TABLE I. Influence of Plasma Filtrate from "Altitude" and "Sea Level" Rabbits on Iron Absorption in Rats.

	No. of rats	Fe^{59} appearing in blood (%)	Unabsorbed Fe^{59} in feces (%)	Reticulocytes (%)*	Hemoglobin (g %)†
Plasma filtrate of "altitude" rabbits	11	19.9 ± 2.6‡	71.1 ± 2.3‡	4.4 ± .73‡	15.1 ± .49‡
Plasma filtrate of "sea level" rabbits	11	7.1 ± 1.4	86.2 ± 1.7	1.2 ± .42	15.2 ± .16
Saline	11	5.8 ± 1.0	87.0 ± 1.8	.8 ± .11	15.3 ± .26

* Reticulocytes: Observed the day that iron was given.
† Hemoglobin: Taken at beginning of experiment.
‡ Mean ± S.E.

in feces of the "altitude" rats compared to the other 2 groups. No significant differences were found between the 2 groups of rats which received "sea level" plasma and saline.

From 1 to 14% of the administered iron did not appear in either blood or feces. This portion was partially used for other needs or went to storage organs, or may have been excreted in the urine.

The reticulocytes were measured the day that iron sulfate was given, *i.e.*, 5 days after injections. They were increased in rats given "altitude" plasma filtrate and within normal limits in rats receiving "sea level" plasma filtrate or saline (Table I).

Discussion. These data show that plasma filtrate obtained from rabbits exposed to high altitude hypoxia has a definite infiuence on iron absorption. However, it cannot be determined from these experiments whether the action of plasma filtrate containing erythropoietic factor acts directly on the intestine to stimulate iron absorption or whether its role is simply to increase red cell production, which in turn might control iron absorption. Observations in polycythemic mice have failed to demonstrate increased iron absorption by exogenous plasma erythropoietine, which has been interpreted as showing no direct action on iron absorption(4). Further experiments are necessary to explain how the plasma filtrate exerts its action. The possible existence of another factor different from erythropoietine cannot be excluded.

Summary. A plasma filtrate from rabbits exposed to a simulated altitude of 22,000 feet increased intestinal absorption of ferrous iron in rats compared with that in rats receiving plasma filtrate of "sea level" rabbits and rats receiving saline.

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Myocardial Oxygen Consumption as Influenced by Isotonic Contractions.* (27362)

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Although available evidence indicates that myocardial oxygen consumption may be greatly influenced by many factors(1-4), the role of isotonic contractions as a determinant of the myocardial oxygen consumption is undetermined. Sarnoff(4) and Wollenberger (5) have provided evidence from studies on

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the whole heart that isotonic contractions do not markedly influence the myocardial energy metabolism as measured by oxygen consumption and changes in the labile phosphate concentrations, respectively. Oxygen consumption of non-stimulated discrete myocardial preparations as compared to that of the some tissues contracting isotonically has not been reported. Consequently, this study was undertaken to obtain information concerning the aerobic metabolism of isolated myocardial tissue contracting isotonically.

Materials and methods. Sprague-Dawley male albino rats were used. Trabeculae carneae were quickly dissected from the left ventricle and placed in bicarbonate buffered Ringer's glucose solution. The trabecular preparation revealed a fairly symmetrical elliptical geometry with a minor axis ranging from 0.5 to 0.6 mm as determined by microscopic histologic examination. The length of the preparation averaged 6 mm. The dimensions were such as to permit adequate oxygenation of the tisue by diffusion from the external surface(6,7).

Flasks were modified to contain 6.9 ml of Ringer's glucose solution and the muscle clamp arrangement. The muscle preparation was inserted between 2 clamps and allowed to support known weights. One end of the muscle came in contact with 2 Ag • AgCl electrodes which were used to stimulate the muscle at the appropriate time with a rectangular pulse. Oxygen consumption of non-contracting and isotonically contracting heart muscle was determined by conventional Warburg manometry. This procedure included the use of appropriate thermobar containing stimulating electrodes which were supplied with the same voltages as those in the experimental flasks. Temperature of the water bath was maintained at 37.6°C. The CO_2 absorber was 20% KOH. As shown by Pardee and within the experimental error of his system(8), QO_2 determinations of homogenates using a bicarbonate buffer were not influenced with concentrations of CO_2 in the gas phase of less than 1.5%.

Five experimental groups of tissues were used with 10 muscles per group. Muscles of each group were allowed to support only one

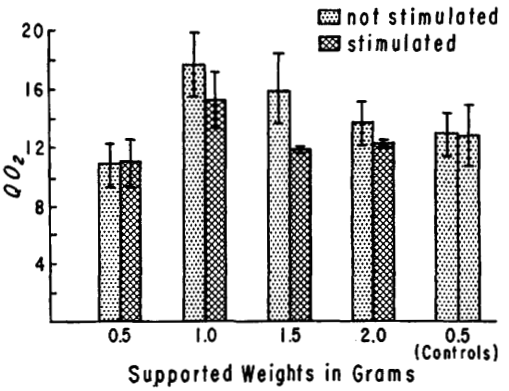

FIG. 1. A bar diagram of mean Q_{O_2} of indicated groups of muscles. The mean Q_{O_2} of unstimulated and stimulated periods is shown. Range designates stand. error.

weight. Weights of 0.5, 1.0, 1.5 and 2.0 g were used for the first 4 groups respectively. The fifth group, a control, supported a 0.5 g weight and remained unstimulated during the entire experiment. Flasks were oxygenated and the tissues allowed to equilibrate for 30 minutes. Manometer readings were made at the end of the equilibration period and every 10 minutes thereafter for 2 hours. During the first hour, the muscles were not stimulated. At the end of the first hour, the muscles of the first 4 groups were stimulated and allowed to contract isotonically at one per second for one hour. At the end of the entire experiment, muscles in the flasks were examined to determine if they were still contracting. Data obtained from muscles that were not visibly contracting or were damaged were not used in the analysis. Tissues were dried overnight in an oven maintained at 105°C and weighed the following morning in a semi-micro analytical balance sensitive to 0.01 mg. Oxygen consumption is expressed as microliters of oxygen per milligram dry weight per hour (QO_2).

Results. Fig. 1 illustrates the mean QO_2 of each group of muscles with their respective weights during the non-stimulated and stimulated periods. The standard error of the mean of each group during these periods has been included in Table I. Group analysis of data from the first 4 groups of muscles during the first hour revealed a significant difference between the QO_2 of the 0.5 g and 1.0

TABLE I. Mean Qo_2 of Muscles during First and Second Hours.

	Qo_2* ± stand. error of mean				
	.5 g	1.0 g	1.5 g	2.0 g	.5 g†
1st hr	10.59 ±1.53	17.69 ±2.37	15.83 ±2.32	13.72 ±1.57	12.98 ±1.57
2nd "	11.09 ±1.49	15.19 ±1.97	11.77 ±.10	12.15 ±.10	12.68 ±1.93

* μl of oxygen/mg dry wt/hr.
† Control group of muscles.

g groups ($P<.05$). There were no significant differences in QO_2 between the 1.0 and 1.5 g groups or between the 1.5 and 2.0 g groups of muscles. When the muscles were contracting, during the second hour, there were no significant differences ($P>.05$) in QO_2 between any of the groups of muscles which were lifting their respective weights. The 10-minute readings of O_2 consumption during the hour of stimulation showed small but variable differences which did not reveal a definite trend.

Paired data analysis of the mean QO_2 of the first and second hour within each group did not reveal any significant difference ($P>.05$) for any of the groups.

Discussion. The finding that a progressive increase in QO_2 did not occur as the resting tension of the groups of muscles increased is in keeping with some of Whalen's observations(7). The increase in QO_2 noted only between the 0.5 g group and the 1.0 g group may be explained on the basis that, *in vivo* the trabeculae carneae are approximately under a one gram resting tension (R.T.) as indirectly measured in this laboratory by the *in situ* length. This is determined by measuring the length of the trabecula carneae after excision of the heart. The trabecula shortens after it is dissected from its attachments. It has been found that approximately one gram of force is needed to extend and maintain the muscle at its *in situ* length. Consequently, when they were placed under 0.5 g R.T., *in vitro,* the myocardial preparations underwent a certain amount of shortening which could have physicaly hindered oxidative mechanisms or spatial orientation of enzymes necessary for normal oxidative metabolism. This type of explanation may also be pertinent to data obtained by Hill(9) and Starling(1).

The fact that there was no significant increase in the mean QO_2 of all muscle groups when stimulated and also concurrently lifting the attached weight during the isotonic contractions was unexpected and at variance with observations previously reported(7,10). The reasons for the discrepancies remain unresolved. It may be that species differences or slight differences in technic play an unexpectedly important role. However, the results are in keeping with those of Sekine *et al.* (11). The aforementioned investigators found in skeletal muscle no difference in oxygen consumption of muscles stimulated at a frequency of one per second as compared to the resting oxygen consumption of the same non-stimulated tissues. However, at higher frequencies of stimulation there occurred a progressive increase in oxygen consumption commensurate with the frequencies of stimulation. Apparently the resting rate of aerobic metabolism is adequate to supply the energy requirements of both heart and skeletal muscle when they are stimulated at a frequency of one per second. Consequently, tissues contracting isotonically at the frequency of stimulation used in these experiments did not exhibit a significant change in their QO_2 from their non-stimulated state. Further corroborative data are being compiled in this laboratory indicating that glucose uptake of stimulated muscles does not exceed that of resting muscle. Therefore, assuming that glucose was the only substrate utilized in these experiments, oxygen consumption during the non-stimulated period would be similar to that of the stimulated period.

Summary. Oxygen consumption of non-stimulated trabeculae carneae, which were maintained at various resting tensions, was not increased when they were stimulated to contract isotonically at a frequency of one per second. The data further indicate that the aerobic metabolism of heart muscle was uninfluenced by resting tensions comparable to those *in vivo.*

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Electrolyte Composition of Histamine Stimulated Gastric Juice from Intact Stomachs of Unanesthetized Dogs.* (27363)

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The change in electrolyte composition of gastric juice after histamine stimulation has been the subject of several reports. Hollander and associates have documented the inverse correlation between $[Na^+]$ and $[H^+]$ in both the content of Heidenhain pouches in dogs and in gastric aspirates of human subjects(1-4). These investigators, however, were unable to correlate $[K^+]$ with $[H^+]$, $[Na^+]$, or with the rate of flow of gastric juice. Some workers have maintained K^+ to be secreted at a fixed concentration from vagotomized gastric pouches of dogs(5), while others have found a positive correlation between $[K^+]$ and rate of flow in the first hour after a single subcutaneous injection of histamine in man(6). A highly significant positive correlation between total outputs of K^+ and H^+ after a slow i.v. infusion of histamine in cats has been reported by Blair, *et al.* (7). More recently Blair and Yassin have found a reduced output of Na^+ and the absence of a linear correlation between total outputs of Na^+ and H^+ following histamine stimulation of gastric secretion in these animals(8). In an attempt to clarify the confusion of the changes in composition of gastric juice after histamine stimulation we have correlated $[Na^+]$ and $[K^+]$ with $[H^+]$, $[K^+]$ with rate of flow, and Na^+, K^+, H^+ and Cl^- outputs with output of water.

Methods. Gastric content was collected for 3 hours from gastric and duodenal fistulas in 5 unanesthetized dogs during an intravenous infusion of 1.8 μg/kg/min of histamine base, a dose which produces a maximal acid response(9). (For details of method of collection see ref. 10.) Each 15-minute collection was filtered through 2 layers of grade 50 absorbent gauze, and free and total acidity were determined by microtitration(11). $[Na^+]$ and $[K^+]$ were determined by flame photometry using the direct reading method, while a coulometric method(12) was used to measure $[Cl^-]$. Concentrations thus obtained were multiplied by the volume of the 15-minute samples to obtain outputs of electrolytes.

Results. The well established inverse correlation between $[Na^+]$ and $[H^+]$ appears in Fig. 1. A similar, but much less dramatic, inverse correlation was found between $[K^+]$ and $[H^+]$ (Fig. 2). During the first hour of histamine infusion an inverse correlation also was observed between $[K^+]$ and rate of flow (Fig. 3), but a positive correlation between these two variables was noted after the beginning of the second hour (Fig. 4), during which time, in all experiments, the volume-rate of secretion remained relatively constant (Table I). When these same data were plotted as rate of output of each ion against rate of water secretion, the positive correla-

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