dangerous or explosive. The principle of the lamp is based on the fact that when a mixture of any inflammable gas or vapour, with air in explosive proportions, is lighted on the surface of wire gauze, having meshes sufficiently small to prevent the passage of flame, and a suitable tube or chimney is placed above, so as to prevent admission to the chimney except through the wire gauze, a musical sound is produced varying in pitch with the size of the flame and dimensions of the chimney.

A number of interesting experiments were exhibited to illustrate this principle, and various miner's lamps as constructed were exhibited and tested in mixtures of air with ordinary coal gas, when they at once indicated the danger as soon as the atmosphere by which they were surrounded contained sufficient gas to be dangerous, by emitting a strong clear sound like that of a horn, which could be heard at a considerable distance. Another form of this lamp was also shown, intended to be employed as a stationary warning apparatus or alarum after being placed in any part of the mine considered likely to ensure the safety of the workmen, so that it might sound the danger signal before the air around it was so far charged with fire-damp as to become explosive. The novelty and importance of such an invention were apparent to an audience of practical men; and besides passing a cordial vote of thanks to the inventor, arrangements were made for at once fully testing its merits by its practical employment in some English collieries noted for fire-damp.

After an interesting paper by Mr. D. Rowan, of Glasgow, "On the rise and progress of the iron shipbuilding trade in Scotland," which, however, was of a purely historical and statistical nature; the next communication was made by Mr. Lauth, of Pittsburg, United States, "On Lauth's system of rolling iron by three high rolls." The improvements proposed in this system of rolling, which is in itself very old, consisted in making the central roll of less diameter than the two others, which are of ordinary size, and in having it fixed, whilst the two others are adjustable by screws. In the hard rolls the bottom roll alone is driven, both the middle and top roll being carried round by friction. All expansion or contraction is prevented by a stream of water constantly kept running on to the roll; and great rapidity in rolling, as well as economy in labour, is claimed for this system. In the discussion which followed, the general opinion appeared to be that, although such rolls were well adapted for plates, in this country they were less adapted for rail rolling, owing to the greater difficulty in adjusting the grooves so as to turn out rails as correct in section as was insisted upon by our and most of the Continental engineers, but not in the United States; also because the necessity for three rails would still further augment the immense stock of rolls requisite to suit the multiplicity of sections required in the English trade, as well as increase the labour and time required in changing the rolls.

The next paper was by Mr. A. Spencer, of West Hartlepool, "On further improvements in Spencer's Rotary Puddling Furnace" a model of the furnace in its present form being exhibited, and its construction, mode of fettling, and working, fully entered into by the author; after which, owing to time not permitting, a lengthy paper by Mr. J. Guildford Smith, of Philadelphia, "On the Westward development of the Iron Manufacture of the United States," was taken as read; and after passing votes of thanks to the Lord Provost and civic authorities of Glasgow, the Council of the Philosophical Society, the Committee of the Royal Exchange, the local Committee, and the President of the Institute, the proceedings of the meeting were brought to a close.

In the afternoon an excursion was made by a special train to the Coltness and Mossend Ironworks, the members of the Institute being entertained on their return at a banquet given in the Corporation Galleries by the local Committee of the Institute.

An interesting feature in connection with the meeting was the arrangement of a temporary museum in the Corporation Galleries containing models, specimens, and objects of all kinds bearing more or less directly on the Iron and Steel manufacture, many of the articles exhibited being of great interest.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Solar Outbursts and Magnetic Storms

In the French *Comptes Rendus* of August 4, which has lately reached this country, is an account by Father Secchi of a remarkable outburst from the sun's limb witnessed by him on July 7, which lasted from $3^h\ 30^m$ to $6^h\ 50^m$ (Roman time, I presume), or nearly $2^h\ 40^m$ to $6^h\ 0^m$ (Greenwich time).

A magnetic storm commenced at Greenwich at $5^h\ 0^m$ precisely on the same day. Its indications began at that time with unusual suddenness and strength, on all the magnetic indicators, namely the declination-needle, the horizontal force magnetometer, the vertical force magnetometer, the earth-current wire, in an approximate N.E. and S.W. direction, and on the earth-current wire in an approximate N.W and S.E. direction. The disturbance lasted, gradually diminishing, to the evening of July 9. During a part of the time it was accompanied with aurora.

I do not venture upon the question whether there really was any connection between the solar outburst and the terrestrial magnetic storm, but I will remark that, if there was such connection, the transmission of the influence from the sun to the earth must have occupied $2^h\ 20^m$; or a longer time if Father Secchi did not see the real beginning of the outburst. This, if established, would be an important cosmical fact; and, at any rate, the notification of this apparent retardation may direct the attention of observers of similar phenomena in future to a new element in their interpretation.

G. B. Airy

Royal Observatory, Greenwich, August 14

Ocean Circulation

Although no mathematician, and only an amateur in physics, it appears to me that the difficulties and objections of Mr. Croll on this subject may be obviated, and the whole question elucidated by a reference to the admitted facts, and a common sense interpretation of them. And first, as to the fact that the surface water of the Atlantic Ocean, in moving northwards from the equator to 60° lat., has almost wholly lost the easterly motion of rotation it should have brought with it. This loss is imputed by Mr. Croll to friction only, and he argues that the much lower velocity of the northward current must, therefore, be wholly neutralised by friction. This is his main argument, which he has repeatedly adduced, and to which he has hitherto received no reply. But, although his reasoning might be admitted if the conditions affecting the two motions were the same, it seems to me to be quite inapplicable to the present case. If, in the temperate zone, the ocean extended uninterruptedly in an east and west direction round the globe, it would no doubt retain a considerable portion of the equatorial eastern motion, and whatever deficiency existed might fairly be imputed to friction. But the Atlantic is actually like a huge lake, with continuous eastern and western shores, and the water which flows northwards along the eastern shore is prevented from moving eastwards, not by friction against water or even against the shore, but by having to perform work in lifting or heaping up the water against the shore, just as the water of a pond or lake is heaped up on the leeward side by a strong wind. As the direction of the motion of the water will, however, by the hypothesis, be oblique or somewhat north of east, some of the motion will be diverted northwards along the eastern shore, and thus tend to increase the northerly flow. The 9,925 pounds of energy (according to Mr. Croll) are not therefore consumed in overcoming the frictional resistance to eastward motion, but for the most part in doing the actual work of overcoming gravitation and holding up the waters at a higher level, and the theoretical amount of this rise can, no doubt, be easily calculated for us by Mr. Croll.

The case of the water moving northward is very different.

There is a clear passage into the polar area, and probably up to and beyond the pole; and within this area there is a continual diminution of bulk of the entering water as it becomes cooled, as well as a continual subsidence of the surface water, producing a partial depression to be constantly filled by water from the south. Experiment proves that if at one end of a vessel of warm water ice is applied at the surface, the cooled water instantly sinks, and its place is taken, not by water rising upwards from below, but by a horizontal movement of the surface gradually propagated to the other end of the vessel, while the descending cold water creeps along the bottom, and gradually acquiring a higher temperature, rises and completes the circuit. It is somewhat difficult to conceive, theoretically, how such a circulation can commence, because the cooled atoms of water must displace others before they can descend, and these again must displace others, and so on over the whole mass. The amount of energy due to the superior weight of the first-cooled atoms may appear inadequate to perform so much work, but nevertheless circulation does commence and indefinitely continues so long as a difference of temperature of the two ends of the vessel is kept up. The extreme mobility of the particles of water, and the almost total absence of friction between them, seems to be influential in producing this result; and it is not probable that any minute difference of level that may be caused on the surface of the water by difference of temperature has anything to do with the motion; and I cannot help thinking that the supposed six-feet incline from the equator to lat. 60° is, if it exists, by no means an effective cause of the oceanic circulation.

ALFRED R. WALLACE

I THINK the root of Mr. Croll's difficulty (see NATURE, p. 324) is to be found in his overlooking the possibility of energy becoming potential in the distribution of oceanic water.

Water running in any direction in the northern hemisphere tends to swerve to its own right, and if this tendency is checked (as it is in fact by the presence of continents) its layers of equal density will be tilted up on the right, the limit of tilt being the angle whose tangent is the quotient of the tendency to swerve by the force of gravity. This consideration is, I think, sufficient to deprive Mr. Croll's argument of one of the two legs on which it stood.

Mr. Ferrel's argument from the tides is quite conclusive in showing that the forces arising from difference of temperature are of sufficient magnitude to keep up an oceanic circulation. Thus the other leg of Mr. Croll's argument is gone.

Mr. Croll may well retract his previous assertion that the difference of kinetic energy is consumed in friction, for he was in a fair way to bring the earth to a standstill.

Brighton, August 20 J. D. EVERETT

Spectrum of Aurora

A FINE aurora was seen at Bedford on Thursday night between midnight and one o'clock. It was brightest under the Polar Star near the horizon, where the colour was a pale green; whilst overhead the hue often changed to a rosy red. On directing a spectroscope at the most brilliant part, a bright green line (W.L. 557) was very distinct, and two or three faint nebulous bands more refrangible were visible; but the red line was not to be seen, though carefully looked for on the rosy parts of the aurora. Objects around were faintly illuminated as if by a young moon. At one time two very faint pale green streamers were seen stretching from the north to a little east of the zenith.

Blackheath, August 11 J. P. MACLEAR

The Method of Least Squares

As the wording of Prof. Hall's letter in NATURE for July 25 might imply that he was calling attention to evidence that would change the opinion expressed in my letter, it seems to me worth while to state that at the time of writing that letter I was acquainted with the passages in question, and to repeat my assertion that with reference to the *method of least squares* I should not regard the neglect of Lagrange's memoir as an omission. Also in spite of Encke's and Prof. Hall's remarks, I think it has received as much attention as, viewed practically, its importance entitled it to.

With regard to the principle of the Arithmetic Mean, I may add that I have devoted the greater part of a tolerably long memoir to its consideration, and feel sure that no remarks on the subject contained in a few lines could be rendered even intelligible.

J. W. L. GLAISHER

Blackheath, August 11

NOTES

WE are informed that M. Faye will in all probability be M. Delaunay's successor as Director of the Observatory at Paris. In the meantime M. Matthieu supplies his place *pro tem.*

THE French Academy has elected two foreign correspondents in the section of botany—M. Planchon in the place of M. Lecoq, and M. Weddel in the place of Prof. Mohl.

THE American Association for the Advancement of Science was to commence its sittings yesterday at Dubuque, Iowa. Prof. J. Lawrence Smith, of Louisville, had been elected President, and Prof. Alexander Winchell, of Ann Arbor, Vice-President. It was announced that the citizens of Dubuque had determined that all members attending the meeting should be entertained at their private residences free of charge during the session; and their travelling expenses would also probably be remitted by the various railroad and steamboat lines. A very successful meeting was anticipated.

AT the recent combined First B.A., First B.Sc., and Preliminary Scientific (M.B.) Examinations of the University of London, Mr. J. M. Lightwood, of Trinity Hall, Cambridge, obtained the Exhibition in Mathematics and Philo ophy; Mr. R. E. Carrington, of Guy's Hospital, the Exhibitions in Chemistry and in Zoology; and Mr. J. C. Saunders, of Downing College, Cambridge, the Exhibition in Botany.

WE regret to announce the death of Mr. Frederick Carpenter Skey, C.B., F.R.S., which took place on Thursday last at his residence, Mount Street, Grosvenor Square. Mr. Skey was in his 73rd year. He was in early life a pupil of the celebrated Dr. Abernethy, to whom he was articled in 1816 by the Royal College of Surgeons. About 1826 he was appointed Demonstrator of Anatomy at St. Bartholomew's Hospital. Subsequently he founded the Aldersgate School of Medicine, which became one of the largest in London. From that time to his death Mr. Skey enjoyed the reputation of being in the first rank of London surgeons. His writings on medical subjects were numerous and important, and on subjects connected with sanitary science his communications to the public journals were frequent.

THE following is the list of candidates who have been successful in obtaining Royal exhibitions of 50*l.* per annum each for three years in the Science and Art Department, and free admission to the course of instruction at the following institutions:—To the Royal School of Mines, Jermyn Street—William Carter, Ambrose R. Willis, and Alexander Gibson. To the Royal College of Science, Dublin—Arthur G. Meeze, Denis Coyle, and Ernest H. Cook.

A NATURAL History Society has been formed at Madrid called "La Sociedad Española de Historia Natural," under the presidency of Don Miguel Colmeiro. The first part of its publication has reached this country, and contains the regulations of the Society, an account of the meetings held by it up to this time, and papers by Poey on Ichthyology, by Colmeiro on the Fumitories of Spain and Portugal, by Espada on the Volcano of Ansango, by Solano on a Meteoric Stone, by Espada on New America Batrachians, and by Perez Arcas on New Reptiles and Insects of the Spanish Fauna. It is extremely well printed, and is illustrated by three capital plates. The subscription to the