

"6. A single loop of silk is passed by a long needle through the remains of the glosso-epiglottidean fold of mucous membrane, as a means of drawing forward the floor of the mouth, should secondary hemorrhage take place. This ligature may with safety be withdrawn the day after operation, and, as it is invariably a source of annoyance to the patient, it is always desirable to adopt this rule.

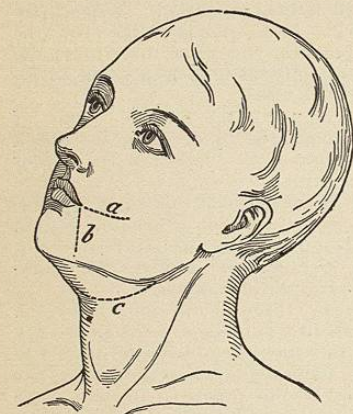


FIG. 4726.—Incisions for Operations on the Tongue. a, Incision through the cheek, after Jaeger; b, von Langenbeck's incision, with division of the jaw; c, incision for removal of glands and ligature of lingual arteries as practised by the writer.

The difficulties and dangers of the operation are few and more imaginary than real. Hemorrhage, the *bête noire* of most surgeons who contemplate removing the tongue, is in reality easily controllable and frequently trifling. I have twice removed the entire tongue without having to secure a single vessel, and more than once have only had to twist one lingual artery." The operation practised by the writer is that commonly known as Billroth's, viz., excision of the tongue by scissors with preliminary ligature of the linguals. This operation enables the surgeon not only to avoid danger from hemorrhage, but also to remove the neighboring glands and structures which are involved in the disease through the same incision made for ligating the lingual arteries. In Billroth's operation the mortality is not greater than that following other operations.

Billroth's Operation.³⁵—The head of the patient having been well thrown back and the chin turned to the side opposite to that on which the artery is to be tied, a curved incision is made from near the symphysis menti to near the angle of the lower jaw, the convexity downward, having its lowest portion running along the upper border of the great cornu of the hyoid bone. A careful dissection is then made through the platysma and deep cervical fascia, and if any veins are cut they should be ligatured before proceeding further with the operation. The tendon of the digastric muscle should now be searched for, and in the angle which this tendon forms with the hyoid bone, the artery will be found—but not immediately, for covering it we have the hyoglossus muscle with the hypoglossal nerve and ranine vein running over it. The hyoglossus muscle should be carefully divided, and then, all bleeding having been arrested by Pean's forceps and ligatures, the artery is felt pulsating at the bottom of the wound. Hemorrhage should now be completely arrested and the artery being brought into view can be easily tied. The artery on the opposite side having been secured in the same way, any glands that may be involved should be looked for and removed through these incisions in the neck. As a rule, they can be found without difficulty. It is a good rule to remove all the submaxillary lymphatic glands as well as the submaxillary salivary gland on the same side as that in which the cancer is. It is well before clearing the submaxillary space to ligate the facial artery.

The mouth should now be kept open with a gag and

the tongue drawn out by a double ligature passed through its substance about an inch from the tip. The operator, holding the ligature in his left hand, draws the tongue outward and upward and removes it with a straight pair of scissors. The attachments of the tongue to the jaw and pillars of the fauces should first be freed and then the muscles at the base, and now, the attachment to the hyoid bone being divided with a few short cuts, the whole tongue will come away, leaving the epiglottis behind. The removal of the tongue takes, as a rule, only two or three minutes. If the tissues of the floor of the mouth be involved, they should now be attended to.

The wounds in the neck, which during the excision of the tongue should be filled with carbolized sponges, are then sewed up and dressed with aseptic gauze dressings. If the floor of the mouth has been removed it will be better to pass a large drainage tube into the mouth through the neck incision; in fact, this ought to be done in every case. The mouth is now packed with sticky iodoform* gauze and the operation is complete.

The after-treatment is the same as after excision of the tongue by other methods.

The advantages of the operation above described are many:

1. The diseased structures, and especially the glands, are discovered and removed with the greatest ease through the neck incisions.

2. The removal of the tongue is bloodless, and there is no fear of secondary hemorrhage.

3. The incision made by the scissors is a clean-cut one, and there is no bruising of the tissues as in the operation with the *écraseur*.

4. The tongue can be more completely and more easily removed with scissors than with any *écraseur*.

5. Drainage of the mouth can be more thoroughly carried out by means of the incisions in the neck.

6. The operation is easy of performance and few instruments are required, no more than every surgeon possesses, viz.: straight scissors, knife, and a few pairs of Pean's forceps.

Kocher's Operation.³⁶—A still more radical and extensive operation than the one described above is the operation performed by Kocher, of Berne. It is the only operation for the removal of the tongue which aims at preserving the parts in a thoroughly aseptic condition. Tracheotomy is first performed and a well-fitting cannula introduced; the pharynx is then packed with a carbolized sponge with a cord attached, so that it can be easily re-



FIG. 4727.—Line in Neck showing Extent of Kocher's Incision for Removal of the Tongue.

moved when necessary. An incision is now made commencing a little below the tip of the ear and extending down the anterior border of the sterno-mastoid muscle to

*The sticky gauze is prepared with resin, alcohol, and iodoform. Weir, of New York, recommends the following formula as an improvement on that introduced by Billroth: Resin, 10 parts; castor oil, 6 parts; iodoform, 5 parts, and alcohol, 15 parts. This is rubbed into the gauze, and certainly, as the alcohol evaporates, it is sticky enough. The writer has, in cases in which the gauze failed to remain in the mouth, painted the surface over with the liquid.

about its middle, then forward to the body of the hyoid bone, and along the anterior belly of the digastric muscle to the jaw. The resulting flap is turned up on the cheek and the lingual artery is ligatured as it passes under the hyoglossus muscle. The facial artery and any veins that may be in the way are also secured. Commencing from behind, all the structures in the submaxillary fossa are removed, viz., the lymphatic glands, the submaxillary, and, if necessary, the sublingual glands. The opposite lingual artery is now tied by a separate incision if the whole tongue is to be removed. The mucous membrane along the jaw and the mylo-hyoid muscle are then divided and the tongue is drawn out through the neck incision, and removed with scissors or galvano-cautery; the latter is preferred by Kocher, as there is less liability to after-oozing. The after-treatment is most important; if the operation be an extensive one, the external wound should not be closed. Kocher's endeavor is to avoid the two great after-dangers of excision of the tongue, pneumonia and general septicæmia. To prevent the discharge causing infection, the whole cavity of the mouth and pharynx is plugged with carbolized sponges and iodoform gauze. The operation as first described was performed under the spray. The patient is fed by the rectum partly, but chiefly by the throat with a tube, twice a day, when the dressings are changed. Thus, if all the minute directions are enforced, the wound remains aseptic throughout, and no food or discharge from the wound can possibly enter the air passages. There is one thing that Kocher has not guarded against, and that is vomiting; should the patient vomit, as is so often the case after the administration of anesthetics, the elaborate preparations against sepsis may come to naught.

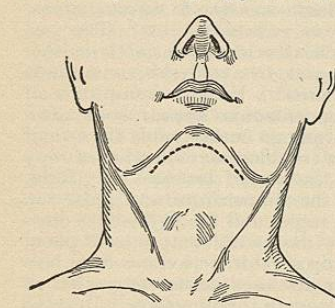


FIG. 4728.—Curved Line Below the Chin, showing the Extent and Situation of Billroth's Incision.

In Kocher's hands this operation has been most successful. He had one death in fourteen cases, eight recurred, one died a year afterward of pneumonia, one lived fourteen months, two five years, and one six and a half years.

With the modern methods of keeping the mouth aseptic, and performing all operations in the mouth with the patient in the Trendelenburg position, tracheotomy is rendered unnecessary. There is no doubt that it adds to the danger of the operation. The one death in Kocher's series of cases was caused by hemorrhage from the tracheotomy wound.

Billroth's modification of Regnoli's operation is very simple and much to be preferred to the original operation. The longitudinal incision is omitted and the curved incision is carried farther outward on each side, so that the linguals may be ligatured before removal of the tongue. It is a very suitable operation in those cases in which the submaxillary fossa is involved in the disease.

The tongue can be removed by scissors. **Removal of the Tongue after Division of the Lower Jaw.**—This operation was introduced by Sédillot, of Strasbourg, and afterward practised by Syme, of Edinburgh. It consists in making a vertical incision in the lower lip, sawing through the inferior maxilla at the symphysis, separating the two sides of the jaw, and drawing out the tongue and removing it by scissors, *écraseur*, or knife. The divided portions of the jaw are afterward wired together. It is a good plan to make the holes for the sutures before dividing the jaw.

Von Langenbeck³⁸ has advised a lateral section of the

jaw opposite the first molar tooth. The skin incision is made from the angle of the mouth downward (see Fig. 4726). Division of the jaw adds to the danger of the operation, and makes it more unpleasant for the patient. Convalescence in these cases is usually prolonged. It is seldom necessary to divide the jaw in extirpating the tongue, even when the disease is most extensive, for the infiltrated glands in the floor of the mouth can be easily removed by one of the submental operations, with less danger and greater comfort to the patient. In some cases in which the disease has extended to the gums and bone itself, a portion of the jaw may require resection. It is often sufficient to remove the alveolar process only.

Occasionally, after removal of the tongue through the mouth, it is found that the glands in the submaxillary region subsequently become enlarged, although apparently healthy at the time of operation; then, if they appear movable and there is no recurrence of the disease in the mouth, a special operation for their removal is advisable. If, on the other hand, the glands are fixed and the tissues infiltrated, operation is of little avail. In cases of carcinoma in which the glands and the sterno-mastoid are first affected, operation is usually of little benefit.

Butlin³⁷ recommends that after removing part or the whole of the tongue, as the case demands, the surgeon should wait three or four weeks, and then by a separate operation remove the glands in the cervical, submental, and submaxillary regions. An incision is made along the anterior border of the sterno-mastoid muscle, from the mastoid to below the thyroid cartilage, and a second incision from the symphysis menti to the first incision about the level of the thyroid cartilage; the flap is lifted up from below and all the glands are removed, and then the flap is replaced and sutured.

The following list of operations, taken from Barker's article in "Holmes' System of Surgery," vol. ii., 1882, will prove of interest to the reader, and will serve to give him some knowledge of the history and progress of the operation of excision of the tongue.

EARLIEST IRREGULAR OPERATIONS.

1. *Pimpernelle*, Died 1658, was probably the first to excise the tongue with success.
2. *Marchetti*, 1664. Extirpated a cancer of the tongue by actual cautery; probably the first recorded extirpation for this disease.
3. *Val. Hoffmann*, 1692. Removed a tongue affected with macro-glossia.
4. *Ruysch*, 1737. Excised tongue with knife.
5. *Memonista*, 1737. Cauterized with a hot iron.
6. *Heister*, 1743. Gave the first methodical description of operative treatment of cancer of the tongue.
7. *Burdorf*, 1754. Excised a true cancer of the tongue with knife.
8. *Guthrie*, 1756. Was probably the first English surgeon to excise a cancer of the tongue, using the knife, followed by cauterization of the cut surface.
9. *Louis*, 1759. Ligatured a fungus of the tongue, and in 1774 spoke in favor of total excision for cancer.

DEFINITELY DESIGNED OPERATIONS.

Ligature.

10. *Inglis*, 1803. Introduced ligature of the tongue from the mouth for cancer, the cord being drawn with needles through the tongue and round the tumor. (*Edin. Medical and Surgical Journal*, 1805, p. 34.)
11. *Major*, 1827. Split the tongue down the centre to apply ligature to the diseased half through the mouth.
12. *Cloquet*, 1827. Also split the organ, but introduced the ligature by suprahyoid incision and strangled the diseased half. (*Archives Gén.*, xii., 511.)

Wedge-shaped Excision.

13. *C. J. Langenbeck*, 1819. Introduced wedge-shaped excision of the diseased part of the tongue with careful suture of resulting flaps. ("Biblioth. f. Clin. u. Augenh.," Bd. 2, 487.)

Preliminary Ligature of the Lingual.

14. *Mirault*, 1833. Introduced preliminary ligature of lingual artery to give a clear, bloodless field for extensive incisions. He was followed later by Roux and Roser. (*Archives Gén.*, vi., 5, 636.)

Ecrasement.

15. *Chassaignac*, 1854. Introduced the *écraseur*, employing Cloquet's suprahyoid method and defining it more exactly, i.e., using puncture instead of incision. ("Traité de l'*écrasement*," lin., p. 31.)

16. *Middeldorp*, 1854. Introduced the galvanic éraseur (*Schmidt's Jahrbücher*, Bd. 107-200.)
 17. *Nummely*, 1856. Introduced the suprathyoid use of the éraseur into England. Adopting Chassaignac's modification. (*Med. Times and Gaz.*, 1856.)
 18. *Girouard*, 1857. Employed circumpuncture with rods of caustic. (*Archives Gén.*, 1857.)

Division of the Cheek.

19. *Jaeger*, 1831. Was the first to divide the cheek for free access to the tongue. ("De Extir. Lingue," 1831.)
 20. *Maisonneuve*, 1858. Divided both cheeks from the angle of the mouth for same purpose.
 21. *Collis*, 1867. Reintroduced Jaeger's operation, using the éraseur. (*Dub. Quart. Journ.*, xliii., 1867.)

Division of the Lower Jaw.

22. *Roux*. Died 1836. Was the first to divide the lower jaw and lip in mid-line in order to gain free access to the floor of the mouth and tongue. (*Maisonneuve, Thèse*, p. 146.)
 23. *Sédillot*, 1844. Improved this method by dividing the bone by a serrated cut. (*Gaz. des Hôp.*, 1844, 83.)
 24. *Syme*, 1857. Divided the jaw in mid-line and excised with knife. (*Lancet*, 1858, vols. 1. and II.)
 25. *Billroth*, 1862. Divided the jaw and soft parts at the side in two places, and turned down the flaps of skin and bone so formed, replacing and wiring the bone afterward. (*Archiv f. klin. Chir.*, 1862.)
 26. *B. von Langenbeck*, 1875. Divided the jaw and soft parts opposite the first molar tooth on one side, in order to gain access to the side of the mouth for removal of tongue, glands, and part of palatal arch and tonsil.

Inframaxillary Operations.

27. *Regnoli*, 1838. Opened the floor of the mouth from below by an incision from middle of hyoid bone to chin, ending in another semilunar incision along the border of the jaw. The tongue was drawn through the opening and excised. (*Bull. Sci. méd. Bologna*, 1838.)
 28. *Czerny*, 1870. Modified Regnoli's procedure, forming lateral flaps.
 29. *Billroth*, 1871-76. Modified it still further, extending both ends of the curved incision much farther backward, and omitting the incision in mid-line. (*Archiv f. klin. Chir.*, Bd. 16, Hft. 2.)
 30. *Kocher*, 1880. Introduced a method of opening the mouth from behind and below the angle of the jaw to reach the base of the tongue and remove it with all the lymphatic glands situated there. (*Deutsche Zeitschrift f. Chir.*, Bd. xiii., 146, 1880.)

Results of the Operation.—The immediate results following excision of the tongue are fairly good, considering the severity of the operation. Whatever operation for excision of the tongue is practised, the mortality in a series of cases is about the same, so that the method of operating seems to have less effect on the result than the after-treatment. Still, certain operations are more favorable than others as regards the recurrence of the disease, and it is reasonable to suppose that when the disease is most completely removed it is least likely to return.

Whitehead in 139 operations had 20 deaths, or 14.3 per cent. *Butlin*³⁷ has collected 333 cases of excision of the tongue from the statistics of 4 operators, and finds that there were 42 deaths due to the operation. Of 202 uncomplicated cases only 14 died. In 109 cases in which there was either division of the lower jaw or excision below the jaw, the mortality was 25. About twenty per cent. of patients live three or more years after operation.

With regard to the frequency of recurrence it may be said that recurrence is the rule. *Barker*³⁹ has collected 170 cases in which the whole or part of the tongue was extirpated, and in only 17 cases was there non-recurrence after an interval of a year. According to the same author the duration of the disease, in cases not operated on, was 11.7 months, and in those operated on 19 months, a clear gain of 7.3 months. The longest period of freedom from the disease after operation seen by the writer was 28 months. It is to be hoped, with the modern methods of antiseptics which are now so universally practised, that the excision of the disease will be more complete, and hence the period of freedom from recurrence prolonged, and also the mortality after operations much decreased.

Dangers of Excision.—Formerly the danger most dreaded during and after operations on the tongue was hemorrhage, primary and secondary. Since the galvanic éraseur has been discarded, secondary hemorrhage is much less frequent, and both primary and secondary hemorrhage is avoided by preliminary ligature of the linguals. This procedure is a very simple one when the

tongue is removed by one of the submental operations, as *Billroth's*, *Kocher's*, etc. Even should the linguals not be previously ligatured, there is usually little danger from hemorrhage, owing to the facility with which a bleeding vessel can be seized by the modern artery forceps.

The greatest danger connected with excision of the tongue is without doubt septic pneumonia, or other lung affection, produced by direct infection from the fetid discharges of the decomposing wound. In some cases there is gangrene of a portion of the lung, or numbers of small, foul, circumscribed abscesses; in others a condition of bronchopneumonia. Whatever affections of the lung ensue after excision of the tongue or severe operations on the mouth and jaws, they are all due, either to the inhalation of fetid gases from the sloughing wound in the mouth, or to discharges from the same source passing down the trachea to the bronchi and lungs. In other words, the lung affection is produced by direct infection from a foul wound. *Barker*⁴⁰ has collected 52 cases of death following operation; of these 30 were fatal from some pulmonary affection; 12 from septic affections, in 6 of which no mention is made of the condition of the lungs; and in the remaining 10, death was due to various causes, as shock, collapse, asphyxia, exhaustion, etc. The passage of blood into the trachea during operation is another cause of lung affection, and, to avoid this, anaesthesia should not be too profound. Usually symptoms of pneumonia and bronchopneumonia appear soon after the operation. The case may go on favorably for two or three days, then there is a troublesome collection of rosy mucus in the mouth and the wound becomes very fetid, cough is complained of, the temperature and pulse run up, respirations are very rapid, and the patient becomes cyanosed and dies in a few days with symptoms of pneumonia. The breath during all this period has been horribly fetid. The autopsy discloses acute congestion of the trachea and bronchi, and in the lungs are numerous small foul-smelling abscesses with, in places, patches of gangrene. Cases occur also in which the patient dies of simple pneumonia threatening to become gangrenous.

Treatment after Excision.—The most important point in the after-treatment is to preserve a condition of asepsis in the wound, for, as has been shown above, the greatest danger is due to direct septic infection from the wound itself. Again, the swallowing of blood at the time of operation, tainted with the foul discharges of the cancerous ulcer, should be carefully guarded against by having the mouth thoroughly and frequently washed out with some antiseptic solution, as Condy's fluid, carbolic acid, etc., before operation, and, during operation, avoiding a condition of too profound anaesthesia. After operation the wound in the mouth should be packed with sticky iodoform gauze as recommended by *Billroth*, painted over with alcoholic solution of iodoform and resin, or at least dusted with iodoform crystals. *Billroth*, as already mentioned, had seventeen cases of excision without a death or even a serious symptom, owing to the mouth being kept thoroughly aseptic by the packing with sticky iodoform gauze, which in a day or two becomes incorporated with the wound. The writer has found great difficulty in keeping the gauze in the mouth after the first day; he has found that it becomes loose and covered with mucus, and that the patient finds it very troublesome. He has used with good results the following paint, advocated by *Weir*, of New York, to impregnate gauze: Iodoform, 5 parts; resin, 10 parts; castor oil, 6 parts; and alcohol, 15 parts. When painted on, the alcohol evaporates and leaves the resin and iodoform behind coating the surface of the wounds. This should be painted on twice daily. The first three or four days after operation the patient should be fed entirely by the rectum, and occasionally allowed to rinse out his mouth with water to allay thirst. After this, feeding should be by the mouth through a tube introduced into the oesophagus. A very good arrangement is a soft catheter with a piece of rubber tubing attached to it, and to this again is attached a glass funnel; by pouring liquid food into the funnel the patient can be easily and

comfortably fed. Should any fætor appear in the wound, the mouth should be frequently washed out with a solution of Condy's fluid, carbolic acid, or chlorate of potash. Washing out is much facilitated if there is a drainage tube through the incision in the submaxillary region.

Palliative Treatment of Cancer of the Tongue.—The object is to relieve pain and lessen fætor and salivation. To relieve pain, division of the lingual nerve is advised, and also the administration of opium. Fætor and salivation may be controlled by frequent washings with some antiseptic solution, as Condy's fluid or carbolic acid, and afterward the dusting on of iodoform or salicylic acid. Bleeding, which so frequently terminates the case, may be controlled by styptics, or by lint soaked in tincture of the muriate of iron and kept continually pressed against the bleeding points with forceps. Should the bleeding be distinctly arterial, then ligature of the lingual artery of that side is the only remedy.

Excision or Stretching of the Lingual Nerve.—Division of the lingual nerve was first put in practice by *Hilton*⁴¹; then *Moore*⁴² advised a more simple procedure than *Hilton's*. This was to make an incision with a curved bistoury through the mucous membrane in a line from the last molar tooth to the angle of the jaw. The simplest method is as follows, and this method is suitable for division, excision, or stretching. The writer has practised it and found no difficulty in reaching the nerve. The mouth should be opened with a suitable gag, then a ligature is to be passed through the tongue near the tip, and the tongue drawn out to the side opposite to that on which it is desired to stretch the nerve; this puts the nerve on the stretch and it can be felt standing out as a cord at the side of the tongue; a sharp hook is passed under it, and then the nerve is exposed by a small incision, pulled out by a blunt hook, and excised or stretched as the necessities of the case may indicate. *Mr. Clement Lucas*⁴³ was the first, as far as the writer's knowledge goes, to put this plan in practice.

Francis J. Shepherd.

REFERENCES.

- ¹ Diseases of the Tongue, p. 231.
² System of Surgery, vol. i., ed. 1884, p. 585.
³ Treatise on Hæmophilia, 1872.
⁴ Oester. medicinische Woch., 1846.
⁵ Legouest: Traité de chir. de l'armée, 1872.
⁶ Diseases of the Tongue.
⁷ Lancet, August 26th, 1857, quoted by *Fairlie Clark*.
⁸ Histoire de l'Acad. Roy. des Sciences, 1742, p. 247 of Memoirs, quoted by *Barker* in *Holmes' System of Surgery*, vol. ii., 1883.
⁹ Chalk: Transactions of Pathological Society of London, vol. viii., p. 305.
¹⁰ Fehleisen: Berlin. klin. Woch., No. 50, 1887.
¹¹ Ferguson: Practical Surgery, fifth edition, p. 519.
¹² Pitha and *Billroth*, Band 6, 1866-73.
¹³ Stromeyer: Chir. Krankh. d. Kopfes, 1868.
¹⁴ Clinical Surgery of India.
¹⁵ Pitha and *Billroth*: Handb. d. Chirurgie, p. 329.
¹⁶ Transactions of the Pathological Society, vol. xii., p. 234.
¹⁷ Ibid., vols. xv. and xviii.
¹⁸ Loc. cit., p. 213.
¹⁹ Loc. cit., p. 247.
²⁰ Loc. cit., p. 250.
²¹ Loc. cit., p. 95.
²² Loc. cit., p. 107.
²³ Loc. cit.
²⁴ Loc. cit., p. 590.
²⁵ Klin. Chir.
²⁶ Loc. cit.
²⁷ Loc. cit.
²⁸ Practice of Surgery, fourth edition, vol. i., p. 603.
²⁹ Koenig: Lehrbuch der Chirurgie, Bd. 2, p. 451.
³⁰ Brit. Med. Journ., vol. ii., p. 765, 1883.
³¹ International Encyclopedia of Surgery, vol. v., p. 508; and British Medical Journal, April 21st, 1888.
³² Heath: British Medical Journal, April 21st, 1888.
³³ Transactions of the International Medical Congress of 1881, vol. ii., and Lancet, October 23d, 1881.
³⁴ Shepherd: Annals of Surgery, November, 1885.
³⁵ Deutsch. Zeitschrift für Chirurgie, 1880.
³⁶ The Operative Treatment of Malignant Disease, second edition, 1900.
³⁷ Vorlesungen über Akiurgie, Berlin, 1888.
³⁸ Loc. cit.
³⁹ Guy's Hosp. Rep., second series, vol. vii., 1852.
⁴⁰ Med. Chir. Trans., vol. xiv., 1862.
⁴¹ British Medical Journal, November 15th, 1884.

TONICS.—Tonics are medicines that promote nutrition and thus increase the strength of the body when it is reduced. The term tonic is derived from the Greek word *tonos*, tension, and was applied to agents that restore the normal strength, because it was supposed that they specially increase the tone or tension of the contractile tissues, that is, restore the constant, active, but weak,

involuntary contraction normally existing in all organs containing such tissues. They were held to act either directly upon the contractile tissues, or upon the nerves by which they are innervated. This view is no longer entertained, as it is evident that the tone or strength of all organs and tissues depends upon the state of their nutrition, any diminution of which becoming manifest in more or less weakness and loss of functional power.

For practical purposes all tonic medicines may be divided into three classes: *gastric tonics*, *blood tonics* or *hamatinics*, and *general tonics*. Gastric tonics improve the digestive process when it is enfeebled, thus enriching the blood, and supplying all the organs and tissues with an abundance of nutritive material. Blood tonics, or hamatinics, supply the blood with material in which it is deficient, especially increasing the number of red blood corpuscles. General tonics increase the nutrition and weight of the body by augmenting or otherwise modifying the process of assimilation in the tissues.

GASTRIC TONICS.—Some of the medicines that improve the process of digestion when it is weak or imperfect, act directly upon the organs of digestion, enabling them to perform their function more powerfully; others, however, have no direct influence upon the stomach and intestines, and act only upon the substances undergoing digestion, hastening this process. The latter are distinguished from the former by the term *digestives*.

Nearly all gastric tonics have an intensely bitter taste, and act similarly upon the digestive organs. Hence they are called *bitter tonics*. Since they closely resemble one another in action, it is unnecessary to consider them separately, with the exception of the principal alkaloids of cinchona and nux vomica, which are supposed to promote nutrition by acting also upon other organs.

BITTER TONICS.—All bitter tonics increase the secretion of saliva, and, soon after coming into contact with the gastric mucous membrane, produce a feeling of hunger. In consequence of the stronger appetite a larger quantity of food is eaten. In cases of atonic dyspepsia the digestion of the large meal is not attended by the feeling of heaviness and discomfort, and other symptoms which usually result from slow and imperfect digestion, showing that the bitter tonics cause some decided improvement in the digestive process. This improvement, however, follows only when the bitter tonics are given in moderate doses; excessive doses, especially if frequently repeated, soon causing symptoms of gastro-intestinal catarrh, nausea, vomiting, and diarrhoea.

In regard to the mode of action of bitter tonics the following facts have been ascertained:

1. They increase the salivary secretion. The saliva hastens the digestion of amylaceous food and stimulates the gastric glands, and thus excites an abundant secretion of gastric juice. It has been held that this sufficiently accounts for their utility in cases of atonic dyspepsia (*Leube*).

2. They gently irritate the gastric mucous membrane, and thus, it is supposed, excite the feeling of hunger. As the larger quantity of food consumed is digested more easily and speedily in cases of dyspepsia, it may be assumed that the secretion of gastric juice becomes augmented, either directly by the moderate irritation, or indirectly by the greater relish of the food. It is supposed that in many cases of dyspepsia due to slight catarrh of the stomach, the moderate irritation gradually restores the normal circulation of the gastric mucous membrane.

3. In experiments it has been found that bitter tonics retard fermentation and putrefaction. The small doses usually effectual in atonic dyspepsia may doubtless exert some antiseptic influence, but it is improbable that their utility is chiefly due to this action.

4. *Cetrarin* and *calumbin*, injected into the jugular vein of animals, cause a rise of the general blood pressure by exciting the vaso-motor centre (*Koehler*). Hence it has been supposed that possibly all bitter tonics may to some extent act like *digitalis*, which, in indigestion dependent upon enfeebled heart action, improves the