PHYSIOLOGY AND MEDICINE.

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By A. C. MacGilchrist, M.A., M.D., M.R.C.P., Lond., Capt., I.M.S.,
Officiating Professor of Materia Medica and 2nd Physician, Mayo Hospital,

(*Continued from page 176.*)

PHYSIOLOGY OF THE CIRCULATORY SYSTEM.

THE *pulse.*—The pulse is caused by the alternate distension and recoil of arteries which occur with each beat of the heart. A wave of heightened pressure caused by each contraction of the heart passes along the various arteries and can be felt as a beat in the arteries lying near the surface of the body, *e.g.*, at the wrists and in the temples. Unless the heart is very weak, the number of beats should correspond with that of the heart and in a healthy adult should, therefore, be about 75 per minute. In children the number of beats per minute is considerably higher and may range from 90 to 140. The radial artery at the wrist is usually chosen to feel the pulse because of its convenient position : the artery, moreover, is superficial and underneath it lies bone, so the impulse or beat is more easily perceived by the superimposed fingers. If the patient be asleep it is sometimes convenient to feel the pulse of the temporal artery in the temple. If the heart is weak and the pulse at the wrist difficult to feel or imperceptible, an attempt should be made to feel the pulse of the femoral or some other large artery. The nurse has to report only as regards frequency of the pulse ; and for this purpose, when feeling the pulse at the wrist, she should allow the hand of the patient to rest supported on the bed and not hold it up.

The wave of heightened blood pressure travels much quicker than the blood itself: if arteries were rigid the transmission of the pressure wave would be instantaneous ; and the higher the blood pressure, the faster the rate at which the pulse wave travels. The pulse wave appears at the wrist about $\frac{1}{10}$ second after the beat of the heart ; but the blood which is discharged from the heart with any given beat takes a much longer time than $\frac{1}{10}$ second to reach the wrist.

Veins.—Veins have thinner walls than arteries of the same size and, in some parts, *e.g.*, the legs, have valves in their interior at intervals. These valves, which from their external appearance are sometimes popularly spoken of as " knots," support the column of blood and prevent back-flow and over-distension of the veins (varicose veins). When veins become over-distended, they also become tortuous at the same time.

To gauge the condition of the heart.—Although when describing the course of the circulation the right and left sides of the heart were considered separately one after the other, it must be remembered that the two auricles contract together and that thereafter the two ventricles also contract together. When the two auricles contract, the blood normally passes without difficulty

into the ventricles: if from disease of the heart there is any obstruction to the onward flow of blood, the veins become distended when the auricles contract. Distension of the veins entering the right auricle can be perceived at the root of the neck; so the condition of the veins at the root of the neck is a gauge of the condition of the right side of the heart. The force with which the left ventricle discharges blood can be estimated by examining the pulse in the arteries; so to gauge the condition of the left side of the heart we examine the arteries.

Cardiac compensation.—The heart can respond in a marked degree to any call upon it to discharge a greater amount of energy. If for any reason the rate of flow into the heart increases, the heart discharges that increased volume; if for any reason the resistance to the outflow from the heart increases, the heart contracts more powerfully to overcome that resistance. In either case, the heart performs more work. The part of the heart, *i. e.*, left ventricle, which is called upon to perform extra work of this nature for a prolonged period, is always found hypertrophied.

Factors which influence the movements of the heart.—Strong stimulation of sensory or afferent nerves from the respiratory tract, especially from the alveoli of the lungs, from the larynx and from the nasal mucous membrane, produces slowing of the heart. Moderate distension of the alveoli of the lungs as by taking a moderately deep inspiration causes acceleration of the heart, but a more severe distension of the alveoli as a forced inspiration produces slowing of the heart. Similarly, forcible distension of the stomach with air causes pronounced slowing of the heart.

Inflammation.—In the first stage of inflammation, the blood vessels of the part dilate and the circulation in the inflamed area becomes very active. In the second stage, the vessels are still dilated but instead of active circulation there is blood stasis or stagnation; instead of active dilation (due to nerve influence) of the blood vessels as in the first stage there is paralytic dilation. In the third stage, large numbers of white blood corpuscles pass through the walls of the dilated blood vessels (*diapedesis*) together with much plasma. As already noted, the different varieties of white blood corpuscles have specific works to perform. Some attack and kill any microbes or other foreign bodies that have gained entrance; others (phagocytes) eat up and remove the dead microbes. Sometimes the white blood corpuscles are not equal to the task of coping with the microbes and are themselves killed by the toxins or poisons manufactured by the microbes; the dead white blood corpuscles become pus cells and if in sufficient numbers form an abscess. The plasma which has escaped from the dilated blood vessels along with the white blood corpuscles has also a useful function to perform: it dilutes the toxins or poisons produced by the microbes, and so the white blood corpuscles and the tissues of the inflamed area are not so injured and handicapped as they would be, if the toxins had remained undiluted. Furthermore, the plasma has bactericidal properties or at least is inimical to microbes and so favours their destruction.

(To be continued.)