the basal metabolic rate of the living rats. Since the ratio of *in vitro* to *in vivo* metabolic rate according to

* The author acknowledges the help of several colleagues at Davis, especially his assistant, Arthur H. Smith.

† Summated *in vitro* metabolism = metabolic rate per unit weight *in vitro* multiplied by the weight of each tissue in the living animal and summated over all its tissues.

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2 Terroine, E. F., and Roche, J., *Compt. Rend. Acad. Sci.*, 1925, **180**, 225.

3 Field, J., 2nd, Belding, H. S., and Martin, A. W., *J. Cell. Comp. Physiol.*, 1939, **143**, 14.