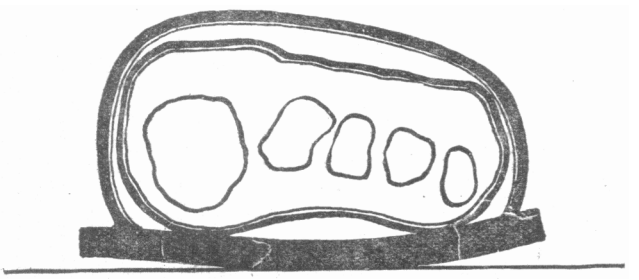
With the greater freedom of action in the larger shoe, there occurs absence of pressure on toe-joints, and corns disappear. There is freedom from pressure on nails, and "ingrowing" gradually ceases, especially if a little aid is given by proper cutting and attention. Toes that have been crowded together have sufficient room for normal function, and under the constant muscle pull and better distribution of weight, both of which forces are almost constantly active in the soldier's foot for from twelve to fourteen hours a day, they gradually assume a normal relation. In many instances, a moderate degree of overlapping has gradually lessened to a very nearly normal position. Similar results obtain in various other conditions in which secondary pathologic changes have not produced a degree of permanence that will yield only to surgery. These superficial conditions are always of mechanical origin, and almost universally from improper foot coverings, not from faulty function primarily. When, therefore, these mechanical conditions are remedied or removed, the effects disappear and the part gradually develops into as nearly normal a state as is compatible with existing pathologic changes or conditions.

As the result of greater freedom of action, the intrinsic muscles of the foot, which have long been



Foot resting on the two sides of a concave inner sole, without support to the transverse arch.

inactive and atrophied, gradually resume again their function. This chiefly concerns the maintenance of the transverse and longitudinal arches. With increase in activity, there is also increase in size. The foot develops power and endurance. The fibrous attachments strengthen to meet the greater strain. Circulation improves by reason of the greater functional activity and the lessening of constriction. This promotes nutrition and a beneficial circle is established to replace the former vicious one. Greater elasticity and increased range of motion in the various joints of the foot allow a greater variation in its length from changing function and strain. The tonicity of the large leg muscles also improves and the support essential to weight-bearing and progression is readily developed. This in turn gives a better position to the foot so far as concerns the carrying of the body weight, and the onset of static disability is prevented.

One other very striking result from the wearing of the properly fitted shoe is in troubles with the transverse or metatarsal arch. Foot inspection shows a large number of men with callosities under the metatarsal heads (ball of the foot). This means a loss of the transverse arch, and may be associated with metatarsalgia (Morton's foot) or with painful callous areas or both.

The preservation of the transverse arch depends mostly on the strength of the intrinsic foot muscles and the vicious circle following the wearing of improper shoes is readily succeeded by sagging and loss of this arch. Furthermore, in the manufacture of a shoe, the inner sole is likely to be concave instead of convex. This is due to the fact that the sole of the last is convex; hence, as the leather is fitted over it, the result is a concave surface inside. The foot then rests on the two sides of this and has no support in the center, as in the accompanying illustration. If now the muscles that furnish support are weak and atrophied, severe use will almost surely result in loss of the foot arch (transverse) before sufficient power can be restored to them.

From the foregoing will be readily seen the great need of proper fitting of the shoes to maintain the best health of the feet. The regulation army shoe has all the essential qualities for foot health and is proving its worth to the soldier. The educational phase of the problem on the soldier is an equally great one, and its influence will persist for a long period after the war ends. The soldier will be a center for education in proper foot wear by reason of his comfort in shoes that are long enough and which conform to the shape of the foot.

FACE MASKS IN INFECTIONS OF THE RESPIRATORY TRACT*

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The use of face masks by those whose duties necessitate their coming in contact with cases of respiratory infection has now become general. The object of such masks is twofold: first, to protect the wearer against infectious material from the respiratory passages of the patient, and second, to protect the patient from such material as the attendant may himself carry in his mouth and nose. The types of masks worn, however, have been variable, and the efficiency of many of these types as barriers to the transmission of bacteria is certainly open to question. We have therefore undertaken experiments with some of the commoner types of masks in order to prove their efficiency or nonefficiency in preventing the dissemination of infectious material from the mouth during the acts of speaking or coughing.

Our first object was to determine, by means of agar plates exposed at different distances from an observer, how far infectious material might be projected from the mouth during speaking or coughing.

Our second object was to determine to what degree the wearing of a mask modified the projection of such material during the same acts.

METHODS AND TECHNIC

B. prodigiosus was selected as a suitable organism to introduce into the mouth for these experiments, because of its innocuous character, and because its pigment formation makes its recognition easy on agar plates.

For our experiments two small rooms were selected which were used for no other purpose during this time. Each of these rooms contained a metal topped table

*From the Hospital of the Rockefeller Institute for Medical Research.

and a chair. The arrangement of the furniture is shown in Figure 1. When the observer was seated in the chair, the table top was just below his ensiform. Agar plates exposed on the surface of the tables before the beginning of the experiments showed no *B. prodigiosus* present in the circulating air and dust.

EXPERIMENT 1.—*To determine the limits of projection of B. prodigiosus from the mouth during ordinary speech, loud speech and coughing.*—The observer first thoroughly rinsed his mouth and gargled his throat with a suspension of *B. prodigiosus* in 0.85 per cent. sodium chlorid solution, the viability of which was proved by subcultures at suitable intervals. The observer then entered the room and seated himself in the chair, facing down the length of the table. In line with the observer's mouth, agar plates were exposed from 1 to 6 feet distant, except in some of the coughing experiments, when plates were exposed up to a distance of 10 feet.

The observer then proceeded: (1) to talk in an ordinary conversational tone for five minutes; or (2) to talk in a loud tone for five minutes; or (3) to cough as much as possible for five minutes. In one instance ordinary conversational speech was maintained for a period of thirty minutes. At the conclusion of his speaking or coughing, the observer left the room. In order to allow the droplets in the air, if present, to settle on the surface of the plates, the plates remained exposed an additional ten minutes after the period of speaking or coughing. The colonies occurring on the plates were counted and recorded after seventy-two hours' incubation at room temperature.

Agar plates were exposed for one hour in the rooms between different stages of this experiment. By this means we found that an eight hour interval between the periods of talking or coughing was sufficient to insure the absence of *B. prodigiosus* in the circulating air.

The results of the projection of *B. prodigiosus* from the uncovered mouth during ordinary conversational speech, loud speech, and coughing, are shown in Table 1. The experiments were paralleled by two observers working in separate rooms.

TABLE 1.—PROJECTION OF B. PRODIGIOSUS FROM THE MOUTH ON AGAR PLATES DURING CONVERSATIONAL SPEECH, LOUD SPEECH, AND COUGHING*

	Distance of Plates from Operator in Feet									
	1	2	3	4	5	6	7	8	9	10
Speaking in ordinary conversational tone for 5 minutes	1	0	0	0	0	0	—	—	—	—
	0	0	0	0	0	0	—	—	—	—
	0	1	0	0	0	0	—	—	—	—
	13	2	0	0	0	0	—	—	—	—
Speaking in ordinary conversational tone for 30 minutes	16	0	0	0	0	0	—	—	—	—
Speaking in loud tone for 5 minutes	72	0	0	0	0	0	—	—	—	—
	43	3	2	0	0	0	—	—	—	—
	0	0	0	0	0	0	—	—	—	—
	115	5	5	1	0	0	—	—	—	—
Coughing for 5 minutes	317	311	245	73	25	4	—	—	—	—
	—	—	—	213	113	84	32	13	11	3
	242	64	10	5	3	1	—	—	—	—
	—	—	4	6	3	1	2	0	0	0

* Number of colonies of B. prodigiosus on each plate in boldface figures; dash indicates plates not exposed.

SUMMARY OF TABLE 1

1. *Ordinary Conversational Speech for Five Minutes.*—In three out of four trials, *B. prodigiosus* was recovered in small numbers on plates 1 or 2 feet distant, but no farther.

2. *Ordinary Conversational Speech for Thirty Minutes.*—One trial. *B. prodigiosus* was recovered only on the 1 foot plate in slightly larger numbers than in any of the preceding experiments.

3. *Loud Speech for Five Minutes.*—In three out of four trials, *B. prodigiosus* was recovered in moderate numbers on plates from 1 to 4 feet distant.

4. *Coughing for Five Minutes.*—In all of four trials, *B. prodigiosus* was recovered, usually in large numbers, on plates up to 6 feet distant.

In two trials in which plates were exposed up to 10 feet, *B. prodigiosus* was once recovered up to 7 feet, and once up to 10 feet.

MASKS

For the subsequent experiments, masks were used. The masks employed by us were of uniform construction, but differed in the nature of the material used and in thickness.

Three sorts of material were employed: (1) coarse gauze; (2) medium gauze, and (3) buttercloth (Fig. 2). From each sort masks were made of from two to ten layers in thickness.

Each mask was about 6 by 8 inches, hemmed on the edges, and made with four plaits on each lateral edge. The mask was equipped with tapes on the four corners by which to tie it behind the head (Fig. 3). When extended to the full width by a fanlike extension of the plaits, the mask presented sufficient surface to cover nose and mouth, and to come below the chin (Fig. 4).

EXPERIMENT 2.—*To determine the effect of a coarse gauze mask on the projection of B. prodigiosus from the mouth during ordinary speech, loud speech, and coughing.*—The methods and technic of this experiment were the same as in Experiment 1, except that during talking or coughing a coarse gauze mask was worn. Each of the experiments of speaking in an ordinary tone, speaking in a loud tone, and coughing, was done with each mask of from two to ten thicknesses of gauze. The results of these experiments are shown in Table 2.

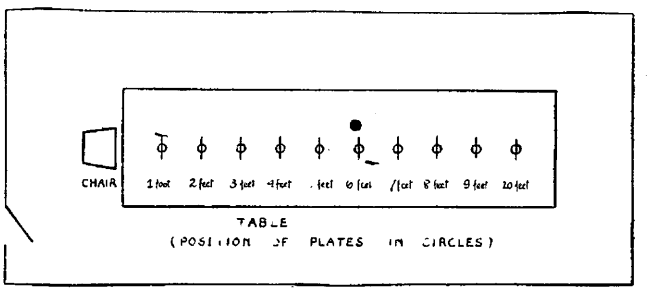

Fig. 1.—Arrangement of furniture and plates for tests.

TABLE 2.—PROJECTION OF B. PRODIGIOSUS FROM THE MOUTH WHILE THE FACE IS COVERED WITH A MASK OF COARSE GAUZE

Speaking in Ordinary Conversational Tone for 5 Minutes						Number of Layers of Gauze in Mask	Speaking in Loud Tone for 5 Minutes						Number of Layers of Gauze in Mask	Coughing for 5 Minutes					
Distance of Plates from Operator in Feet							Distance of Plates from Operator in Feet							Distance of Plates from Operator in Feet					
1	2	3	4	5	6		1	2	3	4	5	6		1	2	3	4	5	6
0	0	0	0	0	0	2	75	1	0	0	0	0	2	703	800	610	397	128	28
0	0	1	0	0	0	3	18	1	0	2	0	0	3	125	84	31	5	4	2
0	0	0	0	0	0	4	22	1	0	0	0	0	4	400	280	126	35	8	3
0	0	2	0	0	0	5	2	0	0	0	0	0	5	140	160	100	42	15	1
0	0	0	0	0	1	6	5	0	0	0	0	0	6	65	20	10	4	0	1
0	0	0	0	0	0	7	3	0	0	0	0	0	7	68	63	15	0	0	0
0	1	0	0	0	0	8	2	0	0	0	0	0	8	8	1	0	0	0	0
0	0	0	0	0	0	9	0	0	0	0	0	0	9	6	4	2	0	0	0
0	0	0	0	0	2	10	0	0	0	0	0	0	10	9	2	0	0	0	0

SUMMARY OF TABLE 2

Coarse gauze masks worn from two to ten layers thick.

1. *Ordinary Conversational Speech for Five Minutes.*—One trial with each mask. *B. prodigiosus* was recovered five times, always in small numbers, on plates at variable distances. Three times organisms were found at 2 to 3 feet and twice at 6 feet. The latter possibly represents an error, as even without masks we never recovered organisms at this distance during ordinary

speech. The error, if present, is insignificant, since the remaining data are conclusive.

2. *Loud Speech for Five Minutes.*—With each mask, one trial. *B. prodigiosus* was recovered on plates from 1 to 4 feet distant with every mask up to eight thicknesses—in fairly large numbers with those up to four thicknesses, and in small numbers with those of from five to eight thicknesses.

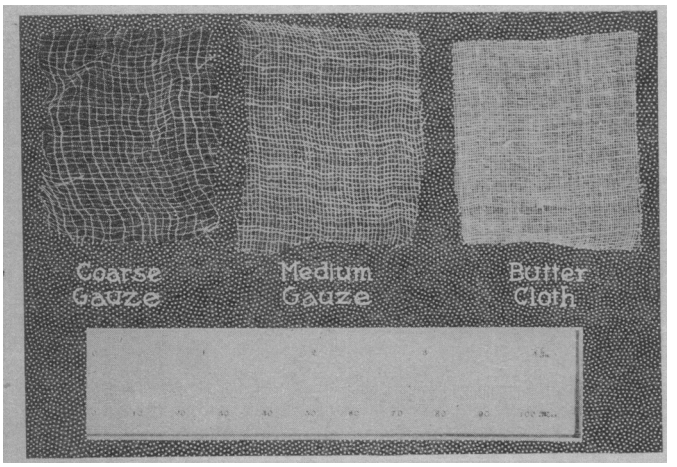

Fig. 2.—Material employed for masks.

3. *Coughing for Five Minutes.*—With each mask, one trial. *B. prodigiosus* was recovered in every instance. It was recovered in large numbers with masks of six thicknesses or less, up to 6 feet. With masks of greater thickness it was recovered in larger or smaller numbers at a distance of 2 or 3 feet.

EXPERIMENT 3.—*To determine the effect of a medium gauze mask in the projection of B. prodigiosus from the mouth during ordinary speech, loud speech, and coughing.*—The methods and technic of this experiment were exactly the same as in the preceding, except that the masks used were of a closer meshed gauze. The experiments of talking in an ordinary tone, talking in a loud tone, and coughing were repeated with each mask of from two to five layers in thickness.

Since the masks of from three to five layers proved to be effective as a barrier to organisms during ordinary speech, this experiment was abandoned with the thicker masks. Only loud talking and coughing were attempted with the masks of from six to ten layers.

The results of this experiment are shown in Table 3.

TABLE 3.—PROJECTION OF B. PRODIGIOSUS FROM THE MOUTH WHILE THE FACE IS COVERED WITH A MASK OF MEDIUM GAUZE

Speaking in Ordinary Conversational Tone for 5 Minutes						Number of Layers of Gauze in Mask	Speaking in Loud Tone for 5 Minutes						Number of Layers of Gauze in Mask	Coughing for 5 Minutes					
Distance of Plates from Operator in Feet							Distance of Plates from Operator in Feet							Distance of Plates from Operator in Feet					
1	2	3	4	5	6		1	2	3	4	5	6		1	2	3	4	5	6
5	0	0	0	0	0	2	**220**	**4**	0	0	0	0	2	**15**	**6**	**1**	**1**	**1**	0
0	0	0	0	0	0	3	**1**	0	**1**	0	0	0	3	**39**	**25**	**12**	**2**	**1**	0
0	0	0	0	0	0	4	0	0	0	**1**	0	0	4	**45**	**21**	**8**	**1**	0	0
0	0	0	0	0	0	5	0	0	0	0	0	0	5	**2**	**1**	0	0	0	0
—	—	—	—	—	—	6	**1**	0	0	0	0	0	6	0	**1**	0	0	0	0
—	—	—	—	—	—	7	**2**	0	0	0	0	0	7	**8**	**10**	**7**	**9**	**7**	**6**
—	—	—	—	—	—	8	0	0	0	0	0	0	8	**5**	0	**1**	**1**	**1**	0
—	—	—	—	—	—	9	0	0	0	0	0	0	9	**3**	**6**	**1**	**1**	**4**	**1**
—	—	—	—	—	—	10	0	0	0	0	0	0	10	**1**	0	0	**1**	0	0

SUMMARY OF TABLE 3

Medium gauze masks worn, from two to ten layers thick.

1. *Ordinary Conversational Speech for Five Minutes.*—With each mask of from two to five layers, one trial. *B. prodigiosus* was recovered in small numbers only on the 1 foot plate with two layer mask.

2. *Loud Speech for Five Minutes.*—With each mask of from two to ten layers, one trial. *B. prodigiosus* was recovered in five cases, never beyond 4 feet, usually in small numbers. The 1-foot plate with the two layer mask was heavily seeded.

3. *Coughing for Five Minutes.*—With each mask of from two to ten layers, one trial. In every instance *B. prodigiosus* was recovered in moderate numbers on plates from 2 to 6 feet distant.

EXPERIMENT 4.—*To determine the effect of a buttercloth mask on the projection of B. prodigiosus from the mouth during ordinary speech, loud speech and coughing.*—The methods and technic of this experiment were the same as used in the preceding, but the masks used were made of buttercloth. Ordinary speech, loud speech, and coughing were repeated with each mask of from two to ten layers in thickness.

The results of these experiments are shown in Table 4.

TABLE 4.—PROJECTION OF B. PRODIGIOSUS FROM THE MOUTH WHILE THE FACE IS COVERED WITH A MASK OF BUTTERCLOTH

Speaking in Ordinary Conversational Tone for 5 Minutes						Number of Layers of Gauze in Mask	Speaking in Loud Tone for 5 Minutes						Number of Layers of Gauze in Mask	Coughing for 5 Minutes					
Distance of Plates from Operator in Feet							Distance of Plates from Operator in Feet							Distance of Plates from Operator in Feet					
1	2	3	4	5	6		1	2	3	4	5	6		1	2	3	4	5	6
0	0	0	0	0	0	2	0	0	0	0	0	0	2	0	**2**	0	0	0	0
0	0	0	0	0	0	3	0	0	0	0	0	0	3	0	0	0	0	0	0
0	0	0	0	0	0	4	0	0	0	0	0	0	4	0	0	0	0	0	0
0	0	0	0	0	0	5	0	0	0	0	0	0	5	0	0	0	0	0	0
0	0	0	0	0	0	6	0	0	0	0	0	0	6	0	0	0	0	0	0
0	0	0	0	0	0	7	0	0	0	0	0	0	7	0	0	0	0	0	0
0	0	0	0	0	0	8	0	0	0	0	0	0	8	0	0	0	0	0	0
0	0	0	0	0	0	9	0	0	0	0	0	0	9	0	0	0	0	0	0
0	0	0	0	0	0	10	0	0	0	0	0	0	10	0	0	0	0	0	0

SUMMARY OF TABLE 4.

Buttercloth masks worn, from two to ten layers thick.

1. *Ordinary Conversational Speech for Five Minutes.*—With each mask, one trial. *B. prodigiosus* not recovered.

2. *Loud Speech for Five Minutes.*—With each mask, one trial. *B. prodigiosus* not recovered.

3. *Coughing for Five Minutes.*—With each mask, one trial. *B. prodigiosus* recovered at 2 feet with the two layer mask only.

Repetition of the coughing experiments while two or three layer masks, both washed and unwashed, were worn, showed like results.

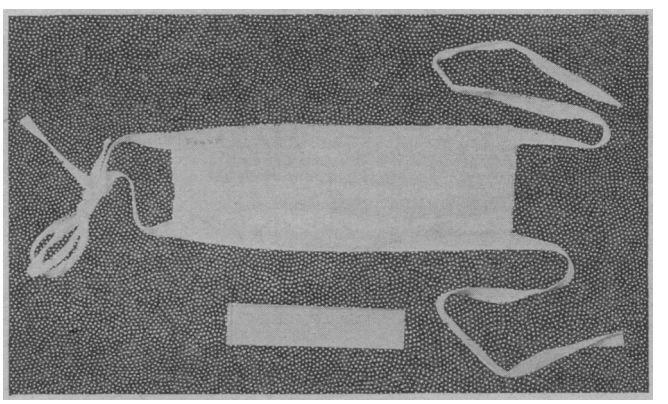

Fig. 3.—Mask, with tapes.

COMMENT

In 1899, Flügge and his followers,[1] working on the problem of tuberculosis infection, first advanced the theory of droplet infection. Briefly speaking, their experiments showed that if an observer retained in his mouth a suspension of *B. prodigiosus,* the organ-

1. Flügge: Ztschr. f. Hyg., 1899, **30,** 107. Laschschenko: Ibid., p. 125. Heyman: Ibid., p. 139. Hillyer: Brit. Med. Jour., 1903, **1,** 595

ism could be recovered on agar plates a meter distant during the acts of speaking, sneezing or coughing. In general they believed that if a person were coughed at from a distance of less than a meter, he might be infected by means of the projected droplets.

From our own work, however, we judge that the infected zone has a considerably greater radius. Our data indicate that during ordinary or loud speech, droplets are rarely projected more than 4 feet, irrespective of the duration of the experiment. In talking for thirty minutes there was no greater projection of bacteria than in talking for five minutes, though during the longer time there may be a heavier seeding of a plate within the effective range. During coughing, however, the danger zone is immensely widened. We were surprised at the distance we could project the organisms during a hard spell of coughing. At first we exposed plates only to a distance of 6 feet. Subsequently we exposed plates up to a distance of 10 feet, on which we recovered *B. prodigiosus* in sufficient numbers to suggest the possibility of even greater projection. We found that the chances of recovering *B. prodigiosus* from the more distant plates were increased if the observer renewed the organisms in his mouth during the period of coughing. From our work it would seem that the danger zone about a coughing patient has at least a 10-foot radius.

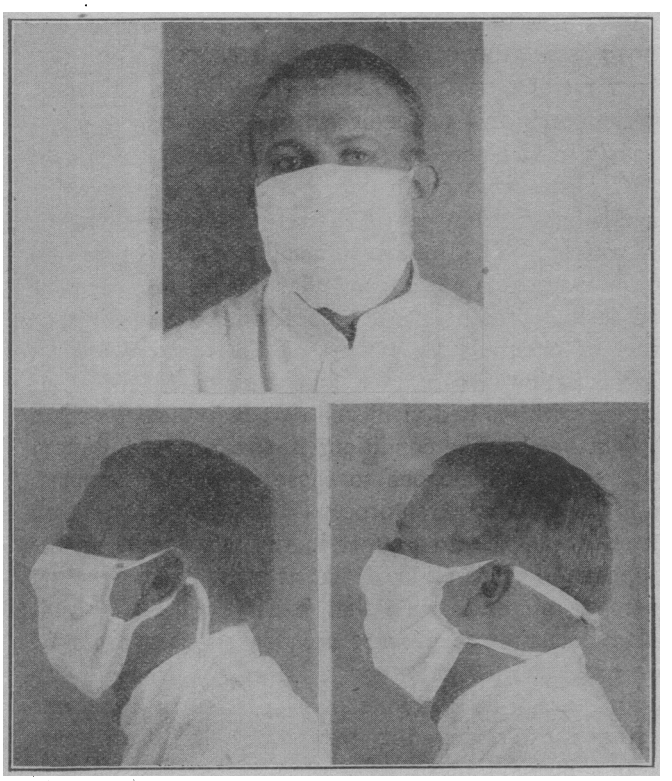

Fig. 4.—The mask as worn.

Our work has also convinced us of the futility of masks constructed from the coarser types of gauze, irrespective of thickness. We were constantly able to cough organisms through ten thicknesses of such material. A three layer buttercloth mask, however, appears to be effective in preventing the distribution of organisms from the mouth even during violent coughing. We have repeated experiments with this mask both before and after washing, with uniform results. Such a mask is not only effective, but easy to make and perfectly comfortable to wear.

These masks are also inexpensive. The quoted price per square yard of buttercloth is 14 cents. A square yard makes nine masks, each three layers in thickness. Each mask requires fifty-six inches of tape, costing about 2 cents. The cost per mask therefore is only between 3 and 4 cents, exclusive of labor. A mask may be repeatedly washed and used indefinitely. An indelible mark should be made on one side of the mask, and when the mask is put on, the same side should always be next to the face.

We have been using these masks in the Hospital of the Rockefeller Institute for physicians and nurses, and in some instances for patients; for example, during carriage to and from the roentgen-ray room, or when being moved about the corridors. They have also been used for ambulatory patients with head colds or other mild respiratory infections.

CONCLUSIONS

1. During ordinary or loud speech, infected material from the mouth is rarely projected to a distance of 4 feet, and usually less. A 4-foot danger zone exists about the patient under these conditions.

2. During coughing, infected material from the mouth may be projected at least 10 feet. The danger zone about a coughing patient has, then, a minimum radius of 10 feet.

3. Masks of coarse or medium gauze of from two to ten layers do not prevent the projection of infected material from the mouth during coughing. Such masks are worthless, therefore, in preventing the dissemination of respiratory infections.

4. A three layer buttercloth mask is efficient in preventing the projection of infectious material from the mouth during speaking or coughing. It is a suitable mask, therefore, to be worn in connection with respiratory diseases.

New and Nonofficial Remedies

THE FOLLOWING ADDITIONAL ARTICLES HAVE BEEN ACCEPTED AS CONFORMING TO THE RULES OF THE COUNCIL ON PHARMACY AND CHEMISTRY OF THE AMERICAN MEDICAL ASSOCIATION FOR ADMISSION TO NEW AND NONOFFICIAL REMEDIES. A COPY OF THE RULES ON WHICH THE COUNCIL BASES ITS ACTION WILL BE SENT ON APPLICATION. W. A. PUCKNER, SECRETARY.

SOLARGENTUM-SQUIBB.—A compound of silver and gelatin, containing 19 to 23 per cent. of silver in colloidal form.

Actions and Uses.—See Silver Protein Compounds (New and Nonofficial Remedies, 1918, p. 361).

Dosage.—Solargentum-Squibb is used in solutions containing 1 to 25 per cent., or more. It is also used in the form of bougies or suppositories.

Manufactured by E. R. Squibb & Sons, New York. No U. S. patent or trademark.

Solargentum-Squibb is produced by the interaction of silver oxide and gelatin in the presence of an alkali. When combination has occurred, the solution is concentrated *in vacuo* and the product scaled.

Solargentum-Squibb occurs in the form of black, lustrous, odorless, non-hygroscopic scales. It is very soluble in distilled water; insoluble in oils and alcohol.

No precipitate is produced when sodium chloride solution is added to an aqueous solution of solargentum-Squibb. An aqueous solution of solargentum-Squibb does not precipitate albumin; it is decomposed with precipitation by addition of free acids; ferric chloride decolorizes the solution.

To about 1 Gm. of powdered solargentum-Squibb, accurately weighed in a porcelain crucible, add a mixture of 4.5 Gm. of lead oxide and 0.5 Gm. of powdered tartaric acid. Rotate and mix in a crucible. Heat continuously until thoroughly carbonized and then heat in a blast flame until the lead button formed is about half its original size. Allow the crucible to cool, then place it in a beaker and dissolve the lead button containing the silver in dilute nitric acid. Transfer liquid, with washings, into an Erlenmeyer flask and titrate the silver nitrate with tenth-normal potassium sulphocyanate volumetric solution, using ferric ammonium sulphate as an indicator. The silver content corresponds to not less than 19 per cent. and not more than 23 per cent. of metallic silver (each Cc. of tenth-normal potassium sulphocyanate volumetric solution is equivalent to 0.0107 Gm. silver).