D inches.	F per cent.	D inches.	F per cent.
2	2.00	11	0.38
3	1.33	12	0.33
4	1.00	13	0.30
5	0.80	14	0.28
6	0.66	15	0.26
7	0.57	16	0.25
8	0.50	17	0.23
9	0.44	18	0.22
10	0.40	19	0.21
—	—	20	0.20

In the above, the friction on a ram 4 inches diameter is given as one per cent. of the gross load.

In forty-eight experiments the friction varied from one per cent. to 0.5 per cent., variation being $\frac{1}{2}$ per cent.

In some experiments made in this city by Messrs. Wm. Sellers & Co., in hydraulic testing machines, they used as a gauge a steel plug, half an inch diameter, fitting into a steel collar of the same size. The collar in which the plunger moved freely was $3\frac{1}{2}$ inches long, and this length of bearing was found sufficient to prevent the escape of oil under the pressure of 5000 lbs. to the square inch. They adopted this expedient for dispensing with packing from their knowledge of the variable frictional resistance of the leather collars.

They found, however, that although all packing was dispensed with, yet as the pressure increased a frictional resistance became manifested. It is now a matter of interest to determine, in a manner similar to the plan of Mr. Hicks, what is the rate of increase in frictional resistance, with plungers depending for their tightness, not upon packing, but upon long closely-fitted joints.

The Smithsonian Institute on the Ice on the Strainer.

In reference to an article published in the May number of this *Journal*, we publish the following as embodying the opinion of a competent authority. We think, however, that the views of Mr. Douglass are undoubtedly correct, and the hypothesis given by Prof. Henry, as of Arago, is insufficient to account for the facts:

UNIVERSITY OF MICHIGAN,
(Department of Chemistry.)
ANN ARBOR, June 13.

To the Editor of the *Detroit Free Press*:

The discussion of the subject of the accumulation of ice on the strainer at the water-works will be recollected by many of your readers. A few days since I received the following letter from Prof. Henry, the distinguished physicist at the head of the Smithsonian Institution:

SMITHSONIAN INSTITUTION, May 17, 1866.

My Dear Sir: In looking over the *Journal of the Franklin Institute* for the present month, I find your letter relating to the freezing of water around the mouth of an iron pipe at the depth of twenty-five feet below the surface. The fact is interest-

ing as a striking example of the production of "ground-ice," the explanation of which has been a puzzle to the physicist. The explanation which you have given is that which most readily suggests itself to those familiar with the experiments of Dr. Wells, and, indeed, is that which was most generally adopted previous to the researches of Melloni. He has shown that terrestrial radiation or heat of low intensity, is interrupted by the thinnest sheet of water. It is true, that the more intense rays of heat from the sun penetrate to a considerable distance below the surface of still water, but the less intense rays do not enter the water to any depth, and it is probable that by far the greater portion of a beam of solar radiation is stopped at the surface of water. Ground-ice is formed at the bottom of streams of running water, adhering to stones, grass, or other solid bodies. The explanation given, I think by Arago, is as follows: The water at the surface is cooled down below the point of congelation, when, by the motion of the water in the stream, it is brought into contact with a solid body at the bottom, which, acting as a nucleus of crystallization, immediately determines its solidification. This explanation will apply equally to the case referred to you, in which the water from the surface is drawn down by the discharge from the pipe. I think it probable that the whole subject requires further elucidation, and it is on this account I have taken the liberty to direct your attention to the facts I have stated.

JOSEPH HENRY.

PROF. DOUGLASS, University of Michigan.

The experiments of Melloni, as well as the explanations of Arago, of the formation of "ground-ice," I was familiar with at the time I gave my views last winter, but deemed them inadequate to the explanation of the singular phenomena, for the following reasons:

First. At $39^{\circ}2'$ of temperature water has its maximum density. This is about 7° above the freezing point. The cooling takes place at the surface, and as the temperature arrives at $39^{\circ}2'$ the cooled water would, by virtue of its diminished specific gravity, remain at the surface. I can scarcely conceive that the current of Detroit River, or the discharge from the pipe, would be sufficient to cause the water to descend twenty-five feet against the force of gravity.

Second. Why is it the ice ceases to form on the strainer as soon as the river is covered with ice, unless it is because the ice intercepts the radiation?

Prof. Henry is probably not aware of the moderate current of the river, or the fact last mentioned.

I send you the above letter from the distinguished Professor, that the public may know the intense interest that scientific men feel in the solution of this mysterious problem. I cannot but express the hope that the Water Commissioners will take measures to test the truth of these theories the coming winter.

S. H. DOUGLASS.

On Magnetical Errors, Compensations, and Corrections, with special reference to iron ships and their compasses. By Professor AIRY.

From the London Athenæum, April, 1865.

Prof. Airy has given three lectures "On Magnetical Errors," &c., at the old lecture theatre of the South Kensington Museum. These lectures were of so much importance as to deserve the utmost publicity.

The subject was treated under the following heads: I. Terrestrial magnetism and the magnetism of permanent magnets. II. Transient induced magnetism of iron. III. Sub-permanent magnetism of iron. IV. Correction of magnetic disturbing forces. V. Magnetism of ships, especially of iron ships, and correction of their magnetic disturbing forces on the ship's compass.

From the Professor's notes we give the following synopsis:

I. *Terrestrial Magnetism and the Magnetism of Permanent Magnets.*—1. Every magnet has two opposite poles, possessing different properties.

2. Every bar-magnet, when freely suspended, takes a definite position, one end pointing to the magnetic north. (The end which points