

inspiratory and expiratory measurements without and with resistance over a wider range of work rates. Respiratory exchange data were also obtained, since this information will be of value in assessing oxygen requirements at various work rates.

EXPERIMENTAL MATERIAL AND METHOD

Measuring Apparatus.—The measuring apparatus used for obtaining the data in this report consisted of an inspiratory and an expiratory flow-measuring instrument, a photographic recorder, the face piece of the United States Army chemical warfare service mask, a pair of low resistance (S-L) valves,¹² known inspiratory and expiratory resistances, and a well counter-balanced gasometer with minimal resistance. A schematic diagram of the complete measuring apparatus and a complete description of each component of the apparatus are given in a recent report.¹¹ The bicycle ergometer described in that report was used to measure work rates.

TABLE 1.—Physical Characteristics of Subjects

Subject	Occupational Record		Age, Yr.	Weight		Height			Vital Capacity, L.*
	Occupation	Athletics		Kg.	Lb.	Cm.	Ft.	In.	
D.	Student	Track	17	59.9	132	170	5	7	5.0
S.	Student	Track	17	74.9	165	180	5	11	5.3
O.	Student	Track	18	61.3	135	178	5	10	5.8
S.	Student	Track	18	69.0	152	178	5	10	5.0
N.	Student	Track	18	70.4	155	191	6	3	5.9
V.	Student	Crew	18	84.5	186	185	6	1	5.7
F.	Student	Crew	18	88.2	194	197	6	6	7.6
P.	Student	Crew	18	88.6	195	193	6	4	6.8
H.	Student	Crew	19	78.2	172	185	6	1	7.7
B.	Student	Crew	19	81.7	180	193	6	4	5.9
McA.	Student	Crew	19	85.4	188	188	6	2	6.1
M.	Student	Track	20	68.0	150	178	5	10	5.7
S.	Student	Track	20	78.1	172	183	6	..	6.1
N.	Med. student		20	80.7	178	180	5	11	5.4
R.	Student	Crew	22	79.0	174	185	6	1	6.3
F.	Med. student		23	80.0	176	183	6	..	7.2
P.	Research investigator		28	88.8	195	183	6	..	6.1
V.	Graduate student		30	54.9	121	173	5	8	4.6

* Corrected to 37 C., saturated air, and observed pressure.

Expired air was collected in the gasometer, and samples were removed and then analyzed by a Haldane gas analyzer.

Subjects.—The subjects used in these experiments were healthy males ranging in age from 16 to 44. To complete the series, data obtained at 415 Kg.-M. (3,000 f.-p.) per minute, 830 Kg.-M. (6,000 f.-p.) per minute and 1,107 Kg.-M. (8,000 f.-p.) per minute which were obtained in this laboratory¹⁰ and from a subsequent report¹¹ are included. The subjects listed in table 1 were subjects who performed the complete work series of this project and who were not listed in the reports just mentioned.

Procedure.—This project consisted of a series of experiments ranging from a relaxed sedentary position to work on a Krogh bicycle ergometer at 1,660 Kg.-M. An experiment was conducted with the subject seated on the bicycle and with the subject riding at 0, 208, 415, 622, 830, 1,107, 1,384, and 1,660 Kg.-M. Each subject performed the series with minimal resistance (air flow-measuring apparatus only) and with 64 mm. inspiratory and 41 mm. expiratory resistance. An additional experiment at 415 Kg.-M. was included with 64 mm. inspiratory and 27 mm. expiratory resistance. The number of subjects performing each experiment varied. Twelve subjects completed the majority of the experiments, and data obtained in previous studies¹³ were

12. Silverman, L., and Lee, R. C.: A Low Resistance Valve and Indicating Flowmeter for Respiratory Measurements, *Science* **103**:537, 1946.

13. Silverman, footnotes 10 and 11.