Mucous membranes : normal and abnormal including mucin and malignancy / by Wm. Stuart-Low.

MUCOUS MEMBRANES
INCLUDING
MUCIN AND MALIGNANCY

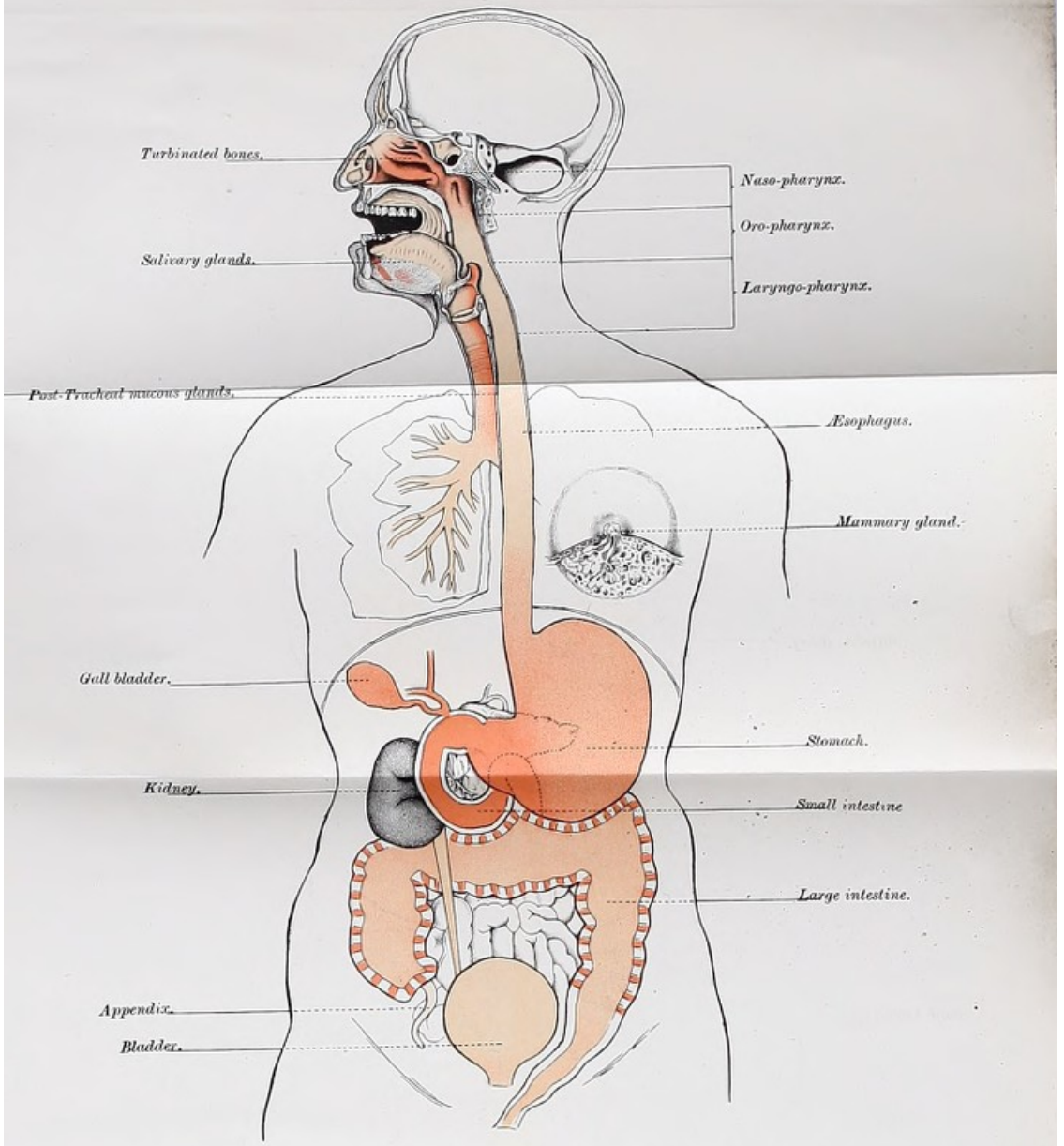
W. STUART-LOW

MUCOUS MEMBRANES:

NORMAL AND ABNORMAL

PLATE I.

MUCOUS MAP.



This mucous map is designed to show at a glance by the depth of shading where most mucin is found or secreted. The mammary gland is destitute of mucous secreting cells or glands. The æsophagus is very scantily supplied, being kept lubricated by the large amount normally swallowed from the post-nasal and upper pharyngeal regions. This mucus goes further on to supplement the large quantity secreted in the stomach. The pale border on the outline of the small intestine is meant to convey that much less is secreted in the wall of the small intestine than in that of the large, as indicated by the striated border outlined. The tracheal region is very liberally supplied by the special post-tracheal glands. The appendix has but poor provision for mucous secretion.

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NORMAL AND ABNORMAL

INCLUDING

MUCIN AND MALIGNANCY

BY

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PREFACE

WHAT is contained in this small work was originally given as a lecture before the students of the Polyclinic College.

I have had numerous communications from medical men with regard to the matter contained in it, and many of the audience have requested further information about the method of treatment then described.

Under these circumstances I have ventured to embody the lecture in this book, with many apologies for evident shortcomings and deficiencies.

W. STUART-LOW.

45, WELBECK STREET, W.,
March, 1905.

SYNOPSIS

INTRODUCTORY.

SCOPE OF THE SUBJECT. NEGLECT OF THE SUBJECT.

ANATOMY.

ARRANGEMENT AND DISTRIBUTION. COMPARATIVE ANATOMY.

PHYSIOLOGY.

MUCIN: SPECIAL FUNCTIONS.

PATHOLOGY.

NOMENCLATURE. ORTHOMYXIA. MYXASTHENIA.

QUANTITATIVE CHANGES.

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HYPERMYXIA—HYPERMUCOUS (TYPE: HYPERTROPHIC RHINITIS).

HYPOMYXIA—HYPOMUCOUS (TYPE: RHINITIS SICCA).

QUALITATIVE CHANGES.

PARAMYXIA—PARAMUCOUS (TYPE: ATROPHIC RHINITIS).

MUCIN AND MALIGNANCY.

CASES.

MUCOUS MEMBRANES:

NORMAL AND ABNORMAL

INTRODUCTION.

I HAVE selected the mucous membranes and their chief secretion, mucus, as the subject of this short treatise, firstly, because it is one which will be of interest; secondly, because I have given very considerable attention to it for the last few years,* and, finally, because it has not hitherto received the share of notice that it deserves from general practitioners, specialists, and physiologists. I know, moreover, that if practitioners will apply the principles arrived at from such a study, they will gain a rich return in their daily medical practice.

The mucous membranes constitute the internal skin, which lines an extensive area of cavities, canals, and internal surfaces, ranging from the intricacies of the aural labyrinth and the farthest mastoid annex, to the ultimate ends of bronchi and rectum, and the remotest glandular ramifications opening on the alimentary tract.

* *Lancet*, September, 1900; October, 1901; September, 1902.

When one reflects on the exhaustive study and research that have been bestowed on the skin proper, and how little is known about mucus and mucous membranes, it is easy to realize how much this department of physiology and medicine has escaped systematic investigation. If all the work arising directly and indirectly from mucous membranes were removed from medical practice, one might judge how little would remain either to general practitioner or consultant. As regards my own department of throat, nose, and ear, I can fairly answer that at least 70 per cent. of the work would vanish.

We need not be apprehensive, however. Far from diminishing, the instances of affection of the mucous membranes, which already represent such a large proportion of the cases which come before us, are yearly increasing, because many of the noxious and baneful influences of modern daily life and so-called civilization afflict these structures.

Mucus has ever been the bane and bugbear of the physician, whose every effort has been strenuously put forth either to brush, to wash, or dissolve it away as an evil thing, serving only to harbour organisms and to retard and jeopardize recovery from pathological conditions. How completely mistaken this depreciatory estimate of the value of mucin is, will be seen from an attentive study of its nature, functions, and probable ulterior destiny, and it will be admitted that mucus is of the very first importance in the animal economy.

ANATOMY.

Arrangement and Distribution.

There are a few facts with reference to the distribution, arrangement, and structure of mucous membranes that have an important bearing on their pathology.

A mucous lining covers nearly every recess and surface which communicates more or less directly with the exterior. The vestibule, cochlea, and semicircular canals of the internal ear, which do not so communicate, are also lined by mucous membrane. The fluid constituting the synovia of joints is mucigenous in its nature, and the fluid contents of the membranous labyrinth similarly contain mucin. The arrangement of the mucous membranes varies in different regions. In some situations the mucous covering is thin, feebly vascular, and with but few mucous glands; this is conspicuously the case in the sinuses leading into the nasal cavities and their cellular accessories, and in the tympanum and its cells, annexes, and adjuncts. In other parts the mucous membrane is noteworthy for its thickness, vascularity, and glandular richness—notably in the stomach, the intestines, and certain portions of the nasal region. It may be found smooth and stretched over the underlying bone blending with the periosteum, as on the nasal floor and accessory nasal sinuses. Where distension is liable to occur, it is thrown into folds, sometimes longitudinally, as in the œsophagus and stomach; or transversely, as in the intestines and bladder; or spirally arranged, as in the

cystic duct and the vesiculæ seminalis; or arranged in a valvular fashion, as at the entrance to the appendix, the common bile-duct, and the lower end of the tear-duct. The number and grouping of the mucous glands also vary very much. In some situations these glands are few, and have a discrete distribution, the secretion being very thin and watery, as in the nasal sinuses and tympanic cavity. In other places the glands are exceedingly numerous and arranged in groups, the secretion being thicker, more abundant, and indeed somewhat viscid, as in the stomach and posterior regions of the nose.

The vascularity varies both in amount and arrangement of bloodvessels, occasionally dense plexuses and even sinuses being formed, as on the inferior turbinated bones; or, again, but slight vascularity is met with, the vessels blending with those of the periosteum.

The Eye.—The conjunctival mucous membrane lines the internal surface of the eyelids, and at the fornix conjunctiva is reflected over the surface of the eyeball. A layer of racemose or tubulo-racemose mucous glands—post-tarsal—occupies the ocular surface of the lids, just under the conjunctiva, and beyond the blind ends of the Meibomian glands. The ducts of these glands open close to the line of reflection of the conjunctiva on to the globe. This mucous lining is loosely attached to the sclerotic, but is thin, and firmly attached to the cornea.

The lachrymal sac and duct are lined by a columnar and in places ciliated epithelium, with but few mucous glands until towards the nasal end of the duct, where

a group of these glands is present, and the lining is thick and thrown into folds, one of which serves as a kind of valve at the orifice.

The Ear.—In the middle ear a ciliated mucous membrane lines the cavity, its accessory cells and annexes throughout; but in some parts there are only patches of cilia, and it is thin in character and adherent to the periosteum of the walls and ossicles. This lining is especially thin in the mastoid antrum and adjacent cells. There are a number of folds of the mucous membrane passing from the attic to the ossicles and the posterior and inner walls. These folds assist the ligaments in maintaining the ossicles in position. The secretion is thin and watery, holding only a moderate amount of mucin in solution, and not having anything like the usual viscidity of mucus. This is explained by there being comparatively few mucous glands arranged throughout the cavity.

In the Eustachian tube the mucous lining is thin, and closely blended with the periosteum in the upper osseous part ($\frac{1}{2}$ inch long), there being in this part of the tube no mucous glands whatever. In the lower and longer cartilaginous part, however, the lining is thicker—notably so at the lower end, where a group of large mucous glands is found. There is also a considerable amount of lymphoid tissue, especially in young subjects, near this pharyngeal end of the tube.

The Nose. — The interior of the nose, and its accessory cavities, is lined by mucous membrane, which varies very much in thickness according to its

situation; and the provision for the secretion of mucus is very complete and extensive. In the olfactory region—everywhere above the middle turbinated bone—there are few muciparous cells and very few glands, but the mucous lining is thick and in places pigmented. The epithelium here is columnar, whereas in the regio-respiratoria it is entirely ciliated. The glands in the regio-olfactoria (Bowman's glands) are mostly aquiparous. In the regio-respiratoria—everywhere below the middle of the middle turbinated bone—the contrast with this anatomical condition is very marked, and the special provision that is here made for the secretion of mucus shows how important the presence of this secretion is, and what a large quantity (estimated at at least half a pint in twenty-four hours) is constantly being poured out, even in the normal nose. The swallowing of this mucus is constantly going on to a much greater extent than we are aware of. The lining membrane of the accessory cavities is thin and pale, with a ciliated surface, a thin basement membrane and submucous tissue, slightly vascular, closely blended with the periosteum, and has glands mostly of the aquiparous type. There are some mixed glands in the antrum maxillare, but in the ethmoid cells and frontal sinuses the secretion is watery, and some authorities doubt whether mucous glands are present. A few are, however, to be found scattered about in a discrete manner. The fact that the lower or respiratory tract is much the wider, the upper or olfactory being narrow and slit-like, is noteworthy, as thus a much larger surface is afforded for

secretion. The most closely-packed gland surface in the whole body is the stomach surface, where are found the open mouths of glands to the number of one hundred to the square centimetre. On the nasal septum, where they are exceedingly abundant, there is an approximation to this number; the glands are muciparous, and number at least seventy to the square centimetre. Again, on the inferior turbinated bones the glands are almost as numerous, being only slightly less thickly placed than on the septum. This is similarly the condition on the lower half of the middle turbinated bones, and also on the posterior half of the outer wall of the nasal cavity.

I am indebted to Dr. Dan McKenzie for the following interesting facts with reference to the secretion of mucus in the nasal region, contained in the 'Report of the 76th Meeting of the German Natura- and Physicians in Breslau, September 18 to 24, 1904,' section for Laryngology and Rhinology.

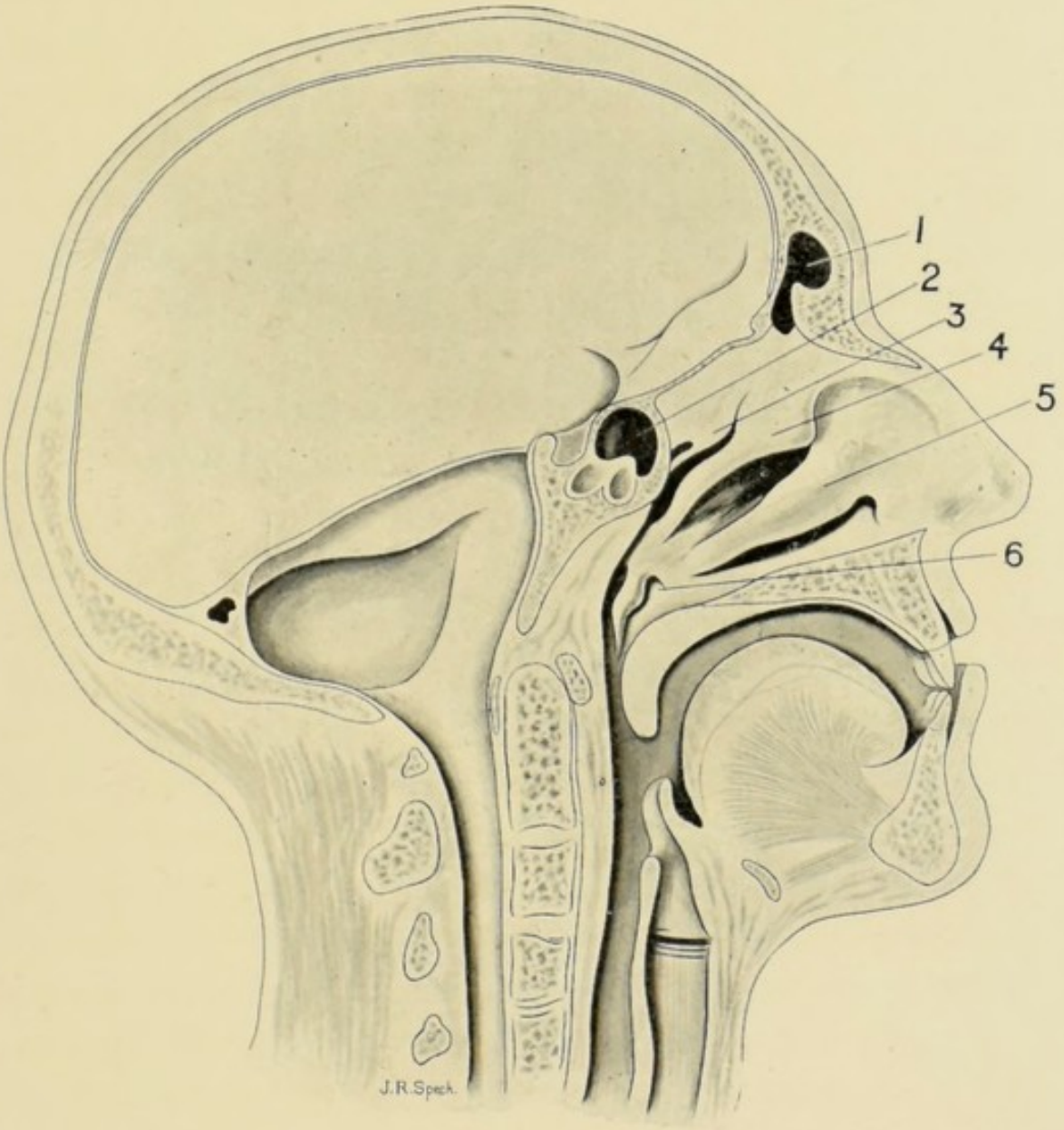
Hajek (Vienna) read a paper, entitled 'A Contribution to the Anatomy of the Glands of the Nasal Mucous Membrane,' in which it was clearly shown that, as a result of careful histological investigation of the nasal mucous membrane, obtained from portions of the inferior turbinal removed by operation, that the glands of the nasal mucous membranes are not, as Paulsen and Stohr have mentioned, mixed glands, but reveal themselves absolutely as pure mucous glands. On examination by immersion, the cells of the tubules exhibit all possible transitional stages from 'serous' to the typical muciparous cells. In the resting stage the cells show a

protoplasmic appearance, and according to the degree of activity of the gland do the cells manifest changes —viz., the mucous transmutation (metamorphosis), with the characteristic swelling (? vacuolation), the peripherally placed nucleus, and the well-known colour reaction with mucicarmin and muchæmatin. The peripheral zone of the cell is first affected, then the half, next the greater part, and, finally, the whole cell itself.

By the use of these colour reactions it was seen that the gland-groups, which showed throughout the protoplasmic appearance, when examined closely with the microscope, manifested in individual fixed cells (? parenchymatous cells) suggestions or very faint degrees of mucous metamorphosis. Thus all the glands of the nasal mucous membrane are composed of mucous cells, and the different appearances presented by the fixed cells depend simply upon the stage of activity at which they had arrived when the section was made. Every cell of a gland is thus to be regarded as an independent organism. Hajek confirmed his views by a microscopic demonstration of his preparations.

In the discussion which followed Bönninghaus (Breslau) said the relationship between the serous epithelium and the epithelium, transformed into mucous epithelium in the nose, was to be seen also in this respect that in pathological cases unions (? connections, groups) of mucous cells formed in the nasal epithelium, which have all the anatomical characteristics of a gland. Bönninghaus described these minutely several years ago (*Arch. f.*

PLATE II.



SHOWING THE BACKWARD AND DOWNWARD INCLINATION OF THE MEATUSES OF THE NOSE.

To face page 8.

Laryng.). He called them 'mucous glands'—a name which had led to some misunderstanding. What was intended by the name was, naturally, a mucous metamorphosis of the normal epithelium of the nose in the folds or wrinkles of this epithelium.

Görke (Breslau) said that there can be no doubt that in the human nose mucous glands were almost exclusively present. With regard to the lecturer's criticisms of Heidenhain's researches, Görke made the following observations: It was not sufficient, in order to discover the presence of serous as distinct from mucous glands, to employ simple stains such as hæmatoxylin, or such specific stains as those used by the lecturer. But stains which showed up the serous elements should also be employed. Görke had continued Heidenhain's researches upon different animals, and had been able to establish Heidenhain's results completely. There were to be found, *especially in dogs*, only *pure serous cells* (*finely granular protoplasm, cylindrical epithelium of the ducts*). Görke replied to Bönninghaus's results with the remark that, in the instances described, we had to do with a simple sinking-in of the surface epithelium with mucous transformation of the glands, and that the epithet 'crypts' was preferable to 'intra-epithelial glands.'

Hajek, in reply, said that he did not doubt the existence of some serous glands. The glands of the nasal mucous membrane are glands secreting mucus, and we can find them in all transition stages, from purely protoplasmic to mucus-secreting glands, from which the uniformity of all these elements

results. From which we argue that the different appearances are simply modifications of one and the same structure. With regard to the bud-like formations in the hyperplastic epithelium, which we should describe not as glands, but as crypts, Hajek found himself in agreement with Bönninghaus. They are developed in this way—that the substitution of the 'beaker cells' through the substitution cells does not occur completely as the mucous transformation progresses. Moreover, in addition to the bud-like formations, multitudes of different forms, which had undergone mucous transformation, could be found—forms which had no single morphological similarity with glands.

The next point of importance anatomically, as determining the direction of the flow and ultimate destiny of all the mucous discharges in the normal nose, is the obliquely backward and downward inclination of the three turbinated bones, and therefore of the three meatuses.* These three bones and cavities all lie obliquely from before backwards and above downwards; and even the floor of the nose, in the erect position of the head, is inclined towards the pharynx, although it is the least oblique of the meatal floors. The result of this structural arrangement is that the secretions slide backwards into the pharynx preparatory to passing down the œsophagus into the stomach. The sphenoidal sinus secretion in dependent positions of the head must also pass into the pharynx. The more watery discharges from the upper regions and accessory cavities will tend to gently flush the

* See Plate II.

more viscid secretions lower down, and on into the pharynx. The only secretion discharged into the nose that might have a chance of escaping passing back into the pharynx is that from the lachrymal apparatus, which is more or less constantly flowing, because of the anterior position of entry; but the oblique inclination backwards of the nasal duct, the valvular fold at its abutting point, and the curved formation of the anterior part of the inferior turbinated bone, all tend to direct the flow pharynxwards.

The pituitary or Schneiderian mucous membrane is a highly vascular organ, and just as it varies much in thickness and in richness of mucous glands, so the vascularity varies in different parts. It is most vascular in the situations where the glands are most found.

The vascularity and the glandular elements are both reduced to a minimum in the sinuses and cells opening into the nasal cavities. The capillaries have been described as being arranged in three sets—a subepithelial, a glandular, and a periosteal set. The veins of the nasal mucous membrane form dense plexuses in the thickest portions, and are placed so closely as to approach the nature of a cavernous tissue. These plexuses are sometimes encircled, with the glands among which they lie, in the submucous layer, by plain muscular fibre bundles.

Through the foramen cæcum the superior longitudinal sinus communicates with the veins of the nasal mucosa; hence epistaxis will directly relieve cerebral congestion, and infective organisms from lesions of the nasal septum may thus enter the sinus and set up a septic phlebitis.

The lymphatics of the nasal mucous membrane are abundant and large. They form a close plexus, the branches extending almost to the surface, though there is a more open plexus of valved vessels nearer the bone. They are in communication with the lymph spaces of the subdural and subarachnoid spaces, and the lymphatics of the nasal mucous membrane can be injected from the cranial cavity. Lymph nodules are here and there present. The subepithelial layer of lymph cells, like the basement membranes, is traversed by minute basal canaliculi, which have been shown to be in communication with the subarachnoid and subdural lymph spaces. The existence of direct communication between the olfactory region and the basal lymph channels of the dura mater has been demonstrated beyond a doubt. Through the minute lymph vessels or clefts between the cells in ciliated mucous membranes a watery lymph, containing a very little albumin, is conveyed to the surface, and this provides the cilia with the fluid necessary for their vibratory functions, as well as the respiratory air with its necessary amount of moisture (Quain's 'Anatomy').

The greater part of the mucous membrane of the nasal fossæ is supplied with nerves of common sensibility from branches of the fifth pair. These nerves appear to terminate amongst the epithelial cells as minute ramifications, which have been traced by the silver-chromate method.

The Mouth, Pharynx, and Œsophagus.—The mucus supply of the mouth is mostly derived from the large salivary glands pouring secretions into

the cavity, especially from the sublingual glands, the submaxillary being a mixed gland, partly serous and only partly mucous, while the parotid is almost entirely serous. There are also small numbers of specially-named mucous glands in the mouth—the buccal, the labial, the molar, and the lingual. The mucus supply in the mouth, however, is, like that of the small intestine, largely an imported one.

On the tonsils, which consist of adenoid-gland-like tissue, the mucous membrane is much modified. The epithelium is reduced to a single layer, closely adherent to the tonsil structure proper. There is no subepithelial tissue whatever, and even in the follicles there are no mucous glands nor mucous cells.

The same arrangement is found in the other parts of the pharyngeal lymphatic ring—in the lingual and pharyngeal tonsils. These lymphatic masses almost appear like foreign structures inserted in the continuity of the oro-nasal cavity and pharynx.

Few mucous glands are found in the pharynx, and those found are in the upper half, in groups on the lateral and posterior walls.

There is a considerable number of mucous glands on the pharyngeal surface of the soft palate and uvula; but below the upper level of the mouth, where the epithelium changes its character from ciliated to stratified, there are very few. There are few mucous glands in the œsophagus until nearing the cardiac orifice, where there are a great many of quite a large size.

In this respect the œsophagus may be divided into

three parts: the upper third, where there are few mucous glands; the middle third, where there are practically none; and the lower third, where mucous glands are numerous.

The Larynx and Trachea and Bronchi. — The larynx is lined by mucous membrane on its internal surface throughout its entire extent. This is continuous with the pharynx above and the trachea below. It contrasts very strongly, however, with that in the lower part of the pharynx, as it has a great many mucous glands in its structure. These muciparous glands are found in nearly every part, but are most numerous on the posterior surface of the lower half of the epiglottis, where they are so large as to pit the cartilage. They are thickly studded over the ventricular bands, and in the ventricle and sacculus laryngis, and on the aryteno-epiglottidian folds and arytenoid region.

In these situations the mucous membrane is thickest, loosest, and most vascular. An especially large number of mucous glands is met with along the posterior margin of the aryteno-epiglottideus folds in front of the arytenoid cartilage. This group has been named the arytenoid group of glands. The ventricle of the larynx is an oblong fossa situated between the superior and the inferior vocal cords on each side, and extending nearly its entire length. It is bounded above by the free crescentic edge of the superior vocal cord, below by the straight margin of the true vocal cord, and externally by the thyro-arytenoid muscle.

The anterior part of the ventricle leads up by a

narrow orifice into a cæcal pouch of mucous membrane of variable size, called the laryngeal pouch. This is a membranous pouch (sacculus ventriculus) placed between the false vocal cord and the inner surface of the thyroid cartilage, and rising up to the upper edge of this cartilage; it is conical in form, and curved slightly backwards like a Phrygian cap. Its laryngeal surface is covered by the aryteno-epiglottideus inferioris muscle (compressor sacculi laryngis, Hilton), whilst its entire exterior is covered by the thyro-arytenoideus and the thyro-epiglottideus muscles. These muscles compress the sacculus, and thus discharge the secretion it contains upon the chordæ vocalis, the surface of which it is intended to lubricate.

In the sacculus there are over a hundred large mucous glands. On the vocal cords the mucous membrane is extremely thin and very closely adherent to their surface, but no mucous glands whatever exist here. The epithelium is squamous on the true vocal cords. Ciliated epithelium covers every part below the true vocal cords, but above the vocal cords cilia are present only in front, as high up as the middle of the epiglottis. The deeper layers of the mucosa on the true vocal cords have a papillary arrangement; this explains the common occurrence of papillary neoplasms here. Their similarity to the papillæ of the skin is marked, and the propensity of both to form horny epithelial warts is therefore readily understood.

The sensibility of the larynx varies in its different parts, being greatest in the arytenoid space. This is

the most dependent part of the entrance to the larynx, and the part most likely to be rubbed, and is therefore well protected and shielded by mucus, there being many large mucous glands here. As a result, affections of this region, by diminishing the amount of mucus or altering its quality, are always very painful and trying to the patient because of the troublesome and constant cough. Even superficial irritation of this region will give rise to attacks of convulsive cough.

The trachea is lined throughout its entire extent by ciliated columnar epithelium, and has both muciparous cells and glands scattered in its tract. There are special glands, which are called the tracheal, placed on the posterior surface. These are large and ovoid, and supply an abundant secretion. Smaller glands are found in the spaces between the tracheal rings. There is much lymphoid tissue in this region in the submucosa.

The mucous membrane lines the bronchi and its ramifications throughout, and is covered by ciliated epithelium. In the lobules the epithelium changes, becoming flattened and non-ciliated, first in irregular patches, and then entirely on reaching the infundibula and air celis, where there is only pavement epithelium (Quain's 'Anatomy').

The Stomach and Intestines. — The gastric mucous membrane is a thick layer with a smooth, soft, velvety surface, and at the pylorus it is much thicker than at the cardia. Immediately on passing through the cardiac opening the epithelium changes its character from stratified, as in the œsophagus, to

deep columnar. Another very noticeable fact is that every cell on the gastric surface is an active mucus-secreting cell, pouring out the secretion over the surface, and thus saving the sensitive walls from irritation and digestion by the gastric juice. Similar cells also line the mouths and necks of the gastric glands.

Towards the pylorus the gastric tubes are lined throughout by columnar epithelium. They are termed the 'mucous-gland tubes,' and they secrete gastric mucus only.

In the other parts of the organ the deeper portion of each tube is filled with nucleated cells, the upper one-fourth being lined with columnar epithelium. These are the peptic glands, and secrete the gastric juice. Every cell on the stomach surface, therefore, as well as these columnar cells lining the outer quarter of the gland tubes, which are a continuation of the surface cells, is mucus secreting. The provision, therefore, for the manufacture of mucus in the stomach is enormous.

The nearly vertical position of the stomach, especially in its cardiac part, necessitates the gravitation of all the swallowed mucus to the pyloric end, where it is most required, on account of the great mechanical strain thrown on this part, and on account of the irritation caused by the gastric juice.

In the small intestine, with a capacity three times that of the stomach and four times that of the large intestine, the surface epithelium has the distinctive feature of a striated border, stamping this as the chief absorptive part of the intestinal tract, far

exceeding in this capacity both the stomach and the large intestine. The other marked feature in the lining membrane of the small intestine is the sparseness with which mucous cells are found. There are only a few goblet cells scattered over the villi, and a few in the glands of Lieberkühn, these Lieberkühnian glands being interspersed, like test-tubes in a stand, between the villi. This is in marked contrast with the large intestine, where as many as forty are commonly found in one gland. The mucus in this part of the canal—the small intestine—is an imported supply. From the stomach much is propelled onwards with the gushes of the chyme, from the pancreas in its very viscid secretions, and from the liver with its specially large supply in the bile, the latter supply being derived from tarrying in the gall-bladder and passage down the bile-ducts. The amount of mucus discharged into the small bowel, therefore, is very large—larger than in any other part of the bowel; but this is almost entirely derived from surrounding organs.

In the large intestine very great provision for mucus supply is met with, vast numbers of goblet cells being placed over the surface and in the glands of Lieberkühn throughout this tube. For lubricating and protecting purposes this is essential, as the contents now become semi-solid in consistency. I would here only further remark that, while this is so in the large intestine, the vestigial part of it—the appendix—has very few Lieberkühnian glands, and these are almost destitute of goblet cells. This sparseness of cells secreting the protecting mucus in the appendix

has probably much to do with its liability to attack by infective organisms, especially if there is at the same time a hypomyxiatous state of the membranes higher up in the naso-pharynx. A recent writer has called the appendix the abdominal tonsil, and in one way the comparison with the faucial tonsil is an apt one—viz., the paucity of mucus-secreting cells and glands in its inner lining.

The Gall-bladder and Bile-ducts.—The mucous lining of the gall-bladder is arranged in rugæ, and has a polygonal outline, being capable of considerable distension. It is a thick lining, richly studded with mucus-secreting glands, the covering consisting of columnar epithelium. The lining of the cystic duct has a spiral arrangement; this acts as a valve at the orifice. The pure mucus from the gall-bladder is a clear, thick, transparent, glairy fluid. The larger bile-ducts are also lined with mucous membrane having cylindrical epithelium and ordinary racemose mucous glands.

The Pancreas.—The duct lobules are lined by columnar epithelium, and many small mucous glands lie in the largest trunks. The secretion is sticky and viscid, like thin white of egg.

The Urinary Organs.—The mucous coat of the bladder is thin and smooth, and of a pale rose colour. It is loosely attached to the bladder wall, unless at the trigone, where it is very firmly adherent. It is provided with mucous follicles, and numerous small racemose glands, lined by columnar epithelium, exist near the neck. The whole surface is covered with a transitional epithelium. There is but a moderate

provision for the production of mucus in the urinary organs.

Over this surface, since only a minimum of friction occurs, and no such attrition, as in the digestive tract, a large amount of mucus is unnecessary; but what is secreted is kept precipitated upon the surface of the membrane by the normally acid urine, and thus the necessity for a more abundant secretion is obviated and protection is facilitated.

COMPARATIVE ANATOMY.

In fishes there is an attenuated layer of mucus over the whole cutaneous covering. This acts as a protector, and also as a lubricator, facilitating their movements in the water.

The lateral line in fishes performs an important function as a mucus-secreting structure.

The horse, ox, sheep, and pig, have quite an extraordinary development of mucin-forming organs.

In the horse, not only are both the anterior and posterior turbinated bones very well developed, but each bone has a special fibro-cartilaginous framework extending to the external orifice of the nose. These turbinated bones are essentially so disposed as to furnish the mucous membrane of the nose with a vast surface, and such flexible appendages are sometimes double. This free surface presents numerous glandular orifices, and is constantly covered by an abundance of mucus that prevents desiccation. The upper-third only of this large area is devoted to olfaction. Racemose mucous glands are specially

numerous on the area of the septum and the cartilaginous appendages (Chauveau). Besides this extensive secretory region, solipeds have another special arrangement which also subserves mucus secretion; this consists of the so-called guttural pouches, one on each side of the pharynx. These have a length of 4 inches each and a capacity of ¾ of a pint. Their mucous lining is thick and vascular, and very thickly studded with racemose mucous glands. Much mucus is secreted in these pouches and poured into the pharynx. Few mucous glands are present in the horse's œsophagus, but it is well lubricated and protected by a copious supply from above, as all this mucus is swallowed, the horse never having any discharge from the nose in health. Jacobson's organ is 5 inches long in the horse, and very thickly packed with mucous glands.

The ox also has a vast development of the turbinated bones, especially of the posterior one; and it has, besides, an extra turbinal—the third turbinated bone of the ox. The sinuses of the head, particularly the frontal sinuses, which are very extensively developed, open freely into the meatus, and afford an additional mucus-secreting surface.

In the pig there is also a large mucus-secreting area, and the turbinated bones are very prolonged.

The ox is constantly licking its muffle, thus swallowing the mucus escaping from the nose, and removing the humid secretion with which it is always kept damp.

The dog and cat possess much less provision for the formation of mucus than the horse, ox, sheep,

or pig. Their turbinated nasal structures are excessively convoluted to enhance the sense of smell, and so mucus secretion being a subordinate factor, is reduced to a minimum. The fæces of the dog indicate but sparse mucus supply along the alimentary canal.

Chauveau, in his comparative anatomy of the domesticated animals, gives the following table of the ratio of the area of the cranium to the face: 1 in 2·69 in the horse; 1 in 3·43 in the ox; 1 in 3·24 in the pig; 1 in 1·17 in the dog; and 1 in 0·68 in the cat. Order: cat, dog, horse, pig, and ox. The face area may fairly be taken as a very good index of the mucus-supply area. It will be noted that this area is much smaller in the cat and dog. The horse's secreting area is very much supplemented by the secretion in the guttural pouches.

PHYSIOLOGY.

Mucin is the substance that gives the sliminess to mucus. It is very largely present in the system, and is found under two conditions: First, universally distributed as the cementing material between cells, when it is known as tissue mucin. This separates connective-tissue cells and endothelial and epithelial cells even where most closely approximated. Normally, there is always a layer, however thin, of mucigenous material, which separates the constituent cells in every tissue and membrane throughout the body. Secondly, mucin is found on all mucous membranes, in mucous glands, and in many epithe-

lial and all special goblet cells, conspicuously so in the surface cells of the stomach wall, where every cell is mucus-secreting.

There are probably several mucins in the body. They are of a colloid nature, viscous, soluble in alkalies, but precipitable from such solutions by acetic acid. On boiling with dilute mineral acids they yield a substance which reduces Fehling's solution, and by appropriate processes mucin is broken up into a carbohydrate called animal gum and a nucleo-proteid. Mucin has been specially investigated in the jelly-like connective tissue of the vitreous humour, the Whartonian jelly, and in tendons.

While the part that mucin plays is doubtless largely mechanical in lubricating and protecting mucous surfaces, its peculiar chemical constitution and behaviour lend support to the belief that it has some further function. Physiologists mostly agree that mucin is not broken up in the digestive process, but that it passes by the bowel unchanged. The very large amount secreted, however, and the comparatively small amount excreted would indicate that much is destroyed or absorbed in the small intestine. The great additional supply in the large bowel supports this supposition. Further, nucleo-proteid, with its valuable percentage of phosphorus, being a result of mucin disintegration, is probably not thrown away, but is absorbed from the intestine for ulterior use in the economy. Where mucin is found fulfilling chiefly a lubricating function, as in the gall-bladder, the bile-ducts, the pancreatic duct, and the lower bowel, it has a distinctly alkaline

reaction, and is mixed with the contents passing over the mucous surface.

On surfaces bathed by acid fluids, on the other hand, the mucin is diminished in alkalinity, and in this manner it is maintained on the surface proper for protective purposes. This is well seen in the case of the urinary passages. Such is a wise provision, for should the urine become alkaline, the mucus present in it becomes then a serious factor in treatment. In the stomach, again, the acid gastric juice maintains the mucus on the surface, the protective function being paramount. On the mucous membrane of the nose and other air-passages the mucus plays an absolutely invaluable part. It maintains moisture and conserves warmth, thus facilitating sensation, both common and special. It also keeps the membrane fit both to catch foreign bodies (dust, bacteria, etc.) as the air filters through, and serves to secure these bodies until the leucocytes can annihilate or remove them.

One of the most important actions of mucin, and one which has hitherto been altogether overlooked, is as a bactericide. This germicidal power was proved in researches I had carried out three years ago. It was shown that mucin has a retarding influence on bacterial growth, that sterilized solutions containing mucin remained sterile for some time on exposure to the air, and that bacteria ceased to grow in culture media when mixed with mucin. This is very interesting and instructive, and proves that, in the secretion poured out on mucous membranes, Nature has provided a ready means of suppressing bacterial

growth. In the *British Medical Journal* of March 8, 1903, there is an account (quoted from the *Lyon Médicale*) of a research by Professor Fernand Arloing, in which this work is repeated. From this he concludes that the mucus of red snails has a bactericidal action on the bacillus of Löffler and other bacteria, and nasal mucus was found to be a bactericide for staphylococcus and pneumococcus, but not for coli bacteria or for Eberth's microbes. It is evident, therefore, that mucin fulfils a potent part in the defence of the body against bacterial attack.

PATHOLOGY.

After giving full consideration to the foregoing anatomical and physiological facts, I noted that patients with irritability of the stomach, painful digestion, or hæmatemesis (gastric erosion or gastric ulcer), suffered simultaneously in many instances from either dry or atrophic rhinitis and pharyngitis. In such cases, too, the frequency of the symptoms of constipation of the bowels, with dry scybalous stools, and the presence of a clear, non-mucous, hyperacid vomit was recorded. I was thus led to try the use of mucin in an endeavour to supply the deficient mucous secretions.

In my work at the Central London Throat and Ear Hospital, examining a great many patients, I have been surprised to find that almost all those suffering from dryness of the nose and throat complain also of long-standing and intractable gastralgia

and constipation of the bowels; and another fact that I have verified at the same large clinic is that the incidence of these affections as regards age and sex is much the same. It is remarkable that dry and atrophic rhinitis and pharyngitis, and gastric erosions or gastric ulcer, are most commonly seen in young females of the domestic servant or indoor-labouring class between seventeen and thirty years of age. There seems to be in such people and at such an age a special liability to desiccation of mucous membranes, beginning with lessened secretion and ending in more or less complete atrophy. This is shown by dryness of the nose and throat. These patients seldom use more than one handkerchief a week, while painful digestion, frequent vomiting after meals, constipation, amenorrhœa, and chlorosis, are concomitant symptoms.

Nomenclature.

Since mucus plays such an important part in diseases of mucous membranes, it might be advisable to adopt a series of new names, and in this way fix in the mind more definitely what the conditions mean. I am indebted to Dr. Walker Overend for this nomenclature,* which indicates some of the changes that may occur in mucus and mucous membrane in these diseased conditions.

* *Lancet*, November, 1901.

Orthomyxia.

Orthomyxia might be employed to convey that the mucous membranes were quite healthy and normal in every way.

No one is more constantly engaged in viewing easily-examined mucous membranes than the throat, nose, and ear surgeon. Yet I fear that in our anxiety to detect something concrete to account for a symptom or complaint, as, for example, nasal obstruction, we may often have been guilty of omitting to observe with sufficient accuracy the vagaries of the first object the eye and the probe encounter — the mucous membrane. The healthy mucous lining of the nose is seen to be of a rosy, somewhat red, colour. The sound surface is always moist, and has a velvety uniform consistency. There is an underlying layer of bloodvessels, lymphatics, and lymphoid tissue, which in health give resiliency without protuberance, and vascularity without turgescence.

I have lately been examining a number of very old people, mostly old men. I have found them all wonderfully orthomyxiatous, having healthy naso-pharyngeal mucous membranes, good digestion, and regular bowel action. I am inclined to believe, therefore, that such is conducive to healthy old age. I certainly have not yet seen one healthy old man who was not orthomyxiatous, so that one is warranted in reckoning this as a condition favouring longevity. I recently examined a man, aged ninety-six years, who was sent from a workhouse to the Central

London Throat and Ear Hospital for slight deafness and tinnitus. With these exceptions, he expressed himself as perfectly well in every way. His mucous membranes were in good condition, and all that could be made out was indrawing of the tympanum of both ears. I had no doubt that this was due to a senile change in the middle ear from desiccation of the mucous membrane, and that this also accounted for the tinnitus. Such was proved to be the case by the success of the treatment—viz., injection of warm mucin solution up the Eustachian tubes—as his hearing improved at once and the tinnitus abated, and after a few injections disappeared.

Myxasthenia.

Myxasthenia might be used to express a state of the mucous membranes, more or less general throughout the system, in which there exists a distinct diminution and weakening of the function of mucous glands and goblet cells. It would compare with the closely allied but rather undefined term 'neurasthenia.'

QUANTITATIVE CHANGES.

Metamyxia. — Quantitative changes may be termed *metamyxia*, and the condition *metamucous*. Where the change is an excess, the terms *hypermyxia* and *hypermucous* would be appropriate, and the converse conditions would then be *hypomyxia* and *hypomucous*.

Hypermyxia (*Type:* Hypertrophic Rhinitis).

Hypermyxia implies that an increased amount of mucus is present, and it may suggest a general condition affecting the naso-pharyngeal, alimentary, and bronchial systems, or may be merely local, and confined to one set of mucous membranes.

I can only speak dogmatically on my own department, but there is a wide field from which young physicians might garner a rich harvest in the investigation of the other regions covered by mucous membrane. Dr. Eustace Smith speaks of hypermyxia colica as 'mucous disease of the bowels,' and in whooping-cough there is certainly a hypermyxiatous state of the naso-pharyngeal and bronchial tracts. Accompanying this in whooping-cough there is probably a deterioration of the quality of the mucus, and therefore of its germicidal powers. This would favour the life of the specific bacillus of whooping-cough, and this view is borne out by the great success of antiseptic douches and sprays applied to the nose in the treatment of whooping-cough.

Wherever a mucous membrane exists, a hypermucous change may arise; but it is typically and most frequently met with in the nasal cavity, because the conditions favourable to its occurrence are abundantly present in this region. The special vascular arrangements which we find normally in the nose lend themselves readily to congestion, and this results in increased secretion. Frequently the occupation of the individual necessitates repeated changes of temperature, or the respiration of fine dust or

irritating vapours or gases. If such be the case, the congestion of the mucous membrane recurs again and again, until a chronic hyperæmia is established.

There is greater predisposition to this hypermucous change if there be any structural defect in the normal anatomy of the cavities of the nose. It requires a good deal of chill or dust to bring such a change about in anyone with a perfectly natural and sound mucous membrane and nasal breathing apparatus; but in the defective conditions so common in the nasal organ of this generation there often exists a deviation of the septum, or some crest, spine, or spur, or some swelling or protuberance, giving rise to more or less nasal obstruction. Anyone doing much special work, therefore, and seeing a large number of cases, is struck with the rarity of the existence of a perfectly normal nasal interior.

In hypermyxia naso-pharyngia there are intervals of comparative comfort, but during the greater part of their life people suffering from it are very seriously annoyed by nasal obstruction of varying degree, and they are much troubled to get rid of the vastly-increased secretion. There is consequently a great deal of sneezing, hawking, and nose-blowing. Surprising quantities of mucus are apt to accumulate in the naso-pharynx, and remain there in spite of very vigorous blowing. Complaint is made of taste and smell being impaired, of nasal respiration being in abeyance, of a dull frontal headache, and sometimes of deafness, due to extension of the congestion to the lining of the frontal sinuses, Eustachian tubes, and tympanic cavity.

There has been much written lately on the dangers of a common cold. The common head cold is constantly being contracted by these hypermyxiatous people, but so long as the mucus secreted retains its germicidal powers there is no danger. When such conditions are prolonged, however, the mucus changes, deteriorates, and loses its power of restraining the growth of germs; and then the real danger commences, because septic organisms can now pass through the regio-respiratoria, and penetrate to the ethmoid cells, frontal sinus, and maxillary antrum. These latter constitute the happy hunting-grounds of such organisms, where they can multiply vastly, because the thin, pale mucous lining, with its sparse supply of mucus-secreting cells, producing only a watery, faintly germicidal secretion, has little or no power to destroy them. This is the real danger of a prolonged head cold, and emphasizes the imperativeness of effectual remedies for its prevention and cure, since a septic empyema or sinusitis may easily be established.

Treatment.—In endeavouring to remedy this condition of hypermyxia, palliation only may be the object, or operative measures may also be undertaken.

Many sprays, douches, etc., have been employed to give temporary relief during an attack of head cold, by removing the large amount of secretion; but it must never be forgotten that in many instances, especially where the history indicates chronicity, there exists some structural deviation from the normal, and that these are therefore suitable cases for an authoritative opinion and some operative procedure.

As regards immediate remedies, the object should be to dissolve away the mucous accumulations before there is any alteration and deterioration in the protective and bactericidal qualities of the mucus. Such deterioration has already taken place when the secretions have become thick and sticky, or when crusts have formed. If this is not done, a septic state may set in, and the consequence be a purulent rhinitis. Purulent rhinitis is very common in children, perhaps because there are no sinuses during the age of childhood for the organisms to migrate into, and their full virulence is expended on the nasal mucous membrane, which is frequently hereditarily a feebly resistive and often hypomyxiatous one.

In young children a very satisfactory treatment consists in spraying the nostrils with a 3 per cent. cocaine solution, and then painting the interior with a 2 per cent. solution of protargol in equal parts of water and glycerine.

In the adult, first see that the patient is removed from unhealthy surroundings—from inhaling dust, or from the too frequent changes of temperature often incidental to the occupation. Then use a suitable douche or spray to dissolve away the accumulated secretions. This is a very efficient one :

Sodii chlor.	gr. ii.
,, biborate	gr. i.ss.
,, benzoate	$\frac{1}{4}$
Menthol crys.	$\frac{1}{200}$
Cocain hydroch.	$\frac{1}{20}$

to one ounce of warm water. This should be used while warm to irrigate the nasal passages occasionally.

The vascular turgescence must then be attended to, and overcome by using a spray of suprarenal gland solution (1 in 4,000). The mucous membrane can be toned up after all the discharges have been got away by a spray of sulpho-carbolate of zinc, 5 grains to the ounce, a little otto of roses being added, or this ointment may be used at bedtime:

Cocaine	gr. iv.
Iodol	gr. iv.
Otto of roses	q.s.
Vaseline	℥i.

Should the erectile mucous membrane, especially over the inferior turbinals, be very turgescent, as indicated by its contracting greatly under the influence of cocaine, then the application of the electric cautery is demanded.

Hypomyxia (*Type:* Rhinitis Sicca).

Hypomyxia implies a diminution in the amount of mucus secreted by any mucous membrane, and may be, as in hypermyxia, either a local or a general change. It is chiefly met with as a local condition in the earlier stages, and most commonly in the nose, mouth, and pharynx, while afterwards it often becomes general in the larynx, bronchi, stomach, and intestines.

There is no doubt that heredity plays a part in the causation of structural thinness and functional feebleness of mucous membranes, and if these are inherited from both sides the hypomyxia may appear at a very early age. I have met with instances as early as at five years of age. People who con-

stantly inhabit a close, dry atmosphere are very liable to develop this feebleness of the mucous membranes, especially those who lead an indoor life and are fond of sitting much over fires. For this reason it is common in domestic servants, and especially in cooks. I have seen quite a number of instances in schoolmistresses, and then it is found not only in the nose and throat, but particularly in the larynx as a laryngitis sicca. Those who teach in large schools with wooden floors are particularly liable to contract it. Not only do teachers having hereditary thin mucous membranes feel the pernicious effects of the dust from wooden floors, but the chalk dust from black-boards and dusters is very detrimental. Laundresses and ironers are likewise often victims to this affection.

When hypermyxia has lasted for long and has been severe, hypomyxia may follow as a result of the increased growth of the submucous tissues, strangling, as it were, the mucous glands, which then undergo atrophy. In such cases the inferior turbinals may appear large, even to the extent of giving rise to considerable nasal obstruction; but even so there is hypomyxia, as the glands have disappeared.

In marked contrast with the hypermyxiatous, the hypomyxiatous are not at all subject to catching head colds. In fact, this is one of the test questions, and the reply invariably is that there is a singular freedom from everything approaching catarrh in the nose; a handkerchief is not soiled in the course of a week.

The mucous membrane of the nasal passages in

hypomyxia is seen to be more or less pale and thin, and sometimes dry and shiny; or, if such is not the case, the moisture is serous, not mucous. The turbinals are diminutive, or even shrivelled. The mucous membrane has lost its velvety appearance and resiliency, and the mucous glands are functionless or atrophied. A similar state very often exists in the gastric mucous membrane, and this is indicated by the tongue. The tongue may be very clean and pale, or red and angry-looking. It is commonly fissured on the surface and indented at the sides. It may be dry and glazed. The pharynx is seen to be capacious. On opening the mouth, the palate is observed to rise up high, showing the space well without tongue depression. The lining of the pharynx is seen to be dry, or pale and shiny. Complaint is made of indigestion, pain and flatulency after food, and constipation. The motions are difficult, or hard and lumpy. Attacks of gastritis are common, when even small quantities of liquid are not retained. These symptoms indicate a similar hypomyxiatous state of the gastric and bowel mucous membranes. This is what the late Sir Andrew Clark named as 'a vicious state of mucous membranes,' but he did not detect that the mucus shortage was the radical cause of the condition.

Tinnitus aurium is also complained of in many instances, being due to desiccation of the tympanic mucous membrane. Dry catarrh of the middle ear is a frequent accompaniment of hypomyxia naso-pharyngia.

The special functions of the nose are abrogated.

Smell is much impaired, and the nose is no longer an efficient filter for the inspired air, which therefore passes, dust and bacilli-laden, into the lungs.

Treatment.—I first remove patients suffering from hypomyxia naso-pharyngia, with the frequently accompanying hypomyxia gastrica and colica, from unfavourable surroundings. They are ordered out of doors as much as possible, and are requested to walk three to five miles a day—in the cold morning air, if they can be induced to do so. The exercise stimulates the secretion of nasal mucus, and the atmosphere is purer and moister in the early morning. The atmosphere of warm, close rooms is strictly forbidden. The most stringent injunctions are given never to sit, night nor day, near fires. There is a strong inclination on the part of such patients to get very near the fire and remain there for hours together. The average air indoors is very much below the normal standard of moisture. Taking 40 per cent. humidity as the relative standard, the average atmosphere of the house may be as low as 18 per cent. It is this aridity which affects the domestic cook so adversely. The restaurant cook who prepares large quantities of vegetables, and is therefore much in a more moist atmosphere, is not nearly so liable to acquire desiccation of the nasopharyngeal lining.

Mucin is prescribed both locally, and as an internal remedy—locally, as a spray for the throat and nose, which may be used once daily, or night and morning. The topical application of mucin is soothing and emollient; it is hygroscopic, and therefore moistening, and serves to remove dry-

ness and discomfort. When the local condition is well marked, the solution of the soloid mucin compound is used, as the grain of menthol which it contains has a stimulating effect on the remaining unatrophied mucous glands. But in mild cases of hypomyxia, or when the menthol is objected to, a solution of the tabloid mucin compound is sufficient. Internally, the mucin tabloids are administered to the number of one or two before and after meals; this soothes and coats the irritated and exposed gastric mucous membrane, taking the place of the deficient normal mucus, and regulating the bowels. I seldom give aperients in hypomyxia, but if necessary I aid the mucin by ordering enemata. I consider that it is wrong to give such patients much aperient, as the intestinal mucous membrane is too clean already, and the inaction of the bowels is mostly due to want of lubricating material; therefore, saline aperients are not desirable if it is essential to continue them for any long period. The appetite soon improves very wonderfully, the patients invariably expressing themselves as able to eat well after being on the mucin treatment for a few days. I generally interdict vegetables for a time, and advise a dietary which includes plenty of mucin-containing substances. These substances are: Turtle-soup; eggs; eels; oysters; ox-tail; sweet-breads; calf's-foot; calf's-foot jelly; tripe; calf's head; cream; and herring roe, hard and soft.

Having found that those suffering from hypomyxia are often very thirsty subjects—large water drinkers—the use of salt, of which most of them are very fond, is interdicted.

Another reason for stopping the consumption of common salt is that it is a solvent of mucus, and thus militates against the object desired—viz., more efficient coating of the mucous membranes. The salt is an irritant, too, and much more so when the mucin is deficient.

Smoking is forbidden to the hypomyxiative whose condition cannot stand tobacco, as the warm, dry smoke not only dries but irritates the thin and feebly-protected buccal, pharyngeal, and nasal surfaces.

QUALITATIVE CHANGES.

Paramyxia (*Type :* Atrophic Rhinitis).

By paramyxia is meant such a condition of the mucous membranes that they secrete mucus of much-altered quality. There is a profound allotrophic modification, as indicated by excessive viscidity. In the naso-pharynx this is typically seen in the affection commonly called atrophic rhinitis. The mucus is still produced, but of such an altered quality that it remains in the form of crusts and scabs. Mucus in such a state is functionless, so that septic organisms inspired remain active ; indeed, these crusts favour their growth. Sometimes the odour from the septic crusts is very fœtid (paramyxia fœtida). But this is not always so ; the affection may be well marked, and yet there may be no fœtor. Germs and dust-particles can readily pass through the lower regions of the nose, enter the sinuses and accessory cells, and be inhaled into the larynx and lungs. Suppuration of the nasal accessory sinuses so often

occurs as an accompanying condition in atrophic rhinitis that some authorities assert that the atrophic rhinitis is in all instances due to the overflow of pus from these sinuses, but this is not often the case.

The fact is, I think, that the organisms can and do pass upwards from below, because of the inferior quality of the mucus rendering it useless as a microbic filter. Masses of crusts can be readily removed from the situations where mucus is normally most largely secreted in the nasal cavities.

The deterioration of the safeguarding mucous lining, together with the fact that the lymphatics of the nose and the brain communicate directly, are very potent factors in the causation of septic meningitis, especially after operations on hypomyxiatous and paramyxiatous patients.

In the larynx, in the interarytenoid space, crusts accumulate, preventing perfect juxtaposition of the cords, and giving rise to chronic hoarseness, and sometimes to much irritation and coughing. The change in this location is usually known as Pachydermia laryngis. It is truly remarkable how many of the pathological states occurring in the larynx begin in the vocal cords—catarrhal erosions; simple papillomata; syphilitic papillomata; tubercular infiltrations; syphilitic infiltrations; neoplasms; carcinoma.

Cancer of the larynx is most often seen on the vocal cords, the ventricular bands, and in the arytenoid region. The reason for the cords being the first to suffer may be that they depend entirely on mucus supplied from adjacent parts for their lubrication and protection from irritation.

There are no mucus-secreting cells nor glands on the vocal cords, and they are supplied entirely by mucus secreted in the laryngeal pouches and on the ventricular bands and other adjacent parts. Should the supply become limited or arrested from hypomyxiatous changes, the cords would suffer most, especially as they are the parts which are the most exercised and strained in the performance of their natural functions.

In the stomach and bowels a similar condition may be established, strings and clumps of altered inspissated mucus clogging these organs, and resulting in intractable dyspepsia and constipation.

In the bile-ducts and gall-bladder this qualitative change in the mucus secreted so impairs the germicidal powers of the mucus that gall-stones result, because microbes can now travel up the common duct.

How often do surgeons open the gall-bladder in people having all the indications of gall-stones, only to find inspissated mucus! The pain produced in this manner is as severe as in the case of gall-stones.

It will be evident, therefore, that dust and overdry air are the enemies to be avoided and fought against tooth and nail. Such is most emphatically the case in those having weakened and semi-functionless naso-pharyngeal mucous membranes. Dust and microbes do no harm if they fall on healthy cutaneous structures, neither can they do much harm by impinging on sound mucous membranes; but falling on such impaired ones as I have portrayed, great havoc and disaster may follow.

In all large cities the atmosphere is laden with

air-polluting and disease-disseminating dust. Dust-collecting and street-cleansing are carried out in a most careless and insanitary manner. In inclement weather the roads are thick and deep with mire, and in the dry weather clouds of dust are blown in our faces at every street-corner. The filthy state of many by-roads, not to mention some of the principal thoroughfares, in the crowded parts of the Metropolis is a reproach to our cleansing systems.

To give some idea of the extent of this pollution of the air we breathe, and of how much work the respiratory mucous membrane has to contend with, I may mention that it has been estimated that in Manchester an adult inhales in ten hours 37,000,000 microbes, and that in London there are present from 80,000 to 210,000 solid particles in each cubic centimetre of air. In the air of the Western Highlands the corresponding number is sixteen.

Treatment.—This includes all that has been said under the heading of 'Treatment of Hypomyxia,' but the treatment must be even more thoroughly carried out, every order must be more emphatically impressed on the patient, and greater strictness urged. The subjects of this condition should be summarily removed from vicious environments if at all practicable, as in this way successful treatment is greatly aided. Drapers' assistants and those engaged in the wool trade, for instance, are very liable to suffer from paramyxia, and if the necessity of avoiding the dusty atmosphere incident to their business is not enjoined on them, such patients are unlikely to derive much benefit from treatment.

Beside regular walking exercise in the open air, deep nasal respiration, both inspiratory and expiratory, is encouraged as a daily habit, so that the stagnant air in the recesses of the capacious nasal cavities may be renovated, and more complete ventilation of the sinuses secured.

Warm, close rooms must be carefully avoided. The anti-hypomyxiatous diet described under hypomyxia should be more strictly enjoined, and salt be expunged from the food. The mucin tabloids ought to be more regularly and largely administered, and the maximum number of sixteen tabloids a day may be necessary for some weeks. Usually eight to twelve a day are sufficient to relieve the distressing gastric condition and regulate the bowels. The local treatment must be most carefully and regularly performed. At first such patients should be seen daily by the surgeon, or at least two or three times a week. The interior of the nasal cavities should be well sponged out with a cotton-wool-mounted probe, saturated with warm solution of mucin. The sites of crust formation should be well rubbed with this preparation. The solution of mucin used for this purpose ought to be a strong one—ten or twelve tabloids dissolved in an ounce of very warm water, and the whole strained through muslin before use. One soloid may be added in addition, if no objection be made to the pungent sensation of the menthol which it contains. The patient must douche the nose once a day, by means of a nose-boat, with a solution made by dissolving half the number of tabloids—five or six—to the ounce of warm sterilized water, filtering the

solution before use. One soloid may be added here, too, if not disagreeable to the patient.

In mild cases, spraying with a similar mucin solution night and morning is sufficient to remove crusts and fœtor, but not in well-marked instances. After the first masses of crusts have been got rid of, and have ceased to form so abundantly, a very effectual method of douching is by means of an ordinary glass nasal syringe. With the collar off, the head thrown as far back as possible, the neck overextended and the face horizontal, and the syringe being charged with the warm mucin solution, the syringing may be done quite forcibly. In this position there is no danger of the passage of any of the contents into the Eustachian tube. The act of swallowing is impossible in this position of the head, and so those tubes are not opened. In such a manner the nasal passage can be most thoroughly cleansed.

When this method of treatment is properly carried out, the most severe and intractable cases improve at once, and in the course of a fortnight such patients are able to return to the social circle from which the fearful fœtor may have expelled them. Perseverance is required, but in some of the worst cases it has only been necessary to syringe two or three times a week after two months' treatment.

MUCIN AND MALIGNANCY.

There are a few notable points about mucin and the mysterious and dreaded malady cancer.

Three-fourths of all cancer in man occurs in the

alimentary canal, and a very large proportion of the whole is located in the mouth, throat, larynx, and gullet. Cancer has therefore an intimate relationship with mucous membranes, since the great majority of instances primarily originate on mucous surfaces.

The mucus secreted by and covering the mucous membranes being the natural protector and lubricant, a plentiful supply of proper quality is essential for the comfortable passage of the food, chyme, and fæces along the alimentary tract, and the prevention of scratches and abrasions.

Should the mucus be deficient or deteriorated, then the superficial cells of the mucous membrane must be exposed to increased irritation, not only from imperfectly masticated food, but from the acid gastric juice.

In my opinion, a considerable proportion of the large amount of mucus in the alimentary canal is broken up and absorbed, and thus the important nucleo-proteid constituent contained in it is saved from loss to the economy. The absorbed mucin may go towards maintaining the vast field of tissue mucin existing throughout the organism in the interstices of the tissues as the universal cement material around the cells.

In the chronic conditions of hypomyxia that I have described in previous chapters, there has existed for many years a diminution of the supply of the surface mucus. This must mean a shortage in the amount of mucin available for the maintenance of the essential tissue mucin, and therefore a much greater proximity of tissue cells to one another, not to say

a rubbing of one cell on another as they lie in the tissues. Is this the condition of the tissues preparatory to carcinomatous change? I have now carefully observed for years a large number of cases of malignant disease, and have never yet seen one that was not decidedly hypomyxiatous and that had not been so for years previously.

The essential lesion of carcinoma is the penetration of cells into the surrounding tissues; but whether this new departure on the part of the cells is the result of a cellular change or of some alteration in the intercellular resisting substance is not yet clear. The probability is that there is a certain degree of both. The cancer cell has acquired a peculiar energy which it did not before possess, and which means rapid proliferation. There is also in cancer depression of the normal power of resistance possessed by the tissues. Much attention has recently been given to the cells and cell changes, but what of the intercellular substance? Does it not normally play some restraining part in preventing riotous behaviour on the part of the cells? Normally, there is always a layer, however thin, of mucigenous material which separates the constituent cells in every tissue and membrane throughout the body; in carcinoma, however, the cells are not thus isolated, but touch one another. Has this no causative significance?

In old age the intercellular material undergoes a wasting change, and, as a result, its resistive power against the ingrowth of epithelial cells is lessened and the onset of carcinoma is favoured.

The overlying surface epithelium remains much longer active, and thus there is an influence inducing the cells to penetrate inwards among the tissues. The centrosome in cells on epithelial mucous surfaces occupies that part of the cell nearest the surface, and therefore the part most exposed to injury and irritation. The centrosome is the dynamic centre, and plays the leading part in the division of the nucleus, in the proliferation of the cell, and in the regulation of movement.

A study of the distribution of mucus-manufacturing structures reveals the striking fact that where mucus normally is least abundant malignant disease is most frequently located. This is the case where skin and mucous membranes meet at the edges of orifices, as at the lips, prepuce, and anus, in the pharynx below the middle (since there are many fewer mucous glands in this situation than in the upper part), and on the tonsil, where there are but few mucous glands or cells, even in the crypts. Malignant disease is common in the upper third of the œsophagus, where there are few mucous structures, and very common in the middle third, where there are practically none; it is least seen in the lower third, where mucous glands are numerous. The œsophagus is peculiar in being dependent almost entirely for its lubrication and protective coating on mucus passing down from above—from the nose and vault of the pharynx.

I have observed a number of cases of malignant disease of the œsophagus, and in these there has been much diminution of mucus secretion from

above, shown by the deficient action of the mucous membranes of the nose and pharynx. These patients suffering from malignant disease of the œsophagus almost without exception complained of chronic dyspepsia, and this I explain by their having been the victims of chronic hypomyxia of the stomach for many years. Malignant disease in the stomach is most frequently situated at the pyloric end; but although there is much mucus secretion in this situation, there are special reasons for this selection —it is the most dependent part, and most subject to injury by lumpy and improperly masticated food, and to constant irritation by the acid gastric juice. Such patients, too, are usually the subjects of deficient mucus supply from above, and of chronic hypomyxia naso-pharyngia, which accounts for the diminished mucus-protective coating in the stomach.

Throughout the whole extent of mucous membranes cancer is most seldom met with in the *small* intestine and in the *lungs*. As I have pointed out in previous chapters, there is more mucus poured into the small intestine than is to be found anywhere throughout the system, and the lungs have an abundant supply in the secretions of the lining membrane of the trachea and bronchi.

The urinary tract, again, is wonderfully exempt from cancer, and here, too, mucus exists in considerable quantities on the surface lining.

It is pathologically proverbial how malignant disease attacks and spreads in the mammary gland, but in this gland there are no mucous cells or glands whatever, not even in the ducts.

This deficiency may be accounted for since no special protection is necessary from irritating secretions, unless the milk were to become acid from the formation of lactic acid, and lubrication is not needed, as fat is the dominant element in milk.

In the salivary glands how rarely is cancer encountered, and here, again, mucin is largely present, and is an element of their secretion—notably so in the submaxillary and sublingual. When malignant disease is met with in salivary glands, the parotid, with its very meagre amount of mucus, is much the most frequently attacked. The exemption of tendon and cartilage, and the frequency with which bone is affected, are also noteworthy.

Hypomyxia being hereditary, the tendency to impairment of the mucus-forming function is often very evident in early life. When seen in early years, the evidence of hereditary transmission is usually present either in one or both parents. I have notes of two cases of sarcoma in the bones of children who were both hypomyxiatous, as were both their parents before them. The question arises, Does this help to explain the strange and unaccountable occurrence of sarcoma in children, and of congenital sarcoma, hitherto a baffling problem?

Two more features I made out, common to nearly all the cases of cancer included in the accompanying table: the first, that they were nearly all much addicted to tobacco-smoking, consuming from one to two ounces of tobacco per day; and secondly, that they were all without exception very much in the habit of consuming large quantities of common

salt with their food as a condiment, besides having had it liberally added during the cooking. Two of them were so addicted to salt-eating that they even had it sprinkled on salt bacon.

Both of these habits tend directly to bring about the condition of hypomyxia. The hot tobacco-smoke for a time may stimulate the mucous glands and cells to increased secretion, but soon causes desiccation and atrophy. Where the mucous membrane is naturally thin and feebly secreting this would occur much more quickly, and such are the people who cannot stand much tobacco and ought never to smoke at all. Excess of common salt is pernicious, because it has a solvent and thinning influence on the mucus and mucous membrane. It dissolves off the protecting layer of mucus that normally shields and protects and lubricates. Moreover, salt is itself a powerful irritant, and after a time, when taken in excess, brings about a loss of the secreting function in the mucous glands and cells.

Since the essential factor in cancer is intrinsic—probably a weakening of the inter-cellular resistance, so that the cells when proliferating can also penetrate into the intercellular spaces and substance—it may be that a myxastheniatous condition of the tissues favours, if it does not cause, this loss of resistance. Normally, as before remarked, there is always, even when reduced to a minimum, a layer of mucigenous material between cells everywhere in the body; it is possible that this is maintained in its natural tonic-resisting state by an internal circulation of

mucigenous matter from the intestine to the tissues. If this be so, a prolonged diminution of mucin in the alimentary tract would account for a deteriorative change upsetting the equilibrium between the cells and the intercellular tissues. With tissues thus prepared the effect of an injury or chronic irritation might be to determine such a morbid process as carcinoma or sarcoma, whereas in the healthy (orthomyxiatous) these would induce no such changes, however long continued, but might cause only a harmless inflammatory action. This theory might also be made use of to explain why carcinoma is an affection of the decline of life, hypomyxia being a senile change.

In the following table of cases of cancer it will also be noted that in nearly every instance there was a history of syphilis. It is very remarkable how the stress of secondary syphilis falls upon the mucous membranes, and how many hypomyxiatous patients have had syphilis or have inherited it. May this throw any light on the obscure but admitted connection between syphilis and cancer?

Cancer has been shown to be much more frequent among civilized than among savage peoples, among the denizens of town than in a rural population, and, in fact, to dog the footsteps of civilization. This may be explained by the fact that much that is incidental to town life is favourable to the development of hypomyxia. Foul and often dusty air and bad ventilation, especially in sleeping-rooms, are some of the most noxious influences. Although hypomyxia has been found to be commoner in town-dwellers, anyone

with an hereditary hypomyxiatous tendency, especially if in unfavourable surroundings, will readily become hypomyxiatous, no matter how rurally remote he may reside. The Boers might be cited as a people well known to be very liable to cancer, whose domestic sanitation is far from perfect, being emphatically bad as regards the ventilation of their sleeping apartments.

The immunity of the lower animals from cancerous processes is still unaccounted for. Wild animals are very seldom affected, and our domesticated animals but rarely. It has been proved that the domesticated animals most subject to cancer are not, as one might expect, the dirty-feeding pig, but those cleanly and affectionate friends and companions of man, the dog and cat. They often share with man the same unhealthy surroundings, and this doubtless to some extent accounts for their liability. Another fact also helps to elucidate this obscure point, for the dog and cat possess much less provision for the formation of mucus than the horse, ox, sheep, and pig. Their turbinated nasal structures are excessively convoluted to enhance the sense of smell, and so mucus secretion is a subordinate factor, little or no mucin being ever formed in an olfactory region.

Now, every one of the cases of malignant disease to which I refer, and of which I have made notes, has been hypomyxiatous to a varying extent. As most of these were instances of the mucous membrane of the alimentary or upper respiratory tract being affected, I am inclined to believe that there is a connection between the two states, and that the

hypomyxiatous is a forerunner of the cancerous, especially in view of the fact that three-fourths of all cancer in man occurs in the alimentary canal.

CASES.

After the lecture a number of patients were shown as typical cases which had been treated on these principles. The students were thus enabled to personally inspect them and question them on the beneficial effects of the mucin treatment in each individual instance. Below are appended brief notes of the histories of some of these patients taken from my case-book, which are similar to those of many others treated in the same manner with equally gratifying results.

1. A. H., aged eighteen years, had been under the mucin treatment for eighteen months, with the result that all her symptoms were relieved. She had received hospital treatment for two years before, with no benefit. In her case there was well-marked atrophic rhinitis, with many crusts and much fœtor. So distressing were the symptoms that she had been obliged to leave her situations as a domestic servant. There was also considerable dryness of the laryngeal mucous lining, which was accompanied by much hoarseness of the voice. This condition was also speedily cured by spraying with mucin solutions.

2. G. E., a carpenter by trade, had suffered from severe atrophic rhinitis for many years. He

had been a patient at various hospitals, and had been under various systems of treatment, having been obliged to leave workshop after workshop owing to the complaints made by his fellow-workmen at the bench of the fœtor of his breath. He had gone in for the mucin treatment thoroughly, observing and practically carrying out every detail, as he found at once that he obtained much relief from doing so. He now expressed himself as quite well and comfortable, and examination of the nose revealed neither crusts nor fœtor. Mucin feeding had been carried out: from eight to twelve mucin tabloids a day had been taken; this gave relief to the accompanying distressful gastric conditions.

3. M. M., a receiving-girl at a laundry, working much in a foul and dusty atmosphere. She had been under treatment for years for crusts and fœtor in the nose. The mucin treatment had been used for six months. It had been thoroughly carried out, with most satisfactory results. The syringing was now only done two or three times a week.

4. C. L., a parlourmaid, who had been obliged to leave good situations on account of the sickening odour of her breath. She had been attending doctors and hospitals for years for this complaint (atrophic rhinitis and pharyngitis). Two years had now elapsed since she first commenced the mucin treatment, and she had remained eighteen months in her present situation, having lost all the local ailment and vastly improved in her general health. She now only syringed occasionally.

5. E. B., thirty-eight years of age, a clerk, had

been under hospital treatment for seven months for total loss of voice, necessitating the giving up of his situation. He was found to be suffering from rhinitis and pharyngitis sicca, with the frequently accompanying state of so-called pachydermia laryngis. Under the mucin treatment his voice gradually improved from week to week, and was soon quite restored, and he was able to resume his ordinary occupation.

6. H. W., aged twenty-one, a turner in a brass-finishing foundry, was another case similar to the last. He had been under treatment for two years for hoarseness, almost amounting to total loss of voice. The nasal and pharyngeal mucous membranes were dry and thin, and that of the larynx was in a similar state, with crusts on the cords and in the inter-arytenoid space. In one week, under the mucin treatment—nose douch and throat and laryngeal spray—the voice was much improved, and in one month quite restored.

Three cases illustrating the combination in the same patient of hypomyxia of the nasal, pharyngeal, and gastric mucous membranes were also shown :

Miss T., Mrs. J., and Mrs. W., all of middle age, had suffered exceedingly from gastric trouble. The leading symptoms were pain, flatulence, constipation, and vomiting after food. In each case the nose and throat gave evidence of thinness of the lining membrane and deficient secretion. Rhinitis and pharyngitis sicca served as an indication of a similar condition of the stomach and bowels.

Mucin had a most beneficial effect upon them, all

the painful symptoms rapidly disappearing under its influence, and their enjoyment of life being restored.

I will only mention one case as illustrative of the beneficial influence of mucin locally in epithelioma, the case being that of No. 17 in the following table, epithelioma of the auricle. The whole outer surface of the ear was implicated in one ulcerated, fœtid, painful, bleeding mass. The pain was so severe as to prevent sleep. A solution of six mucin tabloids to one ounce of sterilized water was used to cleanse the affected part three times a day, and a dressing of soft lint soaked in the same preparation was kept constantly applied. The pain was at once alleviated and sleep obtained. The surface was soon quite clean and the fœtor ceased. The discharge lessened and the bleeding stopped. The topical application of mucin in carcinoma certainly retards growth, soothes, and has a marked cleansing effect.

THE END

APPENDIX

DIRECTIONS FOR PREPARING SOLUTIONS.

I.—For Intratympanic Injection.

Dissolve one mucin soloid and six mucin tabloids in one ounce of hot sterilized water, and after filtering through muslin, use for injection as hot as can be borne. A few drops only to be used.

II.—For Nose Douche and Gargle.

Dissolve thoroughly two or three mucin soloids in a teacupful of warm water, and use as a douche for the nose or with the nose boat, or as a gargle.

If disagreeable, dilute more or substitute six tabloids for the soloids, but filter through muslin before using.

III.—For the Spray.

Tie up six mucin tabloids in a piece of muslin, crush completely, and then soak the muslin bag for twenty minutes in two tablespoonfuls of very warm sterilized water. Squeeze this out thoroughly, and use the liquid as a spray for the nose or throat while warm.

It is better to prepare these solutions as required than to make a quantity at one time.

TABLE OF SEVENTEEN CASES OF

No.	Sex and Age.	Occupation.	Disease.	Common Salt.
1	M., 56.	A "backer of horses"; much indoors and in close rooms.	Malignant of the rectum.	Taken an excessive amount for over forty years.
2	M., 30.	Labourer with the National Telephone Company; much in dust at underground work.	Sarcoma of the tonsil.	Taken an excessive amount all his life; a great meat and bacon eater.
3	F., 45.	Housewife; much indoors.	Malignant of the liver.	Had always taken a considerable quantity.
4	M., 69.	Worked for many years in a very dusty sugar warehouse.	Sarcoma of the left side of the pharynx with a mass of glands in the neck.	Has consumed a very large amount all his life.
5	M., 51.	Cabinet-maker; indoor work and often very dusty.	Malignant of the pharynx and parotid region.	Has always taken a very large amount.
6	F., 45.	Housewife.	Malignant of the omentum.	Has always taken a considerable quantity, and has had a ravenous appetite for shellfish.
7	M., 65.	Piano-polisher; indoor work and often very dusty.	Malignant of the œsophagus.	Has always taken a large amount.
8	M., 68.	Indoor messenger.	Malignant of the œsophagus.	Very large consumer of salt all his life.
9	M., 59.	Carman on the Midland Railway; often in foul dust.	Epithelioma, glosso-epiglottidean region.	Very large amount all his life. Put it on salt bacon.
10	M., 35.	Newsagent (dusty indoor work).	Malignant lympho-sarcoma of the cervical glands.	Had always been fond of salt with his food.
11	M., 71.	Hairdresser in the City; underground and dusty.	Epithelioma, with enlargement of the glands in the neck.	Taken salt in large quantities for fifty years.
12	M., 65.	Engineer; indoors; worked in iron dust.	Malignant of the œsophagus.	Taken salt with all his food in large amount all his life.
13	F., 41.	Housewife; 'always indoors.'	Epithelioma of the tongue.	Very fond of salt, and had taken it in large amount.
14	M., 28.	Broker's clerk; underground dusty office.	Sarcoma of the tonsil.	Always taken salt in large amount.
15	M., 43.	Dustman (very dusty work).	Carcinoma of the pylorus.	Taken an excessive amount of salt always.
16	F., 28.	Domestic cook.	Epithelioma of the tongue.	Always taken an excess.
17	F., 73.	Housewife.	Epithelioma of the auricle.	Fond of salt.

Tobacco.	Syphilis.	Hypomyxia.	No.
Smoked cigars, cigarettes, and a pipe to excess.	Yes.	Has suffered from well-marked hypomyxia naso-pharyngea, gastrica et colica for thirty years.	1
An ounce a day for years.	,,	Well-marked hypomyxia naso-pharyngea et gastrica et colica.	2
No.	,,	Hypomyxia naso-pharyngea moderately marked, but gastrica et colica quite evident.	3
At least one ounce a day for fifty years, often two.	Doubtful, but was exposed to infection in his younger days.	Hypomyxia naso-pharyngea very well marked, and also gastrica et colica very evident.	4
One ounce a day, but often got through one pound a week.	Yes.	Hypomyxia naso-pharyngea et gastrica et colica very evident.	5
No.	Doubtful.	Hypomyxia naso-pharyngea slightly, but gastrica et colica evident.	6
Smokes over one pound a week.	Yes.	Hypomyxia naso-pharyngea and gastrica et colica very well marked.	7
Smokes very large quantity.	Doubtful.	Hypomyxia naso-pharyngea well marked.	8
One ounce a day.	Yes.	Hypomyxia naso-pharyngea et gastrica very well marked.	9
Half an ounce a day at least.	Doubtful.	Hypomyxia naso-pharyngea et gastrica well marked.	10
Over an ounce a day, often more, for all his working life.	Yes.	Hypomyxia naso-pharyngea et gastrica et colica very well marked.	11
Over one ounce a day.	,,	Hypomyxia in nose and throat and stomach well marked.	12
No.	No.	Hypomyxia in nose, throat, stomach, and bowels evident.	13
Smoked nearly one ounce a day.	Yes.	Hypomyxia naso-pharyngea et gastrica.	14
Smoked one ounce a day for years.	,,	Hypomyxia well marked in all the usual situations.	15
No.	No.	Hypomyxia very well marked indeed.	16
No.	Doubtful.	Hypomyxia moderately well marked.	17

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