Remarks

ON

FELT HAT MAKING: ITS PROCESSES
AND HYGIENE.*By CHARLES PORTER, M.D.R.U.I., M.R.C.S.ENG.,
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It is proposed in this article to describe briefly the extremely interesting and ingenious processes of felt hat making; to refer further to those of them which have unhealthy possibilities, and, finally, to adduce some statistics which, limited and incomplete as they unavoidably are, were obtained with great difficulty and after much personal inquiry by the staff of the Health Department of Stockport, the felt-hatting metropolis of the world.

Wool-felts and even cotton-felts³ are used in the manufacture of the cheapest hats. A "sliver" or thin web of carded wool (previously carbonized with H_2SO_4 and water to remove vegetable matter) is guided on to two revolving cones, which move peculiarly through an arc of 45° . The hat "form" thus produced is hardened by mechanical "jibbing" pressure, the subsequent processes being somewhat similar to those hereinafter described. Comparatively few hats of this class are made in Stockport.

The better sorts of felt hats are made from the shorter, finer hairs in the fur of the rabbit, hare, musk rat, nutria, South American rat, beaver, etc. It is necessary to consider separately (I) the dressing of the "fur," and (II) the manufacture of hats from the prepared fur.

I.—THE DRESSING OF THE FUR.

The work of dressing the skins is carried out by "hat furriers," who are to be found chiefly in Southwark, Newcastle-on-Tyne, Glasgow, Manchester, and Stockport.

The various processes include (1) cleaning the skins; (2) mixing the acid nitrate of mercury solution; (3) carotting, which may be manual or mechanical; (4) drying; (5) tying up and damping; (6) cutting; (7) locking; (8) pelt-shaking. In briefly explaining them, free use will be made of the very excellent and accurate description by Misses Deane and Squire, in the Chief Inspector of Factories' Annual Report for 1898.

1. *Cleaning*.—Any fat which remains on the underside of the skin is rubbed with whiting, and the skin is hung up to dry. It is afterwards damped with water and sawdust, and "fleshed," the fleshings being said to be used as manure on hopfields. The fur is next cleansed by revolving brushes of strong wire, and is then "pulled"—that is, the long hairs or "kemps" are removed with a curved knife, and sold to upholsterers, and the remaining short hairs or "down" from which felt is made is now ready for carotting.

2. *Mixing the Acid Nitrate of Mercury Solution*.—This is made of nitric acid, mercury, and water, but the proportions vary in different factories. Arlidge⁴ says that arsenious acid is one of the ingredients, but this is apparently not so at present.

3. *Carotting*.—The skin is spread out on a stone bench, and brushed or sprinkled with the nitrate of mercury solution, the workers usually wearing rubber gloves or finger-stalls. In some places the carotting is done mechanically, the skin being "drawn in between rollers, and thrown out dressed with nitrate of mercury. Each skin is, however, removed wet by hand, so that there is still direct contact of the operator with the mercury solution."

4. *Drying*.—The skins are then hung on racks in a drying chamber for four hours, "the workers usually entering the chamber to bring and remove the dressed skins, and thus necessarily inhaling the acid mercurial fumes."

5. *Tying-up and Damping*.—The dressed skins are tied up in bundles according to quality, ready to be passed on to other workers. Sometimes, not being wanted at once, they are stored, and have then to be damped with water or weak limewash to render them sufficiently pliable for cutting.

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6. *Cutting*.—By an ingenious arrangement of rotating knives the hair is shaved close to the pelt, the fur in perfect form—called a "back"—as if still adhering to the skin, being delivered on to a tray.

7. *Locking*.—The outer edges of the "trays" or "backs" of fur are removed by women who, with their hands, compress the remaining fur and place it in a bag for dispatch to the hat factory.

8. *Pelt Shaking*.—The shavings of skin from the cutting machines are sent to glue makers, but have to be previously freed from dirt, hair, etc. The writer witnessed this being done by shaking on an ordinary riddle, and a good deal of dust—impregnated, of course, with nitrate of mercury—was evolved.

The effect of carotting has been described by Pappenheim and Hillairet.¹ The granular cells and the medulla of the hairs lose their shape, shrink, and become transparent. The epithelial sheath is no longer formed of a very thick layer, but gets markedly thin and transparent. Whilst a normal hair remains long in the water without appreciable change, the carotated hair swells, becomes less transparent, and coils in rounded contours; and it is, these observers believe, to this tendency and not, as was thought, to the imbrication of the epithelial inequalities that the felting is attributable. The researches of Hillairet have satisfied him that this is due to the action of the nascent nitrous gas developed by the decomposition of the acid nitrate of mercury in contact with organic matter, and that mercury is not indispensable. This, he states, can be proved by subjecting a hair in a closed test tube to the action of nitrous vapour generated by the decomposition of HNO_3 by Cu.

M. Merget² has tried to neutralize by chloride of lime the vapours of mercury which become suspended in the air during the process of carotting, and M. Meyer³ claims to have obtained good results in the same direction by the use of ammonia poured on the ground.

Various methods of "carotting" without the employment of mercury have been suggested. MM. Hillairet and Bergeron recommended¹ that the skin should be coated on the hair side with molasses and then washed with a solution of HNO_3 , the only inconvenience to the workmen being the evolution of some nitrous fumes. But it was found that it entailed more labour, took longer to dry, and interfered with "blowing," while the solution itself cost more, and so this method died a natural death.

L'Abbé Nollet, in *L'Art du Chapelier*,⁶ published in 1765, says that a Parisian workman named Mathieu returned from England with a much better method of carotting than that then practised in Paris. The reagents employed were aqua fortis diluted with water, and a little lard with which he rubbed the hair. Others added honey and other substances to the solution without any special reason.

M. Dargelos, in an article on *L'Hygiène Professionnelle des Ouvriers Chapeliers*,¹ claims that with 5 or 10 per cent. solutions of hydrochloric acid in the cold, he has obtained highly satisfactory results, the action on the epidermis of the hands being the sole inconvenience, and one which can be obviated by the use of flannel gloves. The time occupied is no longer, whilst 75 grams of hair carotated in this way went as far as 80 grams treated with nitrate of mercury. There is no liberation of chlorine except when the carotated skins are in the stove, and arrangements can be made to empty the stove without the workman having to enter it at all.

Schoul (*Annales d'Hygiène* September, 1882)² says that he believes he has found a solution of the problem in the use of "sulfure sulfuré de calcium" (bisulphide of calcium) suspended in water slightly acidulated with hydrochloric acid. This solution is perfectly innocuous, but has a disagreeable odour which can be diminished by good ventilation. Albrecht³ states that Hillairet applied a solution of molasses on the hairy side of the skins, and then washed them with a weak solution of nitrous acid (*salpêtre saïre*), but the result does not seem to have been encouraging.

The writer's friend Mr. Thomas Kay, J.P., of the well-known firm of manufacturing chemists in Stockport, has kindly allowed his analyst (Mr. E. Harcastle, Ph.C.) to investigate this matter. Mr. Harcastle treated "fur" with solutions of varying strengths of the following substances: iron nitrate, zinc nitrate, zinc chloride, nitrous acid. He also exposed fur to

the action of gases from a mixture of copper and concentrated nitric acid. Each of the fur samples so treated was separately felted by experienced hatters, and a careful record taken of the time occupied. Without exception this was appreciably longer than that required by similar quantities of ordinary carotted fur, in addition to increased difficulty of manipulation.

Mr. Hardcastle also searched the Patents Records, and found that solutions of the following had been registered: (1) nitrate or sulphate of iron; (2) sulphate of antimony, nitrate or sulphate of soda, or nitrate of potash mixed with oxalic and sulphuric acids; (3) tin dissolved in nitric and sulphuric acids; finally (4) caustic soda solution.

II.—THE MANUFACTURE OF HATS FROM THE PREPARED FUR.

1. *Mixing and Blowing*.—The prepared fur is mixed and opened, and the “kemps” and “dags” separated and removed by passing it repeatedly through mixing and blowing machines containing revolving spiked cylinders and a fan, the finer qualities of fur being so treated as many as seven times.

2. *Forming*.—Boys (“feeders”) weigh out sufficient fur (about 3½ ozs.) for each hat, and feed it into the “forming” machine, from which it is aspirated on to a forming cone on a revolving base by means of a powerful fan fixed below the forming cone, the result being a conical “form.” The cone and the form are then removed by putting a churn-shaped “dipper” over the cone, and are immersed in hot water.

3. *Hardening*.—The water is loosely wrung out, and the “form” is wrapped in flannel and rolled by women to impart the necessary consistency and to start the felting.

4. *Planking* is of two kinds. In *hand-planking* the “form” is dipped in boiling water acidulated with vitriol, and then folded and vigorously kneaded by the planker’s hand, which is occasionally protected by a leather glove, the process being repeated with the form differently folded and turned, so as to secure uniformity. Grégoire⁹ says that in France plankers use a wooden roller (*roulet*) and a large flat wooden appliance (*manicle*) fastened by bands to the wrist and middle fingers. In *machine-planking* or *crozing* (French, *crozier*, to cross or fold) the folded form is repeatedly passed between rollers. It is then “milled” or pounded with heavy oak hammers to reduce it to the necessary size, and may be also passed through the “stamping” machine, which consists of three wooden rollers, two of which have spiral vulcanite flanges, whilst the third is fluted.

Proofing or stiffening is of two kinds: (a) *Water Proofing* is done with shellac and resin dissolved in water with borax or salts of tartar (potassium carbonate). The “body” is dipped into the mixture, and the superfluous shellac is then rubbed on with a piece of wood. (b) *Spirit Proofing*.—The form or “body” is brushed with a solution of shellac and resin in methylated spirit.

Stoving.—The proofed forms are placed in tiers on wire racks in a chamber heated to 180° F. by steam pipes. The spirit given off as vapour during this process is recovered by condensation.

After stoving, the hats are placed under steam pressure of from 10 lbs. to 15 lbs. per square inch; this has the effect of driving the “stiffening” well into the material of the hat.

Scouring and Dyeing.—The bodies are “scoured” with soda and water to remove any stiffening left on the surface; they are afterwards dried, and stretched by hand to prevent premature “setting” whilst still in the conical form. They are then immersed in steam-jacketted dyeing vats, the pigments used being aniline, logwood, and alizarine.

Blocking.—After dyeing the hat is softened in boiling water, and, having been shaken and kneaded, is forced on to a wooden block to get the shape of the crown, the brim being flat and of the requisite width.

Pressing.—After softening in a gas oven the hat is fitted in an iron mould of the requisite size and shape, and is pressed by hydraulic power of from 180 to 200 lbs. to the square inch.

Finishing consists of “*shaving*” with fine sandpaper and “*luring*.” In front of each finishing lathe is a hood and fan to draw off the fine dust produced by the sandpapering process. The “luring” is done with a suitable pad, a little grease being used to give a gloss to the finished hat.

Curling.—The “finished” hats are softened in a steam-heated saddle or “baker,” a metal collar of required width is put over the crown, and by means of a suitably placed hydraulic press the rim-edges are forced or “curled” up, the rims themselves being still flat. The hat is then damped and ironed.

Shaping.—The hat is again softened in a steam-heated saddle, laid over a wooden matrix, and shaped or set by pressing with a hand press, being finished off by hand.

Trimming.—This includes binding the edges and fixing ribbon, inside leather, and silk lining.

EFFECTS ON WORKERS.

Possibilities of injury to health arise in connexion with the following:

1. The various processes connected with the dressing of the skins with acid nitrate of mercury (carotting).
2. The dust evolved during the “blowing” process.
3. The “forming” process.
4. The hot-steam-laden atmosphere in which the plankers work.
5. The effect of hand-planking and blocking on the hands.
6. The process of spirit-proofing and the subsequent drying of the “proofed” hats.
7. The fine dust evolved during the process of finishing.

Risks of Carotting.

Hand-carotting, or brushing the skins with acid nitrate of mercury, subjects the operator to the inhalation of mercurial and nitrous vapour, and marked symptoms of mercurial poisoning frequently ensue. Salivation and intestinal irritation are rare, but amongst those who actually brush the skins there are stomatitis (hatters’ sore mouth), and marked dental erosion. Dr. T. M. Legge finds that whereas those who are exposed to the fumes of metallic mercury only (for example, thermometer makers) suffer hardly at all, the teeth of workers with nitrate of mercury very soon exhibit characteristic erosion and faceting, the tissue which suffers most being the enamel, and not the dentine as in caries. The teeth become blackened and loosened from recession of the gums, and fall out in a certain kind of order, first the upper and lower molars, then the upper canines and incisors, and so on. Dr. Legge adds that 67 per cent. of the workers he examined were more or less affected in this way, and states that an extreme form of this condition has been described by Dr. Vogt, of Berne, amongst persons engaged in converting cotton wool into nitro-cellulose by the action of a mixture of nitric acid and sulphuric acid.

Dr. Legge¹² has further noticed that muscular tremors (“hatters’ shakes”) are most often observed in those engaged in dusty post-carotting processes (for example, cutters, lockers, and pelt shakers), and who swallow dry particles of fur impregnated with the solution. Such fur has been found by Professor Thorpe, F.R.S., to contain 1.34 per cent. of nitrate of mercury.

Amongst the operatives in the hat factories proper, mercurial poisoning appears in England and France to be a rare occurrence. In Stockport the whole of the medical practitioners were circularized on this point, and only some two or three slight cases had been noted during many years. Apparently this has not been so in the States, for Professor S. W. Williston, of Yale College, states¹⁰ that:

The injurious effects have not been so great, perhaps, in the actual carotting as in the forming and pressing of the hats. Since the general use of stiff hats has come into vogue, there has been a decrease in the extent of mercurial poisoning, especially in Connecticut, where comparatively few soft hats are made. The manufacture of soft hats requires in finishing a much greater use of the pressing iron on the damp felt, and a correspondingly greater inhalation of the mercurialized vapour. Still, there is not a little mercurial poisoning amongst the operatives, especially in the hat-forming shops.

It is difficult to reconcile this with the observation of M. Dargelos,¹ that

after the hat is planked it contains nothing hurtful, the sulphuric acid and boiling water having removed all trace of mercury and nitric acid.

Moreover, A. L. Scott, of Danbury, U.S.A.,⁷ states that mercurial poisoning is very rare now. During the Civil War, to meet large contracts, a mixture of fur and shoddy was used, which had to be very strongly carotted to make it “felt,” and it was then that cases of mercurialism were frequent.

On the other hand, Mr. E. Hardcastle of Stockport has

found an appreciable amount of metallic mercury in the alcohol condensed from the vapour given off during the stoving which follows proofing.

Dr. J. G. Taylor¹¹ furnishes detailed clinical particulars of a number of cases investigated by him amongst hatters' furriers in Southwark, and observes that according to Kunkel the inhaled vapour as such does not pass through the walls of the alveoli of the lungs. It first undergoes condensation (?), and the tiny globules become oxidized and then dissolved. The reaction that enables mercury to enter the system is not perfectly understood, but Dr. Taylor thinks that the explanation probably lies in the fact that the perchloride of mercury forms with albumen an albuminate which is insoluble in water, but readily soluble in the presence of sodium chloride.

Injury to the eyes from splashing of the nitrate of mercury solution has been recorded in more than one case.

Prevention.—In December, 1900, Dr. Whitelegge, H.M. Chief Inspector of Factories, issued a circular letter¹² to hat furriers suggesting the following preventive measures, namely: (1) The removal by means of fans, etc., of the noxious fumes and dust; (2) periodical medical inspection, with power of temporary suspension of workers affected; (3) suitable and sufficient washing conveniences; (4) a separate room for meals; (5) daily removal of waste fluff and dust; (6) provision of drying stoves with sliding "horses," etc.

Risks of the Actual Process of Hat-Making.

Blowing.—The dust evolved during fur-blowing is impregnated with nitrate of mercury, and if inhaled is obviously likely to cause mercurialism in addition to the respiratory mischief which dusty occupations often entail. The blowing machines are well covered in, but the figures obtained in Stockport (see Tables B. and C., p. 380) appear to indicate a marked liability to respiratory disease amongst the blowers.

Forming.—This does not appear to be as dusty a process as might be expected, possibly because the atmosphere of the forming room is steamy and moist. The Stockport statistics point to no special cause of mortality, but in 1899 the writer had to investigate an outbreak including 7 cases of pneumonia (2 fatal), 5 of conjunctivitis, and 2 of ophthalmia amongst certain boys from an industrial school who were employed as "feeders" in a forming shop. No special cause could, however, be elicited, but the physique of the boys was poor, and they were very careless in their habits; for example, they left their capes to get soaked with rain in an open yard. Influenza was, moreover, very prevalent at the time.

Planking.—The hot steam-laden atmosphere in which the "plankers" labour is said by Arlidge to favour the development of lung trouble, and to impart a washed-out, pale, and languid appearance. The work is "piece work," and is exceedingly hard, the sight of the plankers, often stripped to the waist, dipping their "forms" into the boiling acidulated water in the huge steaming kettles and then energetically folding and kneading them on a bench or plank being one not easily forgotten. The Stockport mortality figures, so far as they go, do not appear to have any striking significance. The writer repeatedly noticed rapidly physical improvement in police recruits who had been plankers.

The Effect of Hand Planking and Blocking on the Hands.—Arlidge, quoting Lévy, says the felt hat makers suffer much from fissures and abrasures of the hand, and from constant contact with hot and acid water and "carotted" hair. The writer has frequently observed this in Stockport. Dr. Grégoire, of Chazelles sur Lyon,⁶ gives a very interesting and accurate account of the characteristic marks on the planker's hand. He mentions the following peculiarities:

1. A more or less pronounced polish of the whole palmar surface.
2. The dorsal surface is deprived of hair.
3. The nails have the colour of ivory, have rugged borders, are foreshortened, and are loosened or discoloured in the terminal half or third.
4. The terminal phalanges are short, thick, and bulbous.
5. Callosities (called planker's "segs") on the thenar and hypothenar eminences.

The "wear and tear" on the planker's hand is undoubtedly very great, and Dr. Hanson Smith, of Reddish, states that he

has had cases in which almost complete loss of power has resulted.

Fig. 1.—Hand of French hat-planker (after Grégoire); shows enlargement and induration of pulp of fingers, callosities on thenar and hypothenar eminences and mark of manicle on wrist.

The blocker's hand presents an almost equally characteristic appearance, the result of vigorously kneading the dyed "form" after it has been softened in boiling water.

Figs. 2 and 3.—Hand of French hat-planker (after Grégoire); show condition of nails, callosities on joints, and marks made by the loops of the manicle on wrist and middle finger.

Proofing.—The evaporation of the spirit in the spirit-proofing process occasionally causes headache and slight irritation of the eyes.

It will be remembered that within the last year a very serious explosion occurred at Denton in a stoving room in which proofed hats had been placed, owing to ignition of the fumes of evaporated spirit. Messrs. Kay and Hardcastle suggest that such accidents may also be due to the formation and explosion of fulminate of mercury ($\text{CN. C (NO}_2\text{) Hg}$), which results from dissolving mercury in nitric acid and adding alcohol.

Finishing.—The work of "finishing" is probably the least healthy of any of the processes of hat-making proper. Notwithstanding the exhaust fan with which each lathe is provided, there can be little doubt that an appreciable quantity

of the dust resulting from the application of sandpaper to the hat is inhaled by the workers, and the mortality from phthisis and other lung diseases, as well as from heart disease and "other diseases," is much greater than amongst any other class of hat operatives. The use by these workers of suitable respirators ought to have a good effect.

Fig. 4.—Hands of English hat-plunker after 13 years.

Fig. 5.—Hands of English hat-blocker after 34 years.

STATISTICS.

On attempting any inquiry as to the effect on the Stockport operatives of these various processes, one was faced with the difficulty that neither the Census returns nor the Home Office could afford any intimation as to the number, sex, and age distribution of the various classes of workers. The Census returns classified all hatting operatives as "hatters," and gave their numbers as 2,764 males and 1,682 females, total 4,446. To meet this difficulty, the manufacturers (some 20 in number) were circularized, and all of them kindly replied, their figures aggregating as follows:

TABLE A.—Number of Hatting Operatives in Stockport in March, 1900.

Blowers	68	Blockers, including "pres-	
Hardeners	106	mers" (45)	219
Plankers, including "for-		Finishers	451
mers" (91)	730	Curlers, including "shapers"	
Proofers, including "stovers"		(81)	167
(44) and "steamers" (43) ...	161	Trimmers	1,321
Dyers	71		

The next point was to obtain, from the Registrar's returns,

the causes of deaths amongst these operatives; this one was fortunately able to do for a period of five years. As, however, the "employment" was usually returned in the death certificate merely as "hatter," in almost every individual case special inquiries had to be made amongst the relatives in order to ascertain the particular process upon which the deceased was engaged. The results thus laboriously obtained are as follow:

TABLE B.—Causes of Death amongst Hatting Operatives in Stockport during the Five Years 1895-1899.

Deaths from	Fur Blowers.	Hardeners.	Plankers.	Proofers.	Dyers.	Blockers.	Finishers.	Curlers.	Trimmers.	Totals.
Phthisis	3	1	4	1	2	1	35	—	2	49
Bronchitis	1	1	4	—	—	—	3	1	3	13
Pneumonia	1	—	6	1	3	—	11	—	4	26
Heart disease	1	2	6	—	1	1	8	—	5	24
Nervous disease	—	1	1	—	2	—	—	—	—	4
Cancer	—	—	0	—	1	2	—	1	—	4
Other causes	1	—	10	—	8	2	20	2	6	49
All causes	7	5	31	2	17	6	77	4	20	169

All these deaths occurred at ages over 15 years, and even to roughly compare the resulting rates with the corresponding mortality amongst the general population would involve calculation which time compels the writer to leave in the able hands of his successor (Dr. Meredith Young) who will shortly be aided by the recent Census returns.

Bearing in mind the smallness of the figures, the general mortality amongst the different classes of hat works may perhaps be very cautiously and guardedly contrasted as follows:

TABLE C.

	Deaths per Annum.		Deaths per Annum.
Proofers	1 in 402	Hardeners	1 in 106
Curlers	1 in 330	Blowers	1 in 48
Trimmers	1 in 208	Finishers	1 in 28
Blockers	1 in 182	Dyers	1 in 21
Plankers	1 in 116		

It would be extremely unwise to attach too much importance to these figures, and especially to those relating to "proofers" and "dyers," which are based on such very small numbers as to be most unreliable. On the other hand, the writer is quite convinced of the correctness of the indication afforded that the dusty processes of "blowing," and especially of "finishing," are associated with a high rate of mortality from phthisis and other respiratory diseases.

TABLE D.—The Mortality of Hatters from Certain Diseases expressed as a Percentage of all Deaths amongst Stockport Hatters, 1895-9.

Phthisis	29.0	Bronchitis	7.6
Pneumonia	15.3	Phthisis, pneumonia, and	
Heart disease	14.2	bronchitis	52.0

Arlidge³ observes that "the teaching of vital statistics is to the effect that, though in a less degree than formerly, hat making is unhealthy." Dr. Tatham, in his Mortality of Occupations Report¹⁵ of 1897, says that the death-rates of hatters scarcely differ from the average at ages under 35 years, but at all subsequent ages they are considerably above it. Their comparative mortality figure is 1,109, and is therefore above that of occupied males as a standard by 16 per cent. He confirms Dr. Ogle's observation that the conditions under which hatters work appear to lead to excessive drinking and its consequences, their death-rates from alcoholism and also from liver diseases showing serious excess. Their mortality figure from phthisis is also very high, being 301, or 63 per cent. above the standard. Scott,⁷ indeed, remarks that in the States "hatters' disease" was synonymous with phthisis. Dr. Tatham adds that hatters suffer much less severely than the average from influenza and from rheumatic fever, but their figure for urinary diseases is considerably above the average, whilst that for suicide is exactly double.

The writer begs to cordially acknowledge the courtesy of Mr. Frederick Green, of the great firm of Messrs. Christy

and Co., of Stockport, in patiently demonstrating the different processes of manufacture, and subsequently revising the foregoing description. He has also to thank Dr. M. Young for securing the accompanying photographs, and Dr. Edwin Rayner for calling attention to the word "crozing."

REFERENCES.

- ¹ M. J. A. Dargelos, Hygiène Professionnelle des Ouvriers Chapeliers, Cong. Internat. d'Hygiène, etc., *Compte Rend.*, 1899, par. 1890, 770-782.
² Schoull, Des Moyens Propres à Empêcher les Accidents d'Intoxication chez les Ouvriers Chapeliers, *Annales d'Hygiène*, September, 1882.
³ Jungfleisch, Sur les Dangers du Secrétage des Poils par le Mercure, *Ibid.*, December, 1892.
⁴ Albrecht, *Handbuch der praktischen Gewerhygiene mit besonderer Berücksichtigung der Unfallverhütung* (Brit. Med. Assoc. Library).
⁵ Grégoire, La Main de l'Ouvrier Foutleur Chapelier, *Annales d'Hygiène*, par. 1898, 3 s., xxxix, 133-141.
⁶ L'Abbé Nolle, *L'Art du Chapelier*, par. 1765.
⁷ A. L. Scott, Report on Hatting, *Rpt. Bd. Health, Connect.*, 1887-8, New Haven, 1889, xi, 200 (Library, Med. Dept. L.G.B.).
⁸ Arlidge, *Diseases of Occupation*.
⁹ *Patent Records*, Solutions for Carotting.
¹⁰ Professor S. W. Williston of Yale, On Manufacturing Processes and Refuse, *Tenth Report Board of Health, Connect.*, 1888-1889, quoted in *Rafter's Sewage Disposal*.
¹¹ J. G. Taylor, Chronic Mercurial Poisoning, with special reference to Hatters Furriers, *Guy's Hospital Reports*, vol. IV.
¹² Leggo, *BRITISH MEDICAL JOURNAL*, August 17th, 1901, p. 402.
¹³ Deane and Squire, *Annual Report of Chief Inspector of Factories*, 1898, p. 167.
¹⁴ Whitelegge, Circular to Hat Furriers, *Annual Report of Chief Inspector of Factories*, 1900.
¹⁵ Tatham, *Supplement to Fifty-fifth Annual Report of Registrar-General*, part II, p. li, etc.

TYPHOID FEVER IN SOUTH AFRICA: ITS CAUSE AND PREVENTION.

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DURING the past two years the attention of the public, both lay and medical, has been very naturally directed to the prevalence of typhoid fever in South Africa. I remark, too, that the transference of infection by means of dust storms and flies appears to meet with much support.

It is true I have only been living in South Africa a little over six years, but the nature of my employment, that of medical officer of health, has certainly brought to my notice more cases of typhoid than would occur in the practice of any single medical man.

I have during these years inquired into the causes of typhoid fever in the large towns, in the villages, and in the scattered farm houses from Capetown to Mafeking and from Komati Poort to Port Nolloth.

For twenty-two years I was a medical officer of health in England and during that time I had much experience in regard to the causation and prevention of enteric fever. The experience gained in both hemispheres and under very diverse climatic and social conditions must be my excuse for interfering in this discussion.

I should not, however, venture to trouble you with my opinion on this very important question if I did not feel that the growing tendency to attribute enteric to wind and flies was not becoming a source of danger.

The following remarks must be taken as applying only to South Africa. I have read all or most of the accounts of the dissemination of typhoid by dust in India. I do not know what may happen in India, never having been there, but I do know that the reports are remarkably inconclusive, and I felt while reading them that if the epidemics in question had been investigated by any man accustomed to that work a different conclusion would perhaps have been arrived at. However, I do not wish to press this point.

During six years' experience I have found that the causation of epidemics of enteric in South Africa is practically similar to that which gives rise to the majority of cases in England, namely, a polluted water supply. Beyond the opportunity I have enjoyed of investigating the origin of typhoid in the Cape Colony, I have had more than average advantages in that respect in the Transvaal.

In August, 1900, Lord Roberts employed me to superintend the sanitary arrangements of the towns, camps, hospitals, etc., in the British occupation. I did so in and around Pretoria and Johannesburg, and in the Eastern line as far as Komati Poort and Barberton, and never had reason to suppose that enteric was attributable to either dust or flies. In fact, I have on one occasion only—and that was in the Cape Colony in 1899—had any grounds for supposing that dust was con-

cerned in the production of typhoid, and on that occasion the dust appeared to have acted through the agency of the water used for drinking.

Most of my work in the Transvaal was carried out in association with Professor Simpson, who is a member of the Enteric and Typhoid Committee. I know nothing of the opinions which will be expressed in the report he will make conjointly with Colonel Notter and Colonel Bruce, but I shall be extremely surprised if either dust or flies are given an important place in it, the evidence that water was the chief agent in spreading the disease was so overwhelming.

On p. 382 is a diagram showing the weekly incidence of enteric fever, based on the Pretoria notification returns, compared with the average monthly rainfall. The notifications are made to me at my office, for the rainfall I am indebted to a diagram issued by the Public Works Departments prepared from records kept by Mr. J. Lyall Soutter.

It is to be regretted that I can only compare the rainfall and disease in one year and in one place. I had full notes of some hundreds of cases of typhoid fever—I might probably say thousands—which I had inquired into during my tenure of office as Medical Officer of Health for Cape Colony; unfortunately a fire occurred at my office, and most of my manuscript books were lost. Only those cases recorded in printed reports remain and those I cannot now consult—they are in Capetown.

It is true that for some years we have had compulsory notification in the Cape Colony, but during the first period the returns were naturally defective, and for the past two years the war has exercised such a disturbing influence, that it would be a waste of time to work on any figures based on returns made during 1899, 1900, and 1901. I have no doubt that in a few years, working in conjunction with my colleague, Dr. Gregory, much useful information will be obtained on this point. In the meantime I send the official returns relating to one place, Pretoria and for one year—October, 1900, to October, 1901.

There is no intention on my part to deny absolutely the possibility of typhoid infection by means of windborne dust. I should say that such an occurrence is probably possible; at the same time, I deny that it is usual or even frequent.

If dust infection were the predominating or an important cause of enteric, one would expect to find the disease commence soon after the dusty season began and to cease soon after it finished. As a matter of fact, typhoid cases are least frequently met with just at the period during which dust storms prevail, and are most numerous when, on account of heavy rain, dust is less troublesome. This to my mind is conclusive proof that dust does not exert much injurious influence as regards typhoid.

As regards flies, I can only say that I hold a similar opinion. The possibility of the conveyance of enteric through these pests is undeniable; but in this instance also the supposed cause, the flies, begin to be troublesome long before typhoid prevails, and continue to annoy us long after it has subsided. If the flies were really important agents in the spread of typhoid fever, one would expect that, even if the disease did not commence to prevail soon after these nuisances commenced to be numerous—because it is conceivable that at that time typhoid-infected stools would be rare—yet when once typhoid became common the flies should carry on the infection, which should continue as long as or longer than the flies continued.

This year the typhoid fever is again steadily rising, and I should not be surprised if we suffered severely. When Lord Roberts was in command, all cases amongst the military as well as amongst the civilians were reported to the Health Office. For this the army officers in charge were paid a fee of 2s. 6d. per case. Since Lord Roberts has left notification of cases amongst soldiers has been peremptorily stopped. There may be good and sufficient reason for this; I know nothing of military matters, and never have been able to understand them. Certainly if the cessation of notification will have any beneficial effect on the war, no one would grudge a few civilian lives. In the meantime the only result, so far as I am concerned, is that I am completely in the dark as to the occurrence of disease amongst the people for whose health I am officially responsible. Nothing is more difficult than to discover conclusively