ness index is generally a satisfactory measure of clinical exercise tolerance, one then has a quantitative measure which may be compared with other laboratory data. Such comparisons have been made on an heterogeneous group of patients in order to test the relationships under unfavorable circumstances. If physiological relationships can be demonstrated, they should be applicable to various types of cardio-respiratory pathology. Three such relationships, of moderate significance, have been demonstrated by these analyses. One is that exercise tolerance varies inversely with the magnitude of the resting observed gradient of the lungs (mid-capacity pO_2 - mixed arterial pO_2). The others are that exercise tolerance varies directly with the estimated mean tissue capillary pO_2 derived from Barcroft's formula and the arterial pO_2. Furthermore, the observed gradient and the mean capillary pO_2 are closely related to each other in an inverse manner. The observed gradient also varies inversely with the A – V pO_2 difference (in relation to the oxygen dissociation curve for blood). Hence exercise tolerance is dependent upon the availability of oxygen to the tissues. Possibly correlations of higher significance would be derived if suitable measurements were made serially during the performance of exercise. Although the recognition of hypoxemia during rest suggests reduced tolerance for exertion, the best measure of this loss of reserve is the determination of exercise tolerance itself, because there is no assurance that the hypoxemia evident at rest will not be increased by exertion. Inasmuch as oxygen is neither absorbed nor distributed unless the heart is circulating the blood, the ultimate limiting factors of exercise tolerance are circulatory in nature. Finally many of the factors which may influence the magnitude of the observed oxygen gradient in patients with cardio-respiratory diseases may fail to exhibit, from resting measurements, adequate predictions of exercise tolerance, or working capacity.

Summary. Significant correlations were obtained in patients with diverse cardio-respiratory diseases, and varying disability, between the oxygen gradient of the lungs, the oxygen tension of the peripheral tissues during rest, and the physical fitness index of exercise tolerance. Working capacity is proportional to the availability of oxygen to the tissues, and the limiting factor is circulatory in nature.

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Aspartic Acid Decarboxylase in Bacteria.* (17632)

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Billen and Lichstein(1) presented evidence for the existence of an aspartic acid decarboxylase in *Rhizobium trifolii*. The present report is an extension of these studies with *Rh. trifolii* and other species of microorganisms.

Methods. The organisms were grown in a medium of the following composition: 1% each of yeast extract and tryptone, 0.6% glucose, 0.5% dipotassium phosphate, and 0.1% *DL*-aspartic acid. Incubation was carried out for 16-18 hours at 30°-37°C depending on the optimum for the organism. Cells were harvested by centrifugation, washed twice with distilled water, and concentration determined in terms of bacterial nitrogen per ml of suspension by measuring turbidity in a Klett-Summerson photoelectric colorimeter and converting into terms of nitrogen content by use of previously standardized graphs. Dried cells were prepared by drying the washed cell suspensions *in vacuo* over Drier-

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1. Billen, D., and Lichstein, H. C., *J. Bact.*, 1949, v58, 215.

TABLE I.
Distribution of Aspartic Acid Decarboxylase in Bacteria.*

Organism	Mg cell nitrogen	*beta*-alanine produced (μg)	$Q_{(N)}$-*beta*-alanine†	Pantothenic‡ acid requirement
E. coli (Tenn.)	.55	2.4	4.3	—
" (Tex.)	.84	7.3	8.6	—
" (Gratia)	1.31	3.6	2.7	—
P. vulgaris	1.43	1.6	1.1	—
Bact. cadaveris (Gale)	1.56	1	.6	—
Az. vinelandi	.97	6	6.2	—
Rh. trifolii	1.72	11.7	6.8	—
Sachh. cerevisiae	.45	0		+
" *fragilis*	.89	0		+
" *ellipsoideus*	.43	0		+
C. diphtheriae	.47	0		+
S. aureus	1.22	0		—
A. aerogenes	1.13	0		—
L. casei	1.26	0		+
L. arabinosus	.66	0		+
S. faecalis	1.36	0		+

* 60 min., 37°C, pH, 5.5, *L*-aspartic acid substrate.

† $Q_{(N)}$-*beta*-alanine $= \frac{\mu g \text{ } beta\text{-alanine}}{\text{time} \times \text{mg nitrogen}}$

‡ + indicates failure to grow in chemically defined media without added pantothenic acid.
— indicates ability to grow in chemically defined media without added pantothenic acid.

ite. Cell-free juices were prepared by autolysis at pH 8, M/10 phosphate, at 37°C for 24 hours followed by high speed centrifugation to yield a clear supernate.

At the conclusion of an experiment the tubes were immersed in boiling water for 5 minutes to stop the reaction, the tubes centrifuged, and an aliquot of the supernate assayed for *beta*-alanine(1) employing *Saccharomyces fragilis* (ATC No. 2360). For the microbiological assay of *alpha*-alanine the method of Sauberlich and Baumann(2) using *Leuconostoc citrovorum* (ATC No. 8081) was employed.

Results. Inasmuch as Billen and Lichstein(1) had reported positive activity only with *Rh. trifolii* and *Escherichia coli* (Texas), it seemed desirable to screen a number of different organisms for their ability to decarboxylate aspartic acid. It may be seen (Table I) that of 16 strains tested only 7 exhibited positive activity. The limited distribution of this decarboxylase agrees well with that of other amino acid decarboxylases(3). It was thought possible that the limited activity found in all the positive strains could be due partially to concurrent decarboxylation to yield *alpha*-alanine. This was investigated in *Rh. trifolii*, but in no experiment was any activity demonstrated for an aspartic acid decarboxylase to yield *alpha*-alanine rather than *beta*-alanine.

The enzyme is quite stable to vacuum drying yielding preparations having an activity comparable to that found in living cells. At pH 6, 90 minutes incubation, 10 mg dried cells of *Rh. trifolii* per tube, the following values for *beta*-alanine production at various temperatures were recorded: 20° = 0.8 μg; 30° = 4.0 μg; 40° = 7.6 μg; 45° = 6.0 μg. Thus, the optimum temperature appears to be 40°C in contrast to 46°C for the living cell. Employing the same preparation at 38°C the following values for different pH's were noted: pH 3 = 2.0 μg; pH 4 = 5.6 μg; pH 5 = 7.0 μg; pH 6 = 8.4 μg; pH 7 = 3.2 μg; pH 8 = 0 μg. These data suggest an optimal pH of 6 as in the living cell. Although no extensive work was done, the enzyme is reasonably stable to autolysis which yields a cell-free juice from *Rh. trifolii* having a Q value of 2-3 in contrast to 5-7 for the living cell.

Discussion. The results of these experi-

2. Sauberlich, H. E., and Baumann, C. A., *J. Biol. Chem.*, 1949, v177, 545.

3. Gale, E. F., *Adv. in Enzymology*, 1946, v6, 1.

ments provide evidence for the presence of an enzymatic aspartic acid decarboxylase, yielding *beta*-alanine, in several species of microorganisms. The data also show that this enzyme is not widely distributed among bacterial species, and when present exhibits a relatively low activity. If aspartic acid decarboxylase is concerned only with the maintenance of an adequate amount of *beta*-alanine for the synthesis of pantothenic acid, the low activity is in keeping with the small amount of this vitamin usually necessary for optimal growth. Further, the enzyme may be present only in those organisms which synthesize *beta*-alanine, and conversely failure to synthesize *beta*-alanine or pantothenic acid may be an indication of the absence of aspartic acid decarboxylase. In order to test this hypothesis the pantothenic acid requirements of the organisms employed here were studied by employing chemically defined media. It may be seen (Table I) that in keeping with this hypothesis all of the organisms exhibiting positive aspartic acid decarboxylase activity are capable of growing in synthetic media without added *beta*-alanine or pantothenic acid suggesting that they are able to synthesize their own supply. On the other hand, 2 of the 9 strains exhibiting negative activity with respect to aspartic acid decarboxylase, namely *A. aerogenes* and *S. aureus*, are capable of growing in a medium devoid of pantothenic acid. It appears therefore that the correlation between ability to synthesize pantothenic acid and the presence of an aspartic acid decarboxylase is not without exception.

Summary. Of 16 strains of microorganisms studied, 7 exhibited positive aspartic acid decarboxylase activity. Employing *Rh. trifolii* this enzyme was found to be stable to vacuum drying, and active cell-free juices could be prepared.

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Effectiveness of Various Drugs in Prevention of Airsickness. (17633)

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The effectiveness of β-dimethylaminoethyl benzohydryl ether 8-chlorotheophyllinate (Dramamine) in preventing sea(1,2) and airsickness(3) has focused attention on other drugs with similar chemical or pharmacological properties. Since Dramamine is the 8-chlorotheophylline salt of β-dimethylaminoethyl benzohydryl ether (Benadryl) the question immediately arises whether the effectiveness resides in either component or only in the combined form. We have investigated this problem in the airplane, using the simulated turbulence technic of Strickland and Hahn(3). Benadryl and 8-chlorotheophylline were each given in 50 mg doses one hour before take-off.

Table I shows that Benadryl possesses marked protective action against airsickness. There was no significant difference between the protection afforded with Benadryl and

TABLE I.
Effect of Preflight Medication on Airsickness.

Preflight medication	Subjects	Airsick (vomited) No.	%
Placebo	75	40	53.3
Benadryl	75	23	30.7
Placebo	78	52	66.7
8-Chlorotheophylline	78	39	50.0
Placebo*	108	60	55.6
Dramamine* (100 mg)	108	31	28.7

* Data from Strickland and Hahn(3).

1. Gay, L. N., and Carliner, P. E., *Bull. Johns Hopkins Hosp.*, 1949, v84, 470.
2. Gay, L. N., and Carliner, P. E., *Science*, 1949, v109, 359.
3. Strickland, B. A., and Hahn, G. L., *Science*, 1949, v109, 359.