

## INDUSTRIAL NOTES.

## Electrical Instruments for Schools.

THE immense spread of electrical invention and application has required the services of many workers. It no longer suffices that these workers be taken from other callings, or thrust out untrained from our grammar-schools and academies. They must

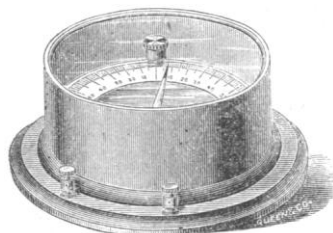


FIG. 1.

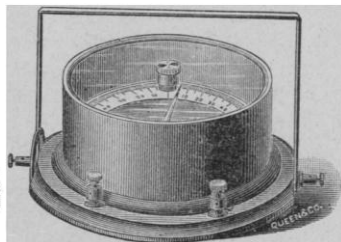


FIG. 2.

be skilled not only in the theory, but in the actual use of instruments and machines. But all cannot go to colleges and engineering schools to acquire this knowledge, and, even if they could, the colleges have not time to go back to elementary principles and teach the elementary use of instruments: hence a great part of this work must be left to the high-schools and other preparatory institutions throughout the country. Recognizing this fact, *a priori*, as well as in consequence of many and repeated demands from the schools themselves, Messrs. Queen & Co. have just designed and placed upon the market a complete series of electrical testing instruments for school use. Queen & Co.'s list of this

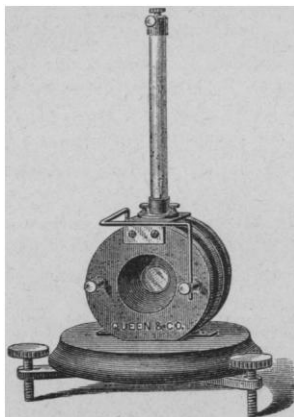


FIG. 3.

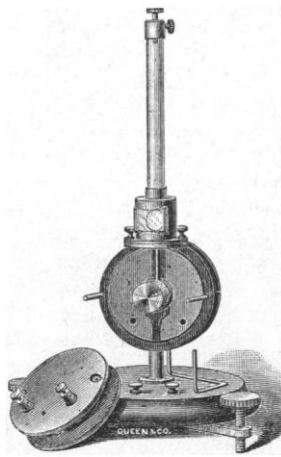


FIG. 4.

apparatus embraces all the instruments needed for a full year's course in laboratory electricity, and includes galvanometers of all kinds, resistance-boxes, Wheatstone bridges, voltmeters, etc. We note, from inspection of their catalogue, seven styles of winding of simple horizontal galvanometers; thus, the first one will measure currents from .01 to .5 of an ampère, and detect currents as small as .0025 of an ampère. This galvanometer is illustrated in Fig. 1. Fig. 2 shows a galvanometer which has, in addition to the usual winding of wire, a heavy copper strip allowing the measurement of currents up to 40 and 50 ampères. In addition to these simple galvanometers, are several styles of fibre-suspended galvanometers having an astatic system of needles and pointer moving over a finely graduated circle, so that deflections can be easily read. For still better work, the galvanometer shown in Fig. 3 has been specially designed. This galvanometer is built somewhat upon the plan of the well-known tripod galvanometer of Sir William Thomson, and is extremely sensitive. The mirror, which is very light, carries the magnetic system (several small bits of steel) on its back, and the whole is suspended by a very fine cocoon fibre about seven inches long. The coils are two in num-

ber, and may be connected in series or in parallel, as desired. They are easily movable. The magnetic system is enclosed by a thin, plane glass in front, and by another similar one behind. The latter is fixed in the end of a small tube which slips easily in the central axis of the rear coil, so that the air-space may thereby be easily increased or decreased at will. The galvanometer may in this way be made dead-beat or used undamped, as desired. By pushing the sliding tube until the air-space becomes small, readings may be taken with great rapidity, as the mirror will come to rest very quickly. The galvanometer may be made even more sensitive by the use of a control-magnet arranged to slide upon the tube containing the suspending fibre. This type of galvanometer is supplied wound to resistances of 100, 800, or 2,000 ohms, according to order.

Fig. 4 is an illustration of a galvanometer which will also be found useful. The coils, as in the last type mentioned, are two in

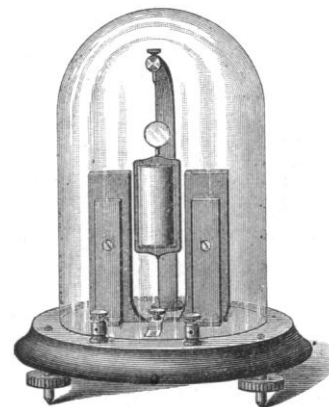


FIG. 5.

number, and may be coupled up in series or multiple, as desired. They are easily removable, and enclose a heavy block of copper fixed in a central fork. This copper block has a small cylinder bored partly through, in which hangs the bell-magnet making up the moving system. The magnet, with mirror attached, is suspended by a long and fine cocoon fibre, and, in consequence of being enclosed in the copper block, comes to rest very quickly after being deflected. In measuring and comparing condenser capacities, electro-motive forces, battery resistances, etc., by condenser methods, this galvanometer is very good, for, by simply lifting the copper block off the fork which supports it, the instrument is made ballistic. The coils are held in place by a special



FIG. 6.

device, so that they may be readily changed for coils of other resistances, thus adapting the instrument to almost all varieties of galvanometer work. This galvanometer, like the preceding, is furnished with any of several windings, or with several sets of coils for the same instrument, thus making it applicable to measurements of various kinds.

Another valuable type of reflecting galvanometer is the Deprez-D'Arsonval dead-beat galvanometer (Fig. 5), or, as it is commonly called, the D'Arsonval galvanometer.

This type of instrument has won favor with all, on account of

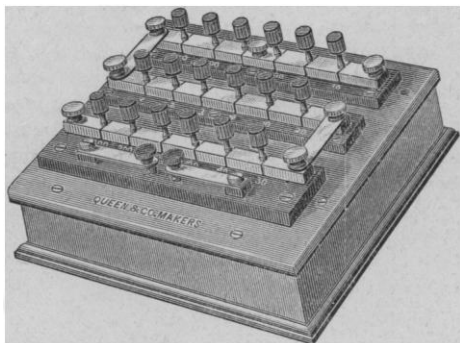


FIG. 7.

its great delicacy of action, simplicity, and convenience. In a recent article in the *London Electrician*, Professor W. E. Ayrton gives it as his opinion, that, properly constructed, this type of galvanometer, is the most sensitive instrument known for the de-

tection or measurement of electrical quantities. It is one of the finest of the "dead-beat" variety; and the needle, after being deflected, returns to its zero position immediately, and without the slightest oscillation, while it is so sensitive that it may easily be

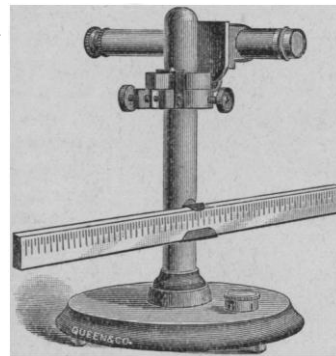


FIG. 8.

deflected through a considerable arc by simply touching the fingers to the two terminals of the instrument. The induction-currents produced by turning a coil of wire about a diameter so as to cut the earth's lines of force may also be rendered visible to an entire

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- HARPER, W. R., and TOLMAN, H. C. *Eight Books of Cæsar's Gallic War.* New York, Cincinnati, and Chicago, American Book Co. 502 p. 12°. \$1.20.
- KANSAS Academy of Science, Transactions of the Twenty-second Meeting of the, 1889. Vol. XII. Part. I. Topeka, Kan. Pub. House. 189 p. 8°.
- MASSACHUSETTS State Agricultural Experiment Station at Amherst, Eighth Annual Report of the Board of Control of the, 1890. Boston, State. 324 p. 8°.
- NEW ZEALAND Journal of Science, The. Vol. I. No. 1. January, 1891. Dunedin, Matthews, Baxter, & Co. 48 p. 8°.
- PACKARD, A. S. *Insects Injurious to Forest and Shade Trees.* (U. S. Entom. Commis., Bull. No. 7. Washington, Government. 957 p. 8°.
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- RIBOT, Th. *The Diseases of Personality.* Chicago, Open Court Pub. Co. 157 p. 12°. 75 cents.
- ROYAL SOCIETY of Canada Hand-Book. Montreal Meeting, 1891. Montreal, Roy. Soc. Can. 140 p. 16°.
- WRIGHT, L. *Optical Projection: A Treatise on the Use of the Lantern, etc.* London and New York, Longmans, Green, & Co. 426 p. 12°. \$2.25.
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class. Another great advantage in instruments of this type is the fact that they are not affected by proximity to masses of iron or dynamo-machines.

Several styles of tangen galvanometers are also included in this list. Fig. 6 illustrates them. This instrument, properly adjusted, can be used as a standard instrument for laboratory work with entire satisfaction. The brass ring is thirteen inches and a half in diameter, and the groove in which the wire is wound is carefully turned so as to be of perfectly rectangular cross-section, thus allowing the constant of the instrument to be carefully calculated, and compared with the constant as obtained by other methods. The whole instrument has been specially designed to meet the requirements of teachers in laboratory practice who desire to make students entirely familiar with all the adjustments of the standard galvanometer before putting a high-grade instrument in their hands. The compass-box, five inches in diameter, is so held in position that it may be raised or lowered, rotated on its vertical axis, shifted out of the plane of the coil, etc., thus enabling the

student to acquire proficiency with the instrument, and to meet all cases of derangement possible.

The dial is graduated to single degrees, while a mirror under it allows readings to be made without error of parallax. The needle is suspended by a very light cocoon fibre. The whole instrument can be turned about its vertical axis, and a quadrant graduated to degrees upon the base allows the amount of rotation to be accurately measured, and the laws of the sine galvanometer investigated.

Of resistance-boxes, this list offers a variety. Fig. 7 is a combination Wheatstone bridge and resistance-box having twelve coils, and, in addition, bridge-coils of 10, 100, and 1,000 ohms on a side, thus giving a total range of measurement of from .01 of an ohm to 111,000 ohms. Separate keys, properly connected, for battery and galvanometer, are mounted on the same top with the set.

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