The Effects of Exercise

by

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The term combustion as used in Chemistry means the combination of two or more bodies with each other, accompanied by the production of light and heat.

We must use the term combustion rather figuratively when applying it to bodily work. The combustion going on within us resembles fermentation rather than combustion, properly so called, producing heat but no light.

The sources of vital heat are chemical combustions of infinite variety. Some of the most important are, the splitting of a substance into two others which enter into its combination, hydration and dehydration, and the most important of all, the action of oxygen.

The chemical combinations necessary to produce heat for work are mostly, though not exclusively, oxidations, that is combinations with oxygen. Oxygen is taken in by means of respiration and is retained in the lungs so as to be ready for the chemical combinations which are rendered necessary by the different functions of life.

Oxidation is either complete or incomplete. The final stages of the former are carbonic acid and water for hydrocarbons and urea for nonnitrogenous substances.

When food is not supplied to the body, the oxygen acts upon the fat which is in reserve or if there is no fat and the food supply is cut off for a time the vital tissues are attacked. At such a time practically no exercise should be taken.

This combustion in the human body may be compared to that in the steam engine. In the latter it is easily seen how heat is transformed to energy or movement. When the temperature of the body is low movement is

slow for the capillaries contract under the influence of cold and the blood is driven into the internal organs.

Heat causes the first stage of contraction in a muscle and the muscle comes more quickly under the influence of the will. We notice in animals preparing for an attack certain movements which prepare them for the work to follow. The expression."boiling with rage," is often used. This came from olden times when anger was not sufficient to warm the muscles and man or animal made a series of movements which,while they threatened the adversary,also tended to increase the vital heat and to raise the body to the degree of temperature favorable for action.

We discover this preparatory working of the muscles in all exercises needing vigor or skill. Thus if the temperature is raised to 40°C the maximum aptitude for contraction is exhibited in the human muscle.

Now that the heat for the body is supplied there are certain other elements necessary before movement takes place;the brain is the source of voluntary movement,the spinal cord is the source of a great many reflex movements,and the nerves are used as transmitters.

When a movement is made for the first time consciousness is also brought into play,that is,it is necessary to will to do it. If this movement be repeated several times it soon becomes reflex or its center is transfered to the spinal cord and this organ then causes the movement to take place without thought,thus walking has become a reflex action.

By this means we are capable of preforming a great many movements without demanding so much energy or will.

When some movement that is in our power is to be made the will is called into action. The will acts upon the molecules of the gray matter of the brain and produces a disturbance which is conducted from here by the

nerves. When the end of the nerve is reached the stimulated points of the muscles produce swellings or nodes which then pass along the fibers to the end of the muscle. If the stimuli follow very closely there will be a swelling ing the entire length of the muscle and thus a contraction.

These fibers which are many in number are bound together with connective tissue and form a muscle.

When a muscle which has not been used for a time is brought into violent use, as in running, when unused to the exercise, great exhaustion is felt. Expiration is decreased and inspiration increased and thus breathlessness follows.

Breathlessness is a feeling of distress which is produced during violent exercise or intense muscular work, and it is characterized by an exaggeration of the respiratory need, and by profound disturbances in the functions of respiratory organs.

Breathlessness is found to be produced quickest in exercises that cause a great expenditure of force. Going up a flight of stairs at a moderate pace soon produces breathlessness because there is a great expenditure of force in a short time. The entire weight of the body is lifted a great height in a short interval of time. The same thing takes place when running for then there are times in which the entire weight of the body is off the ground.

When exercising more heat is necessary and thus combustion must be greater. Since this is the case and as carbon-dioxide is one of the products of combustion we have an increase in this gas; respiratory needs must be proportional to the quantity of carbon dioxide in the blood.

Exercise may have a direct action on the respiratory movements, for many muscular actions are preformed with the aid of the muscles of the

thorax or the back. These muscles being used in the work, are momentarily distracted from their function as respiratory muscles. Thus respiration being suspended for a short time and the carbon dioxide having accumulated to a great extent breathlessness follows.

Exercise at first produces breathlessness but if continued systematically the person exercising will soon be able to regulate his breathing according to the demands, for the chest is increased in size.

It has been thought that exercise, bringing into use the muscles of the thorax, will develope a large chest but on looking into the matter it has been found that the exercises causing increased breathing are the ones which develope the cheat.

When hanging exercises are introduced the ribs are raised but the abdominal organs are also raised and the diaphragm is in a condition of expiration and thus the chest cavity is not made larger. If however running or jumping be taken for exercise increased breathing is produced. Owing to this every cell of the lungs is filled with air, the contents of the chest increased, pushing up the ribs and increasing the size of the chest.

Since the chest cavity is increased and the lungs made stronger breathlessness is overcome and exercise can be taken without trouble for want of breath.

The heart and lungs have a very intimate functional connection and it is rare that the working of one of these organs is disturbed without the other being also effected.

Exercise effects the circulation by increasing the heart beat and consequently the quickening of the blood current.

The quickening of the blood current during exercise is the result of two causes, one of which acts on the systemic and the other on the

pulmomary circulation.

The peripheral circulation is quickened on account of the increased flow of blood to the working muscle. A more rapid current is driven toward the muscle fiber, and in the end all the blood participates in this increased activity; the pulse is more frequent and more blood is sent into the arteries. The whole vascular system is thus traversed by a greater quantity of blood.

The lungs like the other organs become the seat of a more active circulation. owing simply to the increased frequency of the pulse.

But there is another cause of increased flow through the pulmonary capillaries; this is the increased need felt by the organism for the aeration of the blood in which the carbonic acid has increased in quantity during work. Through a reflex mechanism blood over charged with carbon dioxide is driven more energetically toward the organ which will free it from this gas.

From these two causes there results an unusually large flow of blood, therefore active congestion of the lungs.

The consequence of this is that the space occupied by the blood which swells up the pulmonary capillaries is no longer available for the air in the air-cells. The respiratory field is thus rendered smaller. To overcome this the cells of the lungs usually not brought into play are filled and an equilibrium between the amount of blood and the amount of air is established for a time.

If however the exercise is continued and the chest is developed as above stated the lung cells have increased in size and this trouble is overcome.

Another obstacle comes up. The blood pressure is reduced be-

cause the heart contracts with the less force during muscular work than during repose and thus the frequency of the heart beat is increased to almost double.

The blood driven forward with less force produces a passive congestion of the lungs which is one of the most formidable factors of respiratory distress during exercise.

Thus breathlessness results from a weak action of the heart. This weakness is also added to by the excess of carbon dioxide which acts as a poison in the blood.

Exercise also overcomes this after continuation for the increased circulation carries more nourishment to the heart making it stronger and the excess of carbon dioxide is cared for by the lungs which have increased greatly by this time.

Not only is the heart nourished to a great extent but all parts of the body. The digestive system is made stronger for the digestive tract is a muscular organ. There is also a stimulation to the organ and the digestive juices are caused to flow more rapidly.

These are not the only aids given by exercise. Digestion depends to a great extent upon peristaltic action which is brought about by the movement of the digestive tract. More blood reaching this organ during exercises supplies food and like any other muscle will contract and expand with greater force.

Certain exercises may be taken which bring into play the abdominal muscles and these acting over the digestive tract assist in movement.

As the digestive tract is put into better condition so absorption will be assisted and the blood is then capable of supplying more food.

In an active muscle the blood vessels are dilated and the follow-

ing changes may be brought about by metabolism.

The neutral or feebly alkaline reaction of the passive structure becomes an acid reaction when the muscle is contracting, owing it is supposed, to the formation of paralactic acid. A considerable quantity of carbon dioxide is excreted from the active muscle while a large proportion of oxygen is consumed. The amount of glycogen and grape sugar is diminished in an active muscle, the tissue of which contains less extractives soluble in water.

During exercise the amount of water in a muscular tissue increases while that of the blood is diminished in proportion. It has already been stated that there is heat in an active muscle. Through its action any fat or reserve material found there is broken down. The aponeurotic parts are greatly strengthened. Thus a muscle becomes so changed that it is concerned with only material for actual movement. Due to these changes the power of a muscle to contract is increased and movement becomes automatic and thus saves expenditure of active force in the spinal cord and in the cerebral cortex.

Thus it is that the muscles are capable of balancing themselves and not be rigid.

Nothing in physical training is more remarkable than the economy of force which results from muscular education. After practicing an exercise several times one does not need to exhaust himself with meedless vigorous breathing; he learns to precisely regulate his respiratory movements to his immediate needs, and he brings the muscles of his thorax into co-ordination with the other muscles which he employes.

Just as a muscle increases with use and wastes with disuse so so the whole nerve apparatus concerned in movement is structurally improved

by exercise. Athletic men have better developed nerves, a more elaborate organization of their spinal cord, and of certain parts of the brain, than has the individual whose muscular system is not perfectly formed.

When the muscles are first used after a period of rest there is produced a rise in temperature and after several hours the muscles exercised will be stiff, painful and powerless. This same condition takes place if some exercises out of the ordinary are taken.

This trouble, it is said, is due to an excess of lactic acid produced in the muscle. This cannot however be held for it has already been stated that when a muscle is exercised there is an increase in the quantity of blood at that point and the alkalinity of the blood should over come this trouble.

It has already been stated that there is a change in the composition of a muscle after exercise. Some products are used up. These waste products are excreted to a great extent by the kidneys.

The question might be asked. Why does exercise produce this at one time and not at another? The answer for this is that when the muscles in use a great many substances are not are not oxidized but reserved and as the muscles is used these are broken down and gradually thrown into the blood. These being eliminated so slowly cause stiffness to be felt for several hours or days afterwards.

When muscles are used often these waste products are not allowed to accumulate so that muscles used considerably and regularly never become stiff and if exercised systematically will give to the body a firmness and roundness.

Stiffness is often noticed in the joints. This is due to the collection of unused materials at this point. Exercise not only removes this trouble but will cause the lubricating fluid to be more abundant for

here as in other parts of the body the essential secretions are increased.

It has already been mentioned that dissimulation is more active during exercise, owing to the greater intensity of the vital combustion, which leads to the destruction of certain materials; but it also increases the process of assimilation from which the body gains new tissues.

In exercising, health, normal development, and self control are sought. To accomplish these ends there must be a variety of exercises and such that they are evenly distributed over the entire body.

If exercises are given to both sides alike and to one part of the body as much as to the other, there will be normal development, that is, the muscles all over the body will be developed uniformly.

To accomplish this indoors, more and less trying exercises must be given. If however a gymnasium be at hand where there is an abundance of apparatus, there is no doubt but what all muscles will receive their share of exercise.

Indoor exercise lacks one thing that out door exercise does not. When out of doors we have an abundance of fresh air.

The exercises taken out of doors may be numerous but those taken here are more along the line of sports. Some exercises tend to bring into play more muscles than others. Walking exercises only the muscles of the lower limbs but it increases the circulation if taken at all fast.

Rowing or swimming bring into play nearly all the muscles and are thus better than walking.

If but one kind of exercise is taken and this is such that but one set of muscles is developed there will be an abnormal development in those parts and the body as a whole not retained in a good healthy condition.

Fencing may be given as an example of this. Not only is there

a greater development on one side but there is a tendency to contraction of the muscles on the opposite side.which if continued too long will produce a curve in the spine.

If there be any such defects caused in the body they may.in time.be overcome. Thus if there be a lateral curvature of the spine this may be overcome by bending the trunk slightly to the opposite side and by stretching the arms above the head and bending forward trying to touch the floor without bending the kmees.

Round shoulders is another defect commonly met with. Such exercises as arms sideways fling.or those exercises which cause the hands to be brought together behind the back will overcome this.

As has been mentioned exercise also developes courage and self control because the muscles are caused to balance each other to a better advantage and thus there is a feeling that a harder or more continued exercise may be taken next time.

From the above we find that exercise not only causes the muscles to become larger but makes them healthier and being thus they can to a better advantage preform their work. Also all the vital organs are kept in working order and the body being in such a sound condition cannot help but contain a well developed mind. Thus exercise is found to be one of the essentials to long livety and endurance.