How we know TB is airborne

Featured paper

- Infectiousness of Air from a Tuberculosis Ward | Ultraviolet Irradiation of Infected Air: Comparative Infectiousness of Different Patients
  - **Guinea pigs!**
  - Single infectious particle causes infection
  - UV sterilized TB-laden air
  - Treatment blocks transmission
  - Estimate infectious dose per hour
  - Superspreading dynamics

One step further, following Riley…
  - Same physics for humans and guinea pigs

Other reads

- Foundational study of airborne TB transmission on a navy ship The epidemiology of tuberculosis infection in a closed environment

- Editorial from Riley clearly laying out evidence and principles for airborne infectious disease control The hazard is relative

- Good modern review: Reducing tuberculosis transmission: a consensus document from the World Health Organization Regional Office for Europe

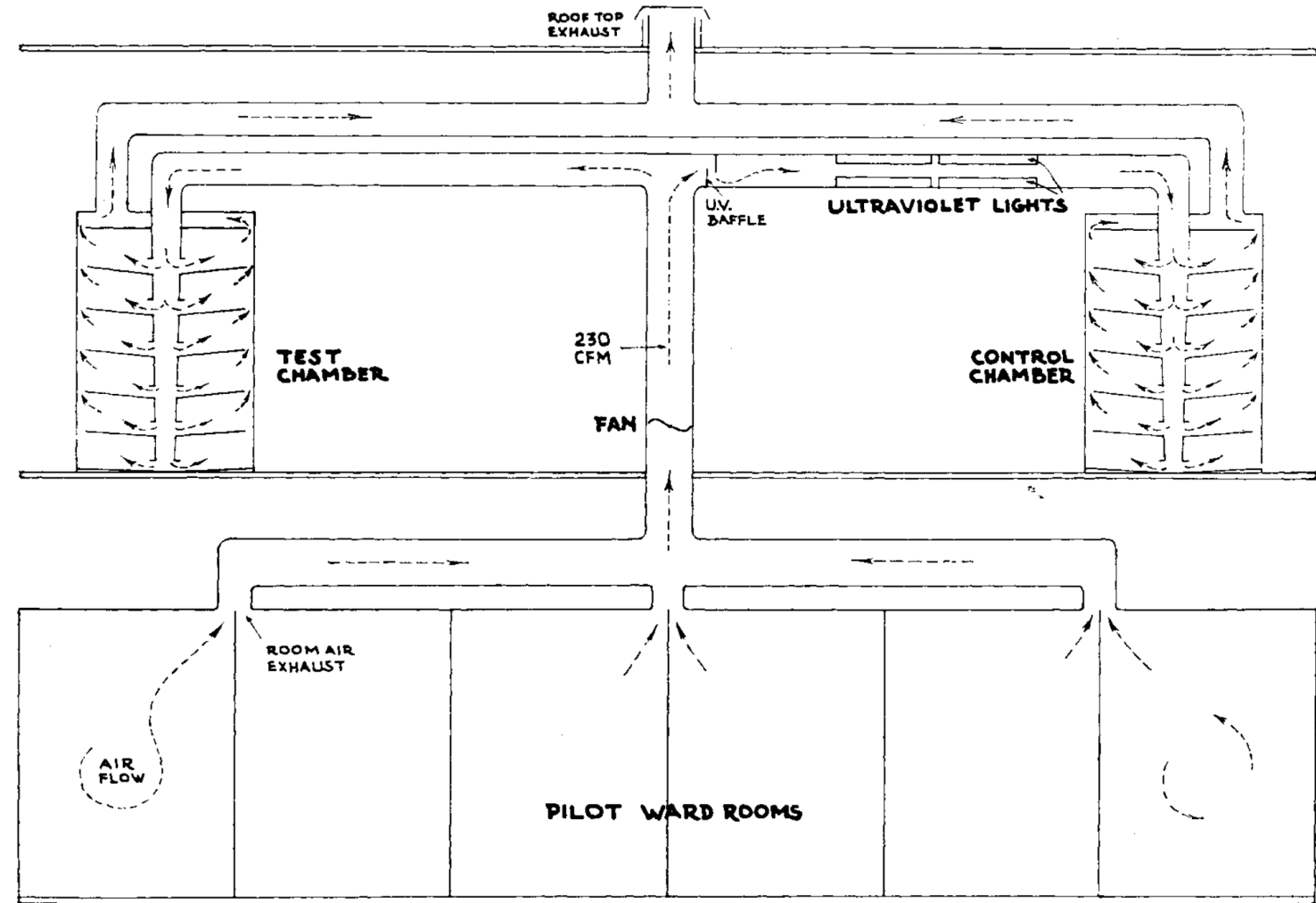512 RILEY, MILLS, O'GRADY, SULTAN, WITTSTADT, AND SHIVPURI

FIG. 1. Schematic drawing of ward, ducts, and exposure chambers.

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foot per hour, the average concentration of infectious particles is calculated to have been 1 in 12,500 cu. ft. for the first two years and 1 in 11,000 cu. ft. for the present study.

$$\frac{63 \text{ infectious particles}}{120 \text{ guinea pigs} \times 8 \text{ cubic feet/day} \times 730 \text{ days}}$$

$$= \frac{1 \text{ infectious particle}}{11,000 \text{ cubic feet}}$$

The average rate at which infectious particles were added to the air was about 25 per day for the first two years and 30 per day during the present study.

$$\frac{230 \text{ cubic feet/min.} \times 60 \text{ min./hour} \times 24 \text{ hours/day}}{11,000 \text{ cubic feet/infectious particle}}$$

$$= \frac{30 \text{ infectious particles}}{\text{day}}$$

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infection produced per hour. An average child with measles produces about 18 infectious units of air-borne measles per hour while the patient with tuberculous laryngitis produced about 60 infectious units of air-borne tuberculosis per hour.[4] As the average number of infectious parti-

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From Guinea pigs to Bellevue Nurses

- **Average time to TB+ for student nurses [~18 months](#)**
- Average person [breaths 6 L/min](#)

Expected exposure time to infection
- 6 L/min * 0.035 ft^3/L * 60 min/hr * 1 infectious particle/11000 ft^3
  = 0.0011 infectious particle/hour
- **= 870 TB-exposed hours / infection**

Consistency check = TB exposure / workday
- 260 workdays/yr * 1.5yr / infection = 390 workdays / infection
- 870 TB-hours/infection * 1 infection/390 workdays
  = **2.2 TB-exposed hours per workday.**

- Roughly consistent!