dose that kills controls within 48 hours, would appear to question seriously the formation of active immune factors, either humoral or cellular. It is suggested that the "shock-tissue" of the particular area is desensitized to the living pneumococcus by the primary injection of the formolized suspension.

It seems likely that with the recent interest awakened in this field that practical application will be attempted especially in the specific prophylaxis of those diseases gaining access through the upper respiratory tract, notably meningococcal meningitis and anterior poliomyelitis.

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A Simple Method for Accurate Injection of Small Volumes of Fluid.

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In order that the volume of dye, patent blue V, injected intradermally during studies on the linear rate of lymph flow in the superficial lymphatics of the skin of man by the McMaster[1] method, might be constant and accurate, an attachment was constructed to fit an ordinary Becton-Dickinson tuberculin syringe. The piece of apparatus proved to be simple, accurate, and very useful for these studies, and especially advantageous for colored solutions which preclude the reading of the scale on the cylinder of a syringe. Since it might prove useful to others whenever very small volumes of fluid are to be accurately measured and delivered with constancy into the tissues of the organism, the apparatus was considered worthy of report.

The attachment consists essentially of 3 parts (Fig. 1) which are mounted and used as follows: The cylinder of a tuberculin syringe is slipped into part *e*, which is fixed to the lip of the cylinder by screwing part *b* into *e*. Part *a* is then screwed on part *e*. The plunger is then inserted through the central openings in parts *a*, *b* and *e* and into the cylinder of the syringe until its head rests against *a*. The outer circumference of *a* was marked off in equal parts so that with the aid of a pointer *d*, fixed on *e* by screws, whole and fractions of a turn of *a* could be determined. The threading on *a* and *e* is such that one com-

[1] McMaster, P. D., *J. Exp. Med.*, 1937, **65**, 347.

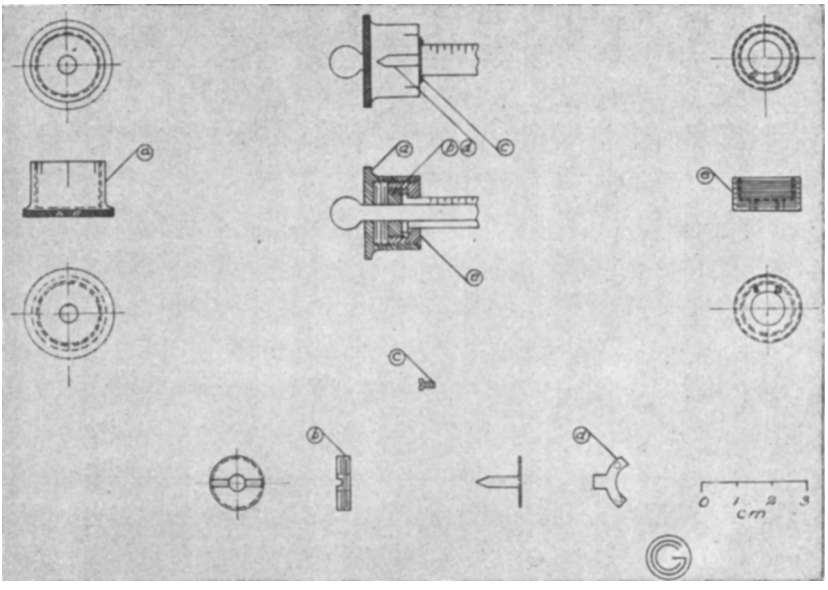

FIG. 1.
Drawing illustrating the construction of the apparatus.

plete turn of *a* on *e* will permit the plunger to be pushed farther into the cylinder and deliver approximately 0.01 cc of fluid before its head again comes to rest against *a*. Fractions of a turn of *a* will permit the delivery of fractions of 0.01 cc of fluid. The apparatus, mounted for use, is shown in Fig. 2. The attachment is made entirely of brass and can be sterilized, mounted in place on the syringe, by autoclaving or boiling.

The apparatus was calibrated as follows: Part *a* was unscrewed as far back on part *e* as possible and then mercury was drawn into the needle and syringe. After carefully removing all bubbles of air, the plunger of the syringe was pushed into the cylinder until the head of the plunger rested against part *a*. Then *a* was screwed one complete turn on *e* and the plunger was pushed into the cylinder of the syringe

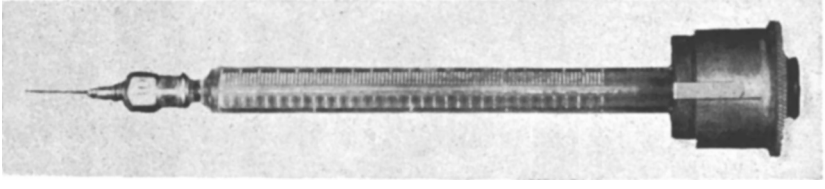

FIG. 2.
The apparatus ready for use.

TABLE I.
Results of Calibration of the Apparatus by Delivering and Weighing Mercury Following a Complete Turn of part *a* on *e*.

Successive turns of part *a* on part *e*	Wt of mercury delivered, g	Volume of mercury delivered, cc	Variations from the mean, cc	% variation from the mean
1st	.1211	.0090	—.0003	3.23
2nd	.1244	.0092	—.0001	1.06
3rd	.1242	.0092	—.0001	1.06
4th	.1251	.0093	.0000	0.00
5th	.1255	.0093	.0000	0.00
6th	.1261	.0093	.0000	0.00
7th	.1271	.0094	+.0001	1.06
8th	.1268	.0094	+.0001	1.06
9th	.1280	.0095	+.0002	2.15
10th	.1227	.0091	—.0002	2.15
Mean	.1245	.0093		
Minimum	.1211	.0090		
Maximum	.1280	.0095		

until the head of the plunger again rested on *a*, ejecting the mercury on a scale to be weighed and its volume determined. This process was repeated until *a* was screwed as far as possible on *e*. This procedure permitted 10 full turns of *a* on *e*, or 10 separate ejections of mercury. The results of the calibration are shown in Table I. It can be seen from the table that one complete turn of *a* permits the delivery of 0.0093 cc ± 0.0003 cc. The maximum variation encountered was 3.2%, which is relatively small for the volumes of fluid ejected. With a specially constructed syringe this error could be further reduced. Desired fractions of 0.0093 cc of fluid can be accurately delivered by making the necessary fractions of a turn of *a* on *e*.

Although the above described apparatus permits the delivery of a total volume of 0.10 cc without refilling the syringe, this could be increased by increasing the length of parts *a* and *e*.

Summary. A simple piece of apparatus for an accurate and constant injection of small volumes of fluid into the tissues of man is described. It is especially useful when colored solutions, which preclude the reading of the scale on a syringe, are used.