II. "Ice Observations." By David Walker, M.D., Surgeon and Naturalist to the Arctic Discovery Expedition. Communicated by Thomas Andrews, M.D. Received December 16, 1858.

(Abstract.)

The contradictory statements of Dr. Sutherland and Dr. Kane, with regard to the saltness of the ice formed from sea-water,—the former maintaining that sea-water ice contains about one-fourth of the salt of the original water; the latter, that if the cold be sufficiently intense, there will be formed from sea-water a fresh and purer element fit for domestic use,—induced the author to take advantage of his position, as naturalist to the expedition now in the northern seas, to reinvestigate the subject.

The changes which he has observed sea-water to undergo in freezing are the following. When the temperature falls below $+28°{\cdot}5$, it becomes covered with a thin pellicle of ice; after some time this pellicle becomes thicker and presents a vertically striated structure, similar to that of the ordinary cakes of sal-ammoniac. As the ice further increases in thickness, it becomes more compact, but the lowest portion still retains the striated structure. On the surface of the ice, saline crystals, designated by the author "efflorescence," soon begin to form, at first few in number and widely separated, but gradually forming into tufts and ultimately covering the whole surface. At first, the increase in thickness of the ice is rapid, but afterwards the rate of growth is much slower and more uniform. The ice formed yields, on being melted, a solution differing in specific gravity according to the temperature at the time of congelation, its density being less, the lower the temperature at which the process of congelation took place. Although the author's observations extended from $+28°{\cdot}5$ to $-42°$, he was never able to obtain fresh-water from sea-ice, the purest specimen being of specific gravity $1{\cdot}005$, and affording abundant evidence of the presence of salts, especially of chloride of sodium, in such quantity as to render it unfit for domestic purposes.

The efflorescence already referred to appeared sooner or later, according to the temperature of the air, but generally commenced when the ice was $\frac{3}{8}$ of an inch thick, and continued to form till

the ice attained a thickness of about 9 inches, when, in consequence of the compactness of the frozen mass, it ceased to appear at the surface. The lower the temperature at which the ice was formed, the more abundant was the efflorescence. Direct experiments made by freezing sea-water in a large tub, showed that the unfrozen residuum contained a considerable portion of salts expressed from the ice. The author therefore infers, that after the efflorescence had ceased to form on the surface, the saline particles were precipitated into the unfrozen liquid below. On exposing the residual liquid from which the ice had been separated to a freezing temperature, a second residuum was obtained, containing more salts than the first; and by repeating the process several times, there remained finally a strong solution of brine.

The author endeavoured, by reversing this process, to procure fresh-water. He remelted the ice from sea-water and froze it again, repeating the operation several times. Ice was thus obtained, which, when melted, gave water, having a density of from 1·0025 to 1·0020.

A "heavy nip" having occurred in the floe near the ship afforded an opportunity of examining the quality of the ice at different depths. The thickness of the entire mass was 54 inches; the density of the solution obtained by melting successive portions varied from 1·0078 to 1·0050; those near the surface giving a liquid of higher density than the rest. A specimen taken from the centre of the mass was reserved for analysis.

With regard to the "efflorescence," the author states that its appearance was very different according as the temperature was above or below −25°. In the former case, it exhibited a plumose form, with secondary plumes branching off; in the latter, it consisted of fibrous crystals varying from $\frac{1}{4}$ to 2 inches in length. This efflorescence acts an important part in the breaking up of the floe. From the middle of January cracks and lanes occur in the floe, which subsequently become filled with new ice covered as usual with the saline efflorescence and a little snow. When the sun's rays fall upon this incrustation, it melts and forms a thick liquid on the top. This penetrates gradually through the ice and aids greatly in breaking it up. The author supposes that a process of endosmosis and exosmosis is, in fact, established through the body of the ice. A

similar, but less powerful, action is produced by the same cause on the mass of the floe itself.

In the artificial freezing of sea-water, the ice was found to be vertically striated, and often divisible into two or more layers, while the under surface was always marked by fine lines intersecting each other at definite angles. From the bottom of the vessel thin plates of ice formed in the unfrozen liquid. They varied in length from $\frac{1}{2}$ in. to $2\frac{1}{2}$ in., and contained less salt than the ice formed on the top.

To explain the observation of Dr. Kane as to the freshness of ice formed from sea-water under $-30°$, the author supposes that it may have depended on the freezing of a portion of sea-water which was covered at the time of its congelation with a stratum of fresh-water produced by the melting of bergs. On the 12th of April, 1857, whilst lying off Brown's Island, within about 4 miles of a glacier surrounded by bergs, the author observed a layer of fresh-water, 2 or 3 inches in depth, floating, like oil, on the surface of the salt-water. To this cause he attributes the occasional occurrence of hummocks from the upper portions of which ice perfectly free from salt can be obtained, while on digging deeper into these hummocks, the ice is always found to lose its freshness.

III. "Inquiries into the Phenomena of Respiration." By Edward Smith, M.D., Assistant-Physician to the Hospital for Consumption, Brompton. Communicated by Sir B. C. Brodie, Bart., P.R.S. Received December 16, 1858.

(Abstract.)

The author gives in this communication the result of numerous inquiries into the quantity of carbonic acid expired, and of air inspired, with the rate of pulsation and respiration,—1st, in the whole of the twenty-four hours, with and without exertion and food; 2nd, the variations from day to day, and from season to season; and 3rd, the influence of some kinds of exertion.

After a description of the apparatus employed by previous observers, he describes his own apparatus and method. This consists of a spirometer to measure the air inspired, capable of registering any number of cubic inches; and an analytical apparatus to abstract