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VICIOUS CIRCLES.*

THE term "vicious circle" (*circulus vitiosus*) denotes a morbid condition in which cause and effect are so correlated that cause becomes effect, and effect becomes cause. *Ablata causa cessat effectus* and *ablato effectu cessat causa.*

Many such circles are met with in disease, as indeed might be expected from the complexity of the processes involved; the better those processes are understood, the more closely will they be found correlated, and the more often will reciprocal relations be observed.

The study of vicious circles is of considerable clinical value as contributing to accuracy in diagnosis and prognosis. Moreover, it assists treatment by directing attention to disease in its widest aspects (that is, to both its immediate and remote manifestations), and to the importance of cutting any link in the chain of morbid processes.

PHYSIOLOGICAL CIRCLES.

By way of introduction some examples of physiological or healthy circles always operative in the body may be mentioned; from these examples it will be seen how frequently morbid processes are but exaggerations of physiological ones.

1. The processes of haemogenesis and haemolysis, by which the adjustment between the birth and destruction of blood corpuscles is effected, furnish an example of a healthy circle. The regulating apparatus is probably of the nature of a chemiotaxis, although this is still doubtful. At all events, a physiological polycythaemia or oligocythaemia is brought about according to requirements; inadequate compensation may give rise to a vicious circle.

2. Another example is found in the mechanism of respiration, where a reciprocal relation exists between the condition of the blood and the activity of the respiratory centre. That activity, as has recently been proved, is augmented if the tension of carbonic dioxide in the blood

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increases, and depressed as that tension falls. The carbonic dioxide acts as the hormone or chemical messenger.

3. The relation of the heart's beat to blood pressure is another illustration of a physiological circle, the rate of the beat being in inverse ratio to the vasomotor constriction. In other words, a rise of pressure diminishes while a fall of pressure increases the rate of the pulse, the adjustment being effected through the intervention of the central nervous system. In this way the arterial tone is maintained.

Two physiological circles associated with vision are of interest here, owing to their connexion with vicious circles.

4. The first is the relation between the size of the pupil and the amount of light falling on the retina. The brighter the light the greater the contraction of the iris; the greater the contraction, the fewer the rays of light transmitted.

5. The other example relates to the intraocular tension, which is governed by a self-regulating mechanism. In the main the tension depends on the arterial pressure. If, however, that pressure is abnormally raised, the outflow of the fluids of the eye through the lymph channels is so increased that the pressure is again reduced to a normal level. Conversely, if the intraocular pressure is diminished (for example, after an escape of aqueous fluid), more blood enters the ciliary body, and more fluid transudes into the eyeball, while less escapes. Such is the automatic mechanism by which the normal pressure is maintained.

6. A different form of healthy circle is met with in the case of an active-minded person, whose brain increases in size as a result of the intellectual activity, which growth leads in turn to further activity; and, again (7), during convalescence, where return of strength in the various organs invigorates the others, the assistance given being mutual.

Vicious Circles.

So varied is the pathology of vicious circles that some classification is necessary for closer study. The following grouping, based on etiology, will be found convenient:

Group I.—Organic Circles.

This group includes circles arising between two organs so interdependent that when the first is diseased and in difficulty, the second, becoming in turn affected, upsets the first, and vice versa.

An example of such a circle is frequently met with in acute pneumonia, the lungs and the heart being the organs reciprocally involved. Dilatation and consequent failure of the heart constitutes one of the chief dangers of pneumonia, due to the unusual effort needed to overcome the increased obstruction in the pulmonary circuit. This failure reacts unfavourably on the lungs by retarding the

circulation through them, and as a result further work is thrown on the heart, whose nutrition is impaired and whose muscular power is already unequal to the demands made upon it. Thus heart and lungs reciprocally embarrass each other, and the vicious circle explains the fatal issue of many attacks of pneumonia. A similar relation may occur between the heart and the bronchial tubes in acute bronchitis. Emphysema and bronchitis supply another illustration of an organic vicious circle, as has been pointed out by West:[1]

> Though emphysema is commonly the result of bronchitis, still it also in turn leads to bronchitis, for the wasting of the alveoli and consequent destruction of vessels leads to obstruction to the circulation through the lungs, and, in the end, to dilatation of the right heart and systemic veins, and thus to congestion of the bronchi.

An example of an organic circle between the heart and liver, given by Mitchell Bruce,[2] is interesting as illustrating the vicarious assistance rendered to each other by the organs concerned:

> When the wall of the heart fails, the liver affords it temporary relief . . . by accommodating mechanically within it the blood that otherwise would have over-burdened the cardiac chambers. But the hepatic functions, and in their turn the stomach and bowels, which are dependent on the portal circulation, presently become deranged; and thereupon the heart is further weakened, and it may be finally undone by a set of conditions created by itself, and for its own immediate temporary advantage. The heart has paid dear for the accommodation. The day of reckoning has come. Bad has led to worse. A vicious circle is established—the penalty attending the accommodating process and the vicarious action by which one organ relieves another in distress.

This example also shows how a circle gradually widens. Primarily the heart and liver are alone involved; but the mischief spreads, and may extend to the systemic and portal systems and involve such remote organs as the kidneys and the brain.

In cases of aortic regurgitation a vicious circle may arise through the insufficient filling of the coronary arteries. Hence follow imperfect nutrition of the myocardium, weaker heart-beats, increased regurgitation, and a still less adequate repletion of the coronaries, culminating in the sudden death caused by aortic regurgitation.

In another circle of less gravity the liver and stomach are the interdependent organs. Gastric catarrh leads to portal congestion, and this, again, reacts on the catarrh. The first disorder causes the second; the second in turn causes the first. Indeed, such reciprocal relations between the stomach and various other organs are by no means uncommon.

In arterio-sclerosis a double organic and progressive vicious circle is met with. Defective metabolism due to gout, alcohol, or other causes leads to increased peripheral resistance in the arterioles and capillaries, to which the left ventricle responds by increased contractile power.

The consequent rise in blood pressure leads to thickening of the walls of the blood vessels and to hypertrophy of the cardiac muscle, which in turn react on, and raise, the blood pressure. Thus is the first circle complete. As a subsequent intercurrent and grave complication occur the obliterative changes in the coronary vessels which impair the nutrition of the myocardium. Thus the consequences of the hypertrophy of the heart are visited upon its own walls and complete the second circle, which begins and ends in the heart.

Pernicious anaemia also affords an interesting example of a double vicious circle. According to Stockman, the haemorrhagic tendency that accompanies severe anaemia converts the latter into pernicious anaemia by means of a vicious circle. In other words, the primary anaemia causes the repeated small haemorrhages, which react on the anaemia and ultimately destroy life. In regard to the second circle, the imperfectly-formed or embryonic blood discs produced in this disease are ruthlessly destroyed with those other discs which have played their part in the economy. This increased destruction of red discs again leads to their increased production, and thus, as Gilford[3] points out, a "vicious circle of bad workmanship, increased waste, and increased output is completed." Here the red bone marrow—or chief haemato-poietic organ—forms one factor; the blood itself, with the liver, kidneys, and spleen—or corpuscle-destroying organs—forms the other factor.

Group II.—Symptomatic Circles.

In this second group the circle is formed by a diseased organ and one or more symptoms, due to and aggravating the morbid processes. For example, adenoids, by obstructing the nasal passages, frequently lead to mouth breathing. The mouth-breathing provokes a further development of adenoids by throwing the nasal function out of action. The circle is constituted by the adenoids and the secondary mouth-breathing; the first factor produces the second, the second the first. Other examples are the following:

Dental caries leads to oral sepsis. Result of the sepsis —increased caries.

Pulmonary haemorrhage sets up coughing. Result of the coughing—increased haemorrhage.

Congestion of the bronchial tubes brings on paroxysms of coughing. Result of the coughing—increased congestion of the bronchi.

Irregular peristaltic action is a frequent cause of intussusception. Result of the intussusception—increased peristalsis.

Prolapse of the rectum excites tenesmus. Result of the tenesmus—increased prolapse.

Neglected constipation leads to dilatation of the rectum. Result of the dilatation—increased constipation.

Strangulated hernia gives rise to vomiting. Result of the vomiting—increased strangulation.

Urticaria provokes severe pruritus and scratching. Result of the scratching—increase of urticaria.

Obesity leads people to take insufficient exercise. Result—increased obesity. Again, obesity hampers movement and respiration, and thus hinders due aëration of the blood. Result—increased obesity.

In gout the local pain and inflammation often compel the sufferer to rest. Result of the rest, increase of gout.

Mitchell Bruce[4] draws attention to vicious circles set up by a group of diseases, in which recovery is incomplete, inasmuch as the affected part cannot be perfectly restored to the normal:

> The patient does not die, but he remains permanently damaged, disabled, delicate, and possibly in distress. Such is the termination of a proportion of cases of cerebral haemorrhage (hemiplegia), and of acute endocarditis (valvular disease of the heart). A part of the brain, a valve of the heart, is permanently damaged; the man is healthy but not sound. . . . The incompleteness of recovery is shown by a disposition to relapse, as in perityphlitis and gastric ulcer, by diminished resistance to the fresh disease. . . . In this way, amongst others, the vicious circle forms and widens.

Somewhat similar are the cases of dilatation of the heart, which so often causes death in beri-beri, as pointed out by Manson.[5]

> Once commenced, the cardiac dilatation tends to increase of itself; for the more the organ dilates, the more difficult does it become for it to contract, the greater the incompetency of the valves, and the more the blood stagnates in and overdistends it. The organ enters on a vicious pathological circle. Finally it becomes so distended that, like an over-stretched bladder, it loses the power to contract altogether.

Certain forms of gastric irritation and catarrh increase the appetite and cause a craving for food (boulimia, polyphagia). Food, however, taken under such circumstances further increases the irritation, the stomach being caught in a vicious circle.

An interesting condition arises where residues are retained in the bronchi, stomach or intestines, and serve as a nidus for fermentation processes. Chronic dilatation of the stomach (gastrectasis) may serve as an illustration. As a result of muscular paresis, insufficiency of hydrochloric acid, or pyloric obstruction, food is retained unduly long in the stomach, and undergoes bacterial fermentation. The gas and other products of the fermentation exert a distending force on the walls of the stomach, and thus aggravate the dilatation and gastritis to which they owed their origin. As a corollary of this condition a secondary circle arises, as Clifford Allbutt[6] has pointed out: "The difficulty in attaining anything like a reformation of the stomach seems to lie in the vicious circle between digestion and nutrition. The stomach suffers directly from its own insufficiency; and by failing to elaborate the means of repair it closes the door to its own restoration."

A vicious circle, sometimes ending fatally, may accompany an attack of vomiting in cardiac disease set

up through the pneumogastric. Here the heart forms the first and the nervous vomiting the second link in the fatal chain of events. Yet another circle is sometimes formed in such cases of damaged heart in which the successful result of processes of compensation and repair depends on the emotional state and nervous tone of the sufferer. Unhappily the heart trouble often disturbs the equanimity so necessary to the processes of compensation, and this loss of equanimity reacts unfavourably on the heart.

Group III.—Infective Circles.

A familiar illustration of an infective circle is supplied by children suffering from oxyurides. The irritation and consequent scratching leads to portions of the worms and to their eggs being caught under the nails, conveyed to the mouth, and swallowed by the host. Thence the ova pass into the intestines and rapidly attain sexual maturity. In this way the irritation secures, by autoinfection, succcessive generations of the parasite.

Another example occurs in pulmonary tuberculosis, when the patient inoculates himself afresh with the sputa coughed up from the primary tuberculous region. In this way infective secretion derived from an apex frequently starts secondary foci in the lower lobes, in the apex of the opposite side, or in the larynx.

Manson[7] has drawn attention to an infective circle met with in the tropics:

> A considerable proportion of the population lives in a chronic state of semi-starvation hard for us to realize. Under such conditions the daily loss of blood which a few hundred ankylostomes entail is a serious matter, and may be all that is required to turn the scale, and start the vicious circle of famine degenerations.

The ravenous appetite which accompanies ankylostomiasis may lead to the formation of another circle, by accumulating the infection which reacts on the appetite.

Group IV.—Neurotic Circles.

To this group belong such vicious circles as are completed by two or more nervous conditions, without any evidence of organic disease.

In neurasthenia, for example, protracted and uncontrolled repose may set up a vicious circle by so deranging the digestive system and affecting the general health that all inclination for physical and mental exertion vanishes. Rest calls for further rest. Sometimes a sudden shock may be the *fons et origo mali*, inducing such a traumatic neurosis as has been described by Treves[8]:

> The patient is irritable and ill-tempered, suffers from palpitation, and cannot bear the least disturbance or noise; mental occupation increases the discomfort in the head, he cannot concentrate his thoughts upon anything—himself excepted—for any length of time, and he complains, therefore, that he has lost his memory. Sight seems to fail him, because the effort of ciliary accommodation is soon followed by fatigue; he loses flesh and looks wasted, anxious and ill. Depression is the

main and most prominent feature in this general state of malaise, and depression and despondency of mind are common. A vicious circle is soon established, in which loss of healthy nervous tone, both in the conscious life of the individual and in the unconscious and insentient working of the various inorganic processes of the animal economy, leads to serious derangement of function in the various parts of the system.

Not only may the happiness and usefulness of a life be ruined under such circumstances, but the circle often widens so as to include a mother, sister, or other relative of the sufferer, especially if the latter is of the female sex.

Nothing is more curious (writes Weir Mitchell[9]), nothing more sad and pitiful than these partnerships between the sick and selfish and the sound and over-loving. By slow but sure degrees the healthy life is absorbed by the sick life, in a manner more or less injurious to both, until, sometimes too late for remedy, the growth of the evil is seen by others. . . . A hysterical girl is (as Wendell Holmes has said) a vampire who sucks the blood of the healthy people about her.

In women morbid local and constitutional conditions may be so correlated that no improvement is possible until the circle can be broken. Herman[10] gives an illustration of this:

In chronic ovarian pain with neurasthenia effects follow one another in a vicious circle. The patient feels more severely the ovarian pain because her nervous system is too sensitive. The persistent ovarian pain keeps the nervous system weak and sensitive and further weakens it. In bad cases the vicious circle can only be broken by removing the ovaries.

Very protean, indeed, are the neuroses and psychoses associated now with the digestive, now with the cardiac, now with the sexual apparatus, and leading to reciprocal relations.

To this group belong cases of exaggerated reflex irritability of the central nervous system. Excessive and prolonged coughing, for example, may so irritate and exhaust the medullary centre as to pervert the reflex mechanism. The cough becomes uncontrollable, and persists even though the local irritation has ceased. Similar conditions accompany attacks of persisting vomiting and diarrhoea.

Another variety is met with in cases of serious illness where acute suffering and distress rob the sufferer of all cheerfulness and self-control. This loss of self-control and of that mastery which all human beings should retain over their own emotions and wants, adds greatly to the sensitiveness of pain and distress.

Group V.—Chemical Circles.

So little is known of the chemical correlations in the healthy body that our almost entire ignorance of what occurs in disease is not surprising. Future research will assuredly throw light on many more correlations than are as yet understood.

A chemical vicious circle occurs in diabetes mellitus, in reference to the two important conditions of polydipsia and polyuria. The polydipsia leads to dilution of the

patient's blood, and thus promotes the excretion of sugar and the associated polyuria. The polyuria, on the other hand (by depriving the system of a large quantity of fluid), leads to greater concentration of the blood, and consequently to thirst and polydipsia.

A second chemical circle is formed in diabetes, based on the well-known observation that the greater the quantity of sugar excreted, the less becomes the tolerance for carbohydrates. On the other hand, the consumption of carbohydrate food diminishes the patient's power of dealing with it, and increases the sugar excretion.

Another example is met with when an incompetent heart fails to properly carry on the pulmonary circulation, so that the blood which is distributed to the myocardium by the coronaries is laden with impurities. The incompetency of the heart tends to keep the blood impure, while the impure blood in its turn impairs the nutrition of the heart and thus increases its incompetency. Cohnheim[11] points out an even graver condition which results when a persistent rise of temperature has depressed the motive power of a previously sound heart and thus led to an inadequate supply of pure arterial blood to the myocardium. The want of aërated blood further enfeebles the heart already unequal to its work, and as a result follows the collapse so often seen in acute febrile disease.

Group VI.—Mechanical Circles.

Mechanical vicious circles are formed when abnormal pressure or tension relations act and react reciprocally on each other. An example is met with in obstetrics when a retroverted gravid uterus becomes so impacted in the pelvis as to press on the urethra and cause retention of urine. The distended bladder increases the retroversion and the impaction; the retroversion increases the retention. Similar effects may be produced by myomata or other pelvic tumours. In ascites pressure on the renal veins may lead to ischuria, which in turn aggravates the ascites.

The surgeon may meet with this form of vicious circle in some of the attacks of urgent dyspnoea due to an enlarged thyroid, where this gland compresses the trachea bilaterally, and reduces the lumen to a scabbard-shaped antero-posterior slit (the *Säbelscheide* of the Germans). The dyspnoea, started perhaps by some casual effort, calls the supplementary respiratory muscles (especially the sterno-hyoid and sterno thyroid) into action. These when contracted press the enlarged thyroid further against the trachea, diminishing the lumen more and more, and increasing the dyspnoea. Thus the two factors—the occluded trachea and the respiratory muscles—complete the circle, which may lead to a fatal result.[12]

Recurrent iritis, in the opinion of many oculists, tends to destroy vision by acting in a vicious circle. If an attack of iritis has led to the formation of synechiae, the healthy circle already alluded to is interfered with. The

synechiae act as irritants by dragging on the sensitive iris, and thus give rise to further attacks of iritis and fresh synechiae.

Another illustration of interest to the ophthalmic surgeon occurs in glaucoma. It has been pointed out above how in the healthy eye the quantity of fluid secreted and excreted is so regulated as to maintain the intraocular tension at a uniform level. But in glaucoma vascular changes in the ciliary processes, by choking the circumlental space, contract the channels of communication, and thus interfere with the regulating mechanism. Hence the intraocular tension is raised, while the fluid, unable to escape, pushes forward the lens and iris and still further blocks the channel. Thus cause and effect act and react on each other until the intraocular tension is raised to an injurious degree.

Again, in paraphimosis the tense preputial skin and mucous membrane cause oedema of the strangulated glans, which oedema again increases the tension of the preputial band.

Group VII.—Artificial Circles.

To this group are relegated such vicious circles as do not arise in the ordinary course of disease, but have an artificial origin. Such are the circles associated with indulgence in alcohol, tobacco, opium, or similar narcotics (especially in neurasthenics), those produced by the injudicious administration of drugs, and those set up by spinal or other supports. For example, alcoholism frequently induces anorexia; this is followed by exhaustion, and tempts the victim to seek relief in further indulgence. Again, a miserable home drives a labourer to the public house and to alcoholism, with the result that he has less money than before to maintain his home, which consequently becomes still more miserable. In the case of chronic poisoning of infants by opiates, the child, when not under the influence of the sedative, is irritable and sleepless. Hence the mother finds an excuse for continuing the drug, and the vicious circle is complete.

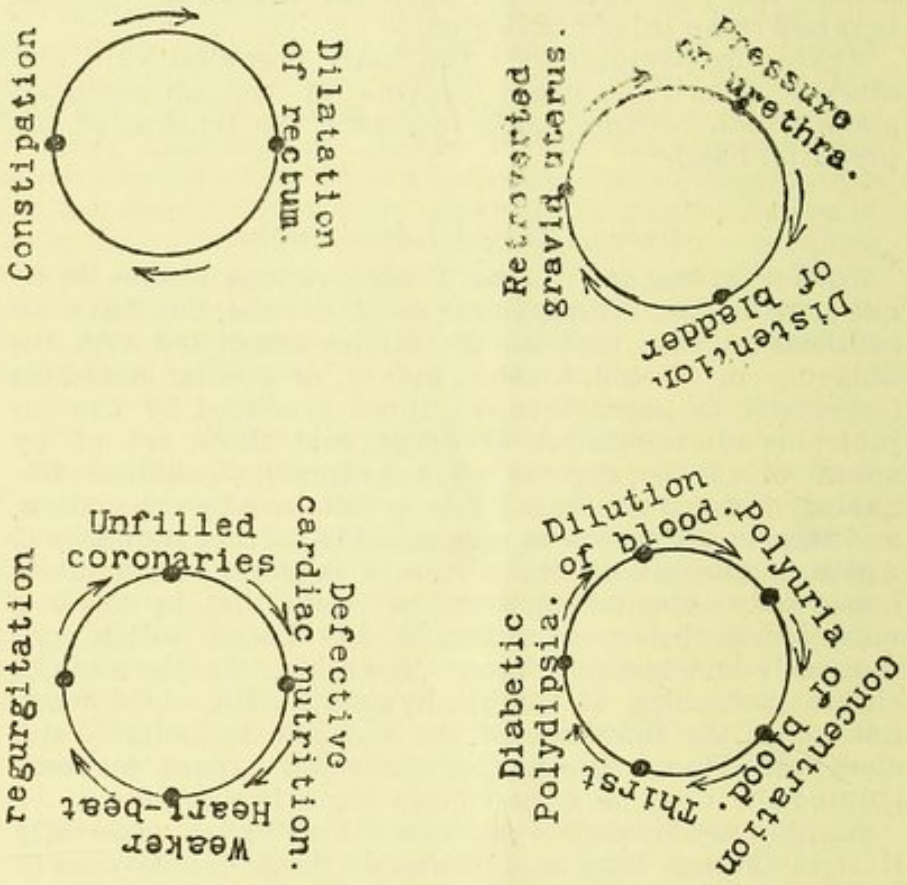
Another artificial circle may be set up by tea, especially if it is infused long and drunk in large quantity, as in Ireland. When dyspeptic troubles and constipation follow, further recourse to tea is the usual remedy.

Gastralgia is occasionally treated by bismuth or similar sedatives, when a wiser plan would be to remove the irritant by an emetic or an aperient. The bismuth temporarily lulls the pain; as a result more of the same food is taken, and the gastralgia returns in an aggravated form.

Bromides, too lavishly used, have been responsible for many a case of vicious circle. Few drugs have a greater tendency to depress the recuperative power of a disordered nervous system. Yet, especially in former days, bromides were extensively administered to cure the very conditions in which that recuperative power was lacking.

An artificial circle may also arise through the injudicious use of aperients in constipation. The constipation may be temporarily relieved; but the remote effect is frequently more obstinate constipation, requiring stronger aperients.

Another injudicious mode of treatment is met with in some cases of spinal weakness, where a mechanical support is relied upon, instead of physical exercises calculated to cure the muscular weakness. The support increases the spinal weakness, which in turn calls for more and more complete support. Applying the lesson to a much commoner article of attire than the spinal jacket, we may say that the corset creates the demand which it supplies.



Group VIII.—Spurious Circles.

The term "vicious circle" has sometimes been applied to conditions where there is no reciprocal action between cause and effect. Such conditions, therefore, do not fall under the definition given above, but may be alluded to here for the sake of completeness.

A so-called "vicious circle" is occasionally met with after the operation of gastro-enterostomy, when the contents of the afferent end of the jejunum (that is, the segment above the artificial opening), instead of passing into the efferent segment, return through the artificial opening into the stomach and set up regurgitant vomiting. Or the contents of the stomach may pass into the afferent loop and back into the stomach instead of escaping through

the efferent loop. A "short-circuiting," in fact, takes place, leading to grave difficulties for which a complementary entero-enterostomy may be required.

Other illustrations occur with a patent foramen ovale or other malformations of the heart, which permit of the direct communication of the arterial and venous system, with varicose aneurysm and aneurysmal varix.

The diagrams on p. 10 may be of service, especially to teachers, in the analysis of a vicious circle into its component factors. The simplest circles have but two factors; in others four or five may be concerned.

Conclusion.

This is not the place to discuss the treatment of the vicious circles described above. But it may be pointed out that the watchful practitioner may sometimes prevent their development, if he is thoroughly acquainted with the course diseases tend to follow, and at the right moment gives such aid as will check the morbid processes at work. When once a circle has been formed, an exact diagnosis of the interacting forces is of primary importance. Such a trivial condition as a tender ovary or a movable kidney may constitute one of the links by which the patient is enchained, and may, if overlooked, perpetuate the disorder. At other times, as in the case of acute glaucoma, an erroneous diagnosis may lead to dire consequences. Generally speaking, vigorous measures will be required in view of the increased gravity of disease which is complicated by a vicious circle.

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[1] *Diseases of the Organs of Respiration*, p. 112. [2] *The Principles of Treatment*, p. 189. [3] *Lancet*, June 30th, 1900. [4] *The Principles of Treatment*, p. 157. [5] *Tropical Diseases*, p. 270. [6] *System of Medicine*, vol. iii, p. 514. [7] *Allbutt's System of Medicine*, vol. ii, p. 1043. [8] *System of Surgery*, vol. ii, p. 258. [9] *Fat and Blood*, pp. 40, 49. [10] *Diseases of Women*, p. 83. [11] *Lectures on General Pathology*, vol. iii, p. 1416. [12] Hurry, Goitre followed by Asphyxia, *Lancet*, 1887, vol. i, p. 570.