The mutual relation of Cardiac and Pulmonary diseases.
Among the many differences recognized as exist-
ing between plants and animals, the mutual re-
lation or sympathy which subsists between
the various parts and organs of the latter
holds a prominent place.
In consequence of this, there is a remarkable
dissimilarity in the manner in which each
is affected by injury and disease.
In the plant, the result of the lesion appears
to be confined to the part injured, and not
to extend to other and remote parts, whereas
in the animal, scarcely any injury, however
trivial, can be inflicted on any part or organ,
without, on the one hand, causing more or
less disturbance of others, or on the other,
producing a certain amount of constitut-
ional irritation. In many cases, indeed,
the constitutional effects are so slight
as to escape observation, but in others,
the shock to the system is so severe,
as to occasion almost instantaneous
death. We are naturally led to inquire
upon what this difference depends.
It seems plainly due to the influence
of the Nervous system, which is present
J. Coftland
In all animals, though under very modified forms. This constitutes the connecting link between the various organs of the body, and is the chief medium of sympathetic actions - the chief medium, we say, for it is not the only one. The circulating fluid exercises a most important influence in this respect and is indeed one of the principal modes in which morbid action is propagated. "Observation has shown that the circulating fluids are readily and early disordered in the course of disease, and, being thus disordered, they become sources of a more general malady - of disease not limited to particular organs, but extending more or less to the whole economy." In addition to these two media, which may be said to be universal in their operation, seeing that they pervade the whole system, there are others of a more limited and local nature. The three following are the chief. 1. Continuity of texture. 2. Contiguity of situation.
3. Association in function.

As might be expected, all parts and organs of the body do not sympathize with each other in the same degree. This may be explained by the concurrence of two or more of the causes above mentioned. In illustration, we may take the organs of vision. The sympathy between these is perhaps greater than we find between any others. Their nervous connection is remarkable, some of the nerve fibres being continuos from one Retina to the other; fibres passing to both Retinas from one side of the brain. Their similarity of function and consequently, of structure, contribute to increase their mutual sympathy. It is somewhat remarkable that this sympathy is so exact that, as a social rule, the very same tissue that is diseased in one, is liable to be affected in the other; thus if a Cataract form in one eye, a Cataract and not any other form of disease will appear in the other, if we find a soft whitish Cataract.
In one eye it is almost certain to be identical in the other, if the capsule alone be opaque in the one, it alone will be opaque in the other, but if both capsule and lens be discolored in one, there will be a capsule-lenticular cataract in the other. The same is true of the affection of the other eyelid of the eye.

With these preliminary observations we now proceed to consider and illustrate the above-mentioned media of sympathy in their order.

1. The Nervous System. As this system extends to all parts of the body, we can readily understand that through it any of the most remote parts of the system may sympathize with one another. The nervous structure operates in two ways as a medium of sympathy. 1. Directly. 2. Indirectly or what is termed reflex sympathy or reflex action. It is frequently very difficult and sometimes impossible to say in which of these modes it operates in a given case. The examples of sympathy so excited are
Few numbers do we shall select only
a few of the most important.
The sympathy existing between the di-
festive organs and the brain is a matter
of daily observation. How often do we
meet with headache, dimness of vision,
muscles voluntary, irritability of temper,
mental depression amounting even to
hypochondria, and many other symp-
toms of derangements of the cerebral
functions in connection with disorder
of the primeval brain to a very
difficult extent. On the other hand,
the earliest symptoms of disease in
the brain or its membranes, are nausea
and vomiting; and how often does men-
tal anxiety, instead of being caused by
lead to dyspepsia. The media of these
morbid associations are evidently in
the first instance the ganglial and
cerebro-spinal nerves systems.
There are some cases, however, which
may be accounted for in a different
manner - through a morbid condition
of the circulating fluid, which acts
Injuries upon the brain, disordering its functions.

The sympathy between the heart and stomach is also very marked—palpitation, and irregularity of the pulse being often dependent upon some derangement of the stomach. This is also probably due in great measure to their nervous connections, though their proximity to one another must also exercise some influence.

Reflex sympathy is of very frequent occurrence. We are chiefly indebted to the labours of Dr. Marshall Hall for the knowledge we possess on this subject. Previously to his researches upon the reflex function of the spinal cord little was known regarding the pathology of the large and important class of convulsive diseases.

As examples of this may be mentioned Chorea arising from the presence of Worms or other sources of irritation in the Intestines—The Convulsions of Children from the irritation of the gums during dentition, or derangement of the brain...
Vieal - Tertaneus from the irritation of the nerves of the foot or hand.

2. The circulating fluid.

The best example of this mode of sympathy is what occurs in cases of granular degeneration of the kidney. In the progress of this disease very important changes take place in the blood, in consequence of which distant parts of the economy become affected - hence the occurrence of numerous secondary disorders such as inflammation of the serous membranes, especially the pleura and pericardium.

3. Continuity of texture.

The influence of this is shown in the tendency of inflammations to spread along mucous and serous surfaces. Thus inflammation originating in the urethra is very liable to spread backwards to the prostate and bladder, and in some cases, the kidneys may become involved. Again, if the peritoneum be wounded or injured, the inflammation which results is almost certain to spread and may eventually affect the whole of
The vesicourethral membrane.
4. Contiguity of position. This has a great influence in complicating diseases and is very well illustrated by the close sympathy existing between the Bladder and Rectum. Irritation in the Rectum from any cause, such as Internal Hemorrhoids, fissure, or mere nervous irritability, is usually accompanied by more or less dysuria, sometimes amounting to actual retention of urine which is only to be relieved, permanently at least, by remedying the condition of the Rectum.

Again, if the Bladder be diseased or irritated from any cause, such as Calculus, the Rectum will be found to sympathize more or less according to the amount of vesical irritation. Besides their close anatomical relations, these organs are very intimately connected through the nervous system which necessarily increases their mutual sympathy.
5. Association of function.
It is a wonderful and beneficent provision in the animal economy that if an organ be from any cause prevented from performing its duties, other organs can in a great measure, by increased activity, compensate for it. Even in health we observe this principle in operation—thus the urinary organs and the skin alternate with each other in a remarkable manner in the important object of eliminating water from the blood. Thus if from any cause, such as the influence of cold, the skin be prevented from discharging its functions with due activity, the kidneys are stimulated to increased secretion and vice versa. A similar relation exists between the organs of respiration and the liver.
Another illustration of sympathy arising from association of function is that subsisting between the uterus and mammal. At an early period of uterine perfusion changes take place in the condition of the breasts; indeed, this alteration
-ion is one of the most valuable signs of pregnancy. About the second month the breasts become the seat of a prickling, thumping, or shooting pain. They are also somewhat increased in size and firmness - this enlargement goes on increasing up to the full time. Again, pain in one or both mammae is of very frequent occurrence in cases of uterine irritation or disease as for example Dysmenorrhea and Retroversum.

With these few and cursory remarks on sympathies in general we proceed to the consideration of the special subject of this Essay - the mutual relation of Cardiac and pulmonary diseases. This is a subject of the greatest interest to the pathologist and practical physician. Without being aware of this connection we should be constantly liable to fall into errors of diagnosis, prognosis, and treatment. How, otherwise, can we understand the nature of the pulmonary symptoms which so frequently, they almost invariably accom-
pany, and so strongly aggravate Cardiac Diseases? Again, Symptoms referable to the heart not infrequently result from pulmonary diseases, and are apt to deceive even the most careful physician. A case is quoted by Dr. Stokes from Dr. Graves' Clinical Medicine, which shows how closely pulmonary diseases may simulate Cardiac. A case of Asphyxia Pericardii.

A man of intemperate habits had for eight years laboured under palpitation and dyspnea. When admitted into hospital he was emaciated and drooping; pulse 94, regular, and there was no visible pulsation, thrill, or fellow murmur in the arteries of the neck or upper extremities. The right side of the chest was dull, with weak and crepitating respiratory murmur. Loud respiration, free from any rale, was heard over the left side, which was clear on percussion. The impulse of the heart was strong and rather diffuse; the sounds loud, the first long accompanied by a fellows murmur.
audible all over the cardiac region, but remarkably intense to the left of the nipple. This did not ascend along the course of the aorta, nor was it accompanied by any preciosity. This patient remained for five weeks under observation, when he sank, no change having taken place in the physical signs of the heart. The right lung was found studded with tubercle, the left was healthy. The heart was hypertrophied and the pericardium was universally adherent; the union being effected by a dense cellular membrane. There was not the slightest trace of recently deposited lymph. All the valves of the heart were perfectly healthy. The ascending portion of the aorta was dilated, and its inner surface rough and scabrous from an abundant deposition of earthy matter. The arch and descending aorta were healthy, and the aortic valves perfect. D. Graves surmises how could such a case as this be distinguished from one of mitral
false disease."
To intimate is the connection between these organs that one cannot be uri-
inely affected without the other. This may be accounted for by
1. Their nervous connections.
2. Their continuity of position.
3. The mutual dependence of their function.
4. Their vascular communication forming the lesser or pulmonic circulation.

The nerves of these organs are so intimately
ly related, anatomically and physiolo-
gically, that disease originating in, or
affecting any part of them, will re-
 frequently influence the functions of the
whole, or of each of them at least as are
most intimately connected with the part
originally diseased. This influence
may be either direct or indirect.
In this way asthma in connection with
disease of the heart may be explained —
the morbid condition causing irritation
of the cardiac nerves, and this impression
being conducted, either directly or through
The medium of the Medulla Oblongata, to the pulmonary nerves, produces spasmic contraction of the muscular fibres of the bronchial tubes, which is generally believed to be the proximate cause of the Asthmatic Paroxysms. The dyspnoea and cough which so frequently accompany cardiac disease may, in some instances, be capable of a similar explanation. The irritation may however be produced in the lungs and be propagated to the heart as for example palpitation arising from pulmonary disease such as Phthisis Pulmonalis.

Dr. Hopper states that "one of the first common causes of palpitation without organic disease of the heart is Pulmonary deposit in the lung. Long before any other symptom of pulmonary consumption has made its appearance, the patient will often complain of distressing palpitation." From the views of other writers on this subject it is probable that this is too strong a statement. Still however it does occasionally occur,
and may be in part explained as above.

I. Their continuance of position.

This works considerable influence in the association of cardiac and pulmonary disease. Inflammation not infrequently extends from the pericardium to the pleura and vice versa. More or less well-marked signs of pleurisy and pneumonia generally attach the coincidence of these diseases in cases of pericarditis. They appear to arise in two ways:

1st. Through irritation exciting by contiguity. Inflammation in parts already predisposed thereto. Thus we generally find the pleurisy and pneumonias most developed in those parts of the lungs which are contiguous to the pericardium and particularly in the left side of the thorax.

2nd. Independently of any local relation. Being the result of a common cause — the Rheumatic diathesis.

Their continuance has another influence — a mechanical one. Thus effusions into the pleura, especially on the left side,
displace the heart to a considerable extent, pushing it to the right side of the sternum, and so greatly distending the vital function of circulation.

Again, when the effusion into the pericardium is considerable, the free action of the lungs is hindered by the pressure thereby exerted upon them; the left lung, in particular, suffers, being sometime found pressed upwards and backwards, and very considerably reduced in size, especially in its lower lobe.

III. The mutual dependence of their functions in health this is shown by the nearly uniform relation which is observed between the frequency of the pulse and the respirations; the respiration being, on an average, one of the latter to five of the former. The same relation is generally maintained in the cases in which the pulse is naturally accelerated, as after food or muscular exertion. In disease this relation ceases to be so exact. In many affections accompanied with increased
Frequency of the pulse, the respiration is also accelerated, but the degree of acceleration bears no definite proportion to the increased number of the heart's pulsations. If from any cause the respiration is interfered with, the circulation is also disturbed. It is a well-known pathological fact, that imperfectly arterialized blood does not permeate the pulmonary capillaries as readily as blood containing its due amount of oxygen; hence any circumstance preventing the free access of air to the blood, must retard the circulation through the lungs and thereby disturb the right chambers of the heart; and, if long continued, may lead to dilatation with or without hypertrophy of these parts.

IV. Their vascular connections.

This is by far the most important and prolific source of these morbid associations. In considering this subject we shall first attend to the influence of
Pulmonary diseases on the heart, and afterwards to the effects of cardiac diseases on the lungs.

It may here be remarked, that the morbid changes in connection with the heart are propagated in a direction contrary to that of the circulation, so that disease in the lungs leads to morbid conditions of the right side of the heart, while pulmonary affections are to be traced, as a general rule, to disease on the left side.

1. The influence of pulmonary diseases on the heart.

The organic changes in the heart produced by pulmonary disorders are chiefly dilatation of the right chambers with or without hypertrophy, but, although the obstruction to the passage of the blood through the lungs must act immediately, and therefore with the greatest effect upon the right side of the heart yet the obstruction thus afforded to the return of the blood through the systemic and
portal veins, must increase the difficulty with which the blood passes from the arteries into the veins, and in this manner call upon the left ventricle for an additional effort, giving rise to distention and perhaps hypertrophy thereof, though in a much less degree than in the right side of the heart.

The first diseased condition that may be mentioned is emphysema of the lungs. The most common morbid condition giving rise to cardiac disease. This consists of expansion of the air cells with thinning and ultimately obliteration of their walls, so that several cells coalesce to form a larger one. Its consequence there is a great obstruction to the pulmonary circulation from 1st the successive accumulation of air in the pulmonary vessels, pressing upon the capillaries, diminishing on their walls, and 2nd the complete obliteration of many of the capillaries by the advance of the disease. In addition to there
Permanent impediments, the circulation is liable to be more seriously interfered with, at intervals of greater or less duration, from the supervention of paroxysms of spasmodic asthma, which are so frequently occasioned by an epitheliotropic condition of the lungs.

The next condition of the lungs is Consolidation from deposit in its substance. Inflammatory deposit. This is not a common cause of cardiac disease, seeing that it is usually of short duration; while if long continued or of frequent recurrence it will have the same effect as other causes obstructing the circulation through the lungs.

In Jones' and Seckline's Pathological Anatomy we find the following. The first marked case of hypertrophy of the right ventricle which we have witnessed occurred in a child of a year and a half, who had been long subject to pneumonia attacks and in whom after death the whole of both lungs
were found studded with small lob.
ular abscesses. The substance of the
right ventricle was increased in thick-
ness by one-third, as compared with
the left ventricle.
2. Tubercular deposit or Phthisis pulmon.
alis. Of all the diseases to which the
lungs are liable, there is no one which
commits such ravages in their structure;
either blocking up by the tubercular
deposit large portions of the pulmonary
substance, or converting it into little
more than a membranous sac.
Considering the very great obstruction
which this disease necessarily produces
to the circulation through the capillaries
he should expect to find in the exam-
nination of those who have died from
it numerous examples of disease on
the right side of the heart.
It is not so however. Phthisis pul-
monalis is not a local but a constit-
tutional affection, in which the defec-
tive and assimilative functions are early
interfered with, and as a consequence of
this, blood is formed slowly and in comparatively small quantity, and as the disease advances always in a diminishing proportion. In many cases of this nature great encroachment is made upon the mass of the circulating fluid by the colliquative diarrhoea, purpuric dyspnoea and hectic sweat. Such considerations afford a ready explanation of the fact that enlargement of the heart is so seldom found in connection with tubercular disease of the lung. According to Rokitansky and others, it is much more frequently remarkably small, pale and devoid of fat. It is, not usually, however, atrophied to the same extent as the other organs, owing doubtless to the obstructed state of the pulmonary circulation, and the excited condition of the heart's action to frequent an accompaniment of Phthisis. It is evident that it is not the quantity of impediment within the lungs themselves taken absolutely, but relatively to the quantity of blood pe-
- forced to circulate through them which becomes the occasion of the heart's dilatation. Accordingly it is in such local diseases—those unconnected with any vice in the system—which while they greatly impede the circulation through the lungs do not interfere to any great extent with the nutrition of the body, that we look for the best illustration of the influence of causes seated in the lungs in occasioning dilatation of the right side of the heart.

3. Cancerous deposit.

Malignant disease is comparatively rare in this part of the body, and is moreover, like the tubercular, only a local manifestation of a constitutional dyscrasia so that the effects on the heart would be modified in a similar manner. I have not found any observations on the condition of the heart in those affected with Pulmonary Cancer.

The next class of Pulmonary diseases
to be noticed are those in which the substance of the lung is in a state of condensation or collapse. This may arise in two ways, either from obstruction to the entrance of air into the bronchial tube leading to the collapsed portion, or from the pressure of fluid, or air, or both, operating from without. It is not infrequently a consequence of chronic bronchitis from the plugging up of the bronchial tubes with mucus, preventing the passage of air inwards, while it is not wholly prevented from passing out, so that the portion of lung so circumstances becomes more and more emptied of air with each expiration. The greatest amount of compression of the lung is produced by large pleuritic effusion—The lung indeed is sometimes so compressed as to become impermeable to air and open to the passage of blood along the capillaries. This condition is called Carcinification, from its seeming resemblance to a piece of flesh.
Excessive condensation of the lungs gives rise to the same consequences as hydrops and consolidation of the pulmonary substance. Dilatation with or without hypertrophy of the right chambers of the heart. In partial collapse of one lung, as first demonstrated by Dr. W. J. Gardiner, the other portion is very liable to become hydropneumatosus thus aggravating the evil as regards the pulmonary circulation.

The last class of pulmonary disorders to be mentioned is the Spasmodic Asthma and Hooping Cough.

In the former of these diseases, owing to the spasmodic contraction of the minute bronchial tubes, the entrance of air into the lungs is greatly impeded, the circulation is in consequence retarded by dilatation of the right side of the heart chambers. Here not infrequently result all incompetency of the tricuspid valve.

During the paroxysm the pulse is rapid, small, and feeble sometimes intermittent, and palpitation not uncommonly.
occurs to a considerable extent. Asthma not only acts directly upon the heart, but also indirectly by giving rise to pleurisy of the lungs. The spastic constriction of the air-tubes, the congestion of the mucous lining, and the accumulation of the mucus in them, present an obstacle, not only to inspiration, but also to expiration, and the lungs being thereby often kept in a state of inordinate dilatation, and the respirating muscles excited to spasmodic efforts, dilatation of the air-vessels, and sometimes even their rupture, occur.

In Hooping Cough, during the paroxysm, the chink of the gullet is spasmodically closed or rather narrowed so that the air enters the lungs with difficulty, and from the violence of the cough the transmission of the blood through the lungs is greatly obstructed. Occasionally it is frequently complicated with other disorders of the respiratory organs. The most frequent are Bronchitis.
Pulmonary Collapse and Hypesthesia. These cause an additional impediment to the circulation and to the free dilatation of the Right Chamber of the Heart.

1. The influence of Cardiac diseases on the lungs.

This part of the subject is perhaps of greater practical importance than the former, seeing that the Pulmonary symptoms are more readily recognized during life, and are much more amenable to treatment. They are very frequent in their occurrence, and are oftentimes very distressing to the patient. They are indicated mainly by difficulty of breathing and cough with expectoration of mucus in some instances. The dyspnea varies greatly according to the nature and extent of the Cardiac affection. It often precedes for a long time all the other general signs of disease of the heart. This particularly happens when
The disease is on the left side and is of such a nature as to interrupt the pulmonary circulation. At first it may occur only at intervals, as after mental emotion or bodily exertion; afterwards it returns more frequently and without any appreciable cause, and at last it becomes constant on account of permanent pulmonary congestion. There are great variations in its intensity—from the slightest shortness of breath after exertion to the most distressing Orthopnea which is almost pathognomonic of disease of the heart. There is a peculiar alteration of the respiration in connection with a weakened state of the heart's action as in Fatty degeneration—lifting or suspensory respiration. It is thus described by J. Stokes—"It consists in the occurrence of a series of inspirations, increasing
to a maximum, and then declining in force and length, until a state of apparent apnea is established. In this condition the patient may remain for such a length of time as to make his attendants believe that he is dead, when a low inspiration, followed by one more decided, marks the commencement of a new ascending and then descending series of inspirations."

This character of the respiration is, when confirmed, almost pathognomonic of a weak and in all probability, a fatty heart.

Cough is another distressing symptom. It arises from a disturbance of the pulmonary circulation, and as such disturbances are often caused by disease of the heart. Cough is a frequent symptom of such affections. It is of importance as regards diagnosis to attend to the character of the cough symp
Tympanic of diseased heart. 

It is harsh and loud, comes on in severe paroxysms, usually brought on by some movement of the body, and is usually unattended by expectoration.

The organic changes produced in the lungs by cardiac diseases are most important, and, though differing greatly from one another, may all be referred to pulmonary congestion and its consequences—hemorrhage, effusion, and inflammation.

1. Pulmonary Congestion. This is the cause, in the vast majority of cases, of the dyspnea and cough which is frequently accompanying cardiac diseases. More than the normal quantity of blood being accumulated in the pulmonary vessels, the volume of air which is ordinarily taken into the lungs is no longer sufficient to arterialize the whole of the blood, hence it becomes necessary to intro-
Once a larger quantity of air is in a given time, and consequently inspiratory movements are more frequent and hence the feeling of oppression. The cough is due in great measure to the irritation of the pulmonary nerves from the congested state of the vessels.

2. Pulmonary hemorrhage.

Just to tubercular disease of the lung
The most common cause of this is organic disease of the heart. It may take place either from the bronchial mucous membrane — bronchial hemorrhage or from the ultimate air cells constituting pulmonary apoplexy. Pulmonary apoplexy occurs in two forms—diffuse and circumscribed. It is the latter which is usually met with in connection with cardiac disease. It has been and is still supposed by many that the disease is in such cases that coming situated in the right chambers. It is easy to understand
How this error arose, because in these cases the right ventricle is frequently found hypertrophied and dilated so that it might plausibly be inferred that the increased power of the ventricle would cause the blood to be propelled with undue violence through the lungs, as to rupture the walls of the capillaries, and in this way give rise to the hemorrhage. This condition of the right ventricle, however, is very rare, being far less, and is usually the result of disease on the left side of the heart obstructing the pulmonary circulation. The real cause then of the hemorrhage, and indeed of all the pulmonary affections to be mentioned, is disease on the left side, and especially a contracted state of the mitral orifice. But while the disease on the left side is the primary cause, it must be admitted that the hypertrophied condition of the right ventricle
Exercises considerable influence in the production of the lesion by filling its contents with increased force into the pulmonary capillaries while there is an obstruction to its passage out through the pulmonary veins.

3. Effusion of Serum or Pulmonary Edema: Draper is a very frequent result of passive congestion in all parts of the body and the lungs. With the exception to the general rule, pulmonary edema consists in the effusion of serum into the bronchial tubes and ultimate air spaces and also into the intercellular substance of the lungs.

It very rarely occurs as an idiopathic disease, but is frequently the result of pulmonary congestion depending on cardiac obstruction.

4. Inflammation: An organic disease of the heart, the mucous membrane of the bronchi frequently becomes the seat of inflammation, which
First occurs in an acute form, but ultimately becomes permanent under a chronic form. The chief symptom of this is cough more or less disturbing and usually accompanied with a cough expectoration, whence the term Bronchorrhea has been applied to it. There is also considerable depression in consequence of the excessive secretion of mucus in the air cells and ultimate bronchi. Chronic bronchitis is a very important complication, and one which should not be left to itself for the violent paroxysms of cough greatly disorder and impede the pulmonary circulation and tend to accelerate the progress of the cardiac disease.

William Forster
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