A NOTE ON THE ASPIRATORY FUNCTION OF THE HEART.

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THE heart is a pump and, like the mechanical pump, possesses aspiratory and propulsive powers—aspiratory power to draw supplies from pulmonary and systemic veins, and propulsive power to discharge the contents of its ventricles into pulmonary and systemic arteries. The heart works in a minus-pressure environment which at the height of inspiration registers 30 to 50 mm. Hg and during expiration falls to half this measure. Since fluids flow in the direction of the least resistance a centripetal current of blood from pulmonary and systemic sources sets in towards the minus-pressure environment of the heart, filling the great tributary veins, the auricles, and the ventricles. Intrathoracic minus pressure thus constitutes a potential aspiratory force which keeps the central venous system perpetually full of blood, and maintains this section of the circulation under favourable conditions for the action of the kinetic aspiratory function of the ventricles.

The kinetic aspiratory function is intermittent and exercises itself only during systole. When the cone of the heart contracts and expels the contents of the ventricles into pulmonary and systemic arteries it vacates a section of the pericardial sac, a space which is instantly filled by the head of the venous column entering and expanding the auricles—the advance movement being rendered imperative by the *vis a tergo* of atmospheric pressure exercised upon the contents of pulmonary and systemic veins lying at the foot of the venous column. The impetus of the moving column of venous blood transmitted to the cone of the heart is felt upon the thoracic wall; hence the quality of the apex beat affords a fair indication of the efficiency of the aspiratory function, a term which denotes and includes both the potential and the kinetic forces of aspiration.

The aspiratory function may be lowered by asthenic states of the myocardium or by reduction of the minus pressure of the environment. The latter event occurs when the fibrous stroma of the lungs loses its elasticity, when the musculature of the diaphragm and the thoracic wall becomes atonic, when intrapleural and intrapericardial effusions accumulate, and when pressure from the abdomen reduces the capacity of the thoracic cavity.

When aspiratory function is lowered certain phenomena occur. *Vis a tergo* of atmospheric pressure loses its potency, and intrathoracic venous circulation languishes. Diastole of the right ventricle and that of the auricles is sluggish, and the current in pulmonary capillary circulation is slow. Congestion of the pulmonary stream and stasis in bronchiolar radicles display themselves in symptomatic expression by asthma and dyspnoea. High peripheral resistance in the pulmonary field leads to high tension in the right ventricle, which, unable to discharge its contents fully, becomes the receptacle of a residual accumulation of blood. The barrel chest of emphysema is the result of attempts made by inspiratory musculature to neutralise the untoward effects of minus-pressure insufficiency.

Contrast circulatory conditions prevailing in states of low intrathoracic minus pressure, as in

emphysema, with those obtaining in the incipient stages of fibroid phthisis, when minus pressure is high, owing to contraction occurring in the fibrous stroma of the lungs. In the latter instance the heart is small. Asthma and pulmonary congestion are almost unknown, and the freshness of the complexion as compared with the greyness of the skin of the emphysemic is a matter of note. The falling in of the chest wall at later stages points to the existence of excessive degrees of minus pressure. This condition is also apparent in the well-defined deflexions of the jugular curve, which contrasts sharply with the featureless appearances of the jugular curve of the emphysemic.

In the recumbent posture, when the shoulders are depressed, the diaphragm seeks a high horizontal plane of activity; intrathoracic minus pressure is correspondingly reduced and aspiratory function is lowered. Hence this posture is intolerable to the subject possessed of a weak aspiratory function. When the trunk is upright the liver, attached by its suspensory ligament to the aponeurosis of the diaphragm, seeks a lower situation in the abdominal cavity, drawing down with it the diaphragm, which now engages itself upon a deeper plane of action. For this reason the subject of a weak aspiratory function even during the hours of sleep assumes an upright pose. When the aspiratory function is excessively low the patient stands up, resting and fixing his arms and bent shoulders over some object of support. He thus secures a depending liver, and at the same time obtains a *point d'appui* from which inspiratory muscles attached to the thoracic wall may exercise themselves with effect. By this means the fullest measure of intrathoracic minus pressure is secured.

To speak of the limitation of the movements of the heart through the direct effects of abdominal pressure is incorrect. The heart is suspended in a bony cage, and the arching of the diaphragm is limited by unyielding aponeurotic structures. Thus when the diaphragm has attained its highest plane of elevation ample room remains for the heart to disport itself without let or hindrance. Nevertheless the heart is affected by intragastric and intra-abdominal hyper-pressure—the one condition determining sympathetic acceleration or vagal inhibition, the other inefficiency of the aspiratory function.

The object of this paper is to draw the attention of the practitioner of medicine to a subject of clinical importance, and one having a bearing upon treatment—a subject which has suffered strange neglect at the hands of the cardiologist. Upon turning over the pages of several recent works upon heart disease I have not found so far even bare mention of the subject.

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LECTURES ON MEDICAL HYDROLOGY.—A course of lectures on Medical Hydrology (Hydrotherapy and Medicinal Springs) will be delivered at the Post-Graduate Medical College and Polyclinic, Chenies-street, London, W.C., on May 11th, 12th, 13th, and 14th, at 5.15 P.M., by Dr. R. Fortescue Fox. The lectures will deal with the effects of heat and cold, the principles of hydrotherapy and its application to acute and chronic disease; the rationale of bathing procedures—cooling, sedative, thermal, and hyper-thermal—employed both at home and at medical baths; medicinal springs and baths, and the choice of health resorts; and indications for hydrological treatment. All medical practitioners interested in hydrology are invited to attend