TABLE II.
Volume of Each Gray Mass Expressed in Percentage of Total Brain Volume.

	Caudate	Putamen	Pallidum		Cortex
			Lateral Seg.	Medial Seg.	
Ovis	1.8	1.0	.30		50.
Galago	1.4	1.1	.21	.082	48.
Perodicticus	2.3	2.2	.51	.30	45.
Cebus	1.5	2.6	.35	.20	55.
Cercocebus	1.6	1.8	.39	.23	50.
Pan	1.1	1.7	.22	.12	50.

The emergence of the putamen in Cebus, Cercocebus, and Pan as the most prominent nucleus of the basal group is a striking result of this study. According to Dusser de Barenne, Garol, and McCulloch,[3] areas 4 and 6 project to the putamen in *Macaca*. This leads to the suggestion that the organization of motor function, which is a prominent feature in primate development may be correlated with a change in the caudate-putamen complex, as well as with the known striking changes in the motor cortex.

[3] Dusser de Barenne, J. G., Garol, H. W., and McCulloch, W. S., *Research Pub. Assn. Res. in Nerv. and Ment. Dis.*, 1942, **21**, 246.

14411

A Method for Collection of Bacteria from Air and Textiles.*

HENRY M. LEMON. (Introduced by O. H. Robertson.)

From the Department of Medicine and the Douglas Smith Foundation for Medical Research of the University of Chicago.

With increasing knowledge of the relationship of infected air and textiles to the dissemination of air-borne diseases, numerous devices for the collection of bacteria have been developed. Some of these are difficult to make (Wells air centrifuge,[1] slit sampler[2]) and others do not appear practical for large scale field studies (textile sampler described by Thomas and Van den Ende[3]). The Moulton atomizer sampler[4] is of relatively simple construction and is easily operated but requires expert glass blowing and is fragile. Furthermore, it has been found unsatisfactory for textile sampling since the lint which collects in the atomizer portion is removed with difficulty.

Application of the Folin aeration tube (as used in the Van Slyke urease method) to the determination of glycol vapor in air by Wise, Puck, and Stral[5] suggested a trial of this inexpensive unit for recovery of air-borne bacteria. Rettger made use of a similar bubbling device[6] which Weinzirl and Thomas

* This investigation was aided in part through the Commission on Cross Infections in Hospitals, Board for the Investigation and Control of Influenza and Other Epidemic Diseases in the Army, Preventive Medicine Division, Office of the Surgeon General, U. S. Army.

[1] Wells, W. F., *Am. J. Public Health*, 1933, **23**, 58.

[2] Bourdillon, R. B., Lidwell, O. M., Thomas, J. C., *J. Hygiene*, 1941, **41**, 197.

[3] Thomas, J. C., and Van den Ende, M., *Brit. Med. J.*, 1941, **1**, 953.

[4] Moulton, S., Puck, T. T., and Lemon, H. M., *Science*, 1943, **97**, 51.

[5] Wise, H., Puck, T. T., and Stral, H. M., *J. Biol. Chem.*, 1943, **150**, 61.

[6] Rettger, L. F., *J. Med. Research*, 1910, **22**, 461.

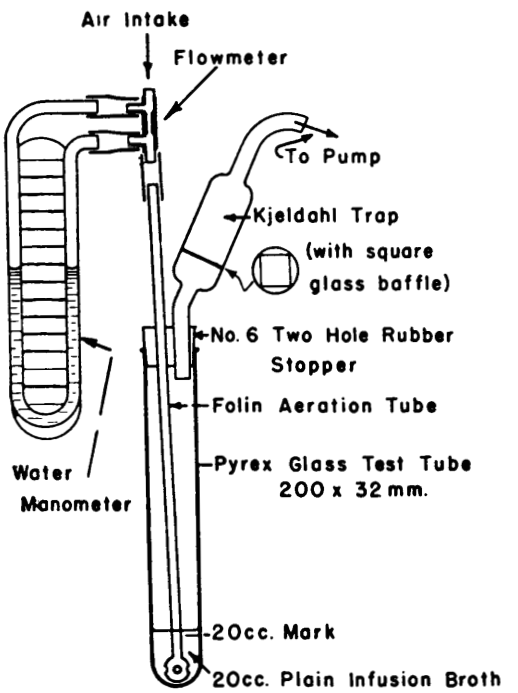

FIG. 1.

noted was highly efficient for this purpose.[7]

Description of Apparatus. The apparatus pictured in the accompanying drawing (Fig. 1) consists of a Folin aeration tube† made of glass (300 mm long, 6 mm diameter) with a bulb at one end (11 mm diameter) perforated by 6 holes (1 mm diameter) 60° apart in a plane at right angles to its main axis. The tube is passed through a 2-hole No. 6 rubber stopper and the bulb centered near the bottom of the containing test tube (200 mm long, 32 mm in diameter). The Kjeldahl trap with square glass baffle† is shortened at both ends for convenience and a slight bend made in the intake, so that this may be inserted into the remaining hole of the stopper. The test tube is scratched at a mark corresponding to 20 cc volume and the Folin tube may be likewise calibrated as a pipette to deliver aliquots from 0.10 to 2.0 cc. A small flowmeter measures the rate of air flow entering the upper open end of the Folin tube.[8] An air pump is attached to the exhaust end of the Kjeldahl trap.‡

For sampling of textiles a glass funnel 75-100 mm in diameter is connected to the open end of the Folin tube by means of a piece of rubber tubing with smooth inner wall 300-400 mm long. If certain textiles give off sufficient lint to plug the Folin tube a plain glass tube of identical size may be substituted for it with little loss of efficiency.§ The apparatus complete with funnel should be mounted in a portable frame by means of clamp holders attached to a piece of metal rod.

Operation. The entire bubbler can be repeatedly autoclaved with the stopper securely in place. The funnel, tubing, flowmeter, and if necessary the bubbler itself can be sufficiently disinfected by rinsing with 70% ethanol and drying. Air drawn in at a rate of 25-30 liters per minute is dispersed through 20 cc of broth containing 2-3 drops of olive oil which inhibits foaming. Room air samples generally require 300 liters of air or more, but 30-60 liters is sufficient for textiles. In sampling the latter, the funnel is slid over the area to be examined, its edges rubbing gently against the fabric, while air is drawn through the material.

Afterwards, the interior of the Folin tube is rinsed by sucking broth up into it. The fluid volume is restored to 20 cc with additional sterile broth. After mixing, suitable aliquots are plated out for bacterial counts.

Collection of Air-Borne Bacteria. This apparatus was compared to the Moulton atomizer sampler (which recovers over 95% of air-borne bacteria) by taking simultaneous air samples at the same location. In addition, the number of microörganisms escaping through the Folin bubbler was determined by passing the exhaust air into a Moulton sampler or a second Folin bubbler (Table I). The Folin bubbler yielded bacterial counts often approximating those obtained from simultaneous tests with the Moulton sampler. These counts represented about 90% recovery

[7] Weinzirl, J., Thomas, J. B., *Am. J. Pub. Health*, 1913, **3**, 171.

† Purchasable at any scientific supply house.

[8] Lemon, H. M., and Wise, H., to be published.

‡ Suitable pumps obtainable at W. H. Welch Mfg. Co., Chicago.

§ Suggested by Margaret A. Johnson.

TABLE I.

Collection of Air-Borne Bacteria by Folin Aeration Tube Bubbler.

Type of air sampled	Test No.	Bacterial content of air as simultaneously measured by: Moulton atomizer sampler Total bact/ft³	Bacterial content of air as simultaneously measured by: Folin aeration tube bubbler Total bact/ft³	Bacterial content of air leaving Folin bubbler exhaust: Type of sampler used	Bacterial content of air leaving Folin bubbler exhaust: Total bact/ft³	% recovery of air-borne bacteria by Folin bubbler
Air of inhabited rooms	1	—	678	Folin	15	98
	2	—	1950	"	26	99
	3	—	169	"	0	100
	4	—	243	"	17	93
	5	—	1480	"	7	99
	6	—	10100	"	34	99
	7	—	2370	"	88	97
	8	—	2230	Moulton	21	99
	9	—	682	"	3	99
	10	896	2290	"	30	99
	11	473	736	"	112	87
	12	122	68	"	11	86
	13	46	33	"	5	87
	14	69	50	"	9	85
	15	948	67	"	23	74
Mean ± S.E.						93 ± 2
		BHS/ft³*	BHS/ft³*		BHS/ft³*	
Air infected with beta hemolytic streptococcus (Group C) dispersed as fine droplets	1	1040	1060	Folin	430	71
	2	1340	1140	"	88	93
	3	706	588	"	37	94
	4	8000	5700	"	935	90
	5	447	343	"	6	98
	6	858	1200	"	64	95
	7	237	225	Moulton	15	94
	8	—	1085	"	172	86
	9	870	570	"	21	96
	10	1320	1480	—	—	
	11	158	141	—		
Mean ± S.E.						90 ± 3

* Beta hemolytic streptococcus.

TABLE II.

Collection of Bacteria from Bedclothes of Scarlet Fever Patients, using Folin Aeration Tube Bubbler. (60 liters of air drawn through textile for each sample.) BHS = beta hemolytic streptococci.

Patient	Day of hospital stay	Throat culture	Location and type of bedclothes sampled	Bedding, days on bed	Area sampled in ft²	No. of bacteria recovered: Total × 1000	No. of bacteria recovered: BHS*
A.L.	5	BHS	Top sheet, under surface	2	8	—	1,500
			Bottom sheet and pillow	"	"	—	48,000
P.W.	2	BHS	Pillow, both sides	½	8	98	120
			Drawsheet	"	"	1,760	960
			Wool blanket	2	18	710	29,000
T.K.	1	BHS	Pillow, top side	1	2	81	107
			Drawsheet	½	4	204	187
M.S.	10	Neg	Two pillows, both sides	2	12	38	0
			Top sheet, under surface	"	8	82	0
			Drawsheet	"	16	950	0
			Wool blanket	10	12	1,400	80

Note: Drawsheet is placed over central portion of bottom sheet.
* Isolated in 1:500,000 gentian violet rabbit blood agar.

of bacteria suspended in normal room air or air infected with a fine spray of beta hemolytic streptococcus Group C.

Sampling of Bacteria in Textiles. Large numbers of beta hemolytic streptococci and other organisms were collected from bedclothes of scarlet fever patients (Table II), when the device was arranged for textile sampling. Although as convalescence progressed it became increasingly difficult to recover streptococci from blankets and sheets, large numbers of miscellaneous bacteria continued to be obtained. Only a rather small fraction of the total bacterial population is removed by one brief sampling; a second test of the same area gives nearly as high a bacterial count. The number of bacteria recovered was not closely related to the area of sampling, but depended more on other factors now under investigation.

Discussion. Bubbling air through liquids has not been widely used as a means of trapping air-borne bacteria. Some of the previously described methods have been unsuitable for use because of their slow rate of air flow (Rettger's "aeroscope" samples only one-half liter of air per minute), others because of incomplete removal of bacteria which escape to the surface in large air bubbles. The Wheeler bubbler[9] avoids the latter objection by the use of glass beads to break up bubbles, but suitable beads are difficult to obtain and tend to devitrify after prolonged use, with consequent bactericidal alkalinization of the collecting broth. The surprisingly high efficiency of the Folin bubbler in recovering air-borne bacteria may be due to the use of a very rapid air flow, which causes many bacterial particles to impinge on the test tube wall, and produces so great an agitation of the fluid that few large air bubbles are able to rise unbroken to the top of the tube.

Summary. A method is described for collection of air-borne bacteria, by means of dispersing air at a rate of 30 liters per minute from a Folin aeration tube into 20 cc of broth contained in a test tube. The apparatus is about 90% efficient, is readily constructed from simple equipment, and may be adapted to estimation of the bacterial content of textiles.

[9] Wheeler, S. M., Foley, G. E., and Jones, T. D., *Science*, 1941, **94**, 445.

14412

Essential Fatty Acid Deficiency in the Mouse.

EDWARD A. WHITE, JOHN R. FOY,* AND LEOPOLD R. CERECEDO.
From the Department of Chemistry, Fordham University, New York City.

It was first shown by Burr and Burr[1] that on a diet devoid of fat but otherwise adequate, rats develop deficiency symptoms characterized by retardation of growth, a scaly dermatitis, necrosis of the tail, and kidney lesions and hematuria. Subsequent experiments of the same workers showed that this condition could be cured or prevented by the inclusion in the diet of certain unsaturated fats, such as lard or corn oil, or unsaturated fatty acids such as linoleic acid. These observations have been confirmed by other workers. In the experiments herein described the fat deficiency syndrome has been produced in mice.

Seven weanling rats of the Wistar strain reared in our laboratory were used to check the purity of the diet and to serve as a criterion for the results to be obtained with mice. Their diet consisted of 24% casein, 72% sucrose, and 4% salts (Osborne and Mendel), with daily supplements of 0.65 g of Northwestern Yeast and an equivalent of 70 mg of cod liver oil as the unsaponifiable fraction. After their weight reached 100 g, the

* Present address: National Oil Products Co., Harrison, N.J.

[1] Burr, G. O., and Burr, M. M., *J. Biol. Chem.*, 1929, **82**, 345; 1930, **86**, 587.