Uranometria Nova 6. This discrepancy may very easily occur in the hurry of such a sensational observation, as on these occasions the time at the disposal of the observer is so limited.

Royal Observatory, Greenwich, G. B. AIRY
August 3

Floating Magnets

I HAVE no intention of discussing the beautiful experiments of Prof. A. M. Meyer on floating magnets; but as a privately-expressed opinion of mine has appeared in *NATURE*, vol. xviii. p. 260, I feel bound to defend it. The mutual repulsion of the vertical floating magnets varies nearly inversely as the fourth power of the distance at great distances, and nearly inversely as the square at small distances. The horizontal attraction of the magnet, held vertically over the water, varies nearly inversely as the fourth power at very great distances. At a certain moderate distance it reaches a maximum, and close to the centre it varies directly as the distance. It is easy to see that variations of the magnetisation of the lengths of the magnets, and of the distance of the large magnet from the surface of the water, may render configurations stable which would, under different conditions, be forms of unstable equilibrium. Prof. Meyer

thinks that the configuration . . . can never be stable. It is

easy to see that it is a form of equilibrium, and in fact that any given size of hexagon will be brought into equilibrium by placing the large magnet at a suitable distance. It may, therefore, be in equilibrium when the floating magnets are on the circle of maximum attraction of the fixed magnet. But, in this case, the equilibrium is stable; for work would be expended in altering in any way the position of any one of the floating magnets. If this one is carried away from the others they repel it less, and it will be brought back; if it is carried nearer to the others they repel it more, and again it will be brought back.

The nature of equilibrium where there are several degrees of freedom may be illustrated by considering a tract of country upon which water can run. The hollows are positions of stable equilibrium; the summits and passes (saddles) are positions of unstable equilibrium. Then, if any one speaks of the former as more or less stable (as Prof. Meyer does of stable configurations), he may be understood as having reference to the curvature of the hollow, or to its level, or to some vague and mixed charac-

ters. It is very easy to understand why the form . . . should

be difficult to produce or maintain. It is because the floating magnets are in this case at much greater distances from the centre than when they assume the form . . . Hence, the potential energy of the former configuration is much greater than that

of the latter. The reverse is the case with . . . and . . . , and

still more so with . . . and . . . , and so with greater numbers of magnets. . . . C. S. PIERCE

Mons. A. Cavallé-Coll on Musical Pitch, the French Diapason Normal, Scheibler's Tuning-Forks, &c.

IN the course of my researches on musical pitch, with the view of discovering the source of the discrepancy between Appunn's and Lissajous's measurement of the French diapason normal, I have had the good fortune to enter into correspondence with M. Aristide Cavallé-Coll, the celebrated Parisian organ-builder, and in his long and obliging answers to my inquiries he has communicated some facts which I have thought it important, with his permission, to lay before the readers of *NATURE*, as far as possible in his own language.

Scheibler, and the Persistency of the Pitch of Tuning-forks.—M. Cavallé-Coll had the advantage of personally knowing Heinrich Scheibler, silk manufacturer, of Crefeld, near Düsseldorf, who died November 20, 1837. Scheibler's experiments on tuning, with which I had long been acquainted, are the most important hitherto made; but I had feared that his wonderfully accurate tuning-fork tonometer was irrecoverably lost. I find that M. Cavallé-Coll is fortunate enough to possess one, and

Herr Amels, of Crefeld, another, that is, a series of fifty-six forks, proceeding by degrees of four beats in a second, from A 220 to A 440 double vibrations in a second, which last was adopted by the Stuttgart Conference in 1836 as the best normal pitch. This was chosen by Scheibler as his standard, because it was the mean of the Viennese grand pianos in his day. Of him M. Cavallé-Coll says:—

"M. Scheibler n'était pas un savant, mais, en s'appuyant sur les expériences faites par Sauveur en 1701 pour la détermination d'un son fixe, il était arrivé par ses patientes recherches à créer, en 1834, un tonomètre différentiel de la plus rigoureuse exactitude et qui n'avait pas été fait avant lui."

Of the exactness with which Scheibler worked M. Cavallé-Coll gives the following remarkable proof, which is at the same time a proof that tuning-forks will preserve their pitch for at least twenty-eight years; so that there is no reason to suppose that, when properly protected, they will not form a lasting record. This was a point on which I dwelt much in my letter to M. Cavallé-Coll, because it has been often thought that they might vary considerably. See Zantedeschi (*Sitzb. Vienna Acad.* vol. xxv., year 1857, p. 172), whose conclusions I believe to be erroneously based. M. Cavallé-Coll says, in his first letter (January 24, 1878):—

"En 1862, j'ai eu l'avantage d'assister aux expériences faites par M. Léon Foucault pour la détermination expérimentale de la vitesse de la lumière. Ce savant expérimentateur, que la mort a enlevé à la science en 1868, se servait, pour mouvoir son miroir tournant, d'un petit tambour mis en mouvement par une soufflerie et un régulateur de pression que je lui avais établis; laquelle turbine devait faire 400 tours à la seconde. Or avec cette vitesse, la turbine faisait entendre un son d'axe dont le nombre de vibrations correspondait au nombre de tours." In a subsequent letter (February 8, 1878) M. Cavallé-Coll adds:—"M. Léon Foucault, bien qu'il fit construire ses instruments par les premiers constructeurs, était toujours obligé de les vérifier et de les rectifier lui-même pour arriver à la régularité de marche qu'il avait en vue d'obtenir."

"Pour mesurer la vitesse de la turbine, M. Léon Foucault avait imaginé un moyen nouveau que je vais essayer de décrire. D'abord une pendule de précision, construite par l'habile constructeur Froment, mettait en évidence une roue dentée de 400 dents, laquelle faisait un tour entier par seconde. Ensuite, la turbine était disposée de manière à réfléchir un rayon lumineux du miroir tournant sur les dents de la roue. Or la coïncidence des rayons lumineux avec le passage des dents de la roue de la pendule permettait de reconnaître, à l'immobilité apparente des dents de cette roue, que la vitesse de la turbine était alors exactement de 400 tours par seconde." This description is necessary to understand the extreme delicacy of the test of Scheibler's work, which follows. "Un jour que j'assistais à une de ses observations, M. Léon Foucault me dit: 'Si nous avions un diapason exactement accordé de 400 vib. par seconde il devrait se trouver d'accord avec le son d'axe de la turbine? Sans rien dire à M. L. Foucault, je cherchai dans mon tonomètre de Scheibler un diapason de 400 vib., et l'ayant comparé avec le son d'axe de la turbine, je le trouvais si exact que je fus émerveillé de constater que par des moyens différents et à plus d'un quart de siècle de distance ces deux savants expérimentateurs avaient atteint avec la même perfection la détermination d'un son fixe donnant exactement 400 vib. par seconde. Cette circonstance est venue confirmer dans mon opinion que le tonomètre de H. Scheibler pouvait être regardé comme un instrument de la plus haute précision." M. Cavallé-Coll concludes:—"Dans mon opinion le diapason conserve le même ton à la même température. Il n'y a que l'altération du métal lui-même qui puisse faire changer le ton; mais si l'on prend les soins nécessaires pour préserver les diapasons des influences climatiques, comme le faisait H. Scheibler, on peut être à peu près certain qu'ils conservent le même ton."

Improvements in the Siren, Bellows of Precision, Double-Action Counter.—M. Cavallé-Coll was also personally acquainted with M. le Baron Cagniard de Latour, and was "initié à ses travaux." He calls him "un des plus savants acousticiens français du siècle présent," and says he is "sans contredit le véritable inventeur de la syène;" adding, "la date de la création de ce merveilleux instrument, qui se trouve aujourd'hui dans tous les cabinets de physique d'Europe, remonte à l'année 1819;" and he complains that Helmholtz should have mentioned Seebeck's first, even on the score of simplicity of construction, as it was invented so long afterwards.