March 2nd, 10.30 A.M. She had a very good night, slept well, and lay on her side. She ate an egg and toast for breakfast. Pulse 96. Bowels quiet.

March 3rd, 10.30 A.M. The patient had a very good night, and slept until nearly ten this morning. She had a mutton-chop for breakfast. Pulse 84; no sickness nor diarrhoea. The rest of the sutures were removed.

March 5th, 10.30 A.M. She had a good night. After having some tea at 5 A.M., she was sick, and brought up a round worm, about nine inches long. The wound was healthy. She was ordered to have sherry wine. Pulse 96. In the afternoon, she had some retching and flatulence, and was ordered to have two grains of sulphate of quinine three times a day, and a morphia injection at night.

March 7th. Pulse 84. The bowels being confined, she was ordered a simple enema. This not acting, a turpentine enema, containing castor-oil, was administered, and acted well.

March 9th. She was progressing most favourably. Pulse 78. The wound was healing rapidly.

March 11th. She slept and ate well. She was sick after her dinner, and was ordered oxide of cerium, which checked the sickness. She turned in bed with great ease.

March 15th. Pulse 68. On dressing the wound, a slight hardness was felt close to an opening left by one of the deep sutures; and, on pressure, a quantity of healthy pus escaped through this opening, and at the lower part of the wound. The cause of this small abscess was explained by the discovery of the thread of a ligature used in tying the abdominal veins, which, being cut short and left in the wall of the abdomen, acted as a foreign body, and no doubt gave rise to many of her symptoms. It was removed, and the abscess rapidly healed. The tongue, which had been preternaturally red, was now quite of a normal colour.

March 18th. She sat up to-day for half an hour in an easy chair, and walked, with the nurse's help, from the bed to the fireplace. Pulse 68. The stump of the pedicle was touched occasionally with the nitrate of silver, as the granulations were rather flabby. The bowels were slightly relaxed; so she was ordered aromatic sulphuric acid, tincture of opium, and cinnamon-water.

March 21st. There was very little discharge from the wound; it was all healed, save the pedicle and the point where the abscess discharged. She sat up every day for an hour or more, and was gaining flesh rapidly.

March 28th. She had improved very much during the past week, ate and slept well, and sat up some hours every day. She walked with comfort about the ward. The wound was all healed, except the small stump of the pedicle. She was becoming stout, and the expression of her face was quite altered.

April 6th. Her nurse left, and she was removed down stairs into a female ward. She walked down from the top of the house herself.

April 25th. She was perfectly well; the wound was quite healed. She was only kept in to improve her general health as much as possible. She wears an elastic bandage.

May 12th. She was discharged cured.

June 21st. She was seen. The catamenia had appeared twice since she left the hospital, and she was in good health.

COUPS DE SOLEIL. In New York city the heat was terribly fatal. The deaths there from *coup de soleil*, were in three days no less than fifty-one in a total of sixty-one cases. The deaths from sunstroke exceeded the number of deaths from cholera.

Original Communications.

OBSERVATIONS ON THE SOUNDS OF THE HEART:

IN REPLY TO DR. SHAPTER'S PAPER OF MAY 12TH.

By ARTHUR LEARED, M.D., M.R.C.P., Physician to the Great Northern Hospital.

UNDER the head of "Notes and Observations on Diseases of the Heart and Lungs", in the JOURNAL of May 12th, Dr. Shapter has stated in detail his views with regard to the mechanism of the sounds of the heart. After having mentioned other explanations which he considers unsatisfactory, he adds: "My own conviction is, that the sounds referred to are mainly, if not entirely, due to the natural interference with the even flow of the blood by the various mechanisms of the heart; and that they are to be referred to the ordinary laws of hydraulics, and little, if at all, to be attributed to the contracting act of the muscle of the heart, or to any vibratory motions in the substance of the valves."

In this passage, Dr. Shapter does not claim the views put forward as his own; but neither does he attribute them to their real source. Possibly he was not aware that many years ago I published a paper in which the heart's sounds were held to be caused entirely by the blood itself. I afterwards published the same views in a more developed form, as a thesis read in the University of Dublin.* I have endeavoured to show, in this publication, that no other explanation of the sounds which emanate from the circulatory system is so comprehensive or so consistent with known principles. But there is another more important matter. I am prepared to prove that none is so compatible with the various morbid deviations from the normal sounds, or with the production of new sounds. In a practical point of view, the subject is no less interesting than important; and I only regret that other pursuits have interfered with my intention to demonstrate by a mechanical arrangement that these sounds are products of a more or less complete arrest of the blood's motion. I have expended much time and trouble in numerous hydraulic devices and experiments, and the final results are highly encouraging. The perfect imitation of the human heart-sounds has yet, however, to be achieved. The difficulties in the way, both as to material, delicacy of finish, want of comprehension and even honesty of purpose on the part of those employed in constructing the necessary apparatus, are great. In a letter of mine published in the *Medical Times and Gazette*, April 7th, 1866, it may be seen how all my pains for the formation of an India-rubber apparatus were frustrated, because the persons to whom its execution was entrusted chose to apply the principle involved to the production of a now popular enema-apparatus!

In the face of long established opinions favourable to the valvular theory of the sounds, sustained by names of eminence and the strong bias which writers on the diagnosis of diseases of the heart must inevitably entertain for the foundation upon which their views are based, I have felt that the demonstration in question requires to be complete. Sanguine

* See pamphlet "On the Sounds caused by the Circulation of the Blood: being a Thesis read in the University of Dublin for Degree of M.D. at the Winter Commencement, 1860." Churchill: 1861.

of success, I hope at no distant day to renew my attempts.

Although my views have not met the attention which I might have expected, this would be no excuse for apathy in the matter. Speaking with a sincere conviction of their truth, I may be pardoned in stating that this neglect will sooner or later be atoned for. Instead of a bare allusion to my explanations in the last edition of the standard work on *Physiology*, and their complete omission in some recent works on diseases of the heart, I am confident they will one day take the place to which their truth entitles them. I am glad, therefore, to find Dr. Shapter, while he points out reasons for dissatisfaction with other theories, adopting the present one. There are, however, certain conditions requisite for the production and modification of the sounds formed in the circulation, which he has not touched on, and for which I must refer him to my paper. The argument in that paper is strengthened by analogies, than which nothing short of direct proof can be more convincing. Dr. Shapter also not only employs analogy, but uses one identical with one I have given, quoting for the purpose a passage from Dr. Arnott, written without reference to the present subject, which I had not before seen.

DR. ARNOTT.

"It has long been observed, in household experience and elsewhere, that while water is running through a pipe, if a cock at the extremity be suddenly shut, a shock and noise are produced there. The reason is, that, the forward motion of the whole water contained in the pipe having been instantly arrested, and the momentum of a liquid being as great as of a solid, the water strikes the cock with the same force as a bar of metal, or a rod of wood having the same weight, and moving with the same velocity. A leaden pipe, if of great length, is often widened or burst in this experiment....

"The circumstances attending the circulation of the blood through the heart will, on consideration, be found to present every condition necessary for the application and illustration of this law; there is the current of blood passing through tubes, and this current suddenly and forcibly arrested by the closure of the valves."

from a cistern, is suddenly turned, a loud jarring sound is heard. It is caused by a concussion in the water from the sudden arrest of its onward flow. The semilunar valves are here represented by the plug of the cock; and, allowing for the difference between rigid and flexible materials, the conditions are very similar, since the elastic reaction of the vessels

DR. LEARED.

"The second sound occurs during diastole, and its mechanism closely resembles the first. The blood having been driven with much force into the aorta and pulmonary artery, a portion of it recoils, but is checked in its rapid descent towards the heart by the semilunar valves. The sound is caused by the concussion thus induced; the force of which is, however, by no means sustained by the valves alone, for they are thoroughly supported by the ventricles and their contents. This is obvious, since there can be no approach to a vacuum in the heart. The valves are to be regarded as separating media, which do not themselves sustain the force of the descending blood. A valve thus supported is known in the arts as an equilibrium valve.

"An experiment at hand in most houses demonstrates the principle on which the second sound is formed. When a cock, attached to the lower end of a perpendicular pipe of some length, through which water is flowing

effects a pressure on the blood which is effected in case of the water by length of the pipe. If, then, the pipe and cistern are capable of yielding a sound which may be heard at a considerable distance, it cannot be wondered at if the heart and its vessels, on the same principles, give rise to sounds audible through a stethoscope or by direct contact with the body.

"If the cock is only turned so as to allow even a small portion of water to pass through, a rushing sound (in this case continuous) results. The change of the normal second sound into a murmur from incompetency of the valves is thus demonstrated."

Space will not allow me to place my explanation of the formation of the first sound before the reader. Let it suffice at present to say that it has nothing to do with the vibration of valves; and that, in support of this statement, very strong reasons, derived from pathology, can be adduced. One of the arguments relied on to prove the valvular origin of the first sound, was the great probability that both sounds were formed by the same kind of mechanism; and the dogma, that the second was a valve-sound, was held to be unassailable. Whether or not this is the case any longer, I must leave for others to judge; only let the matter be impartially considered. That it is more philosophical to look for a common cause for both sounds, is quite true; and that cause will be found, as already said, in the motions of the blood itself, not in such a vibration of delicate valves as would be necessary for the production of sound in a viscid fluid, and which would imply a degree of strain which, to say the least, is highly unphilosophical.

The experiments of my late colleague, Professor Halford, have for the time propped the valvular theory of the heart-sounds, and tended to divert attention from every other. But, ingenious and painstaking as these undoubtedly were, there is no one of them of any moment, which, when rightly interpreted, is contradictory of my views. One experiment was supposed by himself and by others to be conclusive as to the truth of the valvular theory. The heart of a living animal having been exposed, he cut off its supply of blood by compressing its afferent veins. No sound was then heard on applying a stethoscope to the heart, because, as he argued, there was no blood to act on the valves. It curious that I had performed the selfsame experiment some time before seeing the printed account of that by Professor Halford, and then wrote to him to that effect. It was intended alike by him as well as by myself to disprove the once generally accepted muscular theory of the first sound; but it is hardly necessary to say that, according to my explanation of its cause, this sound would be as effectually suppressed by cutting off the ventricular supply of blood, as it would be supposing the sound to be valvular.

PUBLIC VOTES. The following votes have been granted in the House of Commons: £5793 for the University of London; £14,867 for the Scottish Universities; £1452 for the Queen's University in Ireland; £2,250 for the Queen's Colleges in Ireland; £5,000 for vaccination inspectors and public vaccinators; £5,926 for medical officers in the Royal Navy.

STEAM AS A DISINFECTANT. DR. A. N. Bell, of Brooklyn, contends that steam is a far better disinfectant than chlorine, the latter remedy rotting the clothes, while the former is thoroughly efficacious, and makes not the slightest difference in the clothes, beyond the great one of disinfecting them of all disease. The apparatus used for the experiments was simply a steam boiler of three-horse power, and a force pump.