TABLE I.
Effects of Electric Shock on Rats Autopsied on the 11th Day of Pregnancy.

Group No.	No. of animals	No. of shocks	Uterine contents	
			Normal	Resorbing
I	5	1	5	0
II	5	6	3	2
III	5	11	0	5

Control animals are not included.

appeared in a condition to be expected at 7 or 8 days of pregnancy rather than at 11 days. Some proliferation was occurring as indicated by the presence of a few mitotic figures in each section. The embryos, however, were similar in stage of development to normal embryos of the 6th day but were disintegrating. In the uteri of all animals of Group III the entire decidua was disintegrating and no embryonic tissue could be found. The uterine lining was being reconstituted so as to expel the entire necrotic mass into the lumen. The uteri of the 3 unaffected animals contained normal embryos.

The pituitaries of all of the affected animals in Group II and III showed some degranulation of the acidophils and, although no measurements were made, the basophils appeared reduced in size when compared with those of the controls. The pituitaries of the unaffected animals did not show these changes. The ovaries of all the affected animals showed many degenerating corpora lutea and a few which were histologically normal, but smaller than those of controls. The ovaries of the unaffected animals were essentially normal.

Summary. A single electro-convulsive shock administered to 5 pregnant rats 12 hours after mating had no effect on the course of pregnancy. Of 5 rats shocked once daily for 6 days beginning 12 hours after copulation, on the eleventh day 2 showed some degranulation of pituitary acidophils, slight reduction in size of basophils, small or degenerating corpora lutea and degenerating retarded embryos in the uteri. All animals similarly shocked for 11 days, showed the same pituitary and ovarian changes, and, in addition, complete destruction of the fetuses with necrosis and sloughing of decidua into the uterine lumen.

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Effects of Acute Intermittent Anoxia Upon Urinary Volume, Specific Gravity and Chloride.

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Silvette[1] demonstrated a 300% increase in urinary volume of rats exposed to 282 mm Hg barometric pressure for 3-hour periods. Ten human subjects exposed by Armstrong[2] to simulated 12,000 ft. for 4 and 7 hours in a low pressure chamber excreted 100 to 300% more urine than at sea level and the urinary specific gravity fell as low as 1.016. Pincus and Hoagland[3] observed a polyuria in men exposed to reduced oxygen pressure. Burrill,

1 Silvette, H., *Am. J. Physiol.*, 1943, **140**, 374.

2 Armstrong, H. G., Principles and Practice of Aviation Medicine, The Williams and Wilkins Co., Baltimore, 1939, p. 284.

3 Pincus, G., and Hoagland, H., *J. Aviation Med.*, 1943, **14**, 173.

Freeman and Ivy[4] detected a slight increase in urinary volume and chloride content in men exposed to 18,000 ft. for 2-hour periods. Langley and Clarke[5] and Lewis *et al.*[6] reported a polyuria in unanesthetized dogs exposed for prolonged periods to 18,000 and 20,000 ft. altitude equivalents.

The present investigation was undertaken to determine the effects of severe anoxic conditions upon urinary volume, specific gravity and chloride excretion at various stages of the anoxic period. In the work of earlier investigators anoxic exposures have been made over several hours and in such experiments the initial urinary changes have been masked by changes of a different character occurring during a latter portion of the anoxic period.

Methods. Adult Long-Evans rats, male and female, were exposed to reduced barometric pressures in chambers described by Van Middlesworth *et al.*[7] and urine collections were made after the method of Silvette.[1] All exposures to reduced pressure were made at 258 mm Hg (equivalent 27,000 ft.) at 23-26°C. The method differed from those of earlier investigators in that samples were collected every hour. This necessitated returning the animals to sea level pressures for 3 minutes at the end of each hour, returning the animals to the chambers, and redecompressing for another hour. This procedure was repeated until an anoxic interval of 3-5 hours had accumulated.

Urinary specific gravity was determined by the falling drop method, in which a standard drop was allowed to fall through a 124 cm column of benzene and the falling time (range 11.0-13.0 sec.) was measured to within 0.02 sec. Chloride analyses were made on 1 cc of urine by means of the Volhard-Harvey technic.[8] Urine collections from control animals were made over 4-6 hour periods, and the average excretion per hour was taken as the control value. All animals were fed ad libitum, but water was usually withheld for 2 hours before each experiment. The manipulations associated with the changing of the environmental pressure failed to modify the urine volume in 12 control animals subjected to the reduced barometric pressure (258 mm Hg) for 2 minutes before and after the control period. The urine volumes were essentially the same (0.10-0.16 cc/100 g/hr) as those animals simply allowed to remain continuously at sea level. No rats were used more than once in a 4 week period; thus the possibility of acclimatization was avoided. Over 100 rats were used throughout the investigation.

Results. One hour exposure to 258 mm Hg barometric pressure resulted in a drastic increase in urinary output (Fig. 1A). This increase ranged usually from 3-11 times the normal value. Temperatures around 24°C and adult female rats usually tended to produce the greatest volume of urine although occasionally female animals exhibited minimal effects. Young adult male animals often produced only the lower volumes. After the polyuria of the first hour, the rate of urinary excretion decreased but still averaged above normal for the duration of the experiment.

The specific gravity of the abundant first hour urine usually ranged from 1.004 to 1.010 (Fig. 1B). After the first hour, the specific gravity also began to approach control values but did not attain the original level during the experimental period.

Urinary chloride was greatest in the most dilute, most abundant urine (Fig. 1C) and the chloride concentration was drastically reduced as the total solid content increased with continued anoxia. After 3 hours at these severe hypoxic conditions, the detectable chloride had almost disappeared from the urine.

One series of experiments was designed to determine the effect of the dehydration of the first hour exposure. Four groups of 3 rats each were given a saline solution at the end of each hour of altitude exposure. The same volume and chloride content as had been excreted in the previous hour urine collection

[4] Burrill, M. W., Freeman, S., and Ivy, A. C., *J. Biol. Chem.*, 1945, **157**, 297.

[5] Langley, L. L., and Clarke, R. W., *Yale J. Biol. and Med.*, 1942, **14**, 529.

[6] Lewis, R. A., Thorn, G. W., Koepf, G. F., and Dorrance, S. S., *J. Clin. Invest.*, 1942, **21**, 33.

[7] Van Middlesworth, L., Kline, R. F., and Britton, S. W., *Am. J. Physiol.*, 1944, **140**, 474.

[8] Harvey, S. C., *Arch. Int. Med.*, 1910, **6**, 12.

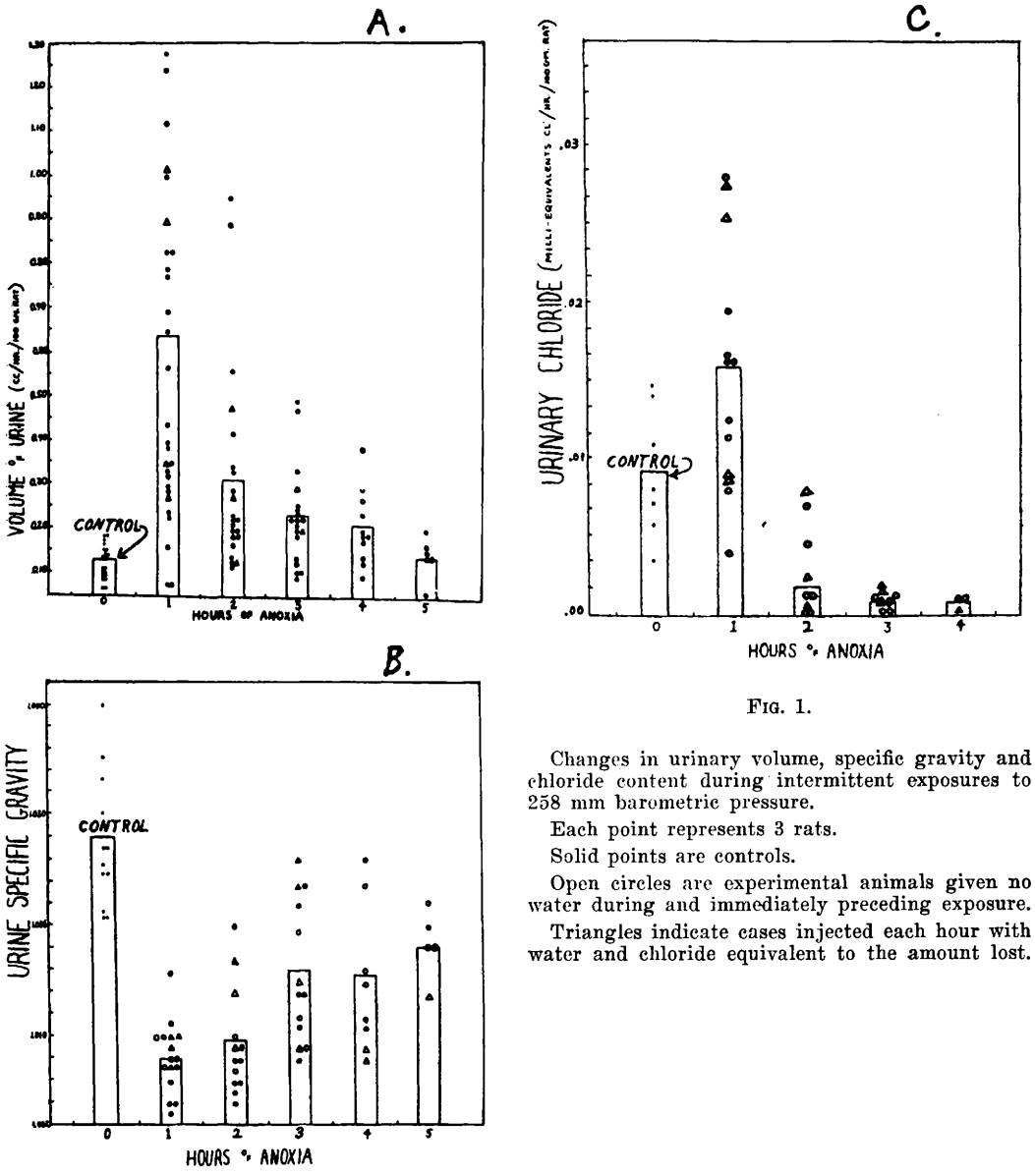

FIG. 1.

Changes in urinary volume, specific gravity and chloride content during intermittent exposures to 258 mm barometric pressure.

Each point represents 3 rats.

Solid points are controls.

Open circles are experimental animals given no water during and immediately preceding exposure.

Triangles indicate cases injected each hour with water and chloride equivalent to the amount lost.

was injected intraperitoneally. The subsequent urine volumes, specific gravity and chloride analyses are within the same ranges as the uninjected rats (triangle values in Fig. 1.) Apparently more comprehensive analyses for additional urinary components will be necessary for interpretation of the changes observed in urinary excretion during hypoxia.

Summary. The first hour exposure of rats to 258 mm Hg barometric pressure resulted in a 3 to 11 (average 7) fold increase in urine production. This increase in volume was accompanied by a marked fall in specific gravity (1.004 to 1.012, average 1.008). At the end of the third hour of intermittent anoxia the urinary volume and specific gravity approached normal sea level values. The chloride content, on the other hand, was *greatest* in the very dilute and abundant urine of the first hour and the chloride content decreased on repeated exposures until the more concentrated urine of the third hour contained practically no chloride.