(*Garrulus glandarius*), an Ortolan Bunting (*Emberiza hortulana*), a Blackbird (*Turdus merula*), a Nightingale (*Daulias luscinia*), British, presented by Mr. E. Cossavella; a Common Jay (*Garrulus glandarius*), a Natterjack Toad (*Bufo calamita*), six Crested Newts (*Molge cristata*), three Palmated Newts (*Molge palmata*), British; three Sand Lizards (*Lacerta agilis*), five Yellow-bellied Toads (*Bombinator bombinus*), an Edible Frog (*Rana esculenta*), European, presented by Mr. G. B. Coleman; four Common Snakes (*Tropidonotus natrix*), British, presented by Count Pavoleri, F.Z.S.; a Malbrouck Monkey (*Cercopithecus cynosurus*) from West Africa, a Barbary Wild Sheep (*Ovis tragelaphus* ♂) from North Africa, two Common Squirrels (*Sciurus vulgaris*), British, deposited; two black Apes (*Cynopithecus niger*) from Celebes, purchased.

OUR ASTRONOMICAL COLUMN.

SOLAR OBSERVATIONS AT THE R. OSSERVATORIO DEL COLLEGIO ROMANO.—Prof. Tacchini, in the *Memorie della Società degli Spettroscopisti Italiani*, gives a tabular statement of the prominences, faculæ, and spots visible on the sun's surface during the first three months of the present year. Taking the case of the number of prominences, no less than 300 were observed during this period, 161 appearng in northern and 139 in southern latitudes. During the first two months prominences were more numerable in the south hemisphere, amounting to an excess of 7 and 5 respectively, but in March as many as 78 were recorded for the northern as against 44 for the southern. The latitudes for the regions of greatest frequency were + 40° + 30° and − 20° − 30°.

For the faculæ 28, 24, and 18 (total 70) were recorded for the northern latitudes, while very nearly the same number (76 = 20 + 18 + 38) was observed on the southern hemisphere. In both cases the record for latitudes ± 50° ± 40° was one, the greatest number appearing in latitudes ± 10° ± 30°.

The total number of groups of spots recorded was 80, of which 38 were observed north of the equator. Curiously enough the month of February only contributed 21 out of this number, 34 being recorded for January; the region of greatest frequency occupied the zones ± 10° ± 30°.

Allowing for the very unfavourable season for observations, a considerable increase over the preceding quarter will be at once noticed. The relative amount of spotted area shows an enormous increase for February, the numbers for the months commencing with January being 79.79, 153.61, and 61.57.

A REMARKABLE PROMINENCE.—Mr. J. Fényi, in the *Memorie della Società degli Spettroscopisti Italiani*, gives an account of an unusually large prominence that was visible at Kalocsa, on May 5 last. At 10h. 25m., Kalocsa mean time, the prominence was very small, but later it developed very considerably, forming itself into a set of small bands, clearly inclined towards the equator. At 11h. 55m. the observed height was 139″, there being no indication of a rapid ascent. At 12h. 11m. a very rapid upward motion had already begun to make itself visible, and by 12h. 17m. 34s. the height reached was 287″, extending to 317″ 1m. 11s. later, when the velocity of ascent was 306 km. per second. After a few minutes the lower parts to the height of 360″ became invisible, but the smooth portions ascended at 12h. 21m. 4s., with a velocity of 368 km. per second to a height of 531″. This latter measurement was made at 12h. 29m. 25s., and soon after the object was no more seen. The actual height attained, then, may be reckoned about 381,800 km., or 237,126 miles. At the terminaton of this eruption, it was noticed that the prominences at 127° and 79°, and even the one at 106°, which very nearly coincided with the position of the eruption itself, still retained the same forms, having apparently suffered no change by this enormous disturbance; no faculæ or spots either were recorded which could in any way be connected with this outbreak.

THE TRAPEZIUM IN THE ORION NEBULA.—During the first three months of the present and preceding year Dr. L. Ambronn, of the Göttingen Observatory, has undertaken a measurement of the distances and position angles between the four bright stars forming the trapezium in the great nebula of Orion. The results which he has obtained are recorded in the 3103 number of *Astronomische Nachrichten*.

Commencing with the star θ′ Orionis, which is here designated *a*, and taking the others in cyclic order following the direction opposite to that of the motion of the hands of a watch, we find these designated by *b*, *d*, and *c* respectively. The accompanying table, for the sake of comparison, shows the position angles and distances for the equinox 1870 from the measurements of W. Struve, Dembowski, O. Struve, Hall, and Ambronn.

	W. Struve. 1836·15	Dembowski. 1867·04.	O. Struve. 1870·0.	Hall. 1877·7.	Ambronn. 1891 6.
	° ′	° ′	° ′	° ′	° ′
ab	311 45	311 22	311 32	311 4	311 15
ac	60 29	61 38	60 22	61 8	60 58
ad	340 20	342 23	342 5	342 15	342 31
bc	95 35	96 2	95 36	95 34	95 26
bd	31 48	32 11	31 43	32 55	33 1
cd	299 34	299 33	299 34	299 18	299 15
	″	″	″	″	″
ab	13·002	12·907	13·049	13·116	13·250
ac	13·344	13·385	13·276	13·453	13·698
ad	16·854	16·681	16·876	16·768	16·997
bc	21·414	21·582	21·410	21·758	22·038
bd	8·706	8·706	8·705	8·772	8·915
cd	19·227	19·340	19·237	19·363	19·576

NEW VARIABLE STARS.—A short note communicated by Prof. Pickering to *Astronomische Nachrichten*, No. 3104, informs us that six new variable stars in the southern sky have been discovered on examination of the photographs of stellar spectra taken at Arequipa in Peru. The following are the constellations, positions, and the dates on which the photographs were taken:—

Constell.	α 1900	δ 1900	Date.
	h. m.	° ′	
Horologium	2 49·5	− 50 10	Sept. 10, 1891
Octans	6 0	− 86 30	Sept. 11, 1891
Bootes	14 22·1	+ 5 2	April 26, 1892
Octans	17 30	− 86 45	Aug. 31, 1891
Sagittarius	19 49·8	− 29 27	Oct. 3, 1891
Tucana	23 53·2	− 65 56	Aug. 25, 1891

All these stars when at a maximum are as bright or brighter than the 8th magnitude, but only one, that in Sagittarius, is a catalogue star (Cord. G.C. 27271, Mag. 8½).

THE BRITISH ASSOCIATION COMMITTEE ON ELECTRICAL STANDARDS.

IN view of the hoped-for presence of Prof. von Helmholtz and other distinguished foreigners at this year's meeting of the British Association in Edinburgh, it will probably be recognized as suitable to take up and continue the discussion on new electromagnetic units for practical purposes, which was begun last year at Cardiff.

I therefore beg to contribute the following notes and to conclude by moving some resolutions.

One great fact brought into prominence by the practical development of electricity is the analogy or reciprocity between the electric and the magnetic circuit, and this is the fact which it behoves us to emphasize in the naming of fresh units.

The magnetic circuit has as yet no authorized names applied to it. The electric circuit is well provided, but perhaps one or two improvements can be made.

(1) THE ELECTRIC CIRCUIT.

The first point on which I consider that practical men would do well to insist is that names shall be given to the complete things dealt with, rather than to mere coefficients. Thus of all units with which they are concerned there can be no doubt but that *volt* and *ampere* are the most prominent. These are the active things with which Electrical Engineers have to deal, and these are the things for which meters exist on every wall in an electric lighting station. The ohm, or unit coefficient of resistance, is comparatively academic in character; it is a constant of a coil of wire or of an underground lead, it is nothing vivid and active. The engineering use of the term ohm is mainly in connection with insulation and other high resistances; for large conductors the equivalent "volt per ampere" is perhaps more often used. It is the drop of potential which a given conductor entails for a given current that is of real interest to an engineer, and it is this of which in large leads he consciously thinks.

A 6 ohm conductor means one that drops 6 volts for every ampere that is sent along it. If you send 3 amperes along such a line, the potential at the far end is 18 volts below that at the near end. The clear realization of this fact would be almost aided by the complete title, 6 volts per ampere, instead of the abbreviation, 6 ohms. Nevertheless, the name ohm is in common use and hence may be assumed useful.

A still more useful name, however, for good conductors would really be the reciprocal of an ohm—the ampere per volt. Suppose this called a mo, as Sir W. Thomson once suggested, then a cable of 20 mos would be one that conveyed 20 amperes with a drop of 1 volt. A thousand-mo cable would convey 500 amperes with a drop of half a volt; and so on. It is more directly practical to think of the amperes conveyed per drop of voltage, than of the drop of voltage per ampere. I believe that some authorized name for unit conductance would be welcomed.

Units of Inconvenient Size.

The authorized name "coulomb" for unit quantity is barely used by engineers, who are content with ampere-hour; thus proving that what is needed in practical units is not so much a consistent decimal system, as a set of units each of practicable magnitude.

Farad.

The effort after consistency has resulted in the useless "Farad"; and this should be a lesson not to try and fix units of unreasonable size. The c.g.s. units already exist as a consistent system; the only objection to them is that they are of unpractical size. The whole object of devising a practical system of units was to have things of every-day size to deal with. The volt, the ampere, and the ohm satisfy this condition. The coulomb, the farad, and the watt do not. Already they have practically given place to the ampere-hour, the micro-farad, and the kilowatt.

Considerably more progress would have been made in knowledge of ordinary capacities if the microfarad had been called the farad, so that easy submultiples of it would have been available to express the capacity of Leyden jars, and such like things. The capacity of an ordinary jar would then have been a few millifarads, and a microfarad would have been the capacity of a short bit of connecting wire. I ask whether this change would introduce serious confusion even now. I think not. Nobody cares the least about "coulombs per volt," and so there is no sense or use in the present farad. Telegraphists would surely soon consent to drop the useless prefix micro; and the factor of a million is too great to render doubt possible as to what was intended, even in the transition stage. It ought to be regarded as essential to have the practical unit somewhere not hopelessly away from the middle of the range of probable multiples and submultiples.

Coulomb.

A coulomb again is almost useless as a synonym for the ampere-second; it is so easy to speak of ampere-minutes or ampere-hours. If the name coulomb could be set free from its present superfluous meaning it could usefully be applied to the electrostatic unit of quantity, which wants a name. Teachers would find it convenient at once, and in the apparently imminent line of development engineers might find it useful before long. It is the charge on a two-centimetre sphere at a potential 300 volts (or on a one-foot sphere at 20 volts). The capacity of the two-centimetre sphere would be $\frac{9}{10}$ of a (new) microfarad.

Watt.

Lastly with regard to the watt. The name volt-ampere is almost as good as the name watt, especially since the watt is also one joule per second.

Both names, watt and joule, are not really wanted by electricians, to whom their coexistence is rather confusing. I believe it would be more convenient to use the term watt in the sense it gets so frequently used now, viz., energy, say a volt-ampere-hour; in which case a kilowatt would be synonymous with the present Board of Trade unit.

The rate of working, or power, could then be expressed in a rational and unforced way as so many watts per hour or so many volt-amperes. It is much more natural to give a name to a definite thing like a quantity of energy, than it is to give it to a mere rate of working. The latter is instinctively felt to need a reference to time; just as a velocity unit has not been practically found to need a name, being quite simply expressible in feet per second or miles per hour; and even when a name has been given, like "knot," instinct constrains people to practically get rid of it again by speaking of knots per hour, just as we find "kilowatts per hour" already often used in electrical workshops. I suggest, therefore, that the present watt is too small, that it is sufficiently expressed by a joule per second, and that it would be more useful if magnified 3,600 times, and turned into a unit of energy.

That we should thus have several energy units—the erg, the joule, and the watt, all of quite different sizes, is no objection, but an advantage, seeing the extreme importance of energy. Such things as length, mass, time, and energy demand a fair range of units. It would be tedious to express centuries in seconds.

(2) MAGNETIC CIRCUIT.

In speaking of the magnetic circuit I wish to refer back to my opening remarks concerning the electric circuit, and the class of things for which names should be found. In the magnetic circuit the only thing at present seriously attempted to be named is, in accordance with the historic parallel of the ohm, a coefficient or characteristic of a coil of wire—its coefficient of self-induction; the unit of which has been called variously a secohm, a quadrant, and a henry.

Total Induction.

But the real active thing with which engineers are concerned is total magnetic induction, total number of lines of force across an airgap: as between the polepieces or through the armature of a dynamo, or in the circuit of a transformer. It may be called the electromagnetic momentum per turn of wire; or the surface integral of B. This total induction is in some respects analogous to electric current, and has occasionally been called magnetic current (a bad name), or "magnetic flux." It is, however, more strictly analogous to the coulomb, and its time rate of variation is the more proper representative of electric current.

Its common practical name at present is "total lines," or "total induction," or "number of lines."

Now "one line" is awkward as a unit, besides being (if a c.g.s. line) inconveniently small. The earth, for instance, sends 4,400 such lines through every horizontal square metre about England; through a square inch it only sends a fraction of a line. A practically sized unit of induction badly wants a name, and "henry" would have done for it very well, and have been both more suitable and more useful for the actual quantity than for a coefficient. But "henry" has already been half appropriated to the secohm, so, for illustrative purposes at any rate, I propose to use the name "weber" for the unit magnetic flux.

Concerning the most convenient size for the weber, there is much to be said for making it 10^8 c.g.s. lines, though that is bigger than ordinarily occurs in practice; because then a wire which cuts one weber per second will have a volt difference of potential between its ends. Or a coil of twenty turns through which the magnetic induction changes at the rate of one weber per second will have an E.M.F. of twenty volts induced in it. The average E.M.F. in such a coil, spinning thirty turns a second, and enclosing a maximum total-induction of one weber, is 600 volts.

This is the dynamo use of the unit; the following is the motor use.

A wire carrying an ampere and cutting a weber per second, does work at unit rate, viz., one joule per second.

Probably the simplicity of all this compensates for the rather unwieldy size of the unit. A strongly magnetized piece of iron may have 20,000 lines to the square centimetre; so a weber could occur across a narrow airgap half a square metre in area.

The earth gives an induction of about one weber through every 23,000 square metres of England, or 100 webers per square mile. The earth induction through a horizontal square metre is 44 micro-webers, so with micro- and milli-webers the range would be fairly covered; though a smaller weber would have been better if it had been equally convenient as regards the volt.

The pull between two parallel surfaces joined by a weber is $\frac{10^{16}}{8\pi}$ dynes, or four hundred thousand tons. A milli-weber gives less than half a ton pull; and a micro-weber less than half a gramme.

Because of the property that the voltage excited in a circuit is equal to the webers cut by it per second, a weber might be called a sec-volt. It is equal to a secohm-ampere-turn; that is to say, if a single turn of wire can have a self-induction coefficient of one secohm, it will excite a weber of induction for every ampere passing through it.

[Such a circuit in the form of an anchor ring would be enormous, something like a mile across; but it could be made in the form of a solid cylinder of best iron ($\mu = 2500$), with an axial perforation for the wire, and 80 metres long.

If a secohm coil has n turns, then an ampere passing through it excites only $\frac{1}{n}$th of a weber; for, since every turn encloses the induction, the latter is effective n times over, and so the induction coefficient is n times the induction per ampere, or n^2 times the induction per ampere turn.]

No name is needed for intensity (or density) of induction (B), for that can always be expressed in webers per unit area.

[For instance, strongly magnetized iron, with say 10,000 lines to the square centimetre, has one-tenth of a weber per square foot, or 0·7 milli-webers per square inch.]

And there is a practical gain in thus leaving the specification of area open, for it enables British units of length to be employed in measuring air-gaps, yokes, cores, and polepieces.

So long as dynamo dimensions are commonly expressed in inches, there is no serious objection to specifying induction in fractions of a weber per square inch or per square foot.

Magnetomotive Force.

Now consider the magnetic analogue of the volt; the unit of magnetic potential or magnetomotive force. By this is understood the line integral of the magnetizing force H, the quantity $4\pi n\mathrm{C}$, the step of potential once through and all round the circuit of a coil. It is a quantity most important in practice, and requires a name.

Mr. Heaviside has suggested the name "gaussage," as analogous to voltage; and, if this were adopted, the unit of magnetomotive force would be the gauss. The intensity of magnetizing force would be the gauss-gradient, or drop of gaussage per centimetre; no special name is needed for the unit of this quantity H.

The common practical unit of gaussage at present is the ampere-turn, and this has several advantages. It may, however, be found better to make some convenient number of ampere-turns into a gauss; for instance, the c.g.s. unit of gaussage would be $\frac{4\pi}{10}$ or 1·2566 ampere-turns. If that were adopted as the gauss, the horizontal component of the earth's magnetic intensity about here would be, say ·18 gauss per linear centimetre.

But this unit, whether the c.g.s. unit or the ampere-turn, is very small. The step of potential all round a single ampere-turn is only equivalent to a vertical step of about 2 centimetres in the earth's field.

Nevertheless, in spite of its smallness, the ampere-turn as practical unit of gaussage will probably commend itself by reason of its simplicity. Let us see how it works out.

Reluctance.

The ratio of gaussage to the induction excited by it, is a quantity characteristic of the magnetic circuit, and called its reluctance or magnetic resistance. This is the quantity $\frac{l}{\mathrm{A}\mu}$ for simple circuits, or $\Sigma\frac{l}{\mathrm{A}\mu}$ for complex ones; it is unfortunately not constant for any but air circuits. This constitutes one difficulty of naming its unit satisfactorily, else it might be expressed as so many "gilberts" or "sturgeons" (analogous to ohms). It is, however, fairly constant under many common conditions of practice, and it can always be expressed as gausses per weber; and perhaps this way is sufficient.

A magnetic circuit with unit reluctance is one that requires one gauss to induce in it one weber.

Permeability.

Permeability (μ), analogous to electric conductivity, would be measured by the webers induced through unit cube of the material between whose faces there is unit fall of gaussage. It has been suggested (by Prof. Perry) that the permeability of air had better be called $4\pi \times 10^{-9}$. But the whole electromagnetic system of units is based on the μ for air being called 1; so it would be rather confusing to change that. Moreover, it would be a retrograde step to affix another incorrect value to the constant μ, instead of waiting and trying to find out what its value really is. It is better to adhere for the present to the existing table of permeabilities, and to use whatever constant factor may be needed in order to turn $\frac{l}{\mu\mathrm{A}}$ into practical units of reluctance.

Permeance.

But the reciprocal of reluctance, or the webers induced per gauss, may be the more instructive thing to attend to and name; just as conductivity is often more directly interesting than resistance. This reciprocal ratio, $\frac{\mu\mathrm{A}}{l}$, has been called "permeance," and that is not a bad name for it; it is proportional to the inductance of a single-looped circuit. Permeability is the permeance of unit cube of the material. Permeance is the webers induced per unit drop of gaussage. Permeability is the webers per unit area induced by unit gauss gradient.

The permeance of the magnetic circuit enclosed by a solenoid of wire is the same as its appropriate self-induction-coefficient divided by 4π times the square of its number of turns.

The c.g.s. unit of permeance (or of reluctance) is that of a centimetre cube of air, and is not a bad-sized unit. But it is inconsistent with the weber as 10^8 and the gauss as a single ampere turn.

One of the three must give way.

On the whole I have no hesitation in suggesting that the derived unit (that of permeance) must give way, and be taken as $4\pi \times 10^7$ c.g.s. units, in order to harmonize with the other two as already defined.

The fact is that the great size of the weber renders a small gauss desirable, in order that their product may not represent too large a quantity of energy. For instance, if 1 c.g.s. unit were taken as the unit of permeance, the weber being fixed at 10^8, then the gauss would also be 10^8, and the gauss-weber would be 10^9 joules, or nearly 300 Board of Trade units; which is far too much.

Whereas if the unit of permeance is fixed high, and the gauss kept small, then the energy corresponding to a gauss-weber may be moderate. Thus with 10^8 c.g.s. as weber, and an ampere-turn as gauss, their product is only $\frac{10^9}{4\pi}$ ergs, or $\frac{100}{4\pi}$ or about 8 joules; which will be useful in energy considerations connected with the heating of transformers.

I therefore propose, in order to retain the ampere-turn as unit of gaussage, that the permeance of a cylinder of material of length l and area A be reckoned as $\frac{\mu\mathrm{A}}{l}$ multiplied by $4\pi \times 10^7$, if dimensions of the cylinder are measured in centimetres; μ being its ordinarily tabulated value with air = 1. If dimensions are measured in inches, then the permeance of a cylinder will be $\frac{\mu\mathrm{A}}{l}$ multiplied by $\frac{4\pi}{2{\cdot}54} \times 10^7$, that is by about $\frac{1}{2}$ 10^8.

The unit of permeance thus suggested is immensely big, and it requires a name of which easy sub-multiples could be formed.

A slab of iron 1 centimetre thick, and with its $\mu = 2500$, would need an area of 5 square metres in order to have unit permeance; but a micro-unit would be possessed by an air-gap a millimetre thick and less than a decimetre square.

PROPOSED RESOLUTIONS.

(1) That the unnecessary prefix "micro" be dropped before the word farad, and that the farad be defined afresh as 10^{-15} c.g.s. electromagnetic units of capacity.

(2) That the name "mo" for the unit of conductance or the ampere per volt, be recognized and adopted. (Every *mo* in a cable enables it to carry an ampere with a drop of 1 volt.)

(3) That the ampere-hour be recognized as a convenient practical unit of electrical quantity.

(4) That the volt-ampere-hour be recognized as a convenient

practical unit of electrical energy, and be called the watt. (It equals 2640 foot-pounds, or a trifle over a foot-ton.)

(5) That the present Board of Trade unit be called a kilowatt.

(6) That the ordinary unit of power be a kilowatt per hour [It equals about 4/3rds of a horse-power, more accurately $\frac{1000}{746}$ HP.]

(7) That it is convenient to retain the name joule in its present sense of a volt-coulomb, or ten million ergs, for use in the science of heat; since heat-capacities are conveniently expressed in joules per degree; and it will be handy to remember that a volt-ampere generates one joule of heat per second.

(8) That the name coulomb be affixed to the electrostatic unit of quantity [for academic purposes].

(9) That a name be given to unit magnetic flux or total induction, and that the name weber is suitable.

(10) That the most convenient size for the weber is 10^8 c.g.s. units or "lines" (since the rate of change of this through a circuit is equal to the induced voltage).

(11) That a name be given to unit magnetic potential or magnetomotive force, and that the name gauss is suitable.

(12) That the handiest size for the gauss is one ampere-turn.

(13) That a name be given to the ratio of the weber to the gauss, or unit of permeance, or self-induction per turn of wire. [If the above resolutions were adopted, this unit would be $4\pi \times 10^7$ c.g.s. units, or $\frac{1}{8}$ secohm per turn.]

(14) That intensities of field be expressed in gausses per unit length, and densities of induction in webers per unit area (leaving the length or area unit open for practical convenience to arrange).

No doubt many of these recommendations have been made before. Mr. Preece has often urged the change of farad, so that I hope there will be no difficulty about that.

I find that my magnetic suggestions are very similar to those suggested by Prof. Perry in his modified letter to the Committee as published in the *Electrician*, vol. xxvii. p. 355 [July 31, 1891], and received there with approving editorial comments. The accordance between our suggestions is satisfactory, and makes it likely that they are such as engineers may be satisfied with and be willing to adopt. I need hardly say that I lay no stress upon the particular *names* here proposed. In choosing them I have been influenced by such trivial considerations as the selection of a monosyllable to correspond with volt, and a dissyllable to correspond with ampere or coulomb.

[With regard to Prof. Perry's footnote concerning college instruction and use of c.g.s. units, I suppose systems of teaching differ, but a senior student *ought* to be taught to deal with concrete quantities in so familiar a manner that no possible admixture of units can be any puzzle to him, nor involve anything worse than a little tiresome arithmetic.]

MECHANICAL UNITS.

There are several quantities in dynamics beside the joule and the watt for which brief names would be advantageous. I do not propose to discuss these fully now, but the present opportunity might be utilized by agreeing to at least one unit, that of pressure, viz., the "atmosphere"; which might be defined as 10^6 c.g.s., or dynes per square centimetre, and stated to be equal to the pressure of a column of mercury 75 centimetres high at a specified temperature. The inconvenient pressure, 76 centims., might be spoken of as a Regnault atmosphere. I believe that a smaller unit of pressure, for instance, the micro-atmosphere or "barad," might also be usefully named. These pressure units will be useful for expressing energies per unit volume also, and the "barad," or whatever other name is decided on for the erg per cubic centimetre, is of reasonable magnitude for many purposes.

OLIVER J. LODGE.

THE INSTITUTION OF MECHANICAL ENGINEERS.

THE annual summer meeting of the Institution of Mechanical Engineers, held last week at Portsmouth, was a successful gathering in regard to numbers present and the attendance at the excursions; but the business part of the meeting, which consists of the sittings at which papers are read, was of a rather tame character. The following is a list of the papers on the agenda:—

On Shipbuilding in Portsmouth Dockyard, by Mr. William H. White, C.B., F.R.S., Director of Naval Construction and Assistant Controller of the Navy.

On the Applications of Electricity in the Royal Dockyards and Navy, by Mr. Henry E. Deadman, Chief Constructor, Portsmouth.

Description of the Lifting and Hauling Appliances in Portsmouth Dockyard, by Mr. John T. Corner, R.N., Chief Engineer, Portsmouth.

Description of the New Royal Pier at Southampton, by James Lemon, J.P., Mayor of Southampton.

Description of the Portsmouth Sewage Outfall Works, by Sir Frederick Bramwell, Bart., D.C.L., LL.D., F.R.S., Past-President.

Description of the New Floating Bridge between Portsmouth and Gosport, by Mr. H. Graham Harris, of London.

Description of the Southampton Sewage Precipitation Works and Refuse Destructor, by Mr. William B. G. Bennett, Borough Engineer and Surveyor.

Description of the Experimental Apparatus and Shaping Machine for Ship Models at the Admiralty Experiment Works, Haslar, by Mr. R. Edmund Froude, of Haslar.

Description of the Pumping Engines and Water Softening Machinery at the Southampton Water Works, by Mr. William Matthews, Waterworks Engineer.

Mr. Matthews' paper was adjourned, and that by Mr. Froude was not read, as time ran short. This was much to be regretted, as the Haslar experimental works are one of the most interesting of all our establishments set apart for scientific investigation. It is to be hoped, now Mr. Froude has broken the ice, that he will contribute a fairly complete descriptive paper to the Institution of Naval Architects, where he would naturally find a more appreciative audience than amongst the members of a society devoted more exclusively to mechanical engineering. Although there was not time for the reading of the paper, Mr. Froude very good-naturedly stopped and explained to some of those present the working of the apparatus which he had brought for the purpose of exhibition, together with the large wall diagrams that had been prepared expressly for illustrating the paper.

On the members assembling in the Town Hall on July 26, Dr. Anderson, the President, occupied the chair, and the usual formal business having been disposed of, Mr. White's paper was read. This was chiefly of a historical character, the author going back to the year 1212, when the sheriff of the county of Southampton was ordered to enclose the King's Dock by a strong wall, and to provide suitable storehouses. A dockyard, properly so called, was not, however, founded until the reign of Henry VIII., so it was second in point of antiquity to Woolwich Dockyard. The latter was closed in 1869, "so that Portsmouth Yard is now," Mr. White says, "the oldest as well as the most important in existence." We do not know whether Mr. White means by this that it is the oldest in existence in Great Britain, or in the whole world. In 1540 the total area was 8 acres. Until nearly the end of last century there was no basin in which ships could lie while completing or repairing, and the dock accommodation was poor, but about that time a basin of 2½ acres and six dry docks were constructed. At that time the yard area was 90 acres. In 1843-50 a steam factory was added, and another basin of 7 acres, besides four docks; the total area of the dockyard being 115 acres. The effect of steam on the navy is well illustrated by the extensions that took place about 1864, when the area of the Dockyard was more than doubled. A fitting-out basin of 14 acres, a rigging basin of the same size, and a repairing basin of 22 acres, were made. There is also a tidal basin of 10 acres. The extent of Portsmouth Dockyard is now nearly 300 acres.

Mr. Deadman's paper was also largely of an historical nature, giving many interesting details of the introduction of electricity into the navy. Among the most notable features in the application of electricity to naval purposes are the temporary installations used for interior lighting during the building and finishing of the vessel. The estimated cost of electric lighting during the period of building the *Royal Arthur* was £1200. This would be about the same sum as would be required were candles used, but naturally electricity affords a far superior light, and it is to its use that is due much of the quickness with which the