

There were 13 experiments. In 6 animals there were no symptoms of consequence. Seven of the animals showed distinct symptoms. Two died within two hours. Three of the remainder showed pronounced symptoms. Two of these died in four to five hours respectively, the third recovered in twelve hours. One animal showed very slight symptoms but died in twelve hours. One showed moderate symptoms, but recovered completely in two hours.

The symptoms presented by the animals were great uneasiness, scratching of the nose, bucking movements, paralysis and pronounced dyspnea. There was usually a fall of temperature of 5 to 7 degrees F. Autopsy of the 4 animals which died within 5 hours showed great distension of the lungs and peritoneal and pericardial hemorrhages. No pathological changes were apparent in the animal which died in 12 hours.

Two series of control were done. (1) The blood of 17 practically normal infants was treated as outlined and injected into guinea pigs. None of the animals developed symptoms. (2) The blood of 13 infants suffering from acute infections was tested. Six had pneumonia, 3 tonsillitis and 4 infectious colds with otitis media. The results were negative. Three of the infants with pneumonia had diarrhea.

These experiments seem to indicate that the blood of infants with a type of intestinal intoxication may show the presence of a substance toxic to guinea pigs. No evidence is available at present to indicate the nature of this substance or its relation to the disease.

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**General effects of increased and decreased pressures of oxygen
on dove embryos.**

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Compared with hatched young or adults the dove embryo has very inferior powers of adjustment to either high or low oxygen

pressures. The earliest stages, in fact, wholly lack the usual or other apparent mechanisms of respiratory compensation. Contrary to permissible inferences from the few studies hitherto made with older embryos only, it is found that the embryos in the youngest stage are usually much affected by prolonged high concentrations of oxygen. Some of these embryos are killed by subjection to high oxygen pressures during 24 hours; others may temporarily survive—as shown by heart-beat—for more than four days, but these embryos usually fail to develop blood pigment, become highly abnormal and remain of very small size; some of these abnormal embryos practically complete their development—producing “monsters” in which the head and eyes are most often affected. That such abnormal embryos and monsters arise only from very young embryos, of 2.2 days or less, is indicated by the data of Table I.

TABLE I.

SHOWING THAT THE PRODUCTION OF DEVELOPMENTAL ABNORMALITIES AND “MONSTERS” BY INCREASED OXYGEN PRESSURES (95.8 PER CENT., DURING 23 HOURS) IS CLOSELY LIMITED TO THE YOUNGEST EMBRYOS TREATED.

Age (in Days) of Embryo.	Killed.	Survived.	Normal or Abnormal (for Survivors).	Age (in Days of Embryos ₀).	Killed.	Survived.	Normal or Abnormal (for Survivors).
7.5		+	Normal	4.2	*	*	
7.5	*	*		4.2	*	*	
7.2	*	*		4.0	*	*	
7.0	*	*		3.5	*	*	
7.0		+	Normal	2.5		+	Normal
6.5	*	*		2.5	*	*	
6.2	*	*		2.5	*	*	
6.2	*	*		2.4	1	1	
6.0		+	Normal	2.2	*	*	Abnormal
6.0		+		2.0	*	*	
6.0		+	Normal	2.0	2	2	Abnormal
5.5	*	*		1.5	+		
5.5	*	*	Normal	1.2	2	2	Abnormal
5.5	*	*		1.2	2	2	Abnormal
5.5	*	*		1.2	3	3	Abnormal
5.2	*	*		1.0	2	2	Abnormal
5.2	*	*		1.0	*	*	
5.0		+		1.0	*	*	
5.0		+		0.5	?	?	Abnormal
5.0		+		0.5	?	?	Abnormal
4.5	*	*	0.0		+	Normal	
4.2	*	*	0.0	?	?	Abnormal	
4.2	*	*	0.0		+	Normal	

* Embryo alive at end of experiment but died soon afterward.

¹ Hemoglobin nearly or quite absent, heart beating 50 hours after experiment.

² Hemoglobin nearly or quite absent, heart beating 74 hours after experiment.

³ Hemoglobin nearly or quite absent, heart beating 100 hours after experiment.

It should be stated that monsters rather similar to those induced by the increased oxygen have resulted also from treatment with reduced oxygen pressures and these have all been produced in embryos aged 2 days or less at the time of treatment. However, some of the abnormalities of the types mentioned above are practically absent in series of embryos treated with reduced oxygen. That the monsters are in fact induced by the altered oxygen pressures is adequately shown by our complete data. These data are the result of 80 experiments upon nearly 2,000 embryos of various but precisely known ages, with oxygen concentrations varying from 8.0 to 96.5 per cent., and with duration of treatment extended from 8 hours to 10 days.

In older embryos subjected to increased oxygen the normal amount of hemoglobin is decreased, as indicated by macroscopic examination, and quantities of it appear in solution in the amniotic fluid. Quantitative studies of the changes in the blood pigment of embryos subjected to decreased and increased oxygen pressures may be made later.

During the various stages of its development the embryo utilizes three different respiratory surfaces and these are further associated with from none to several of the usual compensatory mechanisms. Age therefore becomes the chief factor involved in the death or survival of embryos subjected to altered oxygen pressures. This fact is sufficiently shown in Table II. The data of the table also indicate that longer periods of exposure are more lethal than are 24-hour periods; adequate compensatory changes are usually limited to definite stages or ages of the embryo. Tests have shown that the adult bird readily survives 24-hour periods in either 10 per cent. or 95 per cent. oxygen.

Embryos of 8-10 days and older are like hatched individuals in being able to survive the highest percentages of oxygen. The youngest stages best survive decreased pressures of oxygen; for this stage the oxygen may be reduced to 9-10 per cent. (24 hours). It is clear, however, that this "cold-blooded" stage of the bird embryo is unable to reduce the oxygen demands of the tissues to a further reduction of the oxygen supply.

Although the age of the embryo is the most important factor in its capacity to survive an altered pressure of oxygen the data of

TABLE II.

SHOWING THE RELATION OF AGE OF EMBRYO TO SURVIVAL UNDER ALTERED OXYGEN PRESSURES.

Exp. No. 29, 24 Hours, O ₂ = 95.0%.			Exp. No. X, 240 Hours, O ₂ = 50.1%.			Exp. No. 40, 72 Hours, O ₂ = 12.6%.			Exp. No. 39, 24 Hours, O ₂ = 12.4%.		
Age of Em- bryos.	Killed.	Sur- vived.	Age of Em- bryos.	Killed.	Sur- vived.	Age of Em- bryos.	Killed.	Sur- vived.	Age of Em- bryos.	Killed.	Sur- vived.
9.0		+	5.0		+	5.5	+		10.0		+
7.2		+	4.5		+	5.0	+		9.5	+	
6.5	+		3.2		+	4.5	+		9.0	+	
6.2		+	2.5	+		4.2	+		8.2 ¹	+	
5.2	+		2.5		+	4.0	+		4.5	+	+
5.0		+	2.2		+	3.2	+		4.2	+	
4.5	+		2.0		+	2.5	+		3.5		+
4.2	+		1.2		+	2.5	+		3.2		+
4.0	+		1.2		+	1.2		+	3.2	+	
3.5	+		1.0	*	*	1.2		+	3.0	*	*
3.2	+		0.5	*	*	1.0		+	2.5		+
3.2	*	*	0.5	+		1.0		+	2.5	+	
2.5	*	*	0.5	+		0.0		+	2.2		+
2.2	+		0.3	+		0.0	*	*	2.2		+
1.5	+		0.0	+					2.0		+
1.2	+								2.0		+
1.0	+								1.5		+
0.6	+								1.2		+
0.6	+								1.2		+
0.2	+								1.0		+
0.2	+								0.2		+

* Survived period in altered oxygen pressure but died immediately afterward.

¹ Seven embryos aged 6.5 to 4.5 days, *all killed*, are omitted to save space in table.

the two tables given here clearly indicate that it is not the sole factor. A study of the complete data, one part of which has been previously reported,¹ makes it probable that variations in the permeability of the egg-shell to gases and the sex of the enclosed embryo are such additional factors.

¹ Riddle, Oscar, *Proceedings of the Society for Experimental Biology and Medicine*, 1920, xviii, 88.