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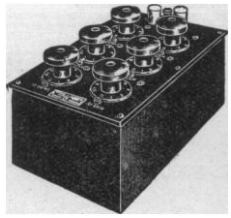
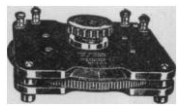
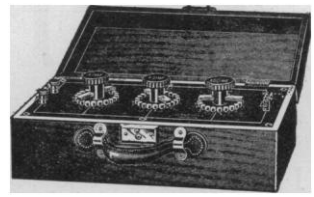
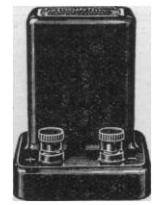
One Ohm Standard


A-C Resistance Box


Brooks Inductometer


Mica Capacitor


Eppley Standard Cell

L&N STANDARDS OF RESISTANCE, INDUCTANCE, CAPACITANCE AND POTENTIAL

D-C RESISTORS

4210 ONE-OHM STANDARD RESISTOR—Adjusted to approx. value of Absolute Ohm. N.B.S. will certify to ±0.0001% in terms of the Washington Ohm, $100.00, plus N.B.S. certif.

N.B.S. TYPE RESISTORS—Limit of error: ±0.01% up to 0.1 watt; ±0.04% up to 1 watt. 4020, 1 ohm, $20.00; 4025, 10 ohms, $20.00; 4030, 100 ohms, $20.00; 4035, 1000 ohms, $20.00; 4040, 10,000 ohms, $25.00.

REICHSANSTALT TYPE RESISTORS—Limit of error, cooled in oil: ±0.02% up to 1 watt; ±0.05% up to 10 watts. 4221, 0.1 ohm, $50.00; 4222, 0.01 ohm, $55.00; 4223, 0.001 ohm, $120.00.

RESISTORS (SHUNTS) FOR LARGE CURRENTS—Limit of error, air cooling, ±0.04%.

	Ohm	Amps.	Volts Drop	
4360	0.1	15	1.5	$ 55.00
4361	0.01	100	1.0	100.00
4363	0.001	300	0.3	90.00
4364	0.001	500	0.5	175.00
4369	0.00004	1,500	0.06	187.00
4372	0.00002	2,000	0.04	187.00
4375	0.00001	3,000	0.03	300.00

SECONDARY-STANDARD RESISTORS—Limit of error ±0.1%. 4205, 1 ohm, $10.00; 4206, 10 ohms, $10.00; 4207, 100 ohms, $10.00; 4208, 1000 ohms, $10.00; 4209, 10,000 ohms, $10.00.

4245 TENTH-MEGOHM RESISTOR — 100,000 ohms. Limit of error ±0.1%, $50.00.

OPEN-DIAL-SWITCH RESISTANCE BOXES *††

No.	Ohms	Dials	Decade Steps	Price
4710	100	3	10x0.1+9(1+10)	$75.00
4711	1000	3	10x1+9(10+100)	70.00
4712	10000	3	10x10+9 (100+1000)	80.00
4715	1000	4	10x0.1+9 (1+10+100)	95.00
4716	10000	4	10x1+9(10+ 100+1000)	100.00
4720	10000	5	10x0.1+9(1+10+ 100+1000)	125.00

ENCLOSED-SWITCH RESISTANCE BOXES—For commercial-power frequency a-c as well as d-c.*†

No.	Ohms	Dials	Decade Steps	Price
4770	99	2	9(1+10)	$21.00
4771	990	2	9(10+100)	21.00
4772	9900	2	9(100+1000)	21.00
4773	999	3	9(1+10+100)	28.00
4774	9990	3	9(10+100+1000)	29.00
4775	9999	4	9(1+10+100+ 1000)	35.00
4776	999.9	4	9(0.1+1+10+100)	35.00

4452 PLUG-DECADE RESISTANCE BOX—19,-999.9 ohms. 9(0.1+1+10+100+1000)+ 10,000,*†† $110.00.

4252 POST-OFFICE PATTERN RESISTANCE BOX—11,110 ohms in steps of 1 ohm. Adjusted by removing plugs. Resistors 1, 2, 3, 4, 10, 20, 30, 40, 100, 200, 300, 400, 1000, 2000, 3000, 4000 ohms,*† $36.00.

*D-C res., with all dials or plugs at zero, does not exceed 0.03 ohm.

**D-C res., with all dials at zero, does not exceed 0.04 ohm.

†D-C res. change from zero setting, measured across binding posts, equals the readings of the dials ±(0.1%+0.01 ohm).

††D-C res. change from zero setting, measured across binding posts, equals the readings of the dials ±(0.05%+0.005 ohm).

4254 POST-OFFICE PATTERN RESISTANCE BOX—Similar to 4252, but 1,110 ohms. Resistors 1, 2, 3, 4, 10, 20, 30, 40, 100, 200, 300, 400 ohms, $30.00.

4244 MEGOHM RESISTANCE BOX — 1,000,000 ohms (4x200,000+2x100,000). Limit of error in resistors ±0.1%, $200.00.

4246 TENTH-MEGOHM RESISTANCE BOX—100,-000 ohms (10,000+20,000+30,000+40,000). Limit of error in resistors ±0.1%. Binding posts on ring mounted on insulating pillars, $90.00.

4247 TENTH-MEGOHM RESISTANCE BOX—Same as 4246 except, binding posts equipped with link connectors, $65.00.

A-C RESISTORS

SECONDARY-STANDARD A-C RESISTORS—Limit of error in d-c res. ±0.1%. Difference between a-c and d-c res. less than ±0.001% at 1 kc, less than ±0.01% up to 50 kc. 4631, 1,000 d-c ohms, $13.00; 4632, 2,000 d-c ohms, $13.00; 4633, 3,000 d-c ohms, $14.00; 4634, 4,000 d-c ohms, $14.00; 4640, 10,000 d-c ohms, $15.00; 4642, 20,000 d-c ohms, $17.00.

A-C RESISTANCE BOXES — Total 11,111.1 ohms. 10(0.01+0.1+1+10+100+1000), 6 dials, shielded. Differ principally in A-C characteristics. 4764*††, $300.00; 4765*††, $270.00; 4750**††, $100.00; 4749*†, $90.00.

A-C RESISTANCE BOXES—Total 11,110 ohms. 10(1+10+100+1000). 4 dials. 4748*††, shielded, $65.00; 4747*†, shielded, $55.00; 4746*††, unshielded, $60.00; 4745*†, unshielded, $50.00.

ATTENUATORS—Information on request.

INDUCTORS

STANDARDS OF SELF INDUCTANCE — Time const. approx. $1x10^{-3}$. Limits of error; 1530,± 1%; 1531, 1532, 1533, ±0.2%; 1530, 1 mh, 1 amp., $30.00; 1531, 10 mh, 0.5 amp., $30.00; 1532, 100 mh, 0.15 amp., $30.00; 1533, 1,000 mh, 0.05 amp., $30.00.

1540 STANDARD OF MUTUAL INDUCTANCE—50 mh. Continuous current capacity 0.15 amp. Time const. approx. $5x10^{-4}$. Limit of error ±0.5% for freqs. up to 1000 cy., $40.00.

1520-A BROOKS INDUCTOMETER—Self-inductance range 1.5 to 12 mh. Continuous current capacity 1 amp. Time const. for max. setting, approx. $2x10^{-3}$. Limit of error ±0.3% of max. inductance for freqs. up to 1000 cy, $150.00.

1520-B BROOKS INDUCTOMETER—Self-inductance range 12 to 100 mh. Continuous current capacity 0.35 amp. Otherwise same as 1520-A, $150.00.

1520-C BROOKS INDUCTOMETER—Self-inductance range 100 to 800 mh. Continuous current capacity 0.1 amp. Time const. for max. setting, approx. $2x10^{-3}$. Scale calibrated at 1000 cy; correction data furnished for 60 cy. Limit of error ±0.3% of max. inductance at each of these freqs., $150.00.

1520-D BROOKS INDUCTOMETER—Self-inductance range 0.8 to 6 henrys. Continuous current capacity 0.03 amp. Limit of error ±0.9%. Otherwise same as 1520-C, $150.00.

CAPACITORS

1056 FIXED MICA CAPACITOR—0.5 mf. Limit of error ±0.25%, $30.00.

1061 ADJUSTABLE MICA CAPACITOR—1 mf, in 8 sections: 0.5, 0.2, 0.1, 0.1, 0.05, 0.02, 0.02, 0.01 mf. Limit of error for each, ±0.25%, $200.00.

1058 ADJUSTABLE MICA CAPACITOR—1 mf in 5 sections: 0.5, 0.2, 0.2, 0.05, 0.05 mf. Limit of error ±0.25%, $65.00.

1071 THREE-DIAL SHIELDED MICA CAPACITOR—1.11 mf in steps of 0.001 mf. 10(0.1+ 0.01+0.001). At 1,000 cy, capacitance diff. between each dial setting and its zero setting (other dials on zero) agrees with nominal ±(0.1%+0.5mmf), $325.00.

1070 THREE-DIAL MICA CAPACITOR—1 mf in steps of 0.001 mf. 9(0.1+0.01+0.001)+ 0.001. Limit of error 0.1 dial, ±0.25%; 0.01 dial, ±0.5%; 0.001 dial, ±2%, $175.00.

1188 ADJUSTABLE AIR CAPACITOR — Minimum, 50 mmf. Range 50 to 1,300 mmf on 2 dials: one reads up to 1,200 mmf in 100 mmf steps; other, 0 to 100 mmf, continuously adjustable. Quartz insulators, $170.00.

1187 ADJUSTABLE AIR CAPACITOR — Same as 1188, but has isolantite insulators, $150.00.

1185 ADJUSTABLE AIR CAPACITOR — Range approx. 40 to 1,100 mmf. Scale 0 to 100 div. Limit of error ±5 mmf, $30.00.

1170 HIGH-VOLTAGE ZERO-LOSS AIR CAPACITOR—For use up to 100,000 volts. Capacitance (adjustable) approx. 100 mmf at 12-inch (100-kv) spacing. Has guard circuit. Approx. 12′x7′x10′. Price on request.

1160 10-KILOVOLT CYLINDRICAL TYPE AIR CAPACITOR—Approx. 100 mmf. Max. continuous potential rating 10,000 volts at 60 cy. Electrostatically shielded. Low-voltage electrode guarded, $575.00.

1161 25-KILOVOLT CYLINDRICAL TYPE AIR CAPACITOR—Same as 1160, except: max. continuous potential rating 25,000 volts at 60 cy, $775.00.

STANDARD (POTENTIAL) CELLS

7308 EPPLEY STANDARD CELL—Not over 500 ohms. Emf guaranteed within ±0.01% of certified value, $20.00.

7309 EPPLEY STANDARD CELL — Same as 7308, except internal res. not over 100 ohms, $25.00.

7310 EPPLEY STANDARD CELL—Not over 500 ohms. Emf 1.018 volts, within ±0.1% at 20 C, $12.00.

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SCIENCE

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THE NATIONAL ACADEMY OF SCIENCES

ABSTRACTS OF PAPERS PRESENTED AT THE ANNUAL MEETING[1]

A hypothesis as to the origin of cosmic rays and the experimental testing of it in India and elsewhere (evening lecture): R. A. MILLIKAN, H. V. NEHER and W. H. PICKERING. The hypothesis here adopted as to the mode of origin of the cosmic rays makes possible the prediction of five definite cosmic-ray bands, each of which should reach the earth in a particular latitude, and of four plateaus of unchanging cosmic-ray intensity, these plateaus being delimited by the latitudes of entrance of the successive bands. The hypothesis rendering possible these predictions rests upon five major discoveries made by the workers in the Norman Bridge Laboratory of Physics at the California Institute of Technology at Pasadena. These discoveries are (1) that more than 60 per cent. of all incoming cosmic-ray energy is of the nature of *electron bullets* each of energy between 2 billion electron-volts and 15 billion electron-volts; (2) Neddermeyer and Anderson's discovery of the production by nuclear impacts within the atmosphere of mesotrons which carry the energy farther down than incoming electrons alone could do; (3) Bowen's two remarkable discoveries: first, that atoms, when out in interstellar space, are able to undergo atomic transformations forbidden to them within the stars, and second, (4) that in ring-nebulae, trillions of miles away from the exciting star and therefore presumably reflecting conditions in interstellar space there are five of the atoms, namely, helium, carbon, nitrogen, oxygen and silicon, each of which is more than ten times more abundant than any other atom save hydrogen (which must be excluded from measurable cosmic-ray effects because of the smallness of its rest-mass energy), and (5) Lauritsen and Fowler's discovery in the Kellogg Radiation Laboratory that a part at least of the rest-mass energy of an atom has the power under suitable conditions of transforming itself directly into the creation of an "electron-pair." The hypothesis made in view of these five discoveries is that, while the evolution of energy by the stars is maintained, as Bethe has recently shown, by the *partial* transformation, within the stars of the rest-mass energy of hydrogen into radiant energy through

[1] Held in the building of the National Academy of Sciences, Washington, April 28 and 29.

terial suspension. As indicated, a linear relationship is obtained between the galvanometer reading and the turbidity of the solution over a range of galvanometer readings from 10 to 60.

A 32 candlepower, 6-volt lamp furnished the light source. Current for the lamp was supplied by a constant current voltage regulator. A galvanometer with a sensitivity of 1 mm deflection per 0.125 microamperes was used to record the current generated by the photronic cell. Round bottom 100 × 13 mm soft glass or pyrex test-tubes were used to hold the turbid solutions.

In checking several hundred of the above test-tubes it was found that only 1 in 10 gave a deviation in reading of over ± 1.0 per cent. with a constant suspension.

RAYMOND L. LIBBY

LEDERLE LABORATORIES, INC.,
PEARL RIVER, N. Y.

AN IMPROVED WATER BOTTLE FOR SMALL "CAGED" ANIMALS

INVESTIGATORS working with albino rats are constantly aware of the inefficiency of the various types of water bottles necessary for large stock cages. Containers which have an opening large enough for the animal to enter its head likewise serve as receptacles for excreta. An improvement over this type of container is the inverted bottle carrying a straight glass tube. Yet, it, too, offers disadvantages, since proper functioning depends on an equal pressure both inside and out. Thus, whenever from one third to one half of the contents are consumed, a vigorous regurgitation is initiated and continues until the container is empty. As a result of such action, the animals may go several hours without water or other liquids. The cages become and remain wet, which gives rise to obnoxious odors and contamination. This problem is particularly evident when the attendants find it impossible to keep a close check on the water bottles.

To meet the problem of inefficient water bottles for rats, an adaptable unit has been devised. The apparatus required is simple and can be put together from materials available in the laboratory. The apparatus used here has a capacity of approximately 500 cc, a number eleven stopper and 7 mm glass tubing. This improved container, schematically shown in Fig. 1, will not leak or regurgitate when properly adjusted. Tubes *C* and *D* should be of equal length when in place. This is best attained after the end *C* has been introduced through the stopper. Place the inside of the stopper along the straight edge of a laboratory table, thus permitting the ends of the tubes *C* and *D* to rest flat against the top surface of the table. Mark both tubes at an even length from the straight edge, cut and fire polish. Tube *A–B* should be a short close bend, and the length between the center of the bend to the end of *B* from 1 to 1½ inches.

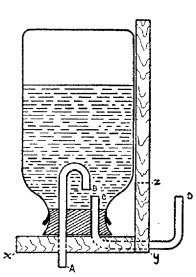

FIG. 1

Fill the bottle, put stopper in place and invert. Tube *A–B* will serve as an air inlet. By means of the inverted siphon *C–D* the water will flow through the tube without the aid of force. However, since *C* and *D* are at the same height the water will not flow beyond *D* without additional pressure. This pressure is supplied through the air inlet tube *A–B*, whenever the animal removes the slightest amount of water. The ideal distance between *B* and *C* is ⅛ inch. In the event that the contents flow too freely, the distance between *B* and *C* should be shortened. On the other hand, should the supply be insufficient the distance between *B* and *C* should be lengthened. The container can be attached to the side of the cage. However, the apparatus is conveniently handled when allowed to rest on a simple rack, as shown in Fig. 1. The rack can be made from two pieces of wood nailed at right angles, and permanently fastened to the side of the cage by screws or bolts. It is necessary to saw a block of wood one quarter inch wide from the center of the rack through *xyz* for the passage of the two tubes. This will allow the bottle to slide in place, thus permitting tube *D* to enter the cage.

Through evaporation, removal of water by the animals or changes in temperature, the equilibrium is maintained. The balance is most delicate and remains constant when properly adjusted.

D. S. THORPE

WASHINGTON HIGH SCHOOL,
ATLANTA, GA.

BOOKS RECEIVED

Bicentennial Conference of the University of Pennsylvania: GOLDBLATT, HARRY, and others. *Hypertension.* Pp. 46. $0.50. FIESER, LOUIS F., and others. *Cause and Growth of Cancer.* Pp. 64. $0.75. KLEIN, HENRY, and others. *Dental Caries.* Pp. 53. $0.50. PETERS, JOHN P., and others. *Problems of Intestinal Obstruction.* Pp. 56. $0.50. JEWETT, FRANK B., and ROBERT W. KING. *Engineering Progress and the Social Order.* Pp. 15. $0.25. University of Pennsylvania Press.

HUNTRESS, ERNEST H. and SAMUEL P. MULLIKEN. *Identification of Pure Organic Compounds.* Pp. xvii + 691. Wiley. $7.50.

Social Security Board. Bureau of Research and Statistics. SAKMANN, MARIANNE, and others. *Bureau Report No. 5; An Outline of Foreign Social Insurance and Assistance Laws.* Pp. 62. $0.15. OTEY, ELIZABETH L. *Bureau Report No. 6; Cash Benefits under Voluntary Disability Insurance in the United States.* Pp. vi + 117. $0.15. Superintendent of Documents, Washington.

The Manuscript; a Guide for its Preparation. Pp. xii + 75. Illustrated. Wiley. $1.00.