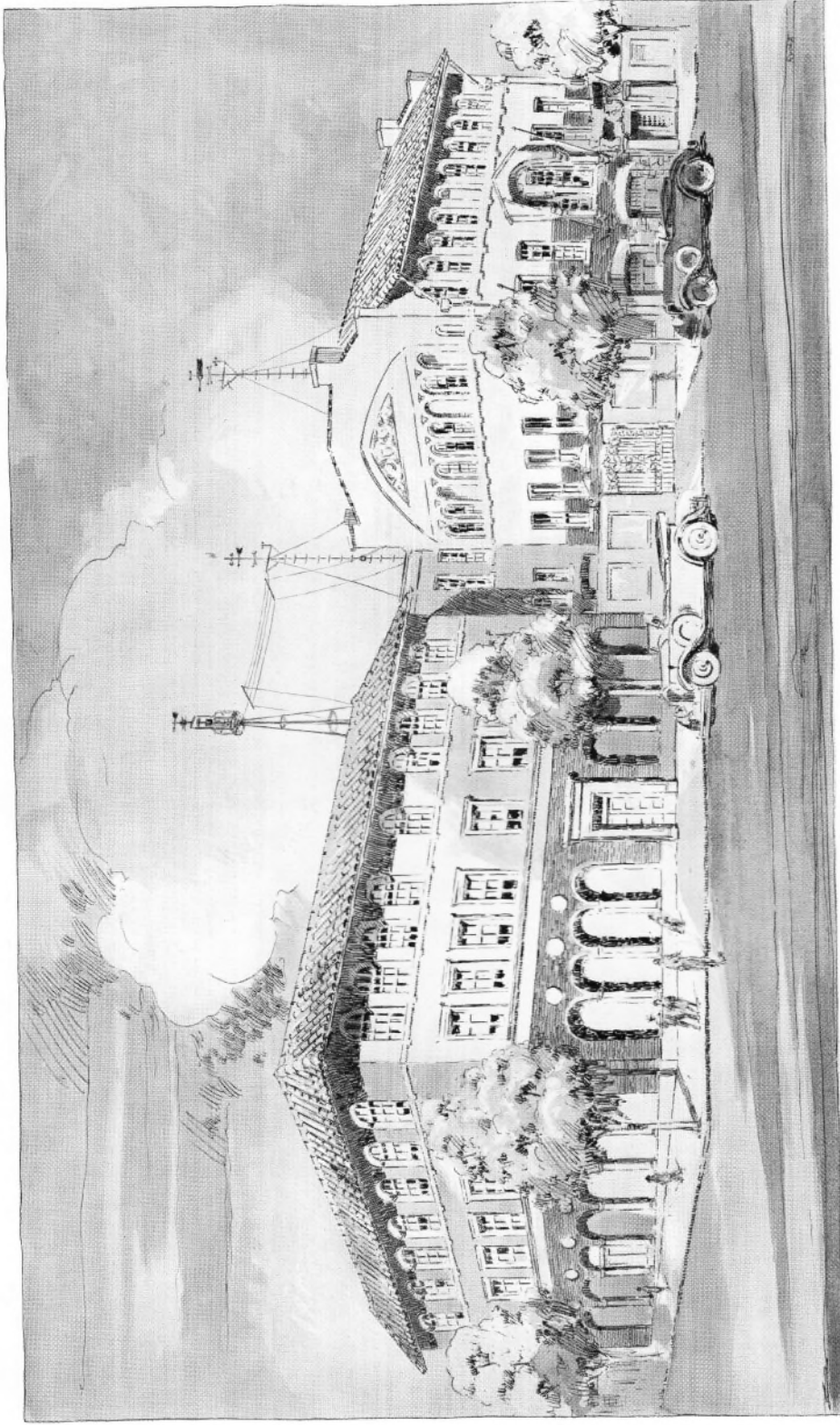




STANDARD
WEATHER
INSTRUMENTS



JULIEN P. FRIEZ & SONS INC.
DIVISION OF BENDIX AVIATION CORPORATION
BELFORT OBSERVATORY BALTIMORE
MARYLAND



BELFORT METEOROLOGICAL OBSERVATORY
(INCLUDING PROPOSED ADDITION)

JULIEN P. FRIEZ & SONS, INC.

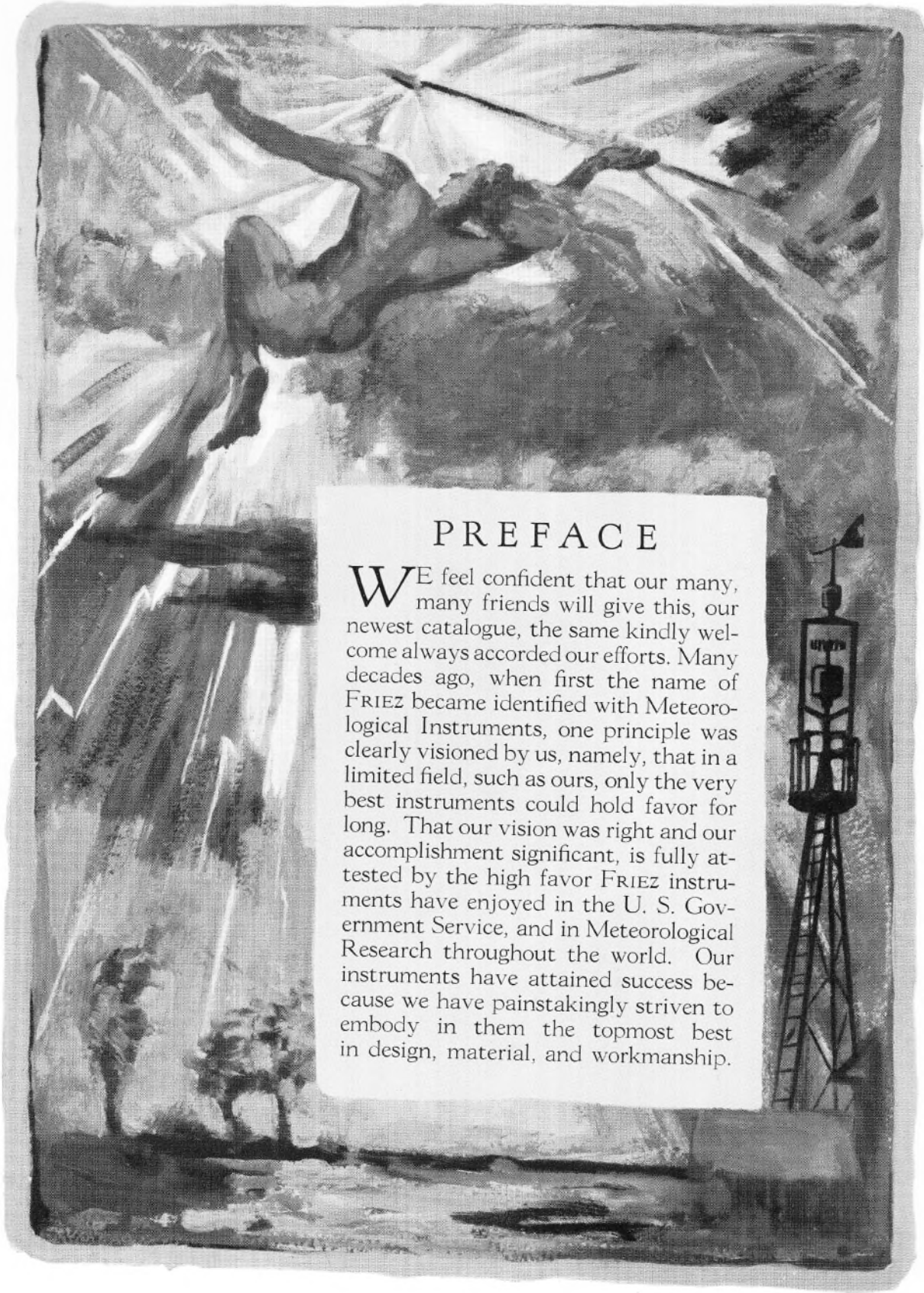
DIVISION OF BENDIX AVIATION CORPORATION
N.W. CORNER BALTIMORE STREET AND CENTRAL AVENUE
BALTIMORE MARYLAND



FRIEZ
WEATHER
INSTRUMENTS

CATALOGUE N^o 5

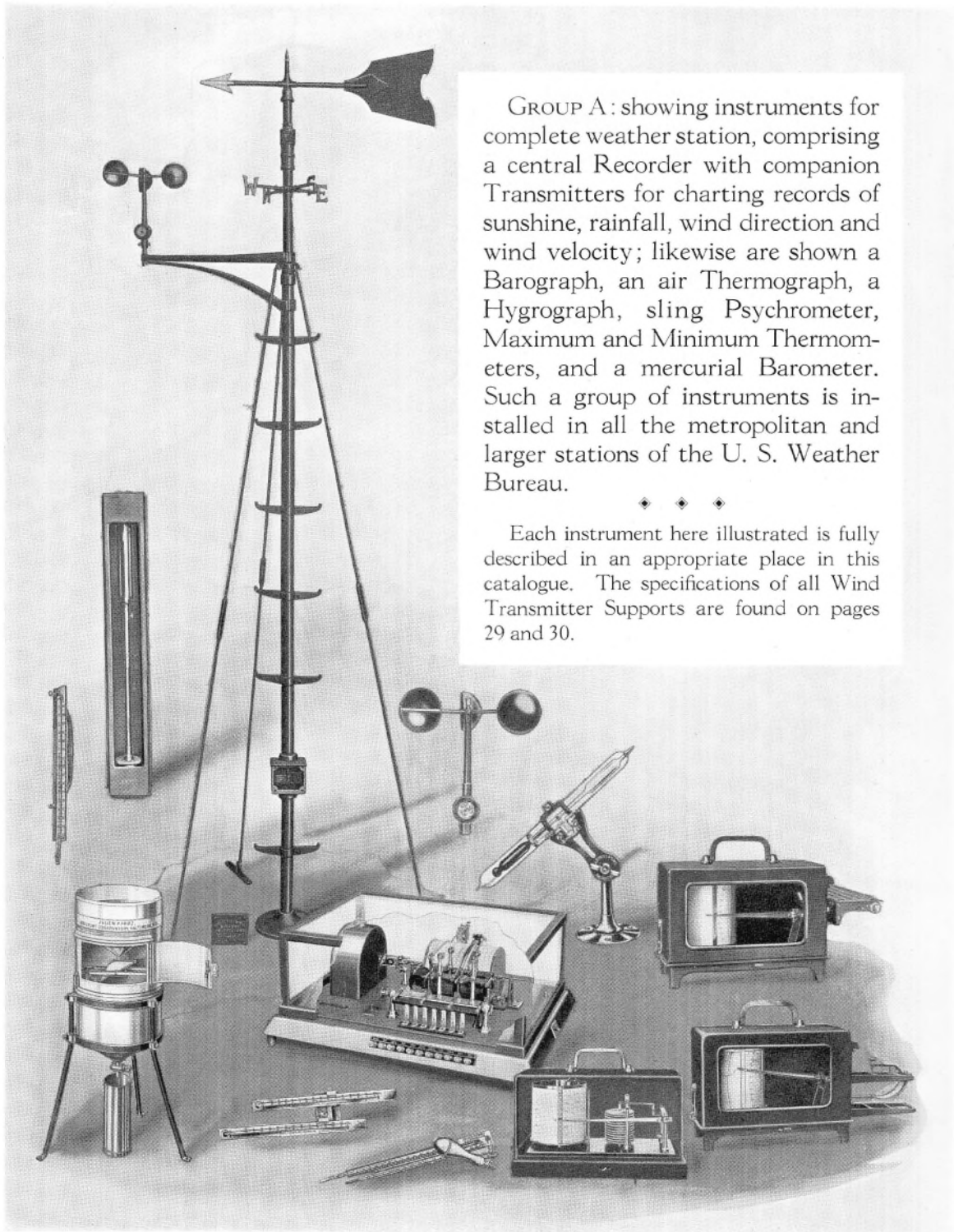
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JULIEN P. FRIEZ & SONS, INC.
Baltimore, Md.



P R E F A C E

WE feel confident that our many, many friends will give this, our newest catalogue, the same kindly welcome always accorded our efforts. Many decades ago, when first the name of FRIEZ became identified with Meteorological Instruments, one principle was clearly visioned by us, namely, that in a limited field, such as ours, only the very best instruments could hold favor for long. That our vision was right and our accomplishment significant, is fully attested by the high favor FRIEZ instruments have enjoyed in the U. S. Government Service, and in Meteorological Research throughout the world. Our instruments have attained success because we have painstakingly striven to embody in them the topmost best in design, material, and workmanship.

ASSEMBLAGE OF INSTRUMENTS FOR COMPLETE WEATHER STATION

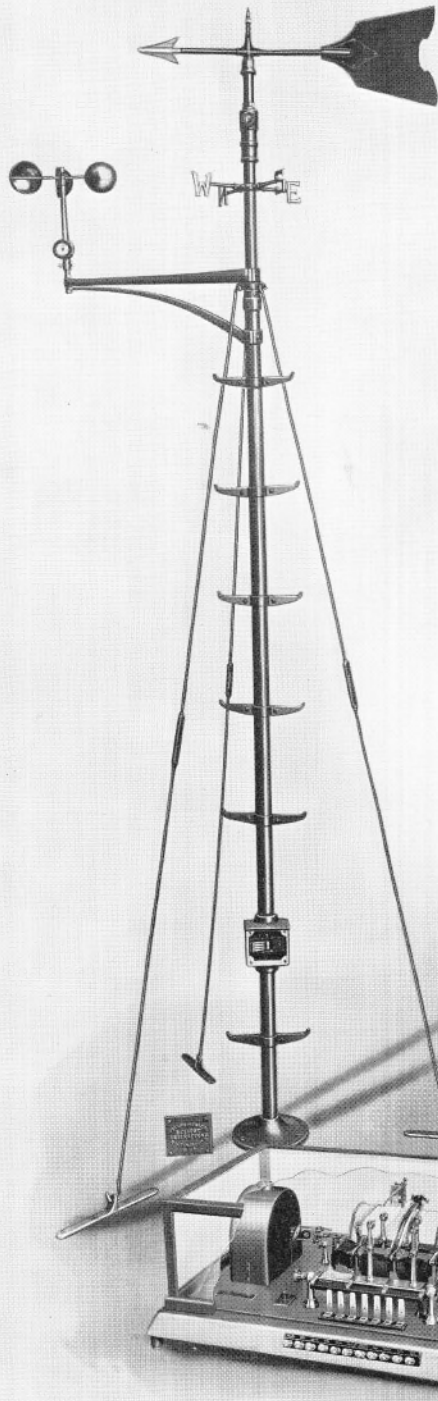


GROUP A: showing instruments for complete weather station, comprising a central Recorder with companion Transmitters for charting records of sunshine, rainfall, wind direction and wind velocity; likewise are shown a Barograph, an air Thermograph, a Hygrograph, sling Psychrometer, Maximum and Minimum Thermometers, and a mercurial Barometer. Such a group of instruments is installed in all the metropolitan and larger stations of the U. S. Weather Bureau.



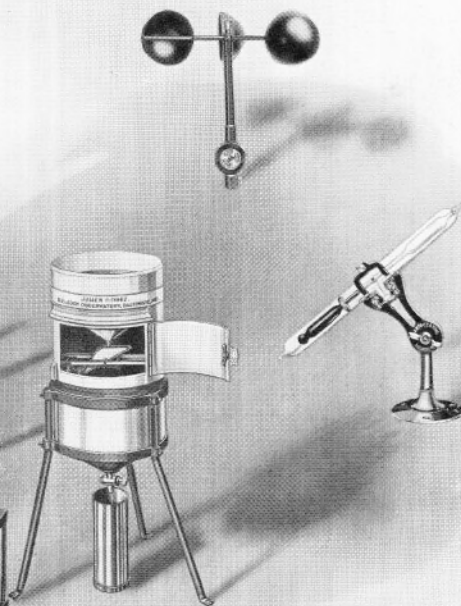
Each instrument here illustrated is fully described in an appropriate place in this catalogue. The specifications of all Wind Transmitter Supports are found on pages 29 and 30.

FOUR CONDITION WEATHER RECORDER
WITH COMPANION TRANSMITTERS

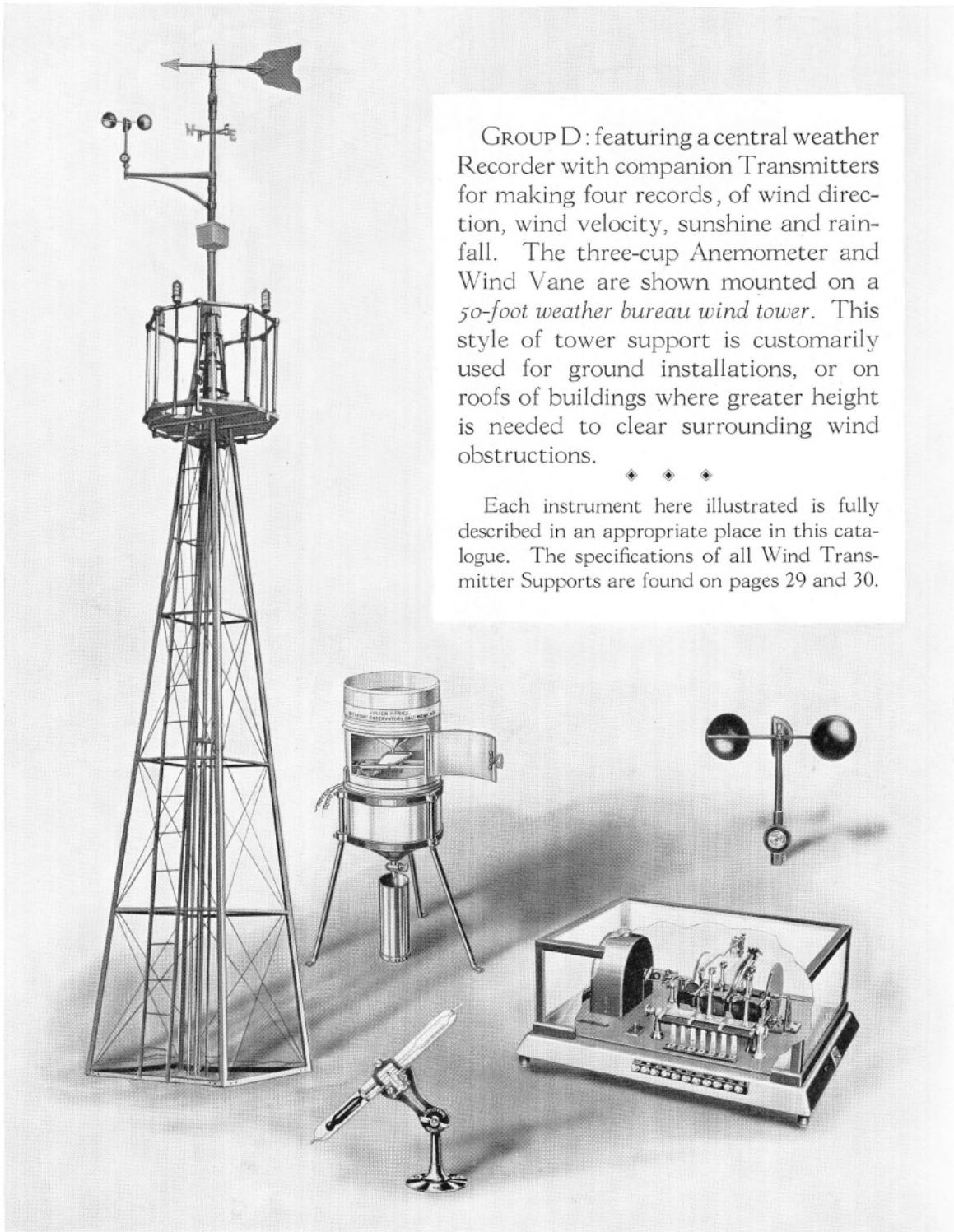


GROUP C: featuring a central weather Recorder with companion Transmitters for making records of wind direction, wind velocity, sunshine and rainfall. The three-cup Anemometer and Wind Vane are mounted on a *standard 18-foot pipe support*. This style of pipe support is ordinarily used on roofs of buildings or where great height of support is not necessary.

Each instrument here illustrated is fully described in an appropriate place in this catalogue. The specifications of all Wind Transmitter Supports are found on pages 29 and 30.



FOUR CONDITION WEATHER RECORDER
WITH COMPANION TRANSMITTERS



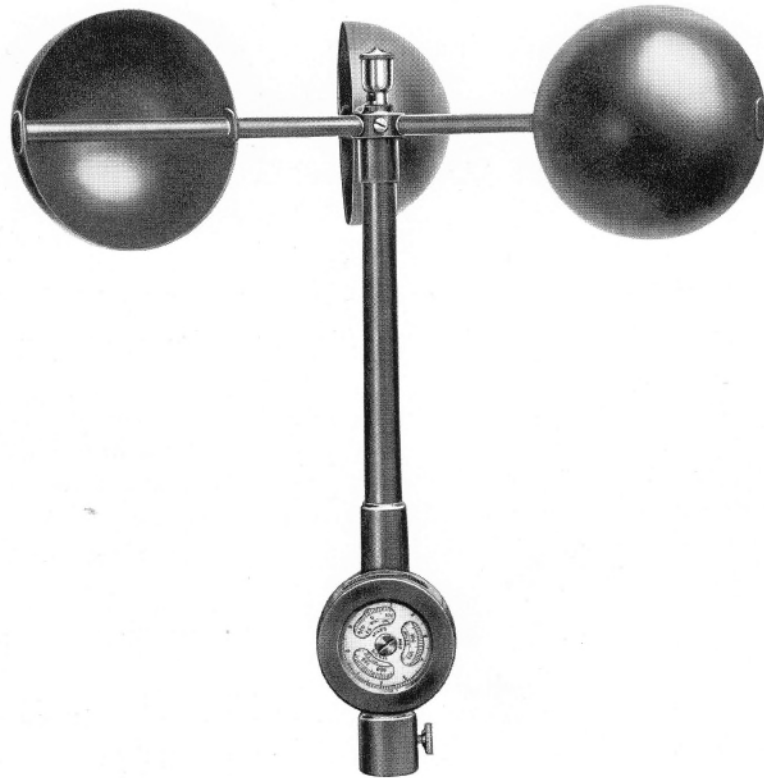
GROUP D: featuring a central weather Recorder with companion Transmitters for making four records, of wind direction, wind velocity, sunshine and rainfall. The three-cup Anemometer and Wind Vane are shown mounted on a *50-foot weather bureau wind tower*. This style of tower support is customarily used for ground installations, or on roofs of buildings where greater height is needed to clear surrounding wind obstructions.



Each instrument here illustrated is fully described in an appropriate place in this catalogue. The specifications of all Wind Transmitter Supports are found on pages 29 and 30.

THREE-CUP ANEMOMETER

U. S. Weather Bureau Pattern



No. 343

- No. 340—THREE-CUP ANEMOMETER, NEW STANDARD, DIAL-REGISTERING, MILE TRANSMITTER, U. S. WEATHER BUREAU PATTERN, for direct reading of wind movement and electrical transmission of such to Velocity Recorder giving *miles* per hour; complete with copper cups. \$
 (Weight: gross, 10 lbs; net, 5 lbs.)
- No. 341—THREE-CUP ANEMOMETER, NEW STANDARD, DIAL-REGISTERING, KILOMETER TRANSMITTER, for direct reading of wind movement and electrical transmission of such to Velocity Recorder giving *kilometers* per hour; complete with copper cups. \$
 (Weight: gross, 10 lbs; net, 5 lbs.)
- No. 343—THREE-CUP ANEMOMETER, NEW STANDARD, DIAL-REGISTERING, MILE AND ONE-SIXTIETH MILE TRANSMITTER, for direct reading of wind movement in *miles* and electrical transmission of such to Velocity Recorders with a buzzer attachment (Nos. 354-355). Instrument complete with copper cups. \$
 (Weight: gross, 10 lbs; net, 5 lbs.)
- No. 347—THREE-CUP ANEMOMETER, NEW STANDARD, DIAL-REGISTERING, KILOMETER AND ONE-SIXTIETH KILOMETER TRANSMITTER, for direct reading of wind movement in kilometers and electrical transmission of such to Velocity Recorder with a buzzer attachment (Nos. 356-357). Instrument complete with copper cups. \$
 (Weight: gross, 10 lbs; net, 5 lbs.)

No. 343-N—THREE-CUP ANEMOMETER, NEW STANDARD, DIAL-REGISTERING KNOT AND ONE-SIXTIETH KNOT TRANSMITTER, for direct reading of wind movement in nautical miles and electrical transmission of such to Velocity Recorders with buzzer attachment (Nos. 354-355). Instrument complete with copper cups.....\$.....
 (Weight: gross, 10 lbs; net, 5 lbs.)

◆◆◆
THREE-CUP ANEMOMETER

U. S. Weather Bureau Pattern

THE Three-Cup Anemometer, which we have been manufacturing now for several years, supplants the obsoleted four-cup type of Robinson Anemometer, and represents a marked advance in instruments for measuring wind velocity by rotating cups.

Greater accuracy of the three-cup is the chief reason for discarding the four-cup rotor. So inconspicuous is the divergence of the velocity indicated by the new Anemometer from the true velocity that correction tables are unnecessary for all average velocities. A velocity of twenty-five miles indicated by the three-cup Anemometer is only about 2 per cent too high and only 5 per cent too high at one hundred miles per hour.

This accuracy of the Anemometer may be fully appreciated from the following table.

TRUE OR CORRECT VELOCITIES CORRESPONDING TO VELOCITIES INDICATED BY NEW STANDARD THREE-CUP ANEMOMETER

IN MILES PER HOUR			IN METRES PER SECOND		
Indicated	True	Remarks	Indicated	True	Remarks
5	5.1		2	2.1	
10	10.1	Average in America	5	5.0	Average in America
20	19.6		10	9.8	
30	29.1	Gale	15	14.6	Gale
40	38.7		20	19.3	
60	57.8	Hurricane	25	24.0	Hurricane
80	76.5		30	28.7	
100	95.2		35	33.4	
120	114.8		40	38.3	
140	134.5	Highest Recorded	45	43.0	Highest Recorded
160	153.0		50	47.6	
180	172.6		55	52.3	
200	191.6		60	57.1	

In this Anemometer, three hollow hemispherical cups are mounted upon cross arms with the open sections vertical and facing the same way around the circumference. The cross arms are on a vertical spindle, at whose lower end is an endless screw. This spindle is so supported as to turn with a minimum of friction. A self-oiling

device is affixed to the crest of the spindle. It is a cylindrical cup, from which a wick extends for continuous oiling of the upper bearing.

The endless screw meshes with a gear wheel which rotates two dials thus registering the number of revolutions of the cups shown in foregoing illustration; it is well protected from the weather, and is designed for outdoor use.

To read the wind movement by means of the dials, consult first the lower inside solid dial whose readings give the number of miles in hundreds and in tens. This number will be that opposite the moving index located on the inside edge of the upper and outer spoked dial. To tell the additional miles and fractions thereof, the fixed index at the top and a little to the left is to be consulted. The numbers on this spoked dial represent mile units and each tooth represents one-tenth of a mile. The addition of the two dials completes the total number of miles of wind movement. To compute the velocity of the wind between two points of time, the subtraction of a preceding reading from the one last observed is the wind-travel in miles during the time interval.

In the Standard Weather Bureau Pattern of Anemometer (No. 340) the readings of wind velocity may be thus taken directly from the dials themselves. To obtain the same readings at a distance, electrical transmission is made of the movement of the dials as follows: the outside dial wheel is graduated into 100 divisions, and at each tenth division a pin for electrical contact is set. When a contact is made by each of these pins with the platinum-pointed flat bronze spring, wired to an outside binding post, the turning of the dials may thus be transmitted electrically to Wind Velocity Recorder No. 350-355.

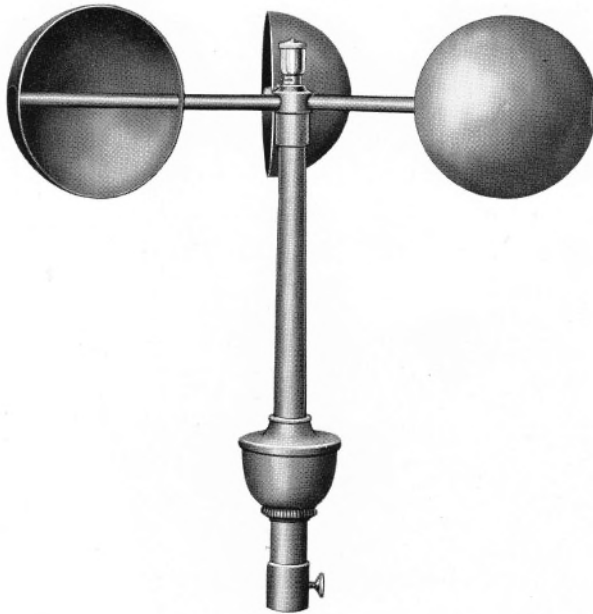
Moreover, in order that a significant electrical registration of the turning of the dials may be made of every complete revolution of the dial, the ninth and the tenth contact pins are bridged across so that a continuous contact will be made during that interval, denoting one complete revolution of the dial. Thus the observer, without counting each mile on the charted record, may reckon the total wind movement in units of ten miles each.

All U. S. Weather Bureau Pattern Anemometers of the new three-cup type are equipped with the bronze contact spring, the specially constructed dial, the wiring, and binding posts required for such electrical transmission. Thus equipped, this Anemometer may be used as an independent instrument or in conjunction with the indoor recording apparatus described hereafter.

The Three-cup Anemometer, like the old Standard Four-Cup Anemometer, has been arranged with several varieties of contact mechanisms to take care of records of velocity either in miles or kilometers, or for the immediate registration of wind velocity by buzzer box or by buzzer attachment on the register, requiring the one-sixtieth mile and one-sixtieth kilometer contacts. Contact is likewise arranged for registering in knots for marine purposes, as with Anemometer No. 343-N.

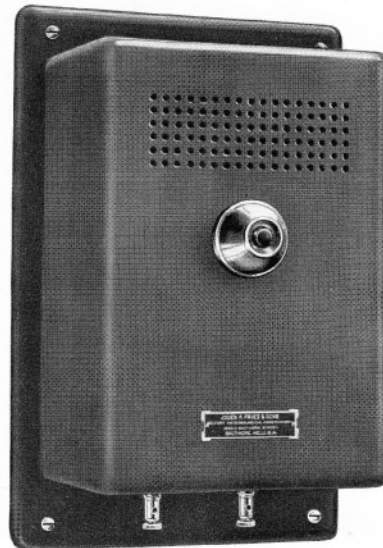
Anemometers Nos. 340 and 341 are used with Recorders Nos. 350, 351, 352 and 353; Nos. 344 and 344-K are used with buzzer box only; Nos. 343, 343-N and 347 are used with such Recorders as include a buzzer attachment.

WIND VELOCITY INDICATOR



No. 344

No. 345—ANEMOMETER BUZZER BOX; indicates wind velocity when wired to Transmitting Anemometers; made of metal, nicely finished, contains a battery of two dry cells, an electric buzzer, with push-button mounted on front.....\$.....
 (Weight: gross, 20 lbs; net, 8 lbs.)



No. 345

No. 344—THREE-CUP ANEMOMETER, one-sixtieth-mile Transmitter, for indications of wind velocity in miles when wired to buzzer attachment. \$.....
 (Weight: gross, 25 lbs; net, 12 lbs.)

No. 344-K — THREE-CUP ANEMOMETER, one-sixtieth kilometer Transmitter for indications of wind velocity in kilometers when wired to buzzer attachment.....\$.....
 (Weight: gross, 25 lbs; net 12 lbs.)

ANEMOMETERS Nos. 344 and 344-K cannot be used with Wind Velocity Recorders.

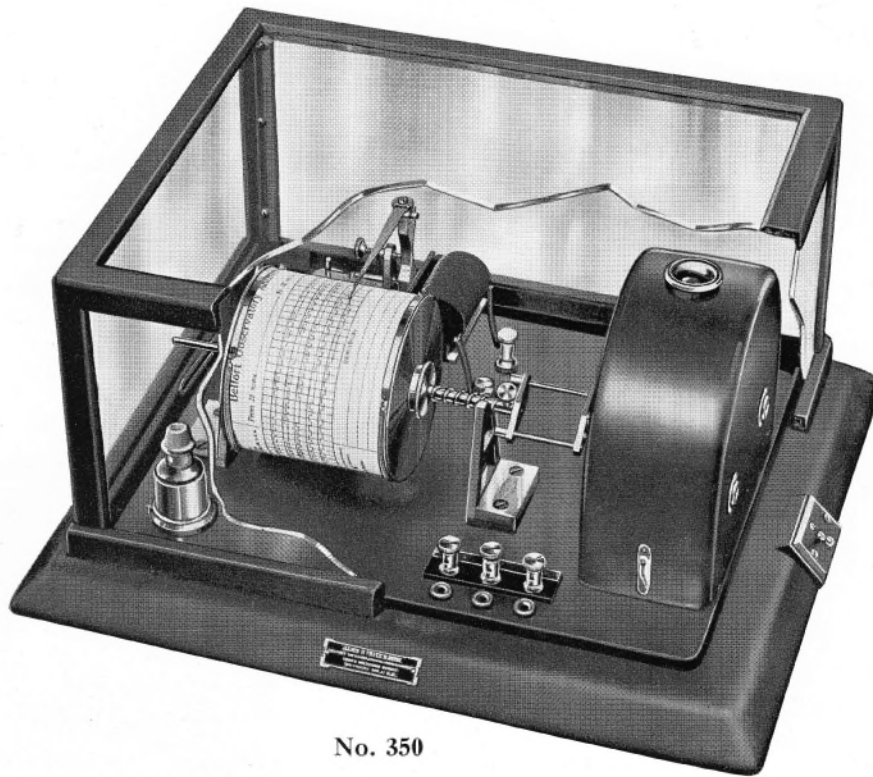
WIND VELOCITY INDICATOR

THE Three-Cup Anemometer and Buzzer Box shown here together is the simplest and least expensive arrangement for indicating wind velocity by instruments of approved design in very general use.

The buzzer box, attractively finished, encloses a battery of two dry cells completely wired to binding posts accessible below; when wired to Anemometer No. 344 or 344-K, the velocity of the wind may be determined simply by holding the push-button closed for one minute, while counting the number of times the Buzzer sounds during that period. The number counted is the number of miles or kilometers per hour the wind is then blowing, *i.e.*, the velocity of the wind. When for boating or yachting or by any maritime interests the wind velocity is to be reckoned in knots, the number of times the Buzzer sounds in fifty-two seconds equals the wind velocity in knots, when Anemometer No. 344 is employed.

WIND VELOCITY RECORDER

U. S. Weather Bureau Pattern



No. 350

- No. 350—WIND VELOCITY RECORDER, U. S. WEATHER BUREAU PATTERN, records electrically the velocity of the wind in *miles* per hour when connected with Three-Cup Anemometer No. 340. Chart cylinder makes a revolution each six hours, four revolutions per day. Instrument complete with pen, ink, and year's supply (375) *daily* charts No. 1015 \$.....
 (Weight: gross, 90 lbs; net, 20 lbs.)
- No. 351—WIND VELOCITY RECORDER, same as No. 350, except that time-screw and chart are extended for a "*two-day*" record. Instrument complete with pen, ink, and year's supply (190) charts No. 1015-J \$.....
 (Weight: gross, 90 lbs; net, 22 lbs.)
- No. 352—WIND VELOCITY RECORDER, U. S. WEATHER BUREAU PATTERN, records electrically the velocity of the wind in *kilometers* per hour when connected with Three-Cup Anemometer No. 341. Chart cylinder makes a revolution each six hours, four revolutions per day. Instrument complete with pen, ink, and year's supply (375) *daily* charts No. 1015-M \$.....
 (Weight: gross, 90 lbs; net, 20 lbs.)
- No. 353—WIND VELOCITY RECORDER, same as No. 352, except that time-screw and charts are extended for a "*two-day*" record. Instrument complete with pen, ink, and year's supply (190) charts No. 1015-J \$.....
 (Weight: gross, 90 lbs; net, 22 lbs.)
- No. 354—WIND VELOCITY RECORDER WITH BUZZER ATTACHMENT. When connected with Three-Cup Anemometer No. 343, equipped with combination mile and one-sixtieth-mile contacts, records electrically the velocity of the wind in miles per hour; buzzer attachment indicates velocity independent of chart reading. Instrument complete with pen, ink, and year's supply (375) *daily* charts No. 1015 \$.....
 (Weight: gross, 90 lbs; net, 20 lbs.)

No. 355—WIND VELOCITY RECORDER WITH BUZZER ATTACHMENT, same as No. 354, except that time-screw and chart are extended for a "two-day" record. Instrument complete with pen, ink, and year's supply (190) charts No. 1015-J\$.....

(Weight: gross, 90 lbs; net, 22 lbs.)

No. 356—WIND VELOCITY RECORDER WITH BUZZER ATTACHMENT, same as No. 352 in that it records *kilometers*; when connected however with Three-Cup Anemometer No. 347 which is equipped with combination kilometer and one-sixtieth kilometer contacts, the buzzer arrangement indicates velocity independent of chart reading. Instrument complete with pen, ink, and year's supply (375) *daily* charts No. 1015-M.\$.....

(Weight: gross, 90 lbs; net, 20 lbs.)

No. 357—WIND VELOCITY RECORDER WITH BUZZER ATTACHMENT. Same as No. 356 except that time-screw and chart are extended for a "two-day" record. Instrument complete with pen, ink, and year's supply (190) charts No. 1015-J\$.....

(Weight: gross, 90 lbs; net, 22 lbs.)

NOTE.—See pages 24 and 26 for Velocity Recorders combined with Wind Direction, Sunshine, and Rainfall Recorders.

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WIND VELOCITY RECORDER

U. S. Weather Bureau Pattern

WIND Velocity Recorder No. 350 is in wide and extensive use by the United States Government Service, by universities and in general wherever a permanent charted record of wind velocity over an extended period of time is sought.

A full glass-panel case encloses upon a cast aluminum base the recording mechanism, consisting of clock movement, recording pen, chart cylinder and electro-magnet.

The jeweled eight-day clock movement is encased in a dust-proof metal sheath and operates the record cylinder by means of a sliding universal joint and a steep-pitch nickel-plated time-screw. The cylinder makes four complete revolutions in twenty-four hours and so provides an open scale reading for wind velocities as high as one hundred miles per hour. The surface of the record cylinder necessarily revolves at a comparatively rapid rate (2 inches per hour). Every mile or kilometer of wind is indicated on the chart by an indented bracket tracing. Moreover, to enable the observer to read his chart more quickly, namely, in counts of ten, every tenth mile or kilometer of wind movement is traced on the chart in a long significant line, caused by the continued contact arranged by bridging the ninth and tenth mile or kilometer pins of the anemometer dial as explained in our description of the U. S. Weather Bureau Pattern Anemometer, No. 340.

Recorders Nos. 351, 353, 355 and 357 provide a two-day record with the same open scale reading as in the one-day type and have found favor with those observers who do not find it convenient to change their charts each day. This arrangement precludes the loss of records over Sundays and holidays.

Besides the recording apparatus and chart, Recorders Nos. 354, 355, 356, 357 contain a complementary buzzer device by which the velocity of the wind at any particular point of time may be observed.

SUNSHINE DURATION TRANSMITTER

U. S. Weather Bureau Pattern



No. 380

No. 380—SUNSHINE DURATION TRANSMITTER, U. S. WEATHER BUREAU PATTERN, essentially a differential air thermometer enclosed within an evacuated glass sheath, with platinum wire electrodes fused into the column at the center. When connected electrically to a Sunshine Recorder (No. 390), the duration of the sunshine is recorded. Instrument is complete with an improved (clamp type) brass mounting, hinged upon a suitable pedestal\$.....
 (Weight: gross, 5 lbs; net, 1½ lbs.)

No. 380-A—SUNSHINE DURATION TRANSMITTER, Thermometric element only, exclusive of metal mounting\$.....
 (Weight: gross, 3 lbs; net, 1 lb.)



NOTE.—By reason of its intricate construction, the Thermometric element of the Sunshine Transmitter can seldom be economically repaired. When the outer glass is broken or platinum wires are broken close to the tube, the whole tube must be replaced.

SUNSHINE DURATION TRANSMITTER

U. S. Weather Bureau Pattern

THIS instrument, devised by Prof. Charles F. Marvin, Chief of the U. S. Weather Bureau, is in universal use for recording the duration of sunshine.

It consists of a brass upright stand, from which a long glass vacuum tube, enclosing a form of differential Thermometer with cylindrical bulbs at each end, is swung with suitable adjusting arrangement for various angles of inclination. Platinum wire electrodes are fused into the center of the thermometer column.

Within a vacuum glass tubular enclosure to exclude temperature changes due immediately to the surrounding atmosphere, the Transmitter consists of an upper cylindrical bulb filled with air connecting by a narrow tube with a lower bulbous cistern, into which the constricted tube extends deeply dipping into mercury. This cistern or whole lower cylindrical bulbous end is coated with lampblack to absorb the heat of the sun's rays. Being but partially filled with mercury the chamber or remaining space above it contains air the expansion of which when heated forces the mercury up the constricted tube. The shining of the sun's rays on the whole instrument raises the temperature and therefore the pressure of the air within the lower blackened mercury cistern higher than that of the air contained within the upper unblackened cylinder and under this difference of temperature and pressure the mercury rises in the tube to a point at which it closes an electrical circuit almost immediately after the sun has begun to shine; and the circuit will be opened again immediately after the sun has been obscured.

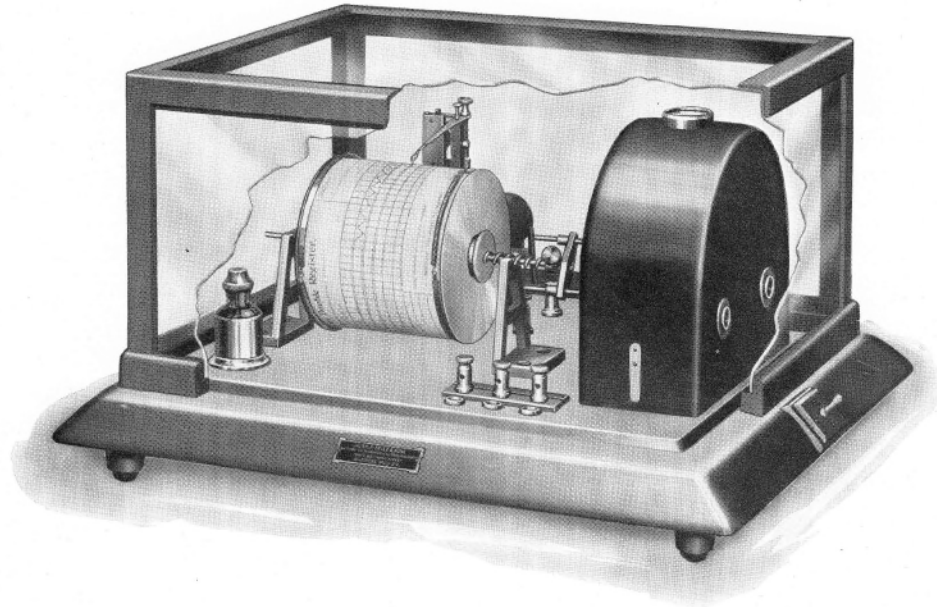
The thermometric portion of the instrument being entirely of glass is somewhat delicate. During shipment, the mercury often becomes more or less distributed in the various parts, but the column is quickly restored and proper adjustment secured, by carefully swinging the glass portion held vertically in the hand, *blackened* bulb downward.

When this instrument is installed, the inclination of the tube should be adjusted at such an angle that the mercury column will just close the electrical circuit during times when the disk of the sun can just be faintly seen through the clouds. If the cloudiness is such that the observer cannot clearly distinguish the sun's disk, then the mercury should not rise high enough to close the circuit. Several trials on successive days may be necessary to secure the best adjustment. In altering the inclination of the Recorder it is best to first make a chalk or pencil mark across the edges of the hinge joint of the support before it is loosened. Any change made in the inclination of the tube is then clearly shown by the amount the lines on the two parts of the hinge separate from each other. If it is desired to make a subsequent adjustment, the first lines are easily erased and a new mark made.

In the use of the Sunshine Duration Transmitter, the observer will be helped by referring to table No. V, on page 150 of this catalogue, in which the approximate hours of possible sunshine are given for Northern Latitudes between 25° and 49° inclusive. These possible hours of sunshine, as is evident, vary during the several seasons of the year, and ten-day intervals for all the months are listed as a part of the table. Obviously, this same table may be made use of in Southern Latitudes by the proper inversion of the calendar months.

SUNSHINE DURATION RECORDER

U. S. Weather Bureau Pattern



No. 390

No. 390—SUNSHINE DURATION RECORDER, U. S. WEATHER BUREAU PATTERN, records at any convenient location the duration of the sunshine when connected electrically to Sunshine Transmitter No. 380. Chart cylinder makes a revolution each six hours, four revolutions per day. Instrument complete with pen, ink, and year's supply (375) daily charts No. 1015-B \$.....
 (Weight: gross, 90 lbs; net, 20 lbs.)

No. 391—SUNSHINE DURATION RECORDER. Same as No. 390, except that time-screw and chart are extended for a "two-day" record. Instrument complete with pen, ink, and a year's supply (190) charts No. 1015-J \$.....
 (Weight: gross, 90 lbs; net, 22 lbs.)



NOTE.—See pages 24 and 26 for Sunshine Recorders combined with Wind Direction, Velocity, and Rainfall Recorders.

SUNSHINE DURATION RECORDER

U. S. Weather Bureau Pattern

THIS Sunshine Recorder is in wide and extensive use by U. S. Government Service, by universities and in general wherever a permanent charted record of the duration of sunshine is sought.

A full glass-panel case encloses upon a cast aluminum base the recording mechanism consisting of the clock movement, chart cylinder, pen, and the electro-magnet.

The jeweled eight-day clock movement is encased in a dust-proof metal cover and operates the record cylinder by means of a sliding universal joint and a steep-pitch nickel-plated time-screw. The cylinder makes four revolutions in twenty-four hours and so provides a very legible record of the occurrence and the duration of sunshine. The surface of the record cylinder necessarily moves at a comparatively rapid rate (2 inches per hour).

The magnet is operated directly by the movement of the second-hand shaft of the clock, which is electrically connected with the outdoor Sunshine Transmitter. An electrical contact maker upon the shaft of the second-hand makes contact when the outside circuit is closed and causes the pen to trace a zigzag symbol on the chart. When there is no closure of the outside circuit, *i. e.*, when the sun is not shining, the pen traces a straight line around the chart. Hence the time periods of the zigzag tracings are the time periods of sunshine; the periods of straight lines represent the periods of no sunshine.

For those desiring a forty-eight hour record in place of a twenty-four hour record, we have designed a Recorder (No. 391) with a time-screw for that purpose and with suitable charts. Its use eliminates the danger of lost records over Sundays and holidays.



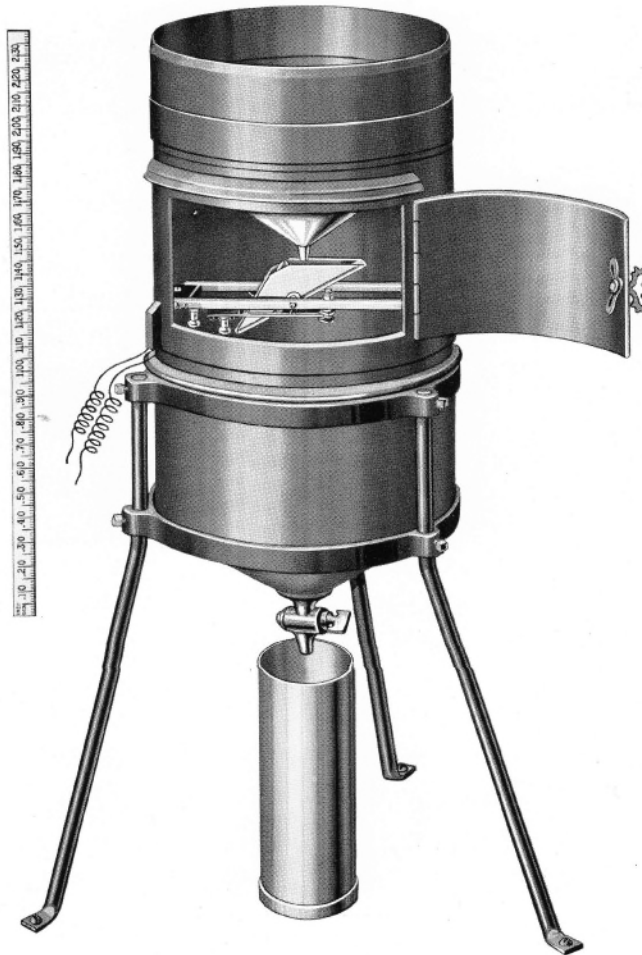
OPERATION RECORDERS

AS many other Recorders shown in the catalogue, the Recorder, designed for recording duration of sunshine, can be used as an operation Recorder, where a symbol for an operation occurring every minute could be made by the magnet-controlled pen-arm.

Where many operations are to be recorded, this type of Recorder can be modified and has been modified to make records of numerous simultaneous operations. On special order, such Recorders have been made by us for as many as eight contemporaneous records. Where multiple records are made, it is customary to use a straight line with offsets to record the opening and closing of the circuit.

TIPPING-BUCKET,
ELECTRICAL-TRANSMITTING RAIN GAGE

U. S. Weather Bureau Pattern



No. 405

No. 405—TIPPING-BUCKET ELECTRICAL-TRANSMITTING RAIN GAGE, U. S. WEATHER BUREAU PATTERN, comprises three principal sections or parts, namely: (a) the rain collector and enclosing case; (b) tipping bucket with its frame and electrical contacts; (c) the iron tripod support. The bucket tips each one-hundredth inch of rain collected, each tip being transmitted electrically to a Rainfall Recorder No. 406, placed at any distant location. A suitable measuring tube and graduated measuring stick are provided for making check comparisons. . . \$.
(Weight: gross, 80 lbs; net, 25 lbs.)

No. 415—TIPPING-BUCKET ELECTRICAL-TRANSMITTING RAIN GAGE. Same pattern as No 405, except that bucket is adjusted to tip for each two-fifths of a millimeter of rain collected. A suitable measuring stick graduated to represent one-fourth of a millimeter of actual rainfall is provided for making check comparisons. \$.
(Weight: gross, 80 lbs; net, 25 lbs.)

TIPPING-BUCKET, ELECTRICAL-TRANSMITTING RAIN GAGE

U. S. Weather Bureau Pattern

THIS form of Rain Gage, in conjunction with the various forms of Friez recording apparatus, has been extensively used for many years by government bureaus, city waterworks, irrigation systems, etc.

The instrument consists of the collecting ring and funnel at top, the reservoir for the rainfall at bottom and the tipping-bucket mechanism as seen in the illustration, and an iron tripod support.

The action of the tipping-bucket mechanism is as follows: the brass trough-like bucket is divided by a central partition into two equal compartments. The bucket is pivoted on suitable bearings placed below the center of gravity. The weight of the bucket and the position of its center of gravity have been so adjusted in relation to a stop-pin on each compartment that when one of these compartments has been charged with a quantity of water, representing one one-hundredth of an inch depth of rain caught with the 12-inch collecting ring, the bucket tips over upon its bearings emptying the water from one compartment and at the same moment presenting the other compartment to receive the incoming water. Each tip of the bucket makes an electric contact through flat bronze contact springs, which electric impulses are conveyed to a Rainfall Recorder located indoors.

For check comparisons, the water can be drawn off from the reservoir below and measured by means of the standard measuring tube and stick supplied with the instrument. The cross sectional area of the measuring tube bears the relation of one to ten to the cross section of the collecting ring, but measurements of rainfall are read directly from the special "measuring stick" supplied with each Rain Gage, measuring sticks or rules being graduated in either inches or millimeters.

The instrument as a whole must be set up level and perpendicular, otherwise the tipping-bucket which is controlled by gravity will not tip uniformly.

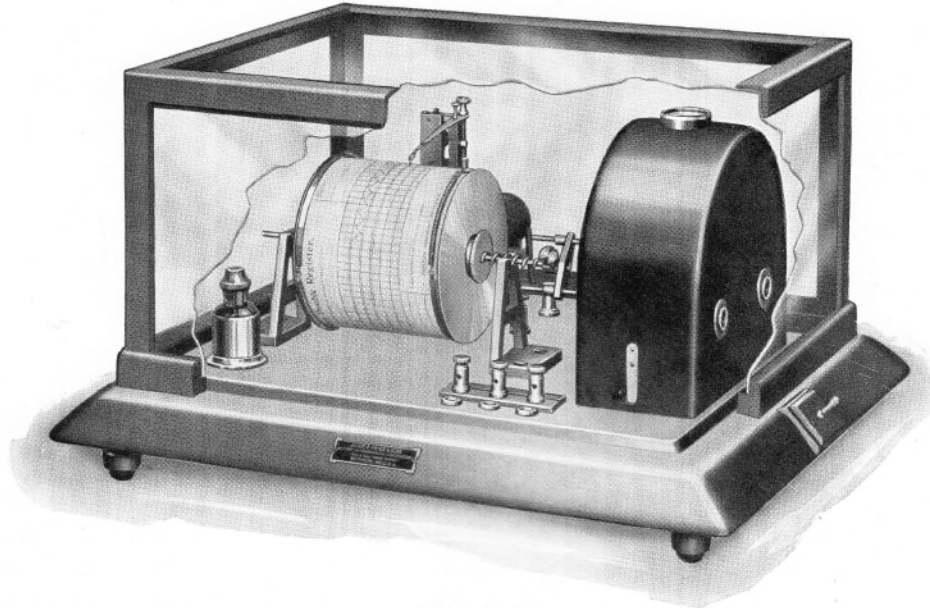
Further details covering the installation, care and management of rain gages will be found in our circular RG, a copy of which is forwarded with each gage.



This is the only electrical-transmitting type Rain Gage manufactured by us; it is therefore illustrated and described in advance of other types which cannot be used in conjunction with indoor Recorders. See other types of Rain Gages illustrated pages 106 to 115.

RAINFALL RECORDER

U. S. Weather Bureau Pattern



No. 406

- No. 406—RAINFALL RECORDER, U. S. WEATHER BUREAU PATTERN, records at any convenient location each hundredth inch of rainfall as collected by Tipping-Bucket Rain Gage No. 405. Chart cylinder makes four revolutions in twenty-four hours, covering 2-inch cylinder surface per hour, sufficient to render a perfectly legible daily record for the most rapid rates of rainfall. Instrument complete with pen, ink, and year's supply (375) *daily* charts No. 1015-A.
(Weight: gross, 90 lbs; net, 20 lbs.) \$.....
- No. 416—RAINFALL RECORDER, same as No. 406, except that time-screw and chart are extended for a "two-day" record. Instrument complete with pen, ink, and year's supply (190) charts No. 1015-J\$.....
(Weight: gross, 90 lbs; net, 22 lbs.)
- No. 417—RAINFALL RECORDER, records at any convenient location each two-fifths of a millimeter of rainfall as collected by Tipping-Bucket Rain Gage No. 415. Instrument is otherwise same as Rainfall Recorder No. 406; complete with pen, ink, and year's supply (375) *daily* charts No. 1015-A.....\$.....
(Weight: gross, 90 lbs; net, 20 lbs.)
- No. 418—RAINFALL RECORDER, same as No. 417, except that time-screw and chart are extended for a "two-day" record. Instrument complete with pen, ink, and year's supply (190) charts No. 1015-J\$.....
(Weight: gross, 90 lbs; net, 22 lbs.)

NOTE.—See pages 24 and 26 for Rainfall Recorders combined with Wind Direction, Sunshine and Velocity Recorders.

RAINFALL RECORDER

U. S. Weather Bureau Pattern

THE Standard Rainfall Recorder No. 406 is in wide and extensive use by the U. S. Government Service, by universities and in general wherever a permanent charted record of rainfall over an extended period of time is sought.

A full-glass panel case encloses upon a cast aluminum base the recording mechanism, consisting of the clock movement, recording pen, cylinder, and the electromagnet.

The jeweled eight-day clock movement is encased in a dust-proof metal cover and operates the record cylinder by means of a sliding universal joint and steep-pitch nickel-plated feed screw. The cylinder makes four complete revolutions in twenty-four hours and so provides an open scale reading for rainfall as high as 7 inches an hour. The surface of the recording cylinder necessarily moves at a comparatively rapid rate (2 inches per hour).

The recording pen traces its record in a zigzag line of steps, each step representing a hundredth of an inch of rain when recording English units and two-fifths of a millimeter when recording metric units. One complete zigzag contains just ten steps and while in the majority of cases the individual steps are perfectly legible yet in records of very rapid rates each individual step cannot always be discerned, but the groups of five steps, as marked by the lateral extremities of the zigzag trace, are perfectly conspicuous and legible under even the most rapid rates.

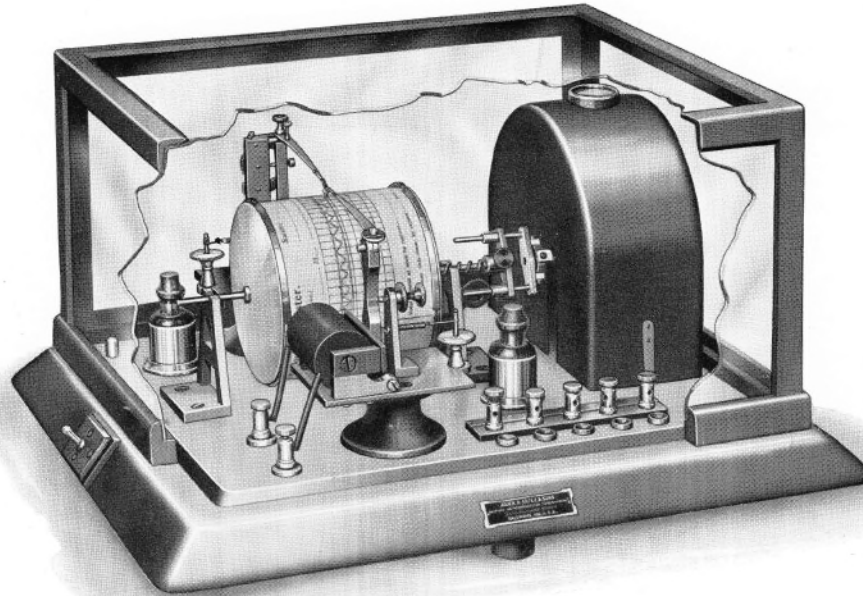
Recorders Nos. 416 and 418 provide a two-day record with the same open scale reading as in the one-day type and have won favor with those observers who do not find it convenient to change their charts each day. This arrangement precludes the loss of records over Sundays and holidays.



The Rainfall Recorder described above is the only electrically operated rain gage of our manufacture. It has long been in universal use throughout the Weather Bureau service. In many installations a non-electrical type of Recorder is preferable, or a Recorder with a chart graduated for a longer time period. Both of these advantages are found in our Fergusson Weighing and Recording Rain Gage, illustrated on pages 112 and 114. Rainfall records for a week's duration are made by the Fergusson gage, which is a Recorder complete in itself, requiring no accessory transmitter or electrical connections.

COMBINED SUNSHINE-RAINFALL-WIND
VELOCITY RECORDER

U. S. Weather Bureau Pattern



No. 426

No. 420—COMBINED SUNSHINE AND RAINFALL RECORDER, U. S. WEATHER BUREAU PATTERN, records at any convenient location electrically the duration of sunshine and the amount of rainfall in hundredths of an inch, when connected with a Sunshine Transmitter No. 380, and a Tipping-Bucket Rain Gage No. 405. Instrument complete with pens, inks, and year's supply (375) *daily* charts No. 1015-B. \$
(Weight: gross, 90 lbs; net, 25 lbs.)

No. 421—COMBINED SUNSHINE AND RAINFALL RECORDER, same as No. 420, except that time-screw and chart are extended for a "two-day" record. Instrument complete with pens, inks, and year's supply (190) charts No. 1015-J. \$
(Weight: gross, 90 lbs; net, 27 lbs.)

No. 422—COMBINED SUNSHINE AND WIND VELOCITY RECORDER, U. S. WEATHER BUREAU PATTERN, records at any convenient location electrically the duration of sunshine and velocity of the wind in miles when connected with a Sunshine Transmitter No. 380, and a Standard Anemometer No. 340. Instrument complete with pens, inks, and year's supply (375) *daily* charts No. 1015-C \$
(Weight: gross, 90 lbs; net, 25 lbs.)

No. 423—COMBINED SUNSHINE AND WIND VELOCITY RECORDER, same as No. 422, except that time-screw and charts are extended for a "two-day" record. Instrument complete with pens, inks, and year's supply (190) charts No. 1015-J. \$
(Weight: gross, 90 lbs; net, 27 lbs.)

No. 424—COMBINED WIND VELOCITY AND RAINFALL RECORDER, U. S. WEATHER BUREAU PATTERN, records at any convenient location electrically the velocity of the wind in miles and the amount of rainfall in hundredths of an inch when connected with a Standard Anemometer No. 340 and a Tipping-Bucket Rain Gage No. 405. Instrument complete with pens, inks, and year's supply (375) *daily* charts No. 1015-D. \$

(Weight: gross, 90 lbs; net, 25 lbs.)

No. 425—COMBINED WIND VELOCITY AND RAINFALL RECORDER, same as No. 424, except that time-screw and charts are extended for a "two-day" record. Instrument complete with pens, inks, and year's supply (190) charts No. 1015-J. \$

(Weight: gross, 90 lbs; net, 27 lbs.)

No. 426—COMBINED WIND VELOCITY, RAINFALL AND SUNSHINE RECORDER, U. S. WEATHER BUREAU PATTERN, records at any convenient location electrically the velocity of the wind in miles, amount of rainfall in hundredths of an inch and duration of sunshine when connected with a Standard Anemometer No. 340, a Tipping-Bucket Rain Gage No. 405, and a Sunshine Transmitter No. 380. Instrument complete with pens, inks, and a year's supply (375) *daily* charts No. 1015-E \$

(Weight: gross, 90 lbs; net, 25 lbs.)

No. 427—COMBINED WIND VELOCITY, RAINFALL AND SUNSHINE RECORDER, same as No. 426, except that time-screw and charts are extended for a "two-day" record. Instrument complete with pens, inks, and year's supply of charts (190) No. 1015-J \$

Weight: gross, 90 lbs; net, 27 lbs.)



COMBINED SUNSHINE-RAINFALL-WIND VELOCITY RECORDER

U. S. Weather Bureau Pattern

THE combination Recorder, shown in the illustration, is adapted for combined records of various conditions; for sunshine and rainfall; for wind velocity and rainfall; for sunshine and wind velocity, and also for three combined records of rainfall and sunshine and wind velocity.

Moreover, in addition to its service for meteorological purposes, this two-magnet Recorder may be used for the charting of various electrical impulses caused by any operation, provided only that the interval of time between each impulse exceeds five seconds.

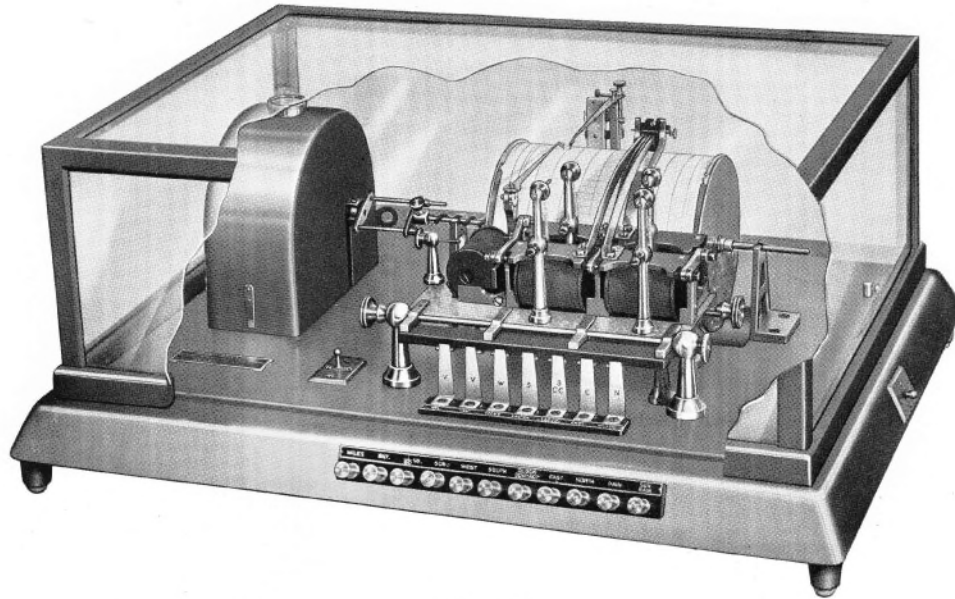
In general design and appearance and in the symbols traced upon the chart this two-magnet Recorder is identical with the single-magnet Recorders for rainfall and sunshine and wind velocity. By the introduction of the two magnets placed on opposite sides of the record cylinder the combined records may be traced simultaneously upon the same single chart.

For the operation of the pen arms and for the reading of the charts, we would call your attention to the descriptions given in connection with the individual Recorders Nos. 350, 390, 406 of this catalogue.

NOTE.—All of the above Recorders are perfectly suited, without any change, to give records in units of metric measurement, when used in conjunction with corresponding outdoor metric registering equipment. But unless definitely specified, Recorders with charts for records in metric units are not furnished.

COMBINED WIND DIRECTION-VELOCITY- SUNSHINE-RAINFALL RECORDER

U. S. Weather Bureau Pattern



No. 441

No. 440—COMBINED WIND DIRECTION, VELOCITY, SUNSHINE, RAINFALL RECORDER, U. S. WEATHER BUREAU PATTERN. When electrically connected with various outdoor instruments, records upon a single chart four important meteorological conditions, wind direction from eight compass points, wind velocity in miles per hour, sunshine duration, and rainfall. Chart cylinder revolving once each six hours, four revolutions per day, is enclosed with all of the electrical mechanism within a highly finished metal, glass-panel case. Instrument complete with pens, inks, and year's supply (375) *daily* charts No. 1017.....\$.
(Weight: gross, 125 lbs; net, 35 lbs.)

No. 441—COMBINED WIND DIRECTION, VELOCITY, SUNSHINE, RAINFALL RECORDER WITH INDICATING BUZZER ATTACHMENT. With the exception of an attachment for determining the velocity of the wind at infrequent intervals without reference to the chart this Recorder is identical with the Standard U. S. Weather Bureau Recorder No. 440. Instrument complete with pens, inks, and year's supply (375) *daily* charts No. 1017.....\$.
(Weight: gross, 125 lbs; net, 35 lbs.)

No. 443—WIND DIRECTION AND VELOCITY RECORDER WITH INDICATING BUZZER ATTACHMENT. When electrically connected with Anemometer No. 343, and to Wind Vane Contact Box, records upon a single chart wind direction from eight compass points, and wind velocity in miles per hour. A special buzzer attachment indicates wind velocity for any time intervals without reference to the chart. Chart cylinder revolves once each six hours and is enclosed with all the recording mechanism within a highly finished glass case. Complete with pen, inks, and year's supply (375) *daily* charts No. 1017.....\$.
(Weight: gross, 125 lbs; net, 33 lbs.)

NOTE.—All the Recorders listed here constitute merely the indoor recording apparatus; complete equipment requires the various transmitting instruments, such as Wind-Direction Vane, Anemometer, Tipping-Bucket Rain Gage and Sunshine Transmitter.

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COMBINED WIND DIRECTION-VELOCITY- SUNSHINE-RAINFALL RECORDER

U. S. Weather Bureau Pattern

THE Standard Wind Direction, Velocity, Sunshine and Rainfall Recorder gives on one single chart compiled information generally needed with regard to four important meteorological phenomena. As produced by the Friez Laboratories it embodies all the many features and advantages resulting from long experience and usage. The unfailing satisfaction which it has constantly given has made it be the chief and central instrument in the equipment of every first-class meteorological station of the U. S. Government Service. Except in those cases where the particular advantages of individual Recorders are of utmost importance, the four-condition weather Recorder answers every requirement of those who are seeking single-charted records of the electrical impulses effected by instruments registering wind velocity, wind direction, sunshine duration, and rainfall.

A full glass-panel case hinged to a cast aluminum base, encloses all the mechanism, consisting of the clock movement, the electro-magnets, the record cylinder, the pens and the wind direction printing points.

The jeweled clock movement, which needs to be wound but once a week, is encased in a dust-proof metal cover and operates the record cylinder by means of a sliding universal joint, the horizontal advance being accomplished by a nickel-plated steep-pitched screw. The surface of the cylinder revolving at a comparatively rapid rate, $2\frac{1}{2}$ inches per hour, makes four revolutions during twenty-four hours and furnishes a very legible daily record for all the conditions recorded, for rainfall as rapid as 7 inches per hour, for every occurrence of sunshine almost instantaneously, for wind direction of the eight points of the compass, and for wind velocities as high as one hundred miles per hour.

The electro-magnet in the rear of the cylinder receives separate impulses from two outdoor instruments. One set of impulses it receives directly from a Tipping-Bucket Rain Gage, every tip of the bucket being recorded by a zigzag symbol. The other impulses are received by the same electro-magnet through a wiping contact mounted on the second-hand arbor of the clock, which is wired directly to the outdoor Sunshine Transmitter. The symbols for rainfall, though charted by the same pen, are conspicuously different from the symbols for sunshine. When the sun is not shining and no rain is falling the pen traces a straight line around the chart.

The wind direction impulses are recorded by means of cylindrical points making dots on the record chart in assigned channels for the eight points of the compass. Connected with the second-hand arbor of the clock, wind direction impulses are recorded every minute. The printing points, inked by a swinging felt pad, are attached to four long levers. These levers are individually joined to four separate magnets stationed on an auxiliary base-plate in front of the record cylinder. Whenever a current passes through a magnet the armature is attracted and the printing point pressed down on the chart, the ink pad being pushed aside at the same time. There being four magnets, four directions may be indicated by the direction dots, but the electric contact mechanism of the Wind Vane is so constructed that when the direction is intermediate between two cardinal points, two circuits will be closed and two dots will be printed upon the chart. Thus for a Northwest wind both N and W magnets will operate the printing levers. By this arrangement four magnets record eight possible directions.

Wind velocity is recorded by means of a pen arm attached to a magnet adjacent to the wind direction magnets. Every electrical impulse received from the outdoor Anemometer causes the armature to move in a lateral direction, every mile of wind movement being indicated by an indented bracket tracing. Moreover, to enable the observer to read his completed chart more quickly, namely in counts of ten, every tenth mile of wind movement is traced on the chart in a long significant line caused by the continuous contact, arranged by bridging the ninth and tenth mile pins on the Anemometer dial, as explained in our description of the U. S. Weather Bureau Standard Anemometer.

The auxiliary base-plate on which the wind direction magnets and the wind velocity magnet are mounted, though so hinged that it may be swung to a vertical position for handy renewal of the charts, is retained in its normal position by a sliding lock-bar.

Recorder No. 441 besides the recording apparatus and chart is equipped with a complementary buzzer device by which the velocity of the wind at any particular point of time may be observed. By means of a toggle switch the buzzer system is joined with the Anemometer circuit, permitting the observer to determine the wind velocity for any interval of time, without reference to the chart.

For investigations that do not need records of sunshine and rainfall, Recorder No. 443 is furnished, equipped with magnets and pens for records of wind velocity and direction. Although the magnet in the rear for rainfall and sunshine records is not supplied, the recorder is built so that this may be easily inserted at any future time. This Recorder is furnished with the extra buzzer attachment as in Recorder No. 441.

NOTE.—All of these Recorders are perfectly suited, without any change, to give records in units of metric measurement, when used in conjunction with corresponding outdoor metric-registering equipment. But unless definitely specified, Recorders with charts for records in metric units are not furnished.

WIND TOWERS AND SUPPORTS

Supports For Group A and C

- No. 371—COMBINED SUPPORT FOR WIND VANE AND ANEMOMETER, U. S. WEATHER BUREAU PATTERN: column 18 feet high, complete with base plate and iron steps, guy rods, cross arm for Anemometer, direction letters, 4-foot all-metal vane mounted upon Fergusson type ball-bearing head, with direction contact mechanism. \$
 (Weight: gross, 425 lbs; net, 250 lbs.)
- No. 373—COMBINED SUPPORT FOR WIND VANE AND ANEMOMETER, U. S. WEATHER BUREAU PATTERN: column 26 feet high; otherwise complete as No. 371. \$
 (Weight: gross, 475 lbs; net, 300 lbs.)

Support For Group D

- No. 375—WIND TOWER INSTALLATION FOR U. S. WEATHER BUREAU INSTRUMENTS: comprising 50-foot galvanized steel tower and combined support No. 376 at top. \$
 (Weight: gross, 1,620 lbs; net, 1,400 lbs.)
- No. 376—COMBINED SUPPORT FOR WIND VANE AND ANEMOMETER adapted for installation upon 50-foot steel wind instrument tower: comprises column 10 feet high, base plate, cross arm for Anemometer, direction letters, 4-foot all-metal vane and wind-direction contact mechanism with Fergusson type ball-bearing head. \$
 (Weight: gross, 215 lbs; net, 125 lbs.)

Supports For Group B and F and G

- No. 377—COMBINED SUPPORT FOR SELSYN MOTOR TRANSMITTERS: 18-foot, with fittings, specially designed for mounting of Selsyn motor wind transmitters, complete with guy rods, steps and base plate, exclusive of transmitters. \$
 (Weight: gross, 550 lbs; net, 350 lbs.)

Support For Group E

- No. 377-A—COMBINED SUPPORT FOR MOUNTING OF SELSYN MOTOR WIND-DIRECTION TRANSMITTER AND WIND TACHOMETER TRANSMITTER: 18-foot, with fittings, complete with guy rods, steps and base plate, exclusive of transmitters . . . \$
 (Weight: gross, 535 lbs; net, 340 lbs.)

Supports For Group H

- No. 378—WIND TOWER INSTALLATION FOR SELSYN MOTOR WIND TRANSMITTERS: comprising 50-foot galvanized steel tower with instrument mounting support No. 379 at top; exclusive of transmitters. \$
 (Weight: gross, 1,620 lbs; net, 1,400 lbs.)
- No. 379—COMBINED SELSYN MOTOR WIND TRANSMITTER SUPPORT: modified for installation upon wind instrument tower, exclusive of transmitters. \$
 (Weight: gross, 200 lbs; net, 125 lbs.)

Supports For Group J

- No. 451—SUPPORT FOR PRESSURE TUBE ANEMOMETER AND WIND VANE as used with Anemograph No. 450: 18 feet high, complete with base plate, steps, guy rods, exclusive of vane and pressure tube Anemometer. \$
 (Weight: gross, 375 lbs; net, 225 lbs.)
- No. 452—SUPPORT FOR PRESSURE TUBE ANEMOMETER AND WIND VANE as used with Anemograph No. 450: 26 feet high, complete with base plate, steps, and guy rods, exclusive of vane and pressure tube Anemometer \$
 (Weight: gross, 450 lbs; net, 275 lbs.)

SUPPORTS FOR WIND INDICATING AND RECORDING SYSTEMS

THE results of many years of experience have been incorporated in the material and design of Wind Transmitter Supports shown as part of the various groups of instruments illustrated in this catalogue. They have been found to give eminent satisfaction in every respect and to require a minimum of care.

The design of each support is special for the different types of Transmitters employed.

For the Standard U. S. Weather Bureau type of Support, the main column is a single standard malleable iron pipe, with steps at convenient intervals, and guy rods for sturdy maintenance against strong winds. The contact device for wind-direction transmission is made an integral part of this Support, and the Support is shipped with this contact mechanism in place, so that only the Vane itself need be mounted when shipment is received. Such a Support is illustrated with groups A and C.

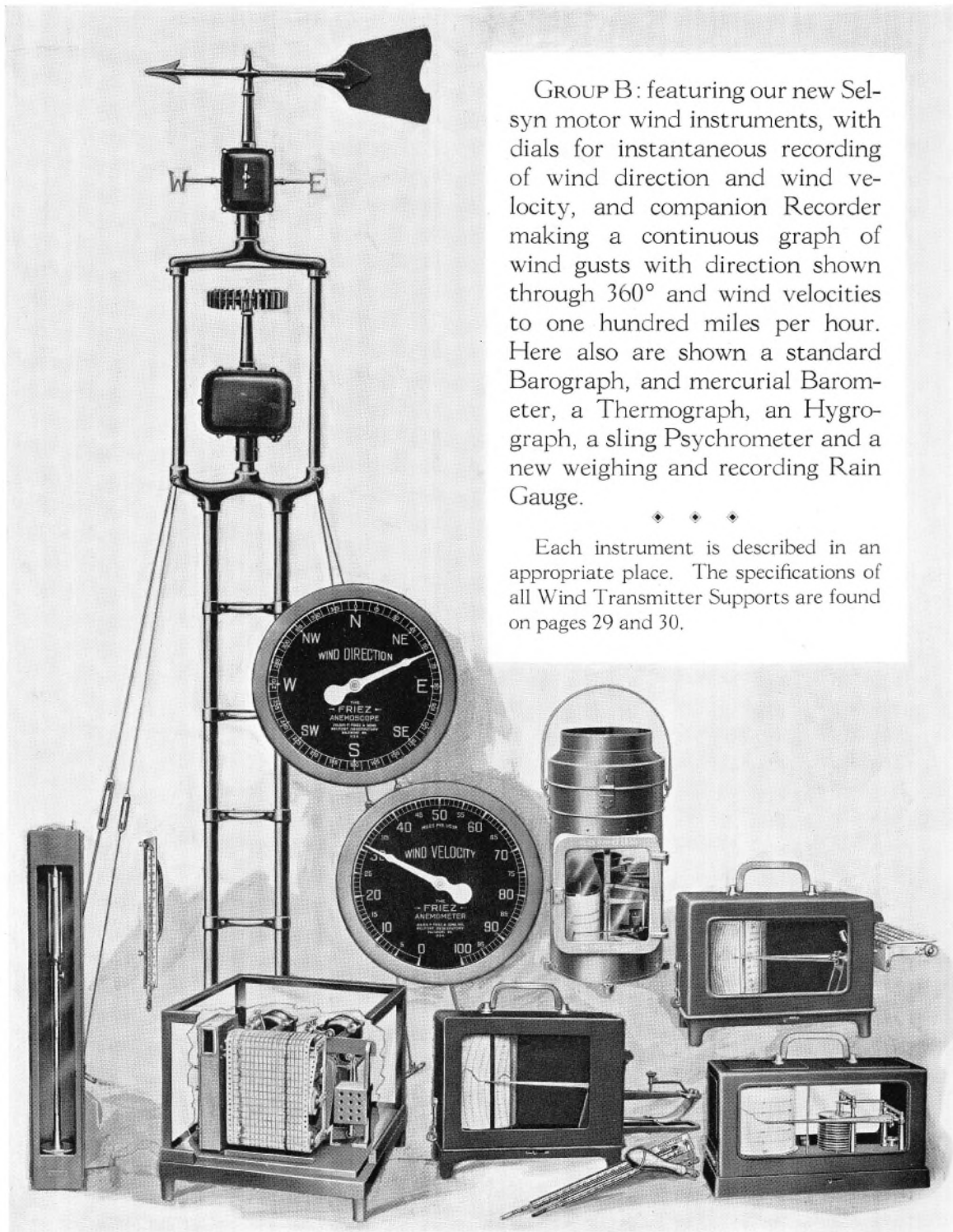
For the Selsyn motor wind-transmitting systems, the Support is of two parallel columns—rising to a spread for the location of the wind-velocity Transmitter and meeting for the placing of the wind-direction Transmitter above. The columns are of standard malleable iron pipe, with steps at convenient intervals, and suitable guy rods for stability. This Support is illustrated with groups B, E, F, G.

Where high elevation of the Wind Transmitters is required to avoid disturbances from surrounding wind obstructions, it is frequently necessary to erect a wind tower, such as is made by the Flint & Walling Company. We provide for such installations, either the complete wind tower with our own shortened Support for the mounting of the Transmitters, or our modified Support alone can be purchased from us, and the wind tower itself can be procured directly from Flint & Walling. Such tower installations are illustrated as parts of groups D and H.

All Supports, when supplied by us, are carefully packed with such partial assembling as makes their erection and installation as convenient as possible. The Wind Vanes and Anemometers or other Transmitters are boxed and shipped separately and can be readily mounted when the Support is being erected. Cable or wire for connecting Transmitters to either Indicators or Recorders is not supplied by us, since such can be obtained with greater convenience in the immediate locality of the purchaser. Blue prints to help in assembling and erection of supports are always packed along with the shipment.

Since all supports or masts are quite heavy and are packed in long heavy boxes, it is advisable that shipment of them be made by freight. Supports are usually carried in stock ready for shipment, and it is our endeavor to make advance shipment of them, so that, though traveling by freight, they will be received in time for erection before the Anemometer and other instruments shall have been received.

ASSEMBLAGE OF FRIEZ INSTRUMENTS
FOR COMPLETE WEATHER STATION



GROUP B: featuring our new Sel-syn motor wind instruments, with dials for instantaneous recording of wind direction and wind velocity, and companion Recorder making a continuous graph of wind gusts with direction shown through 360° and wind velocities to one hundred miles per hour. Here also are shown a standard Barograph, and mercurial Barometer, a Thermograph, an Hygrograph, a sling Psychrometer and a new weighing and recording Rain Gauge.

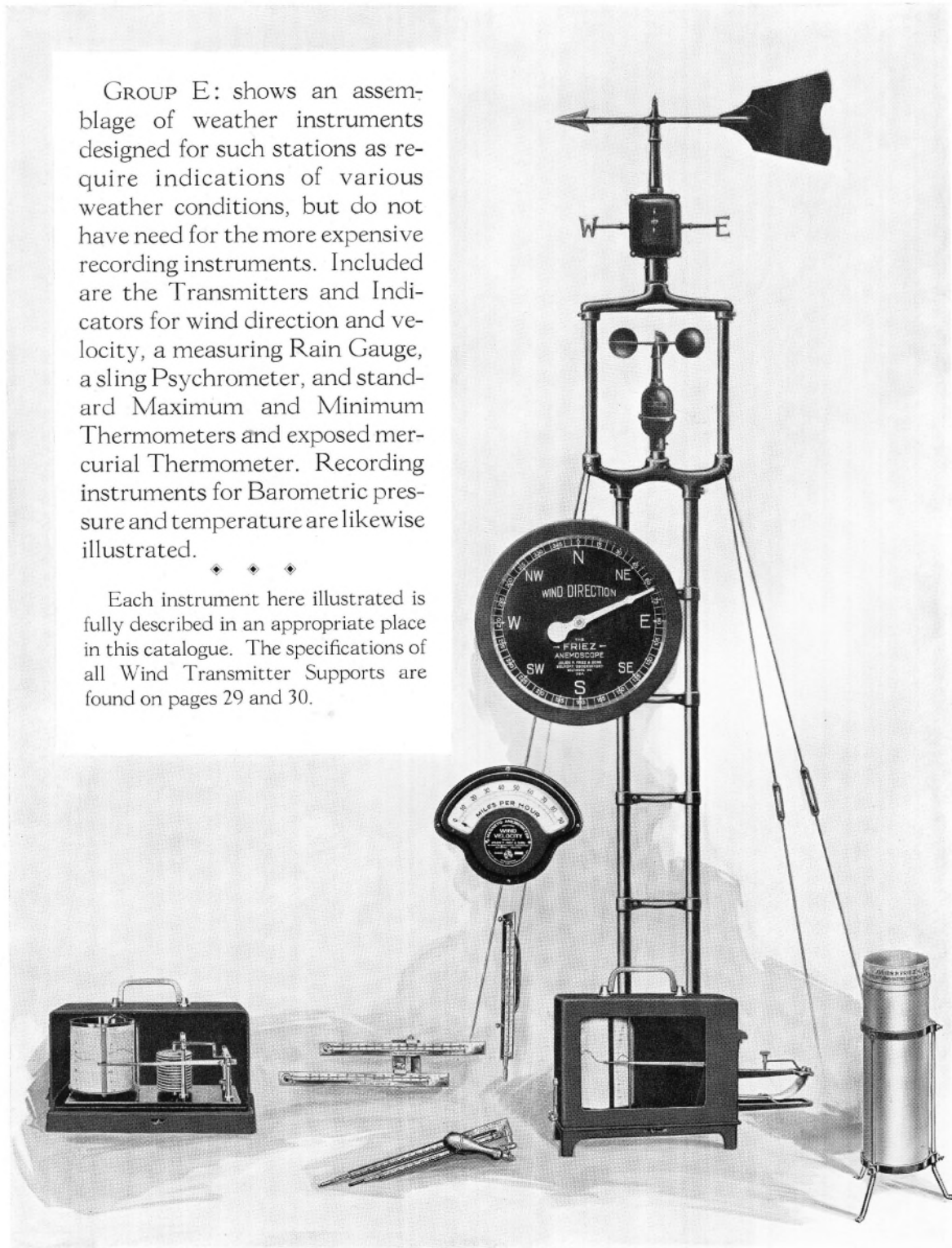


Each instrument is described in an appropriate place. The specifications of all Wind Transmitter Supports are found on pages 29 and 30.

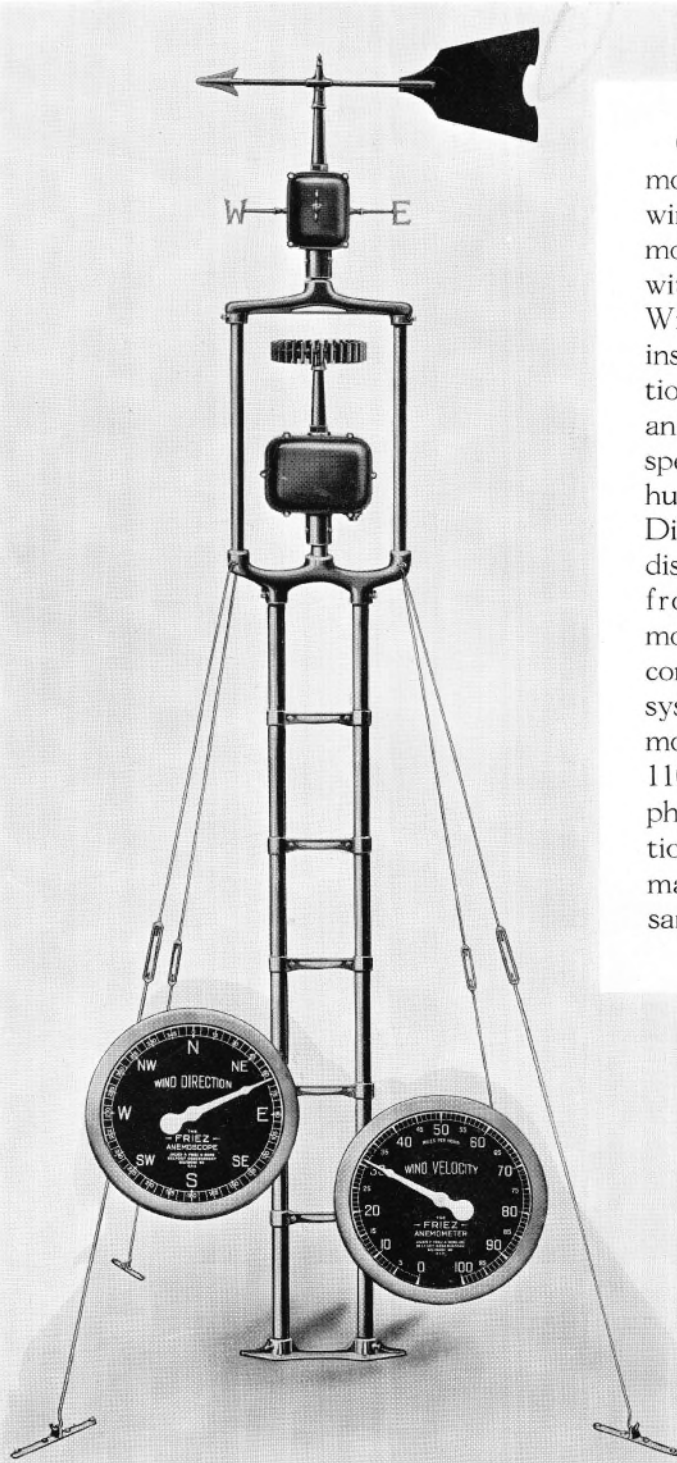
SPECIAL ASSEMBLAGE OF INDICATORS AND RECORDERS

GROUP E: shows an assemblage of weather instruments designed for such stations as require indications of various weather conditions, but do not have need for the more expensive recording instruments. Included are the Transmitters and Indicators for wind direction and velocity, a measuring Rain Gauge, a sling Psychrometer, and standard Maximum and Minimum Thermometers and exposed mercurial Thermometer. Recording instruments for Barometric pressure and temperature are likewise illustrated.

Each instrument here illustrated is fully described in an appropriate place in this catalogue. The specifications of all Wind Transmitter Supports are found on pages 29 and 30.



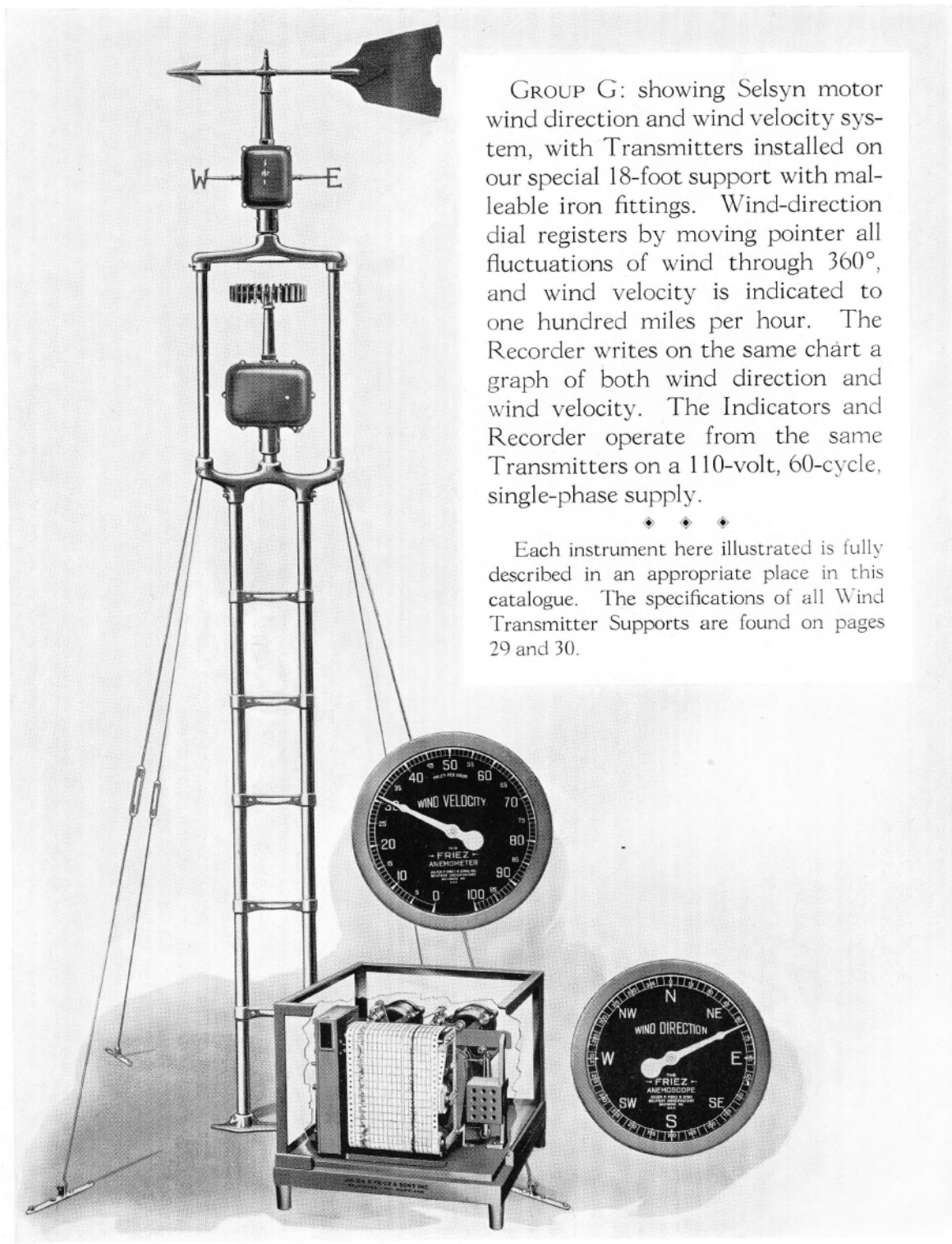
SELSYN MOTOR SYSTEM FOR TRANSMISSION AND REMOTE INDICATIONS OF WIND MOVEMENT



GROUP F: showing Selsyn motor wind direction and wind velocity Transmitters mounted on 18-foot support with malleable iron fittings. Wind-direction dial shows instantaneously all fluctuations of wind through 360°, and wind-velocity dial all speeds of wind up to one hundred miles per hour. Dials can be located at any distance up to 5,000 feet from transmitters, and more than one dial may be connected in circuit. This system for indicating wind movement operates on a 110-volt, 60-cycle, single-phase supply. A wind-direction and velocity recorder may be also operated on the same supply line.

Each instrument here illustrated is fully described in an appropriate place in this catalogue. The specifications of all Wind Transmitter Supports are found on pages 29 and 30.

SELSYN MOTOR SYSTEM FOR REMOTE INDICATIONS
AND RECORDS OF WIND MOVEMENT

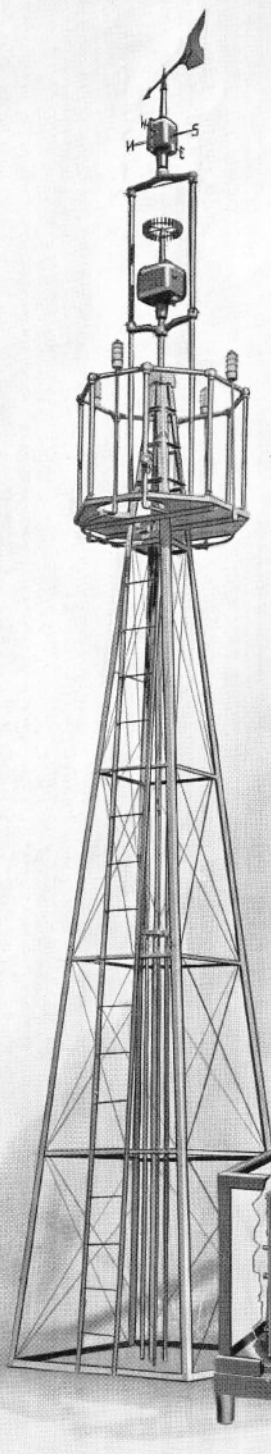


GROUP G: showing Selsyn motor wind direction and wind velocity system, with Transmitters installed on our special 18-foot support with malleable iron fittings. Wind-direction dial registers by moving pointer all fluctuations of wind through 360°, and wind velocity is indicated to one hundred miles per hour. The Recorder writes on the same chart a graph of both wind direction and wind velocity. The Indicators and Recorder operate from the same Transmitters on a 110-volt, 60-cycle, single-phase supply.



Each instrument here illustrated is fully described in an appropriate place in this catalogue. The specifications of all Wind Transmitter Supports are found on pages 29 and 30.

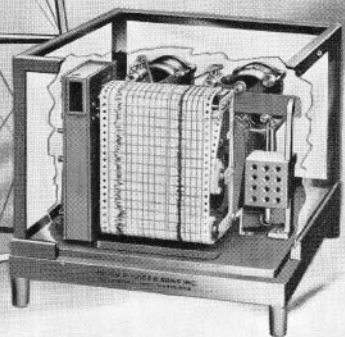
SELSYN MOTOR SYSTEM FOR REMOTE INDICATIONS AND RECORDS OF WIND MOVEMENT



GROUP H: showing complete Selsyn motor wind-direction and wind-velocity system, including the Transmitters mounted on a 50-foot Weather Bureau Wind Tower. Wind direction dial registers by moving pointer all fluctuations of wind through 360°, and wind velocity is indicated to one hundred miles per hour. The Recorder writes on the same chart a graph of both wind direction and wind velocity. The Indicators and Recorder operate from the same Transmitters on a 110-volt, 60-cycle, single-phase supply.



Each instrument here illustrated is fully described in an appropriate place in this catalogue. The specifications of all Wind Transmitter Supports are found on pages 29 and 30.



FRIEZ COMPLETE SELSYN MOTOR SYSTEM FOR REMOTE INDICATIONS AND RECORDING OF WIND MOVEMENT

THE system of indicating and recording wind movements by use of Selsyn motors installed as integral parts of special transmitters for wind velocity and wind direction is unique with our organization. Such a system was installed by us first for the airplane carriers, the *U.S.S. Lexington* and the *U.S.S. Saratoga* on which seven dials showing wind direction were operated by one transmitter, and seven dials showing wind velocity were controlled likewise by a single transmitter. A Recorder also was set in circuit to give a complete record of wind velocity and wind direction.

This system is unique in that wind direction for every fluctuation is indicated and recorded and, too, the speed of every gust is caught by the Wind Velocity Transmitter.

The use of Selsyn motors for transmitting wind movement to a distance depends upon the well-known characteristics of two such motors, namely that the rotors of these motors maintain always the same geometrical position with relation to their stators. Structurally these motors are three-phase synchronous motors excited by alternating current. Five wires are required to connect the receiver motor with the Transmitter, that is, there are three secondary or stator connections and the 110-volt A. C. supply lines to the rotors. Electrically the system is very practical in that the quite universal 110-volt A. C. 60-cycle supply is employed.

The value of large 12-inch dials with moving pointers and extremely legible numberings and letterings, that can be read as time is read on a large clock, goes without saying. A complete picture of wind movement is thus placed directly before the observer. Supplemental to these dial indications is the recorders' continuous graph of the wind direction and speed of travel. More and more, the value of charts both for their historical value and for forecasting future weather conditions is growing in regard. The dials may be used with the Recorder or either dials or Recorder may be omitted.

The Wind Direction Transmitter (see illustration No. 1020, page 38) employs a 4-foot all-metal Wind Vane coupled to the shaft of a Selsyn motor. The motor is enclosed in a weather-proof aluminum case with a removable front which is attached by bolts. Gilded wind direction letters N, E, W, S are set on the case itself. The sleeve at the lower end of the case fits on a standard support or can be mounted on a 3-inch pipe.

The Wind Velocity Transmitter (see illustration No. 1030, page 39) employs a multiple blade rotor, which is restrained in its rotation by special helical springs attached to a sector gear running with a gear on the shaft of a Selsyn motor. A copper disc turning between the poles of permanent magnets serves as an effective damper against overswings and oscillations. The case is of aluminum and painted, and is weather-proof. The front of the case is removable, though secured by bolts.

Our Standard Transmitter is made to register velocities up to one hundred miles

per hour; for special localities, where hurricane velocities are experienced, we have built special Transmitters of the same type to register velocities to one hundred and fifty miles per hour, and such Transmitters, if needed, can be supplied.

This type of Wind Velocity Transmitter is classed as a bridled Anemometer, but the old deficiencies of the bridled Anemometer have been completely avoided by us in the design of a 32-blade rotor of light construction and in the construction of our dampening disc. The rotor is of our special design.

The Recorder (see illustration No. 1060, page 40) used in connection with this installation employs two pens coupled to individual Selsyn motors by rack and pinion drives, thus repeating the positions of the transmitting heads to the pens. As the Vane turns continuously about a central point, while the direction pen oscillates to and fro across the chart, a device installed on the direction pen resets the pen to a central point on the trace when the rack reaches the end of its travel in either direction. This shifting device has been improved and simplified to such an extent that no part of it is ever called into operation until the Vane has actually made a complete revolution.

Siphon pens with large reservoirs are used in making the traces on the chart.

The chart itself is a continuous strip 90 feet long driven normally by an eight-day spring clock with a gear shift providing speeds of 3 inches per hour or 3 inches per minute. Telechron clocks can be provided if desired.

The chart is printed with rectangular co-ordinates and separate tracks are provided for the wind direction and wind velocity traces. With the chart held horizontally the velocity lines are numbered from zero up to the maximum velocity provided on the particular instrument and the direction lines are marked N, NE, E, SE, S, SW, W, NW, N, NE, E, SE, S. This lettering provides the central points to which the pens are shifted at the end of the rack travel. The time lines are marked for all twenty-four hours of the day, an hour mark occurring every 3 inches. The velocity and direction markings are provided every 6 inches.

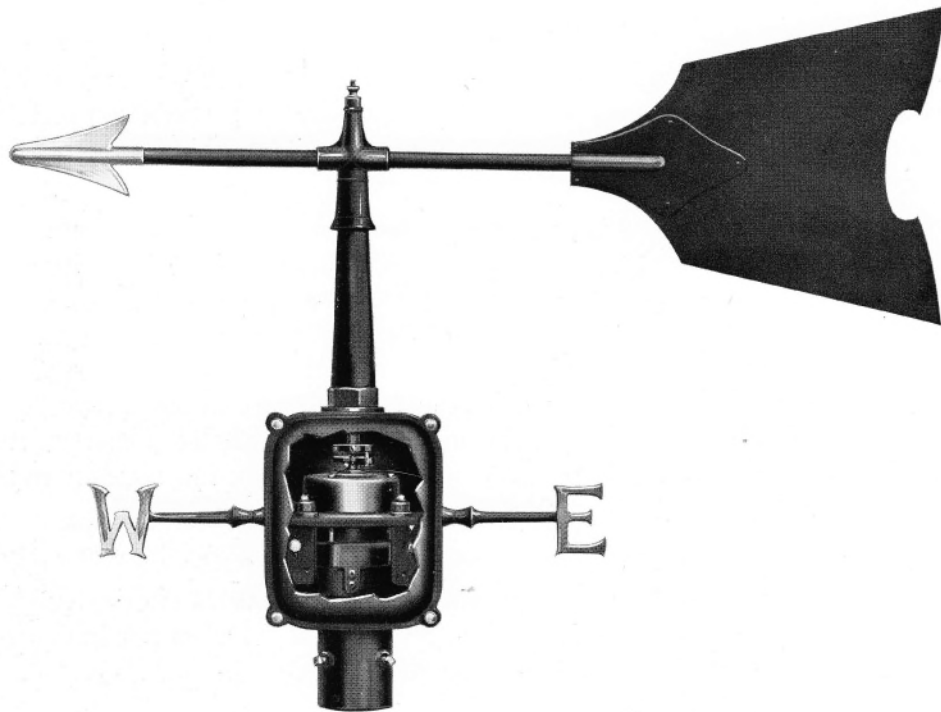


This Selsyn motor system for indications and records of wind direction and wind velocity is extremely flexible, and some very interesting installations of it have been made by us.

It is a part of the elaborate weather instrument set up, furnished by us for the lobby of the Daily News Building in New York City, and the special large-sized dial showing wind direction and velocity in the Empire State Building is likewise of our manufacture. The Transmitters for these two installations are high above the roofs of New York buildings, and give a very excellent report of unobstructed wind travel.

Dials can be supplied by us of many diameters and of special design to accord with the surroundings of any building or room for which they would be intended.

SELSYN MOTOR WIND-DIRECTION TRANSMITTER



No. 1020

No. 1020—WIND-DIRECTION TRANSMITTER, SELSYN MOTOR TYPE, complete with 4-foot all-metal vane; Selsyn motor is enclosed in all-metal weather-proof case; gilded wind direction letters are made integral with the case. \$
 (Weight: gross, 80 lbs; net, 40 lbs.)

WIND-DIRECTION TRANSMITTER

WE show here the Transmitter for our Selsyn motor indicating and recording system, which operates on a 110-volt, 60-cycle, single-phase circuit. The Wind-Direction Transmitter displays at its top a 4-foot all-metal vane. The vertical shaft of the vane is coupled to the shaft of a Selsyn motor, which is enclosed in a weather-proof aluminum case with removable face.

Gilded wind direction letters N, E, W, S are set on the case itself. The sleeve at the lower end of the case fits on a standard support or can be mounted on a 3-inch pipe.

This Wind-Direction Transmitter is used for showing wind direction on a dial by means of a pointer. Several dials located at various points may be operated by a single Transmitter. Likewise a wind direction recording unit may be electrically connected with this Transmitter for inked graphs of wind direction on our combined Wind-Direction and Wind-Velocity Recorder No. 1060.

The Vane, a single blade, 4 foot over all and of metal, is carefully balanced, and of such design as to show minute fluctuations of wind direction.

The Selsyn motor is so installed as to be readily removable for cleaning.

SELSYN MOTOR WIND-VELOCITY TRANSMITTER

No. 1030 — WIND-VELOCITY TRANSMITTER, SELSYN MOTOR TYPE, complete with multiple blade rotor; Selsyn motor is enclosed in all-metal weather-proof case; all velocities up to 100 miles per hour.

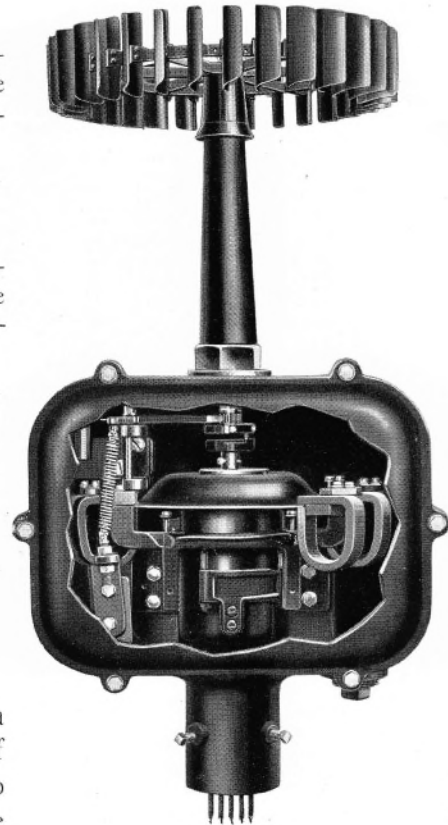
\$.....

(Weight: gross, 120 lbs; net, 60 lbs.)

No. 1031 — WIND-VELOCITY TRANSMITTER, SELSYN MOTOR TYPE, complete with multiple-blade rotor; Selsyn motor is enclosed in all-metal weather-proof case; all velocities up to 150 miles per hour.

\$.....

(Weight: gross, 120 lbs; net, 65 lbs.)



No. 1030

WIND-VELOCITY TRANSMITTER

THE Wind-Velocity Transmitter employs a multiple blade rotor, one complete turn of which represents the maximum wind velocity to be indicated or recorded. The vertical shaft of the rotor is coupled to the shaft of a Selsyn motor, which shaft is geared to a sector-gear restrained by a multiple helical spring. A copper disc made a part of the motor shaft swings between permanent magnet poles and serves as an effective damper against oscillations.

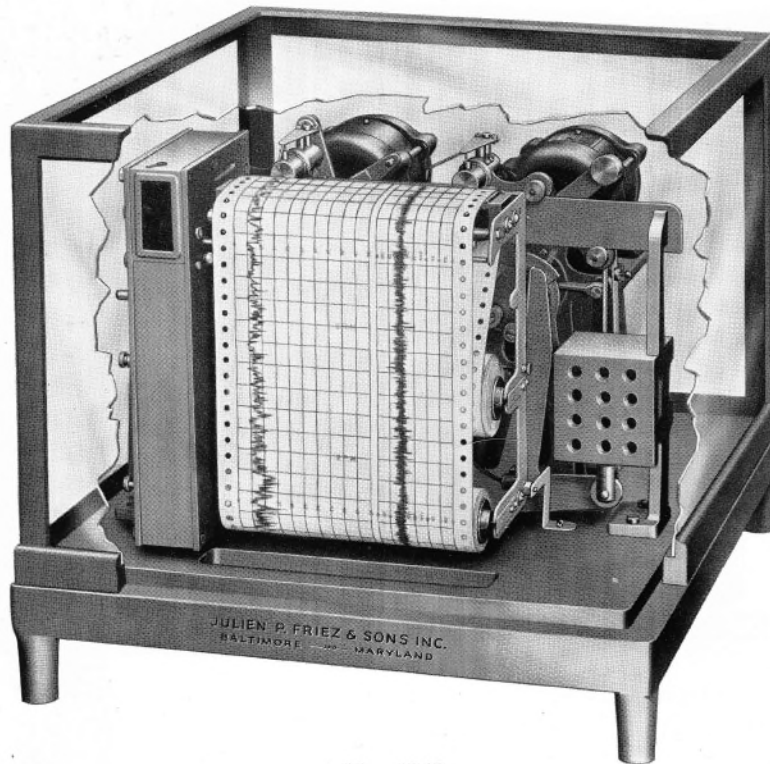
This Wind-Velocity Transmitter, which operates on a 110-volt, 60-cycle, single-phase circuit, may be used with a dial for showing wind velocity by means of a moving pointer. Several dials may be operated from the same Transmitter. Likewise a wind-velocity recording unit may be wired to this Transmitter for inked graphs of wind velocity as made by our combined wind-direction and wind-velocity Recorder No. 1060.

Our Standard Transmitter is calibrated for velocity up to 100 miles. For special installation where extreme high wind velocities are occasionally experienced, and indications and records of such high velocities are desired, we make a Transmitter for velocities up to 150 miles per hour.

The rotor used is of thirty-two aluminum blades equally spaced about the periphery of the rotor frame, and riveted. The form of the blades and their location insure a true response to wind velocity in all rotor positions.

The Selsyn motor is so installed as to be readily removable for cleaning.

SELSYN MOTOR SYSTEM RECORDER
FOR REMOTE GRAPHS OF WIND-DIRECTION & VELOCITY



No. 1060

No. 1060—SELSYN MOTOR RECORDER FOR CONTINUOUS PARALLEL GRAPHS OF WIND-DIRECTION AND WIND-VELOCITY, when wired to Transmitters Nos. 1020, 1030. Strip chart, clock-driven for speeds of either 3 inches per hour or 3 inches per minute; wind-direction graduations for eight compass points; wind-velocity graduations up to one hundred miles per hour. Instrument complete with pens, ink, and 90-foot chart roll, No. 2040. (Weight: gross, 150 lbs; net, 50 lbs.) \$.....

No. 1061—SELSYN MOTOR RECORDER FOR CONTINUOUS PARALLEL GRAPHS OF WIND-DIRECTION AND WIND-VELOCITY, when wired to Transmitters Nos. 1020, 1031. Strip chart, clock-driven for speeds of either 3 inches per hour or 3 inches per minute; wind-direction graduations for eight compass points, wind-velocity graduations up to one hundred and fifty miles per hour. Instrument complete with pens, ink, and 90-foot chart roll, No. 2050. (Weight: gross, 150 lbs; net, 50 lbs.) \$.....

WIND-DIRECTION AND VELOCITY RECORDER

THE Combined Wind-Direction and Wind-Velocity Recorder, shown here, employs Selsyn motors to repeat the deflections of the transmitting motors installed outdoors for registering wind direction and wind velocity. The record is written upon a continuous 90-foot chart whose travel is timed by the upright clock movement. Chart travel can be regulated to either 3 inches per hour or 3 inches per minute.

SELSYN MOTOR SYSTEM DIALS
FOR REMOTE INDICATIONS OF WIND-DIRECTION & VELOCITY



1040



1050

No. 1040 — WIND-DIRECTION INDICATOR, Selsyn motor type, for use with Transmitter No. 1020 complete with Selsyn motor, enclosed in aluminum case: 12-inch etched dial graduated in degrees, and with letters for eight compass points.

\$.....

(Weight: gross, 50 lbs; net, 15 lbs.)

No. 1050—WIND-VELOCITY INDICATOR, Selsyn motor type, for use with Transmitter No. 1030; complete with Selsyn motor, enclosed in aluminum case: 12-inch etched dial graduated from zero to one hundred miles per hour \$.....

No. 1051—INDICATOR: Velocities to one hundred and fifty miles per hour. \$.....

ILLUSTRATED above are the special visual indicators of wind-direction and wind velocity, which can be remotely located from their Transmitters. The 12-inch dials with extremely legible letterings and numberings make these indicators of great value installed for general observation. When the companion dials are located together, the moving hands show a true and complete picture of wind movement. A duplicate or triplicate installation of indicators may be actuated from a single pair of Transmitters. This Selsyn motor system requires a 110-volt A. C. circuit; where direct current only is available, a rotary converter may be wired in to furnish the necessary alternating current.



WALL-FACE
TYPE OF
INDICATOR
MOUNTING

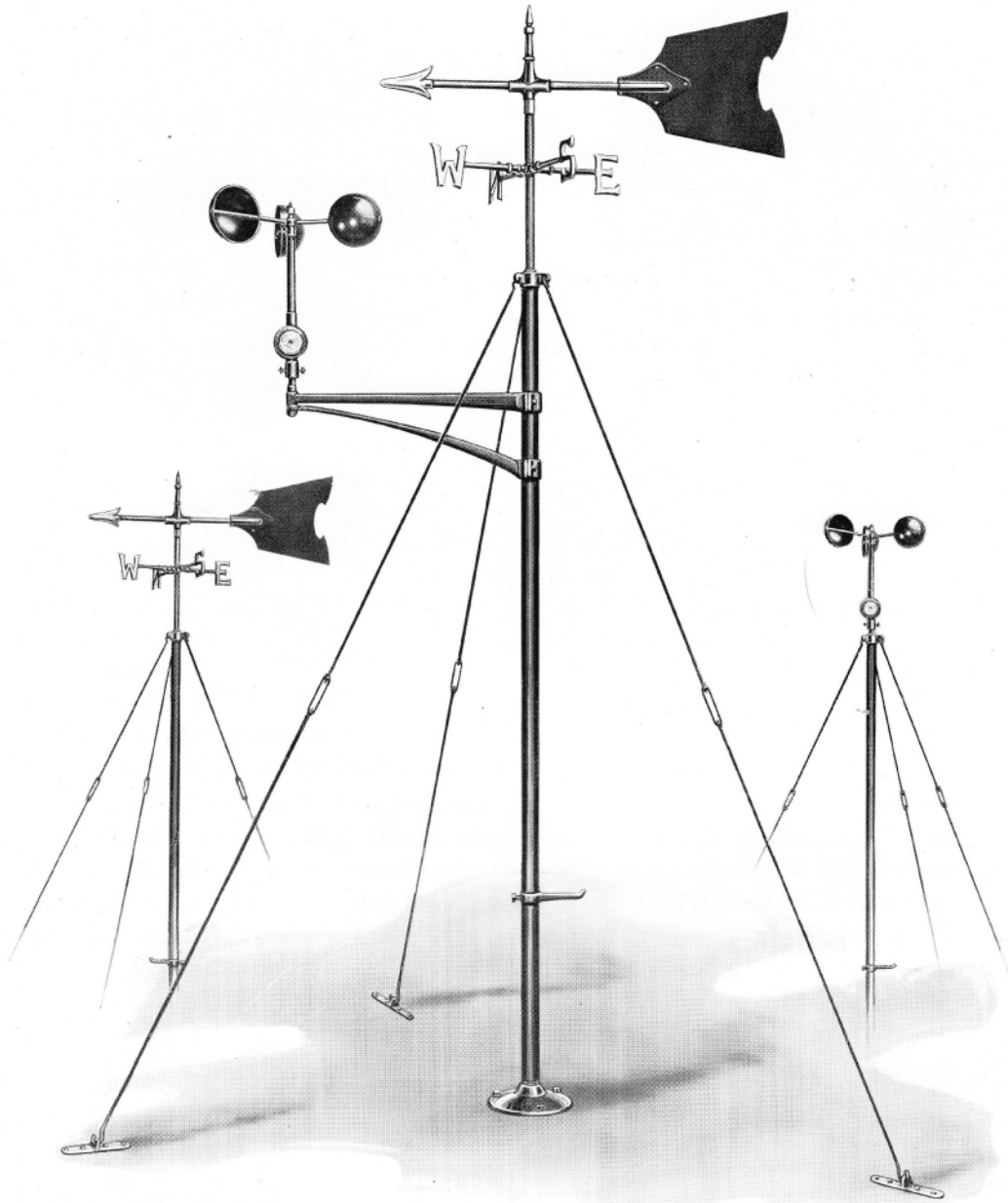
SEMI-FLUSH
WALL TYPE OF
INDICATOR
MOUNTING



Illustrated here are cross-sections of the wall-face type of Indicator Mounting, and semi-flush wall type of Indicator Mounting, which will be supplied as specified.

COMBINED SUPPORT FOR WIND VANE AND ANEMOMETER

U. S. Weather Bureau Pattern



No. 360

No. 360—COMBINED SUPPORT FOR WIND VANE AND ANEMOMETER, U. S. WEATHER BUREAU PATTERN, 6 feet high, complete with 3-foot all-metal Wind Vane having plain solid rod bearing, gilded direction letters, guy rods of suitable length, shoes, base-plate, also the cross-arm support for Anemometer with brass tapered pin. Wind Vane is not equipped with contact mechanism for transmission of direction to Recorders but is for observation only \$.

(Weight: gross, 100 lbs; net, 50 lbs.)

- No. 360-A—Same as No. 360 except 8-foot column with proper fittings.....\$.
 (Weight: gross, 130 lbs; net, 60 lbs.)
- No. 360-B—Same as No. 360 except 10-foot column with proper fittings.....\$.
 (Weight: gross, 140 lbs; 70 lbs.)
- No. 360-C—Same as No. 360 except 12-foot column with proper fittings.....\$.
 (Weight: gross, 160 lbs; net, 85 lbs.)
- No. 361—SUPPORT FOR WIND VANE ONLY, U. S. WEATHER BUREAU PATTERN, 6 feet high, complete with a 3-foot all-metal Wind Vane having plain solid rod bearing, gilded direction letters, guy rods of suitable length, shoes, etc., but without the cross-arm support for Anemometer.....\$.
 (Weight: gross, 90 lbs; net, 42 lbs.)
- No. 361-A—Same as No. 361 except 8-foot column with proper fittings.....\$.
 (Weight: gross, 120 lbs; net, 52 lbs.)
- No. 361-B—Same as No. 361 except 10-foot column with proper fittings.....\$.
 (Weight: gross, 150 lbs; net, 63 lbs.)
- No. 361-C—Same as No. 361 except 12-foot column with proper fittings.....\$.
 (Weight: gross, 150 lbs; net, 75 lbs.)
- No. 362—SUPPORT FOR ANEMOMETER ONLY (when direction vane is omitted the cross-arm support for Anemometer is not employed; the tapered pin mounting is fitted to the head of the staff). Support 6 feet in height, including guy rods of suitable length, shoes, etc.....\$.
 (Weight: gross, 90 lbs; net, 50 lbs.)

◆◆◆

COMBINED SUPPORT FOR WIND VANE AND ANEMOMETER

U. S. Weather Bureau Pattern

THE satisfactory operation of Anemometers and Direction Vanes depends in a great measure upon suitable supports for the instruments, as well as upon the place selected for their exposure.

The simplest type of support in use by the Weather Bureau is not adapted for electrical transmission of wind-direction. The cross-arm support, however, provided for the Anemometer used both for infrequent observation and, where desired, for electrical recording of wind velocity, is arranged so that it can be wired to an indoor wind velocity Recorder or to an indoor indicating buzzer.

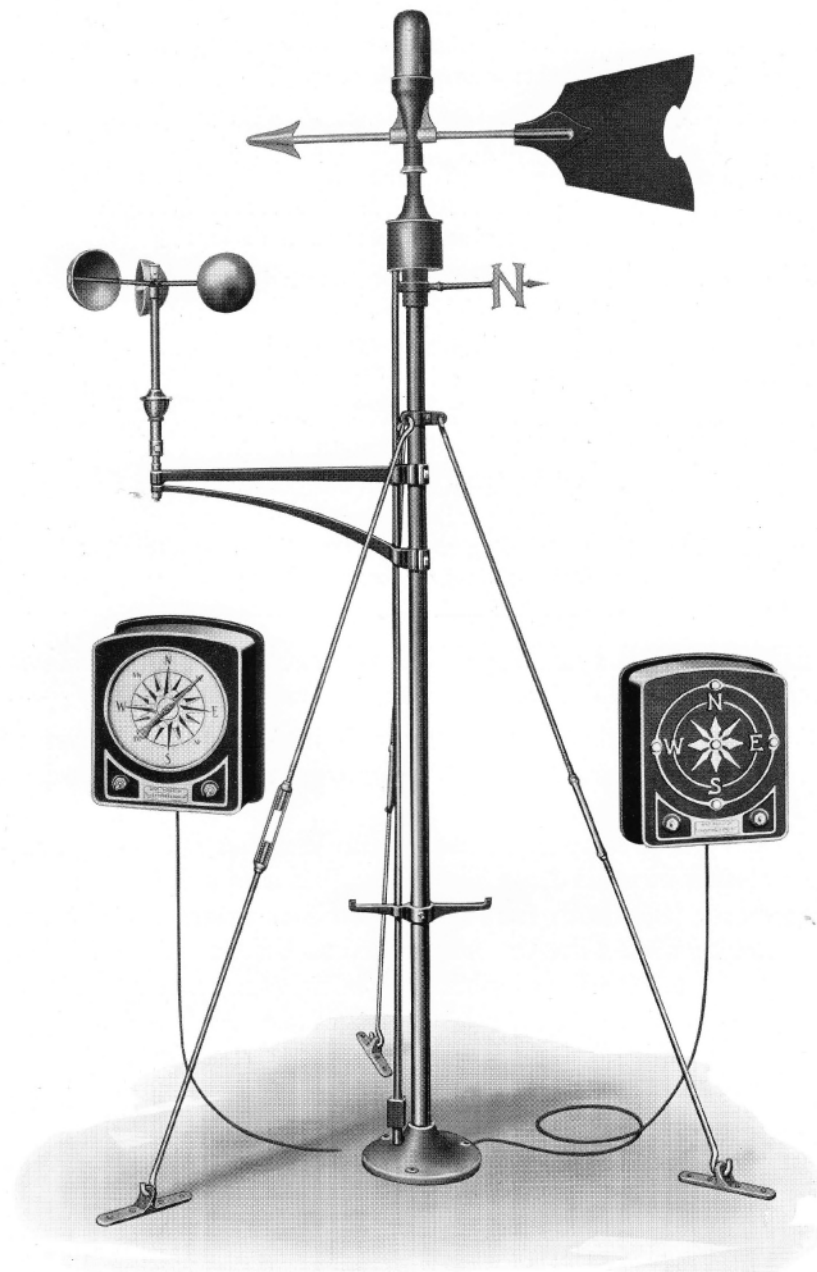
The support (No. 360) shown in the accompanying illustration is 6 feet in height with a standard 3-foot all metal Wind Vane mounted upon a plain type of solid rod bearing. Gilded direction letters are clamped immediately below the vane bearings. Three guy rods of light construction, with turnbuckles of suitable size for adjustment purposes, are provided along with specially designed shoes for securing the rods permanently to the roof.

The support (No. 361) is furnished *without* the Anemometer cross arm when only the direction of the wind is to be observed by a Direction Vane.

Similarly when velocity exclusively is to be either observed or recorded the same support (No. 362) is provided without the Wind Vane, direction letters and the cross arm. In their place is located a tapered pin for the mounting of the Anemometer. The guy rods, shoes, etc., are identical with those described under No. 360.

Supports with proper fittings are also supplied in heights of either 6, 8, 10 or 12 feet.

WIND-DIRECTION AND VELOCITY INDICATORS
AND TRANSMITTERS



Assemblage of Nos. 365-344-366-367

No. 365—WIND-DIRECTION TRANSMITTING HEAD, including contact mechanism; 3-foot all-metal wind vane with obstruction light above; direction letter (inclusive of support).

\$.....

- No. 365-A— Same as No. 365 but without obstruction light.....\$.....
- No. 344—WIND-VELOCITY TRANSMITTER (Three-Cup Anemometer as described on page 13), including set of copper cups.....\$.....
- No. 366—INDICATING DIAL, showing wind direction for eight compass points by means of moving hand and wind velocity by buzzer attachment.....\$.....
- No. 366-A—INDICATING DIAL, showing wind direction for eight compass points by means of electric lamps and wind velocity by flashing lamp at center of dial.....\$.....
- No. 367—SUPPORT FOR WIND-DIRECTION TRANSMITTING HEAD AND FOR ANEMOMETER, of 1½-inch pipe, 8 feet high including steps, base plate and set of adjustable guy rods.....\$.....



WIND-DIRECTION AND VELOCITY INDICATORS AND TRANSMITTERS

THE Wind Direction Indicator illustrated here is entirely new and is, we believe, the most inexpensive instrument for remotely showing within doors the changing wind directions.

As shown, the transmitting head comprises an all-metal single-blade 3-foot Vane, the movement of whose vertical shaft makes contact on a specially constructed contact bearing of new design—for eight points of the compass.

Mounted above the Vane is an obstruction light making this Vane and head of especial value at airports or wherever an obstruction light is required. The transmitting head is completely wired by us including the wiring to the obstruction lamp.

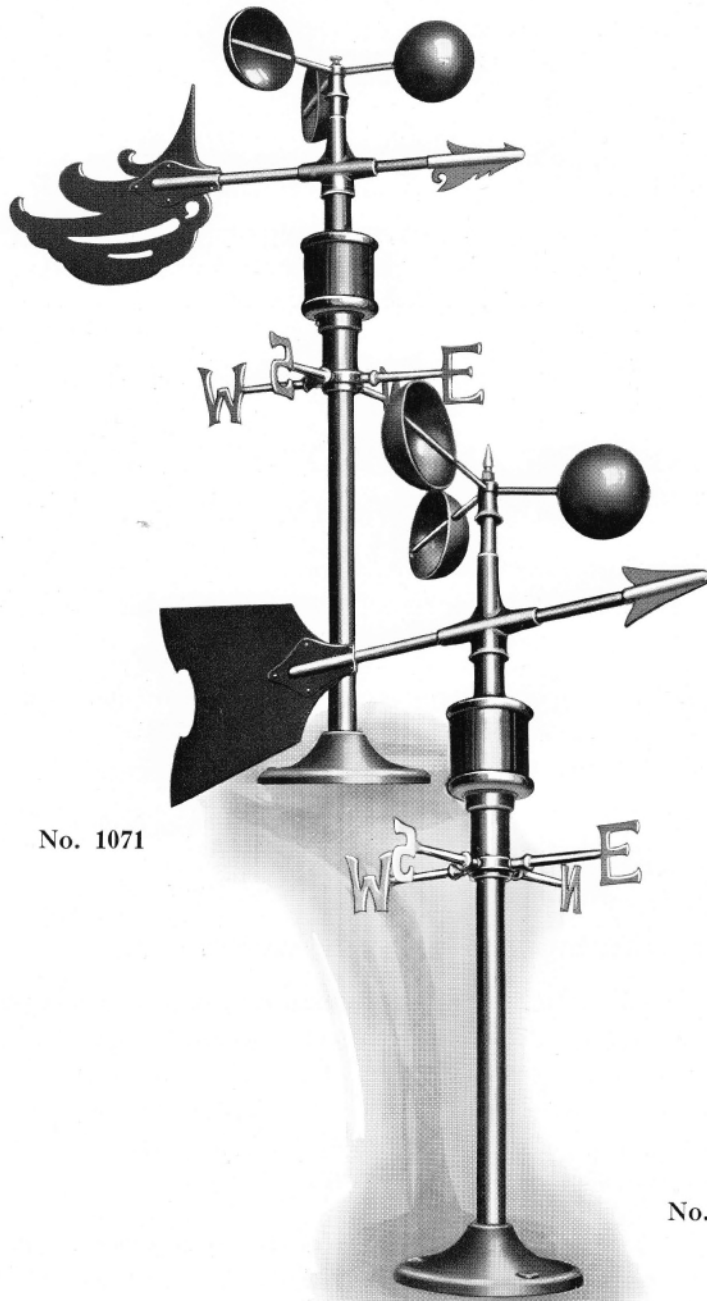
The letter N is supplied attached to the wind vane column.

The Indicator is of cast aluminum construction in box form and is made in two types. One Type No. 366 shows the changing wind direction by means of a moving hand for eight compass points, that is N, NE, E, SE, S, SW, W, NW. The other type shows wind direction by means of electric lamps, whose lighting is controlled by the contacts made by the varying of the wind direction. Each type of Indicator is so equipped that it may be wired to a Three-Cup Anemometer No. 344 for indications of wind velocity. If Indicator No. 366 is used, velocity of wind is ascertained by means of a buzzer attachment, so that, when a button is depressed, the number of buzzes heard in one minute equals the number of wind-miles per hour. With Indicator No. 366-A velocity is shown by a light flashing at the center of the dial. The number of flashes counted in one minute equals the velocity of the wind in miles per hour.

This complete system of indicating wind direction and velocity is very practical in that it is so constructed that it can be used with either A.C., with a transformer, or low voltage D.C. supply. It is necessary to specify whether it will be used with either A.C. or D.C.

COMBINED DIRECTION AND VELOCITY TRANSMITTER

For Lord Electrical Wind Indicator



No. 1071

No. 1070

No. 1070—COMBINED DIRECTION AND VELOCITY TRANSMITTER FOR LORD ELECTRICAL WIND INDICATOR, including three-cup Anemometer, plain tail Wind Vane, contact box, direction letters: with 4-foot support and base plate\$.....
 (Weight: gross, 100 lbs; net, 40 lbs.)

No. 1071—Same as No. 1070, except with ornate Vane\$.....

LORD ELECTRICAL WIND INDICATOR

FOR fine homes, yachting or golf clubs, or in large metropolitan buildings where a decorative installation gives visual knowledge of wind direction and wind velocity, the Lord Electrical Wind Indicator has won distinguished favor. A complete installation includes the outside Transmitters and the indoor dial. More than one dial may be operated from a single Transmitter.

For transmitting wind direction we use an all-metal 3-foot vane and for velocity a three-cup Anemometer rotor, equipped with one-sixtieth-mile contact. The contact head for both wind direction and wind velocity is enclosed in the same cylindrical case of neat design located below the vane at the point of attachment of the support rod. (See illustration No. 1070, page 46.) The contact arm of the wind-direction switch is attached to the shaft of the vane, and the copper contact segments, eight in number, are wired to appropriate lamps located around the periphery of the Indicator. The wind velocity light is set at the center of the remote dial.

This complete transmitting head for both wind direction and wind velocity is fitted below with a sleeve such that it may be mounted upon any of our standard supports or upon a 1¼-inch standard pipe.

The indoor Indicator or dial which is wired to the transmitting head consists of an aluminum case enclosing the lamps, each in a separate compartment with the direction lamps around the outer edge and the velocity lamp at the center. The face of the dial is of brass with artistic etchings. The standard direction letters for the eight compass points shown are cut out so that the light from the incandescent lamps hidden behind a circle of translucent glass, shines through as contact is made for the various positions of the wind. The wind velocity lamp located at the center flashes once for each sixtieth mile of travel so that the number of flashes counted in one minute equals the number of miles per hour of wind velocity.

These ornamental dials are supplied by us for either flush wall-mounting or wall face-mounting. Also the dials are made of either 14-inch diameter or 10-inch diameter. A special type of Lord Indicator in which the dial case is set in a solid mahogany cowl mounting of colonial design is also supplied by us with a 10-inch dial. A special ten-prong plug and cable and special wall receptacle is supplied with this dial, for proper and elegant installation.

Usually the Lord Electrical Wind Indicator is installed, where a short mast or support gives sufficient exposure for the Wind Vane and Anemometer. Wherefore, we specify more particularly for it a short 4-foot pipe support of 1¼-inch standard pipe with base-plate only, but without guy rods. When an installation requires an elevation of greater height than 4 feet we supply a support, fitted with guy rods for stability, in either, 6, 8, 10, or 12-foot heights.

The contacting mechanism of the transmitting head is so arranged that either A.C. or D.C. supply may be used.

LORD ELECTRICAL WIND-DIRECTION & VELOCITY INDICATOR



No. 1080

No. 1080—LORD ELECTRICAL WIND-DIRECTION AND VELOCITY INDICATOR, FLUSH-WALL TYPE; with ornamental dial 10-inch diameter; completely wired with two CP 110-volt candelabra type lamps \$
(Weight: gross, 20 lbs; net, 8 lbs.)

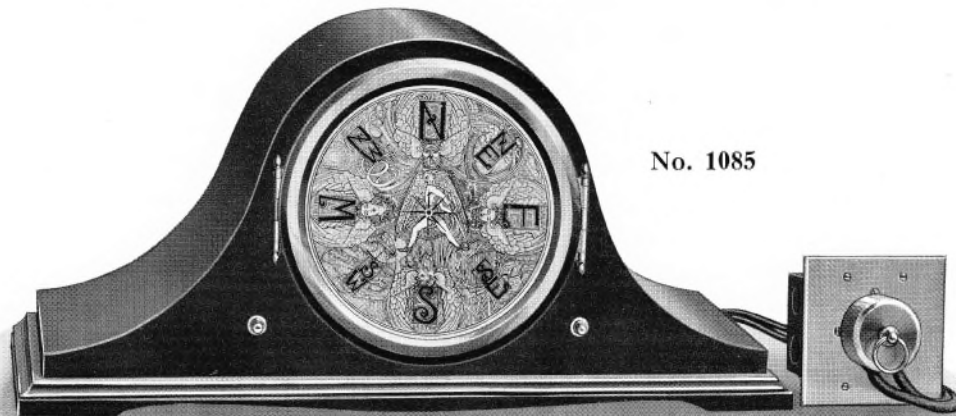
No. 1081—LORD ELECTRICAL WIND DIRECTION AND VELOCITY INDICATOR, FLUSH-WALL TYPE; with ornamental dial 14-inch diameter; completely wired with two CP 110-volt candelabra type lamps. \$
(Weight: gross, 23 lbs; net, 10 lbs.)

No. 1075—LORD ELECTRICAL WIND-DIRECTION AND VELOCITY INDICATOR, WALL-FACE TYPE; with ornamental dial 10-inch diameter; completely wired with two CP 110-volt candelabra type lamps. \$
(Weight: gross, 20 lbs; net, 8 lbs.)



No. 1075

No. 1076—LORD ELECTRICAL WIND-DIRECTION AND VELOCITY INDICATOR, WALL-FACE TYPE; with ornamental dial 14-inch diameter; completely wired with two CP 110-volt candelabra type lamps. \$
(Weight: gross, 23 lbs; net, 10 lbs.)

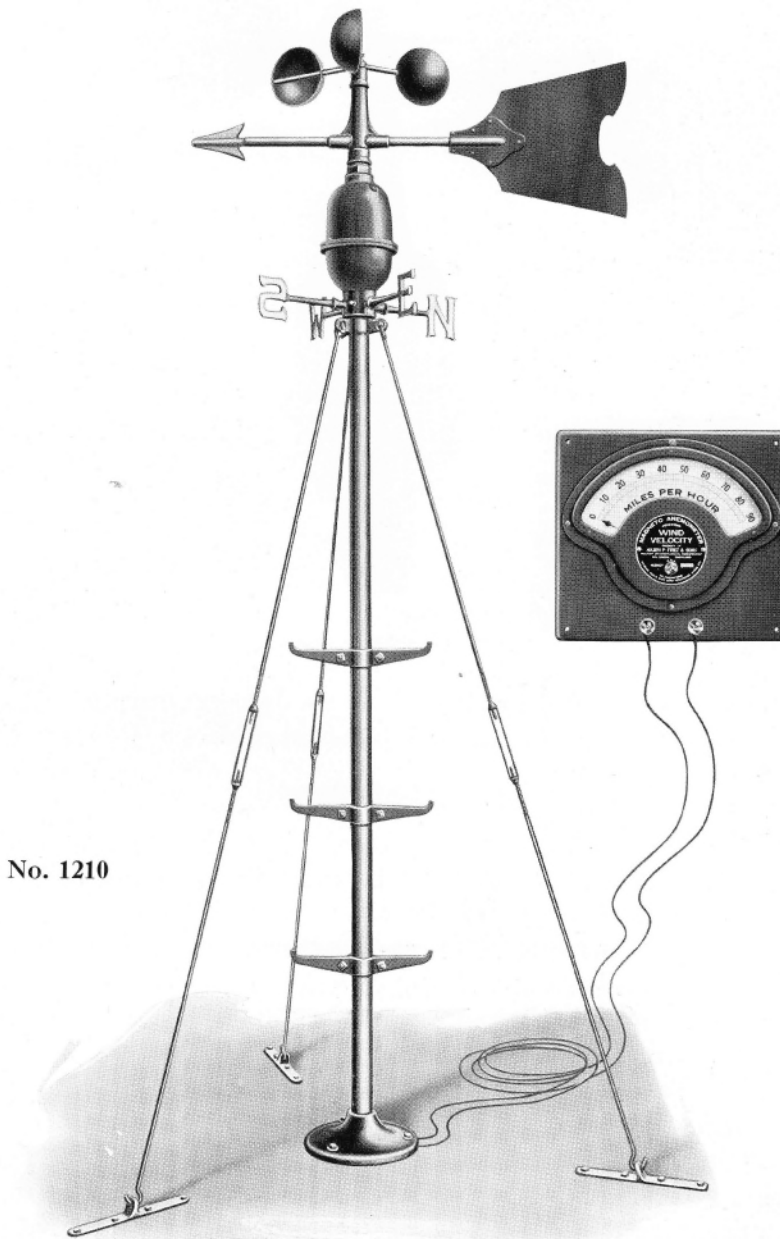


No. 1085

No. 1085—LORD ELECTRICAL WIND-DIRECTION AND VELOCITY INDICATOR, MANTEL TYPE, mounted in solid mahogany case of colonial design; with ornamental dial 10-inch diameter; completely wired with two CP 110-volt candelabra type lamps. A special ten-wire outlet connection is included. (Weight: gross, 75 lbs; net, 30 lbs.) \$

WIND TACHOMETER WITH WIND VANE INCLUDING VELOCITY INDICATOR

For Remote Indications of Wind Velocity and Observations of Wind Direction



No. 1210

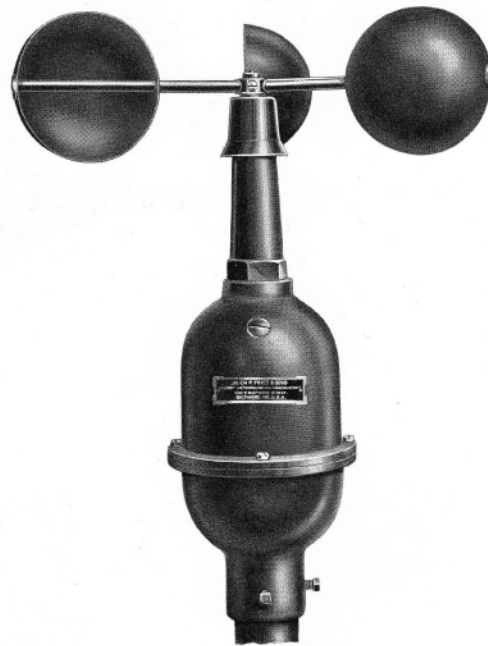
No. 1210—THREE-CUP WIND TACHOMETER, AND WIND VANE, WITH GILDED DIRECTION LETTERS, installed upon standard 8-foot support complete; steps, base-plate, suitable length guy rods (indicator not included).....\$.....

(Weight: gross, 135 lbs; net, 80 lbs.)

No. 1211—SUPPORT only, 8 feet in height, of 1½-inch standard pipe, complete with steps, base-plate and guy rods.....\$.....

(Weight: gross, 100 lbs; net, 50 lbs.)

WIND TACHOMETER



No. 1200

No. 1200—THREE-CUP WIND TACHOMETER, without wind vane and without support. (Sleeve of lower section is arranged for clamping upon standard 1¼-inch iron pipe).....\$.....
 (Weight: gross, 30 lbs; net, 18 lbs.)

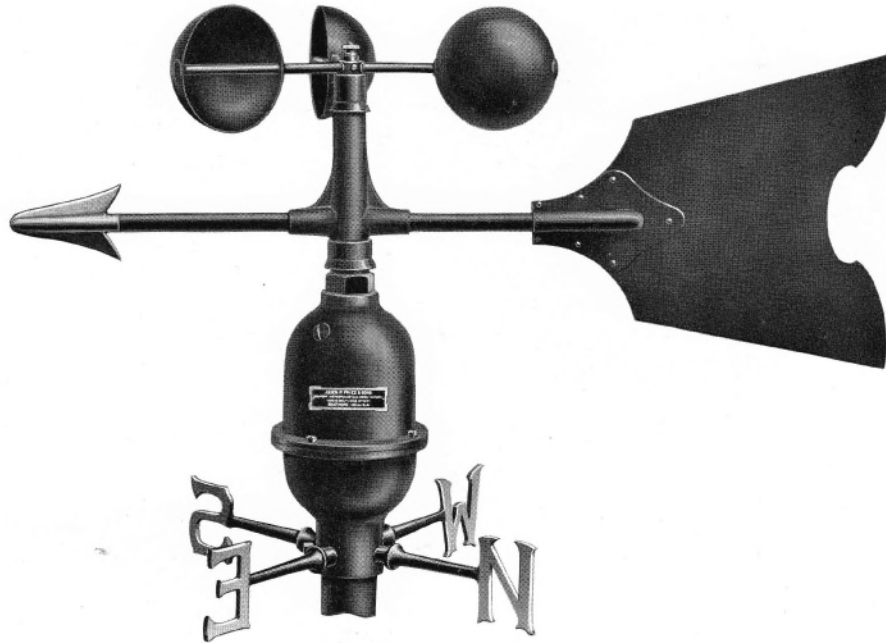
THE Friez Three-Cup Wind Tachometer is an ingenious union of two devices; with it remote readings of wind velocity on a dial are made possible for the first time.

PRINCIPLE OF OPERATION—A Three-Cup Anemometer Rotor is coupled to the shaft of an Electric Tachometer. Long experiments of the U. S. Weather Bureau found the three-cup rotor to be eminently better than any rotor heretofore used. For practically all wind velocities it is an almost perfect interpreter of wind speed.

The Electric Tachometer, to which the shaft of the cups is coupled, generates an electric current whose voltage varies directly with the speed of the rotating cups. Wherefore, a voltmeter, calibrated for and graduated in miles per hour, shows the actual wind speed in all its fluctuations. As is clear, no external source of electric current is required since the whole system is energized by the action of the wind itself.

CONSTRUCTION—Besides the accuracy of the principle involved, the instrument is characterized throughout by great mechanical perfection. Ball bearings of highest grade are used for both upper and lower bearings of the spindle. The three-cup rotor is balanced and built strictly to the specifications of the U. S. Weather Bureau. Both the Tachometer and the voltmeter are highest grade Weston electrical parts that need no other commendation. Six volts are generated at 1,000 R.P.M., thus increasing the factor of safety against loose connections, poor wiring or defective brushes.

WIND TACHOMETER AND WIND VANE



No. 1201

No. 1201—THREE-CUP WIND TACHOMETER AND WIND VANE WITH GILDED DIRECTION LETTERS, exclusive of any support. (Sleeve of lower section is arranged for clamping upon standard 1¼-inch iron pipe).....\$.....
 (Weight: gross, 85 lbs; net, 30 lbs.)

IN addition to its own housing, the Tachometer is enclosed in a special bullet-shaped, weather-proof, aluminum case, and all parts are heavily covered with black enamel to withstand outdoor exposure.

Where observation of wind direction is also desired, a wind vane incorporated as an additional element is also supplied by us, with gilded wind direction letters appropriately placed.

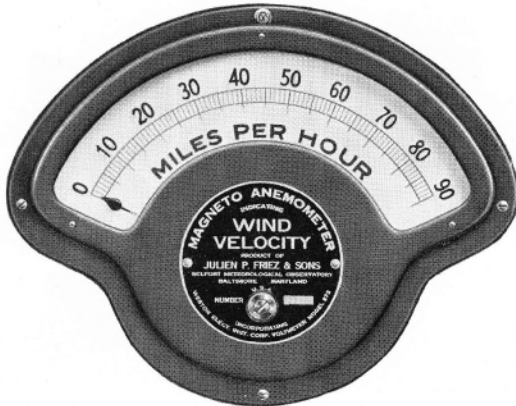
INSTALLATION—The transmitting head, either with or without wind vane, may be installed upon any suitable support, of 1¼-inch standard pipe fitting the lower sleeve of the transmitter, or a standard type of support 8 feet tall can be supplied by us.

Only two wires are needed. Using No. 10 B. & S. wire, the indicator can be located as far as two miles from the transmitter. More than one indicator can be operated from a single transmitter.

The dials or indicators are furnished in two styles, one with long studs for use on a switchboard panel, or one with metal back to hang upon a wall.

SUMMARY—Our complete line of wind instruments includes Recorders and Indicators for both wind direction and velocity. Among our indicating devices, the Three-Cup Wind Tachometer is the simplest outfit and is most accurate, reliable and sturdy, with a complete story of the wind ready for the eye at any moment. Since it requires no external source of current, there is no isolated location in which it cannot be used at its fullest value.

WIND VELOCITY INDICATOR



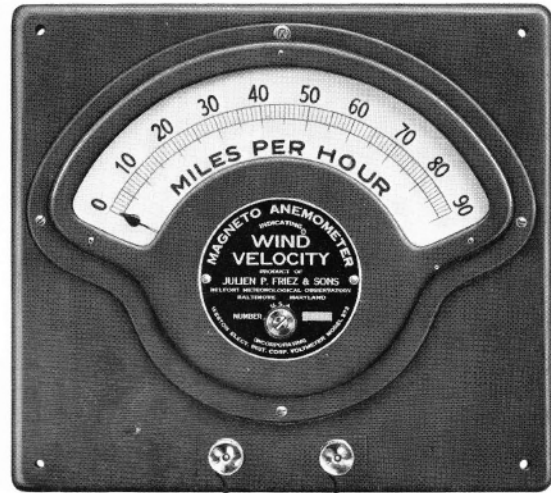
No. 1220

No. 1220—WIND VELOCITY INDICATOR, with long studs for switchboard or panel installation, calibrated for and graduated in miles per hour from 0 to 90. . . \$

(Weight: gross, 20 lbs; net, 5 lbs.)

No. 1221—WIND VELOCITY INDICATOR, mounted upon metal back with binding posts for wall installation, calibrated for and graduated in miles per hour from 0 to 90. * \$

(Weight: gross, 20 lbs; net, 6 lbs.)



No. 1221

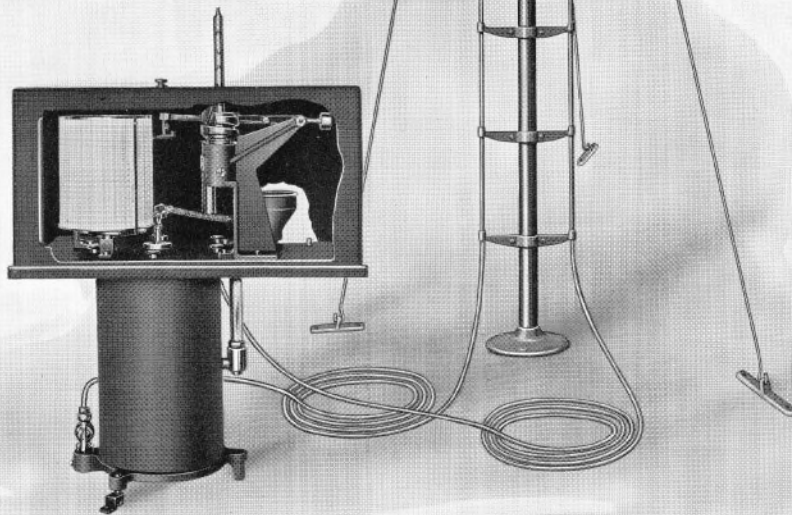
CALIBRATION DATA FOR WESTON VOLTMETER WITH STANDARD THREE-CUP ANEMOMETER AND WESTON MAGNETO

MILES	R.P.M.	VOLTS
0	0	.0
10	107	.636
20	218	1.308
30	330	1.980
40	441	2.652
50	554	3.240
60	665	3.990
70	780	4.680
80	894	5.370
90	1006	6.042

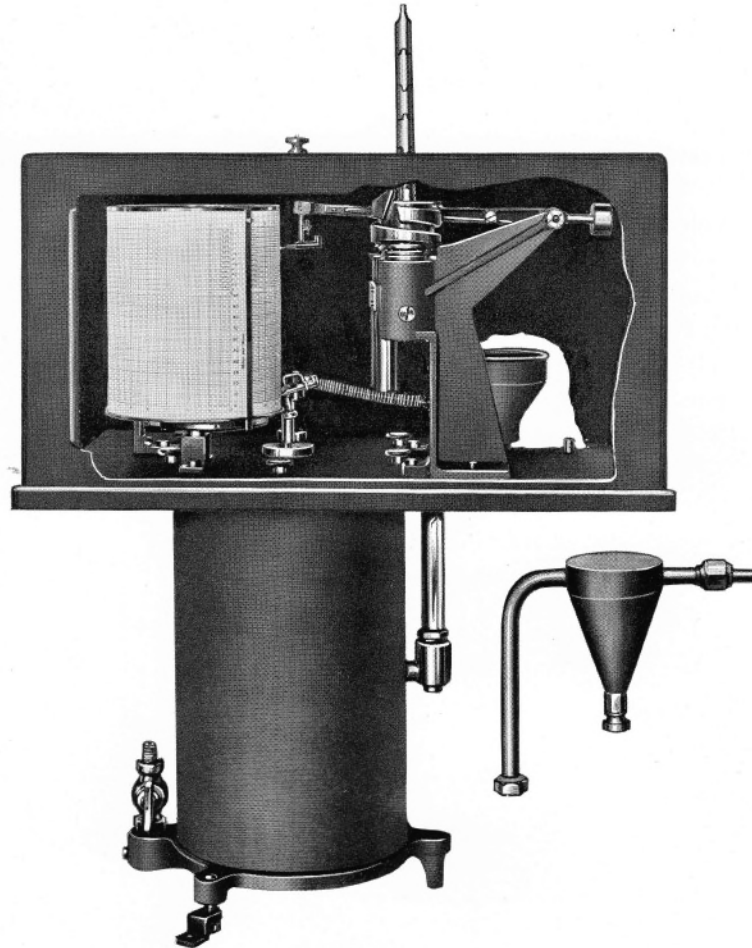
MECHANICALLY OPERATED WIND RECORDER

GROUP J: showing Anemograph No. 450 as installed with its support and outdoor overhead vane and pressure tube Anemometer. Records of wind direction and wind velocity are made on the same daily chart, without electrical connections. Vane placed in vertical with Recorder and coupled by a $\frac{1}{2}$ -inch steel sectional shaft operates the recording mechanism for wind direction; and wind velocity, registering through a pressure tube Anemometer made integral with the rotating vane, is communicated to a balanced float whose movement is calibrated in miles per hour of wind.

◆ ◆ ◆
 The instrument here illustrated is fully described on the pages immediately following. The specifications of the Support are found on pages 29 and 30.



ANEMOGRAPH
MECHANICALLY OPERATED WIND RECORDER



No. 450

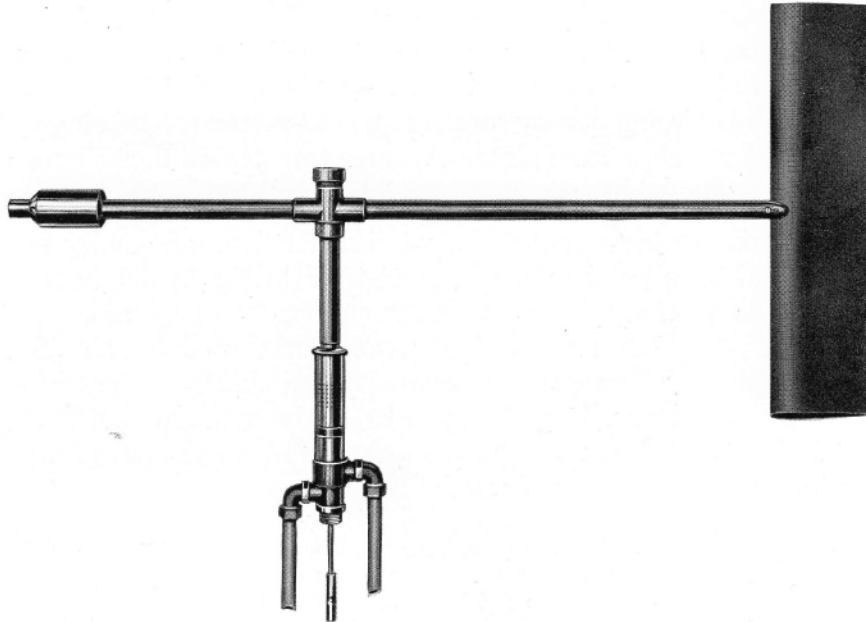
No. 450—ANEMOGRAPH: records mechanically upon engraved chart, wind velocity and wind direction, when connected with the (over head) outdoor Pressure Tube Anemometer and Wind Vane. Accessory equipment consists of 40 feet of steel tubing in 5-foot sections for transmission of wind direction, 80 feet flexible lead tubing in two lengths for transmission of wind pressure, 5 quarts liquid for pressure tank, oil for dash-pot, pens, ink, and year's supply (375) *daily* wind record charts No. 1017-B. Instrument complete with outdoor Pressure Tube Anemometer and Wind Vane.....\$.....

(Weight: gross, 255 lbs; net, 120 lbs accessories included.)

No. 450-I—ANEMOGRAPH WITH OUTDOOR PRESSURE TUBE ANEMOMETER AND WIND VANE, AND SUPPORT: consisting of malleable iron pipe 20 feet in height, with suitable steps designed to clamp and retain firmly in place the tubes leading to the Recorder. Complete instrument with support and all accessories assembled and ready for installation.....\$.....

(Weight: gross, 650 lbs; net, 360 lbs.)

ANEMOGRAPH VANE AND PRESSURE TUBE ANEMOMETER



ANEMOGRAPH

(Wind-Velocity and Wind-Direction Recorder)

DESIGNED upon the Dines model, this Anemograph has been constructed and modified in the Friez Laboratories, to meet the needs of those who desire a direct rather than an electrical-recording apparatus for wind direction and wind velocity.

A tubular wind vane with a vertical stream line tail rotates upon grooved-type steel-ball thrust-bearings and communicates the wind-direction changes through a vertical seamless steel tube to the indoor recording part of the instrument by means of an ingeniously contrived cam.

The wind velocity is determined by the pressure which the wind exerts upon a movable inverted cup-like float. As the wind blows through the open end of the tube, which forms the vane, it is carried through a flexible lead tubing to the under surface of a balanced copper float, resting slightly submerged in a liquid of special specific gravity. The pressure of the wind lifting the float is an index of the wind's velocity. The neck of the vane head is made of two concentric tubes. The inner tube leading to the under surface of the float is closed, while the outer one is perforated

and the wind blowing past these perforations sets up a diminution of pressure in the annular space between the tubes. This lessening of the pressure is communicated to the upper surface of the float as a suction lifting force and the combined suction force above and pressure force beneath the float not only increase its motion, but offset the effects on the instrument due to the pressure changes in the room in which the recording part of the instrument is located. The float, contained in an air-tight tank surmounted by an aluminum plate on which the record cylinder is placed, is attached to a roller moving in a guide slot to prevent rotation. The top of the float is joined with the recording pen by means of a gold-plated rod passing through a close-fitting sleeve in the aluminum plate. A water trap placed in the pressure tube takes care of all rain water that may be blown into the Wind Vane.

The records of wind velocity and wind direction are made by two pens upon a chart 6 inches high placed around a cylinder 5 inches in diameter. This chart is so graduated as to give wind velocities from zero to one hundred miles per hour through twenty-four hours. Wind direction is recorded for all the points of the compass by means of the continuous cam slot particularly designed for this purpose. The clock movement revolving the cylinder is the standard Friez vertical cylinder type, with full-jeweled anchor escapement. The whole recording mechanism is enclosed in a suitable dust-proof case.



WIND VELOCITY PRESSURE GAGE SCALE

For calibrating tubular Anemometers, such as the Anemograph, page 54, the following table has been prepared giving inches of water observed on a water Manometer as produced by the pressure of the wind in the tubular vane and the equivalent velocities in miles per hour. The values in the tables have been deduced from the formula.

$$W = .000732 V^2$$

where "W" is the pressure in the Anemometer tube in inches of water and "V" the speed of the wind in miles per hour.

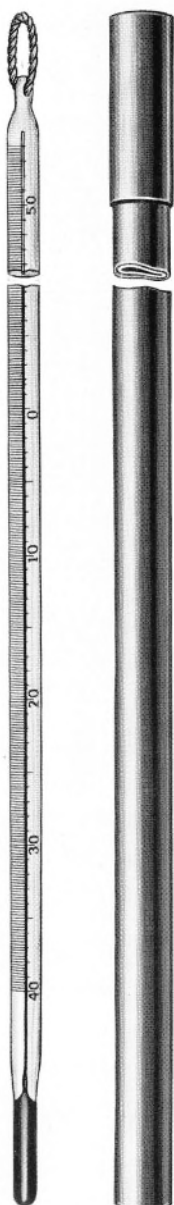
Miles per hour	10	20	30	40	50	60	70	80	90	100
Inches of water by Manometer .....	.075	.292	.673	1.173	1.831	2.638	3.583	4.685	5.945	7.323

THERMOMETERS OF EXTREME PRECISION

Graduated and Figured on the Stem and Provided in Felt-lined Brass Cases

ALL the good qualities of our cylindrical bulb test Thermometers have been perfected to the highest degree in these Thermometers.

To make a perfect Thermometer, every reading of which on the tube would be absolutely accurate, it is clear that the bore of the tube containing the mercury must be mathematically uniform throughout its length. Since such uniformity can only be approximated, the graduations set upon any high-grade Thermometer are the results of calibration. In proportion as the methods employed in such calibration are the more elaborate and thorough, the more precise and accurate are the Thermometer readings. The Thermometers listed here are characterized as being of extreme precision, because, on account of the great refinement of method employed, calibration errors are practically out of question.



FAHRENHEIT SCALE

CATALOG No.	LENGTH OF TUBE	APPROXIMATE SCALE RANGE	UNIT OF GRADUATION	PRICE
301	24 inches to 28 inches	- 30° to + 50° F.	$\frac{1}{10}^{\circ}$	.....
303	24 inches to 28 inches	- 30° to +120° F.	$\frac{1}{10}^{\circ}$	.....
305	24 inches to 28 inches	+ 30° to +120° F.	$\frac{1}{10}^{\circ}$	.....
307	24 inches to 28 inches	0° to +120° F.	$\frac{1}{10}^{\circ}$	.....
309	24 inches to 28 inches	0° to +150° F.	$\frac{1}{10}^{\circ}$	.....
311	24 inches to 28 inches	+ 30° to +220° F.	$\frac{1}{5}^{\circ}$	.....
313	24 inches to 28 inches	+100° to +220° F.	$\frac{1}{10}^{\circ}$	.....
315	24 inches to 28 inches	+ 30° to +300° F.	$\frac{1}{5}^{\circ}$	.....
317	24 inches to 28 inches	+ 30° to +400° F.	$\frac{1}{2}^{\circ}$	.....
319	24 inches to 28 inches	+ 30° to +500° F.	$\frac{1}{2}^{\circ}$	.....
321	24 inches to 29 inches	+ 30° to +600° F.	$\frac{1}{2}^{\circ}$	.....
323	24 inches to 28 inches	+ 30° to +930° F.	1°	.....

CENTIGRADE SCALE

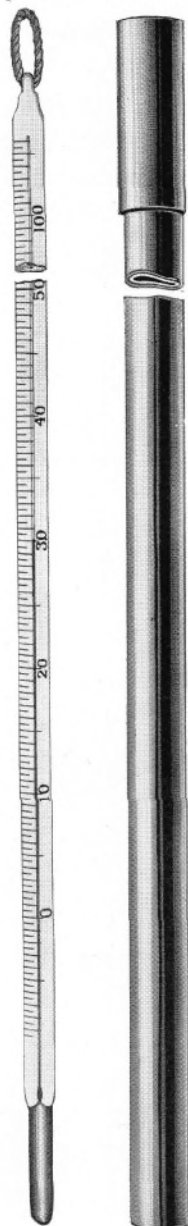
CATALOG No.	LENGTH OF TUBE	APPROXIMATE SCALE RANGE	UNIT OF GRADUATION	PRICE
329	500 to 650 M.M.	- 5° to +110° C.	$\frac{1}{10}^{\circ}$	.....
330	500 to 650 M.M.	-15° to + 50° C.	$\frac{1}{10}^{\circ}$	.....
331	500 to 650 M.M.	-15° to + 65° C.	$\frac{1}{10}^{\circ}$	.....
332	500 to 650 M.M.	-35° to + 50° C.	$\frac{1}{10}^{\circ}$	.....
333	500 to 650 M.M.	- 5° to + 50° C.	$\frac{1}{10}^{\circ}$	.....
334	500 to 650 M.M.	- 5° to +150° C.	$\frac{1}{20}^{\circ}$	.....
335	500 to 650 M.M.	+98° to +200° C.	$\frac{1}{5}^{\circ}$	.....
336	500 to 650 M.M.	- 5° to +200° C.	$\frac{1}{5}^{\circ}$	.....
337	500 to 650 M.M.	- 5° to +250° C.	$\frac{1}{2}^{\circ}$	.....
338	500 to 650 M.M.	- 5° to +400° C.	$\frac{1}{2}^{\circ}$	.....

CYLINDRICAL BULB TEST THERMOMETERS

Graduations and Figures Etched on Stem. Furnished in Felt-lined Brass Cases

THESE Standard Thermometers, of high precision and reliability, are made of the best materials available and are produced under the supervision of technical experts, and the certification requirements of the U. S. Bureau of Standards are maintained in their production and testing.

The bulbs are of Normal Bulb Glass; for the higher temperatures the entire Thermometer is made of Borosilicate Glass. The mercury is refined by a special process; careful annealing and precise calibration insure a Standard Thermometer of the highest accuracy and stability. The calibration is made for a condition of total immersion.



FAHRENHEIT SCALE

CATALOG No.	LENGTH OF TUBE	APPROXIMATE SCALE RANGE	UNIT OF GRADUATION	PRICE
11	6 inches	0° to +120° F.	1°	.....
13	6 inches	+30° to +220° F.	2°	.....
15	9 inches	0° to +120° F.	1/2°	.....
17	9 inches	+30° to +220° F.	1°	.....
19	12 inches	-30° to + 50° F.	1/5°	.....
21	12 inches	-30° to +120° F.	1/2°	.....
23	12 inches	+30° to +150° F.	1/2°	.....
25	12 inches	+30° to +220° F.	1/2°	.....
27	12 inches	+30° to +300° F.	1°	.....
29	15 inches	+30° to +450° F.	1°	.....
31	15 inches	+30° to +700° F.	2°	.....
33	15 inches	+30° to +120° F.	1/5°	.....
35	15 inches	+30° to +400° F.	1°	.....
37	15 inches	+30° to +750° F.	2°	.....
39	18 inches	+30° to +100° F.	2°	.....
41	18 inches	-30° to +120° F.	1/5°	.....
43	18 inches	+30° to +500° F.	1°	.....
45	18 inches	+30° to +750° F.	1°	.....
47	18 inches	+30° to +930° F.	2°	.....

CENTIGRADE SCALE

CATALOG No.	LENGTH OF TUBE	APPROXIMATE SCALE RANGE	UNIT OF GRADUATION	PRICE
51	150 M.M.	-15° to + 50° C.	1/2°	.....
53	150 M.M.	- 5° to +110° C.	1°	.....
55	225 M.M.	-15° to + 50° C.	1/5°	.....
57	225 M.M.	- 5° to +110° C.	1/2°	.....
59	300 M.M.	-35° to + 50° C.	1/5°	.....
61	300 M.M.	- 5° to + 65° C.	1/5°	.....
63	300 M.M.	- 5° to +110° C.	1/2°	.....
65	300 M.M.	- 5° to +250° C.	1°	.....
67	300 M.M.	- 5° to +360° C.	1°	.....
69	400 M.M.	- 5° to + 50° C.	1/10°	.....
71	400 M.M.	- 5° to +500° C.	1°	.....
73	500 M.M.	-35° to + 50° C.	1/10°	.....
75	500 M.M.	- 5° to + 50° C.	1/10°	.....
77	500 M.M.	- 5° to +110° C.	1/5°	.....
79	500 M.M.	- 5° to +360° C.	1/2°	.....

EXPOSED MERCURIAL THERMOMETER

U. S. Weather Bureau Pattern



No. 470

No. 470—EXPOSED MERCURIAL THERMOMETER, U. S. WEATHER BUREAU PATTERN, 11 inches in length, mounted upon aluminum back; stem graduated in *Fahrenheit* degrees from -20° to $+120^{\circ}$ with markings on the back numbering every 5° . The lower part of the back is cut away to properly expose the cylindrical bulb. Thermometer complete with a brass support for extending the Thermometer about an inch from the wall.

\$.....

No. 470-A—EXPOSED MERCURIAL THERMOMETER, U. S. WEATHER BUREAU PATTERN, same as No. 470, without the brass support.

\$.....

No. 471—EXPOSED MERCURIAL THERMOMETER, U. S. WEATHER BUREAU PATTERN, 11 inches in length, mounted upon aluminum back; stem graduated in *Centigrade* degrees from -35° to $+45^{\circ}$ with markings on the back numbering every 5° . The lower part of the back is cut away to expose the cylindrical bulb properly. Thermometer complete with a brass support for extending the Thermometer about an inch from the wall.

\$.....

No. 471-A—EXPOSED MERCURIAL THERMOMETER, U. S. WEATHER BUREAU PATTERN, same as No. 471, without the brass support.

\$.....

(Weights of all Thermometers listed above are: gross, 2 lbs; net, $\frac{1}{2}$ lb.)



EXPOSED MERCURIAL THERMOMETER

U. S. Weather Bureau Pattern

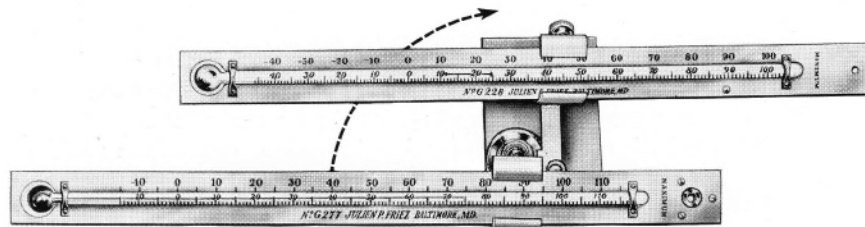
In keeping with our principle of sparing no effort to reach the very best attainable in all meteorological instruments, we restrict our specialty in Thermometers to the one type of Standard Exposed Thermometer in use throughout all the Government Service. Since its readings are in practical agreement with the Hydrogen scale of the U. S. Bureau of Standards no better Thermometer can be found for meteorological purposes. They are not only exceptionally accurate for temperatures above the freezing point, but for all lower temperatures as well. Unlike cheaper Thermometers, age will not increase their readings.

Eleven inches long, the tube of each Thermometer has been thoroughly seasoned and is stem graduated in *Fahrenheit* degrees from -20° to $+120^{\circ}$, or in *Centigrade* from -35° to $+45^{\circ}$, with markings on the aluminum back, numbering every 5° .

The cylindrical mercury bulb of special construction is such as to combine strength with great sensitiveness.

MAXIMUM AND MINIMUM THERMOMETERS

With Townsend Support

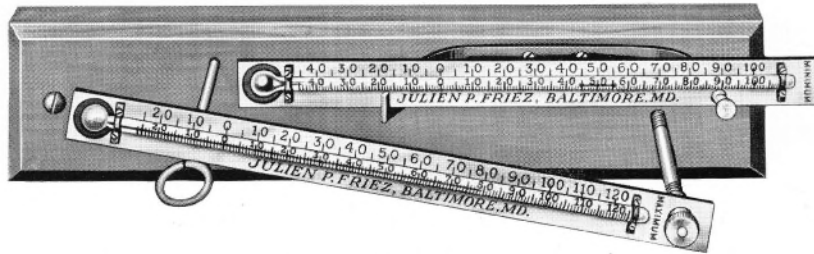


No. 480

- No. 480—MAXIMUM REGISTERING THERMOMETER, U. S. WEATHER BUREAU PATTERN, 12 inches in length, mounted upon an aluminum back; stem graduated in *Fahrenheit* degrees from -25° to $+120^{\circ}$ with markings for each 5° on the back; arranged for use with Townsend all-metal support.....\$.....
 (Weight: gross, 2 lbs; net, $\frac{1}{2}$ lb.)
- No. 481—MINIMUM REGISTERING THERMOMETER, U. S. WEATHER BUREAU PATTERN, 12 inches in length, mounted upon aluminum back; stem graduated in *Fahrenheit* degrees from -25° to $+120^{\circ}$ with markings for each 5° on the back; arranged for use with Townsend all-metal support.....\$.....
 (Weight: gross, 2 lbs; net, $\frac{1}{2}$ lb.)
- No. 482—MAXIMUM REGISTERING THERMOMETER, differs from No. 480 in that stem is graduated in *Centigrade* degrees from -35° to $+45^{\circ}$ arranged for use with Townsend all-metal support\$.....
 (Weight: gross, 2 lbs; net, $\frac{1}{2}$ lb.)
- No. 483—MINIMUM REGISTERING THERMOMETER, differs from No. 481 in that stem is graduated in *Centigrade* degrees from -35° to $+45^{\circ}$, arranged for use with Townsend all-metal support\$.....
 (Weight: gross, 2 lbs; net, $\frac{1}{2}$ lb.)
- No. 484—SET OF MAXIMUM AND MINIMUM REGISTERING THERMOMETERS, U. S. WEATHER BUREAU PATTERN, consisting of a Maximum No. 480 and a Minimum No. 481, mounted upon a Townsend all-metal support complete\$.....
 (Weight: gross, 4 lbs; net, 2 lbs.)
- No. 485—SET OF MAXIMUM AND MINIMUM REGISTERING THERMOMETERS, U. S. WEATHER BUREAU PATTERN, consisting of a Maximum No. 482 and a Minimum No. 483, mounted upon a Townsend all-metal support, complete.....\$.....
 (Weight: gross, 4 lbs; net, 2 lbs.)
- No. 486—TOWNSEND ALL-METAL SUPPORT FOR MAXIMUM AND MINIMUM REGISTERING THERMOMETERS, U. S. WEATHER BUREAU PATTERN, complete with screws for mounting to cross board of an instrument shelter or wall. Support exclusive of Thermometers\$.....
 (Weight: gross, 2 lbs; net, 1 lb.)

MAXIMUM AND MINIMUM THERMOMETERS

With Pine Board Support



No. 490

- No. 490—MAXIMUM REGISTERING THERMOMETER, 12 inches in length, mounted upon an aluminum back; stem graduated in *Fahrenheit* degrees from -25° to $+120^{\circ}$ with markings for each five degrees on the back; arranged for pin support as used with pine board mounting (former U. S. Weather Bureau Pattern) \$
 (Weight: gross, 2 lbs; net, $\frac{1}{2}$ lb.)
- No. 491—MINIMUM REGISTERING THERMOMETER, 12 inches in length, mounted upon an aluminum back; stem graduated in *Fahrenheit* degrees from -25° to $+120^{\circ}$ with markings for each five degrees on the back; arranged for bracket support as used with pine board mounting (former U. S. Weather Bureau Pattern) \$
 (Weight: gross, 2 lbs; net, $\frac{1}{2}$ lb.)
- No. 492—MAXIMUM REGISTERING THERMOMETER, differs from No. 490 in that stem is graduated in *Centigrade* degrees from -35° to $+45^{\circ}$, arranged for pin support as used with pine board mounting \$
 (Weight: gross, 2 lbs; net, $\frac{1}{2}$ lb.)
- No. 493—MINIMUM REGISTERING THERMOMETER, differs from No. 491 in that stem is graduated in *Centigrade* degrees from -35° to $+45^{\circ}$, arranged for bracket support as used with pine board mounting \$
 (Weight: gross, 2 lbs; net, $\frac{1}{2}$ lb.)
- No. 494—SET OF MAXIMUM AND MINIMUM REGISTERING THERMOMETERS, consisting of a Maximum No. 490 and a Minimum No. 491, mounted upon an oil-finished pine board (former U. S. Weather Bureau Pattern) \$
 (Weight: gross, 3 lbs; net, $1\frac{1}{2}$ lbs.)
- No. 495—SET OF MAXIMUM AND MINIMUM REGISTERING THERMOMETERS, consisting of a Maximum No. 492 and a Minimum No. 493, mounted upon an oil-finished pine board (former U. S. Weather Bureau Pattern), complete \$
 (Weight: gross, 3 lbs; net, $1\frac{1}{2}$ lbs.)
- No. 496—SUPPORT FOR MAXIMUM AND MINIMUM REGISTERING THERMOMETERS (former U. S. Weather Bureau Pattern), consisting of rigid brass shouldered pin, and bracket attached to an oil-finished pine board; complete with screws for mounting to cross board of an instrument shelter or wall, exclusive of thermometers \$
 (Weight: gross, 2 lbs; net, 1 lb.)

MAXIMUM AND MINIMUM THERMOMETERS

FOR registering and indicating both the highest point of temperature as well as the lowest obtained in a determined period of time, a pair of thermometers, each peculiarly adapted for its purpose, one called a Maximum and other the Minimum Thermometer are attached to the same support and exposed to the same free air.

The Maximum Thermometer is a mercurial thermometer, the tube of which is slightly narrowed or constricted by a short indentation about one-eighth of an inch above the bulb. The mercury expanding with the rising temperature will force the column past the constriction, but as the temperature becomes lower again, the column broken at the narrow part, remains stationary. Its top surface will remain the maximum reading. For subsequent readings it is evident that the thermometer must be whirled in order that the column of mercury be made continuous again.

The Minimum Thermometer employs colorless alcohol as its fluid, within which a small black glass double-end index will move to the surface of the alcohol in the column when the thermometer is inverted by hand. As the alcohol recedes in the tube with a lowering of the temperature, the index clings to the surface of the liquid and also recedes; when the temperature rises, the index remains at the lowest point reached by the surface of the liquid. This will be the minimum or lowest reading, which must be taken while the thermometer is in its normal horizontal position. To reset for subsequent readings, the index has to be returned to the surface of the liquid by tilting the bulb of the thermometer.

These two thermometers as supplied by us are stem graduated and are characterized generally by the same accuracy of detail and finish of workmanship as the standard Exposed Thermometer. The graduations are made in either Fahrenheit or in Centigrade readings.

The complete instrument comprises in addition to the Maximum and Minimum Thermometers special supports designed particularly for the best exposure of the thermometers and for the manipulation of them required for their resetting, and for the two kinds of supports specially adapted thermometers are supplied as outlined in our listing of Maximum and Minimum Thermometers. In ordering thermometers it is necessary to take account of the type of support which is to be employed. See Nos. 480 to 484, and also Nos. 490 to 494.



SUPPORTS FOR MAXIMUM AND MINIMUM THERMOMETERS

THE Townsend Support No. 486 for Maximum Thermometers, the latest type of support, as adopted by the U. S. Weather Bureau Service, is a brass base plate, 2 by 3 inches, with screw holes for securing the instrument to a wall or the cross board of an instrument shelter. Two projecting studs of unequal heights with carriers for the thermometers are mounted upon this base. The taller support, with a pawl at its base for locking and releasing the rotating shaft, is designed to hold the Maximum Thermometer and also to permit its vigorous whirling without removal from the support. The shorter projecting column with carrier holds the Minimum Thermometer, which may also be tilted to reset the index without removing the thermometer from its clamping carrier.

The position of the Minimum Thermometer during exposure is horizontal; the position of the Maximum Thermometer is almost horizontal with a slight inclination of the bulb upwards to prevent the mercury in the column from forcing its way under gravity back past the constriction into the bulb.

Instructions for the reading of the thermometers, for their resetting for subsequent observations, for the manner of whirling the Maximum and of tilting the Minimum Thermometer accompany each instrument.

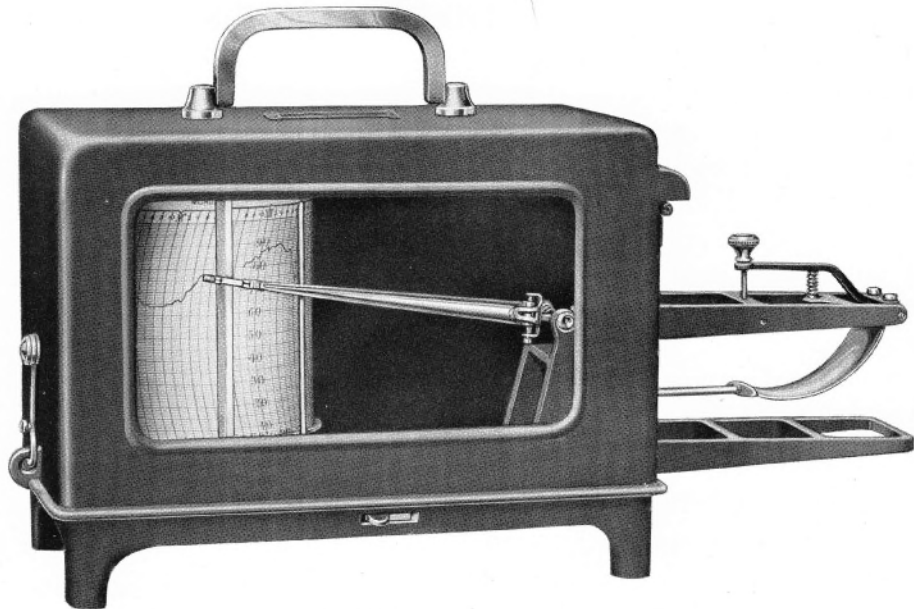
The older type of support for these thermometers No. 496 is a solid 14-inch backing of white pine, on which a curving brass bracket holds the Minimum Thermometer in its horizontal position and away from the wall to allow the free circulation of the air about the bulb. The Maximum Thermometer, with its brass bushing (No. 490), used with this type of support, is mounted on a brass vertical-shouldered pin, a nut securing the bushing of the aluminum back of the thermometer, and allowing for vigorous whirling of the thermometer after a reading has been taken, in order that the mercury may be driven back past the constriction into the bulb and be made continuous.

The best service of Maximum and Minimum Thermometers in the outdoors can only be obtained by housing them in proper shelters. Such shelters we catalogue on pages 122-124 and refer the reader to them, calling attention that the Cotton Region Shelter and the Large Instrument Shelter have been adapted universally throughout the U. S. Weather Bureau Service. Either type of thermometer support can be used within these shelters, while the special Thermometer Shelter No. 960 is suited only for the Maximum and Minimum Thermometers with pine board backing.



THERMOGRAPH

3½-Inch Chart



No. 500

No. 500—THERMOGRAPH, U. S. WEATHER BUREAU, BOURDON TUBE TYPE; 3½-inch chart; weekly clock movement; range +5° to +100° *Fahrenheit*. Instrument complete with pen, ink, and year's supply (55) *weekly* charts No. 1072.....\$.....

(Weight: gross, 27 lbs; net, 9 lbs.)

No. 501—THERMOGRAPH, U. S. WEATHER BUREAU, BOURDON TUBE TYPE; 3½-inch chart; weekly clock movement; chart cylinder making one revolution in twenty-nine hours, is arranged for daily records; range +5° to +100° *Fahrenheit*. Instrument complete with pen, ink, and year's supply (375) *daily* charts No. 1072-J.....\$.....

(Weight: gross, 30 lbs; net, 9 lbs.)

No. 502—THERMOGRAPH, BOURDON TUBE TYPE; 3½-inch chart; weekly clock movement; range -15° to +40° *Centigrade*. Instrument complete with pen, ink, and year's supply (55) *weekly* charts No. 100-B.....\$.....

(Weight: gross, 27 lbs; net, 9 lbs.)

No. 503—THERMOGRAPH, BOURDON TUBE TYPE; 3½-inch chart; weekly clock movement; chart cylinder making one revolution in twenty-nine hours, is arranged for daily records; range -15° to +40° *Centigrade*. Instrument complete with pen, ink, and year's supply (375) *daily* charts No. 1072-K.....\$.....

(Weight: gross, 30 lbs; net, 9 lbs.)

No. 504—THERMOGRAPH, BOURDON TUBE TYPE; 3½-inch chart; weekly clock movement; range -30° to +110° *Fahrenheit*. (Note: the chart space or height is the same as chart No. 1072 used on Thermograph No. 500. The scale is, therefore, slightly closed to permit the added 45°). Instrument complete with pen, ink, and year's supply (55) *weekly* charts No. 120..\$.....

(Weight: gross, 27 lbs; net, 9 lbs.)

THERMOGRAPH

ALMOST every meteorological station of the Government Service is equipped with a Thermograph for giving continuous graphic records of all the variations in atmospheric temperature for extended periods of time. Cold storage plants, greenhouses, agricultural stations and various branches of industry find them indispensable instruments for acquiring accurate and permanent information of temperature changes.

The temperature registering element employed in the Friez Thermograph is a Bourdon tube of phosphor bronze containing alcohol, being situated well outside the instrument case; the reaction of this element to heat variations has been shown in the Friez Laboratories to be just slightly less than that of a mercurial thermometer. The bending of this Bourdon tube, due to the expansion or the contraction of the fluid within it, operates a link controlling the lever of the pen-arm. The vertical cylinder, about which the record chart is held with a metallic clip, is $3\frac{3}{8}$ inches in diameter and of the same dimensions in height and makes one complete revolution in seven days and eight hours, being operated by an eight-day clock movement, with full-jeweled anchor escapement, thus requiring winding but once a week. In Thermographs giving daily records, the cylinder revolves once in twenty-nine hours, winding being necessary but once in seven days.

The pen, needing to be filled with ink but once a week, can be made to agree with the Standard Mercurial Thermometer readings by means of an adjusting thumb nut controlling the position of the Bourdon tube and situated above on the framework supporting the tube.

The weekly charts on No. 500 are accurately ruled so that the lateral lines denote a range of temperature from $+5^{\circ}$ to $+100^{\circ}$ Fahrenheit, and the longitudinal arcs signify each a time-period of two hours. On the daily chart used with No. 501, each time-line denotes a half-hour interval.

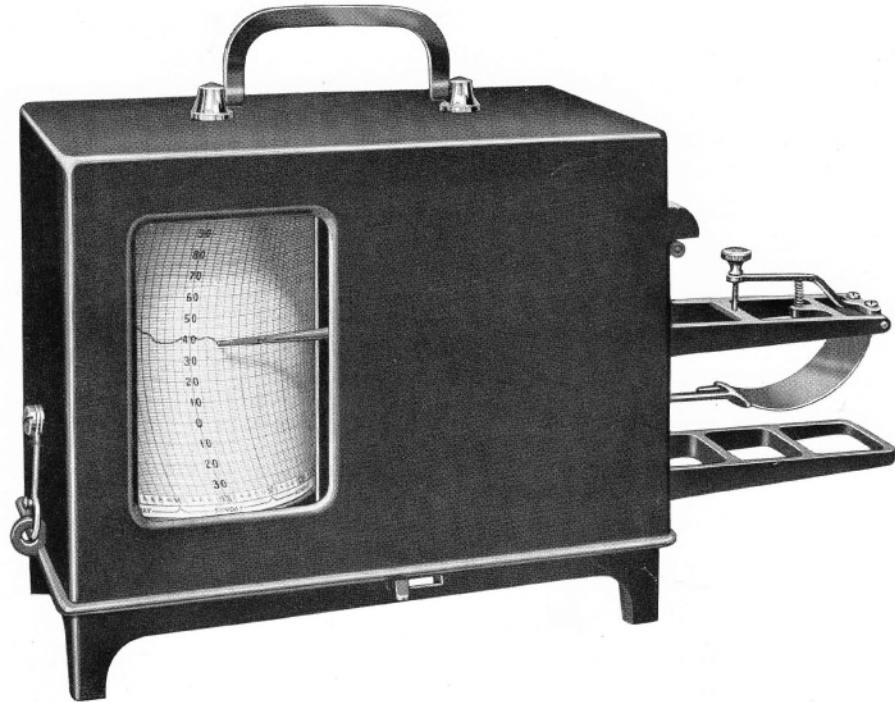
Identical in all other respects with the above, Thermograph No. 502 is furnished with a chart giving a weekly record of temperature changes graduated in Centigrade degrees from $+15^{\circ}$ to $+40^{\circ}$. No. 503 gives a daily record in Centigrade degrees for the same range.

The base of the instrument is a rigid one-piece casting of aluminum, and to this is hinged a single glass-panel metallic case with a handle above for carrying purposes. The Bourdon tube and its support are shielded from all foreign disturbances by a wide bracket or guard attached to the base beneath it.

Each individual Thermograph before shipment from our Laboratories is separately calibrated by means of hot and cold constant temperature baths and its readings made to conform with the readings of a Standard Mercurial Thermometer throughout the whole range of the scale. Pen, ink, and a year's supply of charts accompany each instrument.

THERMOGRAPH

5-Inch Chart



No. 518

No. 518—THERMOGRAPH, U. S. WEATHER BUREAU, BOURDON TUBE TYPE; 5-inch chart; weekly clock movement; range -35° to $+110^{\circ}$ Fahrenheit. Instrument complete with pen, ink, and year's supply (55) *weekly* charts No. 200-W. \$
(Weight: gross, 27 lbs; net, 10 lbs.)

No. 518-A—THERMOGRAPH, U. S. WEATHER BUREAU, BOURDON TUBE TYPE; 5-inch chart; weekly clock movement; chart cylinder making one revolution in twenty-nine hours, is arranged for daily records; range -35° to $+110^{\circ}$ Fahrenheit. Instrument complete with pen, ink, and year's supply (375) *daily* charts No. 200-D. \$
(Weight: gross, 30 lbs; net, 10 lbs.)

No. 518-C—THERMOGRAPH, U. S. WEATHER BUREAU, BOURDON TUBE TYPE; 5-inch chart; weekly clock movement; range -35° to $+40^{\circ}$ Centigrade. Instrument complete with pen, ink, and year's supply (55) *weekly* charts No. 205-W. \$
(Weight: gross, 27 lbs; net, 10 lbs.)

No. 518-D—THERMOGRAPH, U. S. WEATHER BUREAU, BOURDON TUBE TYPE; 5-inch chart; weekly clock movement; chart cylinder making one revolution in twenty-nine hours, is arranged for daily records; range -35° to $+40^{\circ}$ Centigrade. Instrument complete with pen, ink, and year's supply (375) *daily* charts No. 205-D. \$
(Weight: gross, 30 lbs; net, 10 lbs.)

No. 518-H—THERMOGRAPH, U. S. WEATHER BUREAU, BOURDON TUBE TYPE; 5-inch chart; weekly clock movement; range $+5^{\circ}$ to $+150^{\circ}$ Fahrenheit. Instrument complete with pen, ink, and year's supply (55) *weekly* charts No. 202-W.....\$.....
 (Weight: gross, 27 lbs; net, 10 lbs.)

No. 518-I—THERMOGRAPH, U. S. WEATHER BUREAU, BOURDON TUBE TYPE; 5-inch chart; weekly clock movement; chart cylinder making one revolution in twenty-nine hours, is arranged for daily records; range $+5^{\circ}$ to $+150^{\circ}$ Fahrenheit. Instrument complete with pen, ink, and year's supply (375) *daily* charts No. 202-D.....\$.....
 (Weight: gross, 27 lbs; net, 10 lbs.)

THERMOGRAPH

SINCE so many localities experience very wide ranges of temperature, we supply for such a Thermograph, using a wide chart of 5 inches, for a range from -35° to $+110^{\circ}$ Fahrenheit, or for an equivalent Centigrade range. This instrument is suitable for winter and summer temperatures without recourse to winter and summer charts. Likewise using the same tall cylinder, our high range Thermograph is prepared for unusual temperatures, using charts graduated from $+5^{\circ}$ to $+150^{\circ}$ Fahrenheit.

The instrument itself embodies all the design characteristics of a Friez Thermograph, viz, a gold-plated Bourdon tube, an all-metal base and case, and other such features as are described in the treatment of our Thermograph No. 500, page 65.

Without sacrificing an open scale, we make provision for an extended range, by using a taller 5-inch chart cylinder. Such ranges have been selected as experience has proved to answer the needs of all localities of our own country, and charts are made for either Fahrenheit or Centigrade readings.

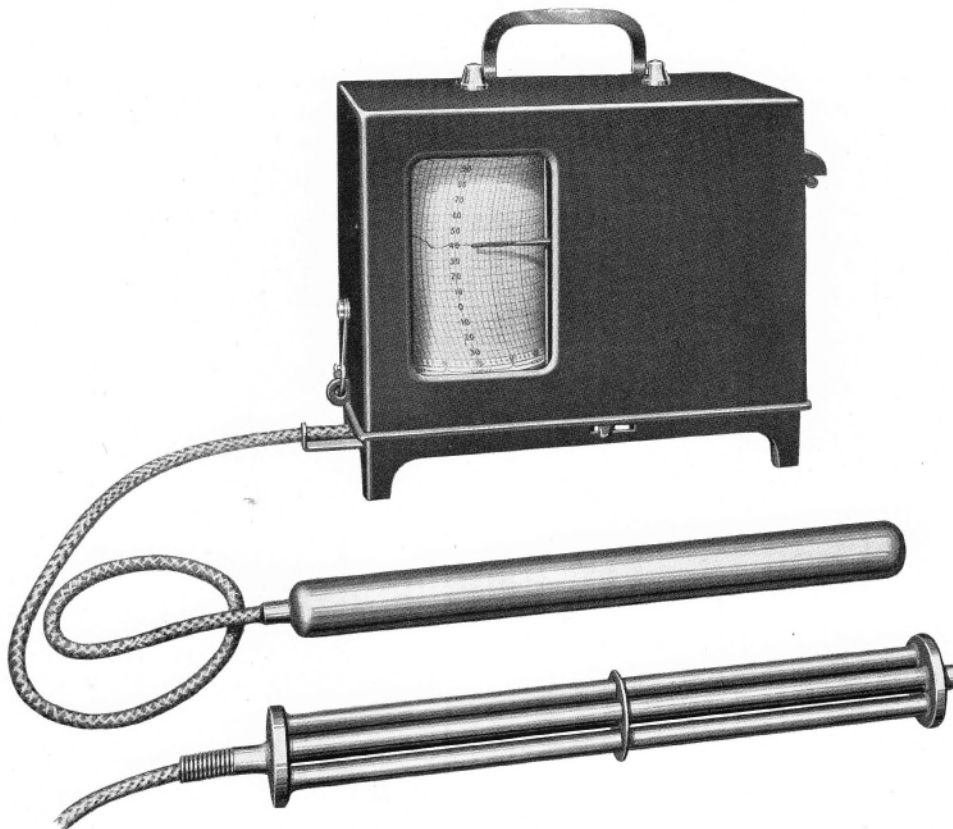
The most universally demanded high-range Thermograph is our No. 518, using weekly chart for a range from -35° to $+110^{\circ}$ Fahrenheit. Instrument No. 518-A uses a daily chart for the same range. For Centigrade readings with the same extent of temperature range we supply our No. 518-C for weekly charts and No. 518-D for daily charts. The range in Centigrade graduations is -35° to $+40^{\circ}$.

Demand is also made for unusual temperature ranges; for such demands we offer our No. 518-H with weekly charts, and No. 518-I with daily charts, for a range from $+5^{\circ}$ to $+150^{\circ}$ Fahrenheit.

In this 5-inch chart Thermograph, the time markings are printed on both upper and lower borders of the chart.

SOIL OR DISTANCE THERMOGRAPH

U. S. Weather Bureau Pattern



No. 1100

No. 1100—SOIL OR DISTANCE THERMOGRAPH, CYLINDRICAL TYPE BULB; 5-inch chart; weekly clock movement. Instrument supplied with capillary tube 10 feet in length, pen, ink, and year's supply (55) *weekly* charts No. 200-W; range -35° to $+110^{\circ}$ *Fahrenheit*. \$
(Weight: gross, 27 lbs; net, 12 lbs.)

No. 1101—SOIL OR DISTANCE THERMOGRAPH, EXTRA SENSITIVE GRID (CIRCULAR) TYPE BULB; 5-inch chart; weekly clock movement. Instrument supplied with capillary tube 10 feet in length, pen, ink, and year's supply (55) *weekly* charts No. 200-W; range -35° to $+110^{\circ}$ *Fahrenheit*. \$
(Weight: gross, 27 lbs; net, 12 lbs.)

No. 1102—SOIL OR DISTANCE THERMOGRAPH, CYLINDRICAL TYPE BULB; 5-inch chart; weekly clock movement. Instrument supplied with capillary tube 10 feet in length, pen, ink, and year's supply (55) *weekly* charts No. 205-W; range -37° to $+43^{\circ}$ *Centigrade*. \$
(Weight: gross, 27 lbs; net, 12 lbs.)

No. 1103—SOIL OR DISTANCE THERMOGRAPH, EXTRA SENSITIVE GRID (CIRCULAR) TYPE BULB; 5-inch chart; weekly clock movement. Instrument supplied with capillary tube

10 feet in length, pen, ink, and year's supply (55) *weekly* charts No. 205-W; range -37° to $+43^{\circ}$ *Centigrade*\$.....

(Weight: gross, 30 lbs; net, 12 lbs.)

No. 1104—SOIL OR DISTANCE THERMOGRAPH, CYLINDRICAL TYPE BULB; 5-inch chart; weekly clock movement. Instrument supplied with capillary tube 10 feet in length, pen, ink, and year's supply (55) *weekly* charts No. 202-W; range $+5^{\circ}$ to $+150^{\circ}$ *Fahrenheit*\$.....

(Weight: gross, 27 lbs; net, 12 lbs.)

No. 1105—SOIL OR DISTANCE THERMOGRAPH, CYLINDRICAL TYPE BULB; 5-inch chart; weekly clock movement, chart cylinder making one revolution in twenty-nine hours is arranged for daily records. Instrument supplied with capillary tube 10 feet in length, pen, ink, and year's supply (375) *daily* charts No. 200-D; range -35° to $+110^{\circ}$ *Fahrenheit*\$.....

(Weight: gross, 30 lbs; net, 12 lbs.)

No. 1106—SOIL OR DISTANCE THERMOGRAPH, EXTRA SENSITIVE GRID (CIRCULAR) TYPE BULB; 5-inch chart; weekly clock movement, chart cylinder making one revolution in twenty-nine hours is arranged for daily records. Instrument supplied with capillary tube 10 feet in length, pen, ink, and year's supply (375) *daily* charts No. 200-D; range -35° to $+110^{\circ}$ *Fahrenheit*\$.....

(Weight: gross, 30 lbs; net, 12 lbs.)

No. 1107—SOIL OR DISTANCE THERMOGRAPH, CYLINDRICAL TYPE BULB; 5-inch chart; weekly clock movement, chart cylinder making one revolution in twenty-nine hours is arranged for daily records. Instrument supplied with capillary tube 10 feet in length, pen, ink, and year's supply (375) *daily* charts No. 205-D; range -37° to $+43^{\circ}$ *Centigrade*\$.....

(Weight: gross, 30 lbs; net, 12 lbs.)

No. 1108—SOIL OR DISTANCE THERMOGRAPH, EXTRA SENSITIVE GRID (CIRCULAR) TYPE BULB; 5-inch chart; weekly clock movement, chart cylinder making one revolution in twenty-nine hours is arranged for daily records. Instrument supplied with capillary tube 10 feet in length, pen, ink, and year's supply (375) *daily* charts No. 205-D; range -37° to $+43^{\circ}$ *Centigrade*\$.....

(Weight: gross, 30 lbs; net, 12 lbs.)

No. 1109—SOIL OR DISTANCE THERMOGRAPH, CYLINDRICAL TYPE BULB; 5-inch chart; weekly clock movement, chart cylinder making one revolution in twenty-nine hours is arranged for daily records. Instrument supplied with capillary tube 10 feet in length, pen, ink, and year's supply (375) *daily* charts No. 202-D; range $+5^{\circ}$ to 150° *Fahrenheit*\$.....

(Weight: gross, 27 lbs; net, 12 lbs.)



SOIL OR DISTANCE THERMOGRAPH

THE special need in agriculture and in horticulture of an instrument to record the changes in the temperature of the soil, and in many other fields to record temperatures of water or of other liquids, as these are distinguished from the tempera-

ture of the atmosphere, has caused the construction of a Soil or Distance Thermograph recording upon a chart, adapted for either a weekly or daily record, the temperature variations in these different elements. Though the original idea embodied in this instrument was conceived elsewhere, it has been very much modified and perfected in the Friez Laboratories.

Our Soil Thermograph, sometimes called a Telethermograph, is supplied by us with either a 12-inch cylindrical type copper bulb of $1\frac{1}{16}$ -inch diameter, or with a multiple bulb radiator type of registering element. The cylindrical bulb, which is less expensive to manufacture, gives perfectly satisfactory results, when high-speed reaction to quick changes in temperature is not required. For extra sensitivity we recommend the extra sensitive radiator type of multiple bulb. A Thermograph, equipped with this type of sensitive element and using a 10-foot capillary will show itself quite as sensitive in inking records, as will a mercury Thermometer in indicating temperature fluctuations.

The capillary tubing used by us is protected by a four-ply copper braiding, and can be bent with great security without injuring the capillary tubing itself. When less than and up to a 30-foot capillary is supplied, we employ a capillary of .040 bore; above 30 feet, the bore is .028.

The whole system is liquid filled, and possesses all the advantages of a liquid fill against the vapor type of Thermometer.

The expansion of the liquid in the bulb and capillary is registered through a special device, consisting of a double-ply slyphon located on the base of the instrument into which the capillary leads. The slyphon is kept under constant tension by a spring; by this means wide ranges of temperature can be registered, without affecting the sensitivity of the slyphon registering element. The general advantages of the slyphon, or seamless corrugated tube over other forms of diaphragms, as a means of measuring pressure or expansion changes is universally recognized.

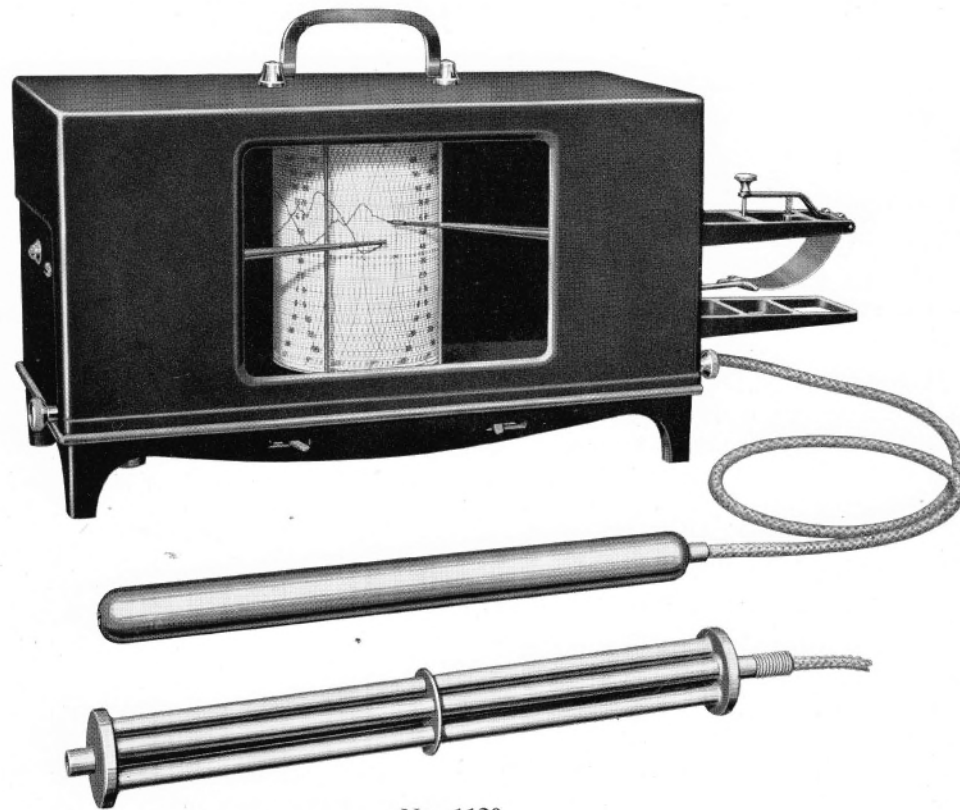
In the construction of Soil or Distance Reading Thermographs, correct compensation is made for temperature effects on the instrument head: nor, since the tubular system is completely filled with liquid, do atmospheric pressures influence temperature registrations, whether the bulb is placed either below or above the level of the instrument itself.

Our line of Distance Thermographs embraces the models and types as are specified under Nos. 1100 to 1109.

They may be considered as two models of several types. One model uses the cylindrical bulb and the other uses the extra sensitive radiator type of bulb. Charts for either model are printed for either weekly or daily records; the temperature range in Fahrenheit is -35° to $+110^{\circ}$, and in Centigrade it is -37° to $+43^{\circ}$.

For special localities, where unusually high temperatures are experienced, instruments with charts printed for a range from $+5^{\circ}$ to $+150^{\circ}$ Fahrenheit are provided.

COMBINED AIR AND SOIL OR DISTANCE THERMOGRAPH



No. 1120

- No. 1120—COMBINED AIR AND SOIL OR DISTANCE THERMOGRAPH, Bourdon and cylindrical type bulbs; 5-inch chart; weekly clock movement. The soil unit is supplied with capillary tube 10 feet in length. Complete with pens, inks, and year's supply (55) *weekly* charts No. 201-W; range: -35° to $+110^{\circ}$ *Fahrenheit*. \$
 (Weight: gross, 35 lbs; net, 18 lbs.)
- No. 1121—COMBINED AIR AND SOIL OR DISTANCE THERMOGRAPH, Bourdon and extra sensitive grid type bulbs, otherwise identical with No. 1120, including the *weekly* charts No. 201-W; range: -35° to $+110^{\circ}$ *Fahrenheit* \$
 (Weight: gross, 35 lbs; net, 18 lbs.)
- No. 1122—COMBINED AIR AND SOIL OR DISTANCE THERMOGRAPH, Bourdon and cylindrical type bulbs; 5-inch chart; weekly clock movement. The soil unit is supplied with capillary tube 10 feet in length. Complete with pens, inks, and year's supply (55) *weekly* charts No. 206-W; range: -37° to $+43^{\circ}$ *Centigrade*. \$
 (Weight: gross, 35 lbs; net, 18 lbs.)
- No. 1123—COMBINED AIR AND SOIL OR DISTANCE THERMOGRAPH, Bourdon and extra sensitive grid type bulbs, otherwise identical with No. 1122, including the *weekly* charts No. 206-W; range: -37° to $+43^{\circ}$ *Centigrade*. \$
 (Weight: gross, 35 lbs; net, 18 lbs.)
- No. 1124—COMBINED AIR AND SOIL OR DISTANCE THERMOGRAPH, Bourdon and cylindrical type bulb; 5-inch chart; weekly clock movement. The soil unit is supplied with

- capillary tube 10 feet in length. Complete with pens, inks, and year's supply (55) *weekly* charts No. 203-W; range: +5° to +150° *Fahrenheit*\$.....
 (Weight: gross, 35 lbs; net, 18 lbs.)
- No. 1125—COMBINED AIR AND SOIL OR DISTANCE THERMOGRAPH, Bourdon and cylindrical type bulbs; 5-inch chart; weekly clock movement, chart cylinder making one revolution in twenty-nine hours, is arranged for daily records. The soil unit is supplied with capillary tube 10 feet in length. Complete with pens, inks, and year's supply (375) *daily* charts No. 201-D; range: -35° to +110° *Fahrenheit*\$.....
 (Weight: gross, 37 lbs; net, 18 lbs.)
- No. 1126—COMBINED AIR AND SOIL OR DISTANCE THERMOGRAPH, Bourdon and extra sensitive grid type bulbs, otherwise identical with No. 1125, including the *daily* charts No. 201-D; range: -35° to +110° *Fahrenheit*\$.....
 (Weight: gross, 37 lbs; net, 18 lbs.)
- No. 1127—COMBINED AIR AND SOIL OR DISTANCE THERMOGRAPH, Bourdon and cylindrical type bulbs; 5-inch chart; weekly clock movement, chart cylinder making one revolution in twenty-nine hours is arranged for *daily* records. The soil unit is supplied with capillary tubes 10 feet in length. Complete with pens, inks, and year's supply (375) *daily* charts No. 206-D; range: -37° to +43° *Centigrade*\$.....
 (Weight: gross, 37 lbs; net, 18 lbs.)
- No. 1128—COMBINED AIR AND SOIL OR DISTANCE THERMOGRAPH, Bourdon and extra sensitive grid type bulbs, otherwise identical with No. 1127, including the *daily* charts No. 206-D; range -37° to +43° *Centigrade*\$.....
 (Weight: gross, 37 lbs; net, 18 lbs.)
- No. 1129—COMBINED AIR AND SOIL OR DISTANCE THERMOGRAPH, Bourdon and cylindrical type bulbs; 5-inch chart; weekly clock movement, chart cylinder making one revolution in twenty-nine hours is arranged for *daily* records. The soil unit is supplied with capillary tubes 10 feet in length. Complete with pens, inks, and year's supply (375) *daily* charts No. 203-D; range: +5° to +150° *Fahrenheit*\$.....
 (Weight: gross, 37 lbs; net, 18 lbs.)

COMBINED AIR AND SOIL OR DISTANCE THERMOGRAPH

A COMBINED Air and Soil Thermograph makes records of temperature for two localities on the same chart, giving a comparison basis for intimately related temperatures.

Air temperature is registered by a gold-plated Bourdon tube located as is standard on our Air Thermograph No. 500.

The temperature of a remote locality is registered by a liquid-filled capillary system as is explained in our description of a Soil or Distance Thermograph No. 1100 and following.

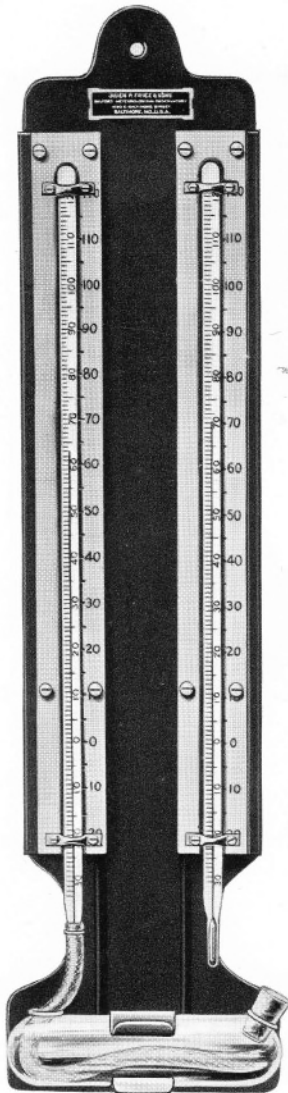
Two instruments, therefore, are combined in one, and a single chart keeps record of two correlated temperatures.

All of our Air and Soil Thermographs are constructed with a 5-inch chart cylinder, affording an open scale range for ranges of 145° *Fahrenheit*. The charts are fitted for either daily or weekly records, and for either *Fahrenheit* or *Centigrade* readings.

The temperatures range in *Fahrenheit* is: -35° to +110°, and in *Centigrade* it is -37° to +43°. For special localities, where universal high temperatures are experienced, instruments with charts printed for a range from +5° to +150° *Fahrenheit* are provided.

HYGROMETER

Wall or Stationary Type



No. 540

No. 540—HYGROMETER, WALL OR STATIONARY TYPE, consisting of wet and dry cylindrical bulb *Fahrenheit* scale Thermometers mounted upon a formed attractively finished metal bracket. Instrument complete with glass reservoir, wicking and set of Government Psychrometric Tables.
(Weight: gross, 4 lbs; net, 1½ lbs.) \$.....

No. 540-A—THERMOMETER (WET BULB) FOR HYGROMETER, (when purchased extra), mounted upon aluminum back and graduated along stem in *Fahrenheit* scale with markings on the back numbering every 5°....\$.....
(Weight: gross, 2 lbs; net, ½ lb.)

No. 540-B—THERMOMETER (DRY BULB) FOR HYGROMETER, (when purchased extra), mounted upon aluminum back and graduated along stem in *Fahrenheit* scale with markings on the back numbering every 5°....\$.....
(Weight: gross, 2 lbs; net, ½ lb.)

No. 541—HYGROMETER, WALL OR STATIONARY TYPE, same as No. 540, except that Thermometers are graduated in *Centigrade* scale. Instrument complete with glass reservoir, wicking and set of Government Psychrometric Tables.
(Weight: gross, 4 lbs; net, 1½ lbs.) \$.....

No. 541-A—THERMOMETER (WET BULB) FOR HYGROMETER, (when purchased extra), mounted upon aluminum back and graduated along stem in *Centigrade* scale.
(Weight: gross, 2 lbs; net, ½ lb.) \$.....

No. 541-B—THERMOMETER (DRY BULB) FOR HYGROMETER, (when purchased extra), mounted upon aluminum back and graduated along stem in *Centigrade* scale.
(Weight: gross, 2 lbs; net, ½ lb.) \$.....

HYGROMETER

Wall or Stationary Type

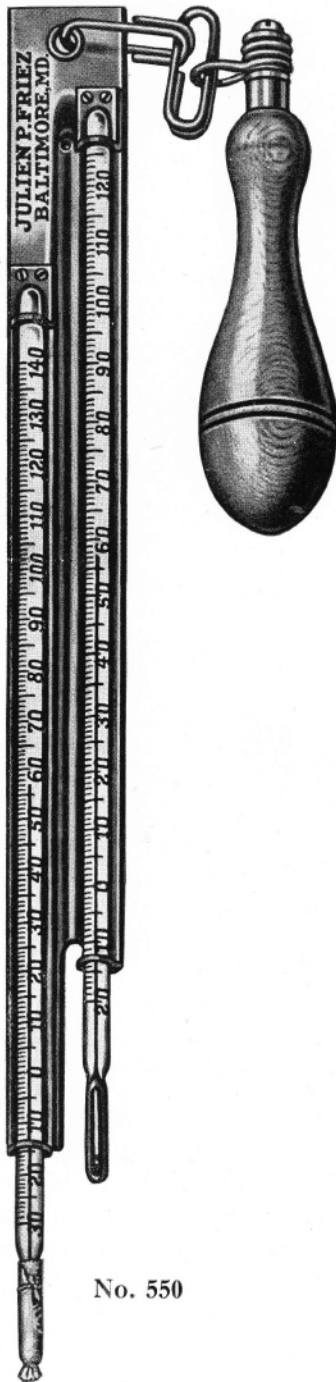
THE presence and amount of moisture in the atmosphere and its bearing upon other meteorological conditions, such as the probability of frost or rain, is determined by several forms of Hygrometers. The simplest of all forms and eminently useful within its range of accuracy is the Wall or Stationary Hygrometer No. 540. An attractively constructed metallic frame, with an eyelet at the top for suspension on a wall or within an instrument shelter, carries two Thermometers mounted above a glass reservoir of water. The Thermometer at the right, stamped "dry," indicates the actual temperature of the free air. The Thermometer marked "wet" has its mercury bulb wrapped in a moistened wick extending below into the water. Evaporation about the wet bulb will lower the temperature and manifest its amount by the difference of the readings of the two Thermometers. When these readings are used in conjunction with a table supplied with these instruments, the relative humidity of the atmosphere can be easily computed. The special form of frame employed by us allows the best circulation of air. The Thermometers are stem graduated, thoroughly seasoned and individually tested, being in practical agreement with the hydrogen scale of the U. S. Bureau of Standards.

SLING PSYCHROMETER

U. S. Weather Bureau Pattern

FOR determining relative humidity of the atmosphere, the dew-point and the aqueous content of the atmosphere, the Sling Psychrometer is well known as the standard instrument by all interested in weather conditions. In the Weather Bureau pattern, two mercurial Thermometers are mounted each on a one-piece aluminum frame. One of these Thermometers is a simple Standard Exposed Thermometer for indicating the temperature of the air. The bulb of the other Thermometer is wrapped in a tubular gauze moistened with distilled water. At the top of the aluminum frame a hard wood handle is loosely linked, with which the instrument may be whirled vigorously causing evaporation of the moisture of the gauze covering the wet bulb. This evaporation lowers the temperature, and the difference between the readings of the dry bulb and wet bulb Thermometers will be an index of the relative humidity of the atmosphere.

The Thermometers used in this instrument are each thoroughly seasoned, stem graduated, individually tested and in practical agreement with the hydrogen scale of the U. S. Bureau of Standards.



No. 550

SLING PSYCHROMETER

U. S. Weather Bureau Pattern

No. 550—SLING PSYCHROMETER, U. S. WEATHER BUREAU PATTERN, of two 10-inch graduated mercurial Thermometers with cylindrical bulbs, mounted upon a substantial ribbed aluminum back. A hard wooden handle with suitable links is included. Thermometers are accurately graduated along the stems in *Fahrenheit* degrees from -30° to $+120^{\circ}$. Complete with set of U. S. Government Psychrometric Tables. \$

(Weight: gross, 3 lbs; net, 1 lb.)

No. 550-A—THERMOMETER FOR SLING PSYCHROMETER, 10 inches long, for use as wet or dry bulb, graduated along the stem in *Fahrenheit* degrees, from -30° to $+120^{\circ}$.
\$

(Weight: gross, 2 lbs; net, 4 oz.)

No. 551—SLING PSYCHROMETER, consisting of two 10-inch graduated mercurial Thermometers with cylindrical bulbs, mounted upon substantial ribbed aluminum back. Differs from No. 550 in that the Thermometers are graduated in *Centigrade* degrees from -35° to $+45^{\circ}$; complete with set of Government Psychrometric Tables. \$

(Weight: gross, 3 lbs; net, 1 lb)

No. 551-A—THERMOMETER FOR SLING PSYCHROMETER, 10 inches long for use as wet or dry bulb, graduated along the stem in *Centigrade* degrees from -35° to $+45^{\circ}$.
\$

(Weight: gross, 2 lbs; net, 4 oz.)

WHIRLING PSYCHROMETER

Whirling Apparatus



No. 560

No. 560—WHIRLING PSYCHROMETER (Whirling Apparatus), U. S. WEATHER BUREAU PATTERN, consisting of two accurately graduated thermometers (wet and dry bulb), each mounted vertically upon balanced arms; the shaft is propelled by beveled gearing to a crank or power handle extended 25 inches. A substantial iron column forms a rigid mounting. Thermometers are 10 inches in length, graduated in *Fahrenheit* degrees from -30° to $+120^{\circ}$. Complete with set of U. S. Government Psychrometric Tables\$.....
 (Weight: gross, 45 lbs; net, 25 lbs.)

No. 560-A—THERMOMETER FOR WHIRLING PSYCHROMETER (when purchased extra), for use as wet or dry bulb, graduated along the stem in *Fahrenheit* degrees, from -30° to $+120^{\circ}$.
 (Weight: gross, 2 lbs; net, 4 oz.)\$.....

No. 561—WHIRLING PSYCHROMETER (Whirling Apparatus), differs from No. 560 in that the thermometers are graduated in *Centigrade* degrees from -35° to $+45^{\circ}$. Complete with set of U. S. Government Psychrometric Tables. \$
 (Weight: gross, 2 lbs; net, 4 oz.)

No. 561-A—THERMOMETER FOR WHIRLING PSYCHROMETER (when purchased extra), for use as wet or dry bulb, graduated along the stem in *Centigrade* degrees, from -35° to $+45^{\circ}$.
 (Weight: gross, 2 lbs; net, 4 oz.) \$

WHIRLING PSYCHROMETER

Whirling Apparatus

ALL wet and dry bulb thermometers must be whirled in some manner in order to set up the necessary evaporation around the wet bulb thermometer. In all methods of whirling by hand, the thermometers stand in danger of breakage, and errors are likely also to occur due to the lack of sufficient whirling by the observer or to the heat from his body. For this reason, throughout the Weather Bureau Service, a Whirling Psychrometer such as we manufacture, has been extensively used and has given eminent satisfaction. With no danger of breaking the thermometers, it permits of vigorous whirling and thus insures the completest evaporation possible, at the same time keeping the instrument far removed from the body of the operator.

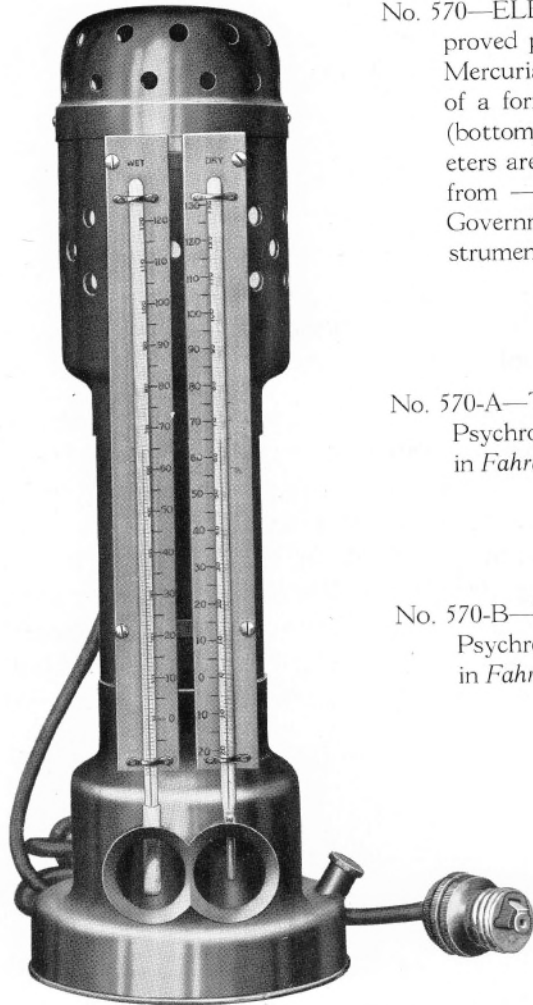
The wet and dry bulb thermometers are supported each on a vertical arm of a staunch upright column, and the shaft connecting these two arms is geared to a drive shaft 25 inches long, at the end of which is a conveniently gripped handle, which makes the whirling safe and easy. The thermometers are of the best, being thoroughly seasoned and stem graduated and agree practically with the hydrogen scale of the U. S. Bureau of Standards. They are supplied graduated in either *Centigrade* or *Fahrenheit* degrees.

The base of the instrument is supplied with screws for securing it to the floor of the instrument shelter.

In making readings from wet and dry bulb thermometers, and especially in using them as a check against Friez Hygrographs, it is important to realize that it is quite difficult to make exact computations of humidity by the wet and dry bulbs. Scarcely two observers will make the same readings under identical conditions. Likewise in making such comparisons, the observer should be careful that the hygrograph, and the wet and dry bulb thermometers receive the same exposure.

NOTE.—In ordering Thermometers for replacement, the purchaser should state, in addition to the serial number of the Thermometer, the catalogue number of the instrument for which the replacement is needed.

ELECTRIC ASPIRATING PSYCHROMETER



No. 570

No. 570—ELECTRIC ASPIRATING PSYCHROMETER, improved pattern, consisting of two accurate stem-graduated Mercurial Thermometers, mounted rigidly upon the face of a formed nickel tube which encloses a water reservoir (bottom) and a 110-volt universal motor (top). Thermometers are 10 inches in length graduated in *Fahrenheit* degrees from -30° to $+120^{\circ}$. Extra wicking and a set of U. S. Government Psychrometric Tables accompany each instrument.\$.....

(Weight: gross, 15 lbs; net, 5 lbs.)

No. 570-A—THERMOMETER (dry bulb) for Electric Aspirating Psychrometer (when purchased extra) graduated along stem in *Fahrenheit* degrees from -30° to $+120^{\circ}$\$.....

(Weight: gross, 2 lbs; net, 4 oz.)

No. 570-B—THERMOMETER (wet bulb) for Electric Aspirating Psychrometer (when purchased extra) graduated along stem in *Fahrenheit* degrees from -30° to $+120^{\circ}$\$.....

(Weight: gross, 2 lbs; net, 4 oz.)

No. 571—ELECTRIC ASPIRATING PSYCHROMETER. Improved pattern; differs from No. 570 in that the Thermometers are graduated in *Centigrade* degrees from -35° to $+45^{\circ}$\$.....

(Weight: gross, 15 lbs; net, 5 lbs.)

No. 571-A—THERMOMETER (dry bulb) for Electric Aspirating Psychrometer (when purchased extra) graduated along stem in *Centigrade* degrees from -35° to $+40^{\circ}$\$.....

(Weight: gross, 2 lbs; net, 4 oz.)

No. 571-B—THERMOMETER (wet bulb) for Electric Aspirating Psychrometer (when purchased extra) graduated along stem in *Centigrade* degrees from -35° to $+45^{\circ}$\$.....

(Weight: gross, 2 lbs; net, 4 oz.)

ELECTRIC ASPIRATING PSYCHROMETER

THIS instrument by which the moisture of the air in any portion of space may be easily and accurately determined has been designed in the Friez Laboratories to meet the demands of textile industries, steel mills, lumber drying kilns, paper factories, chemical laboratories or generally wherever accurate information with regard to humidity is required. Likewise it may be used as a standard by which to check the readings of all recording Hygrometers.

Using the power of an electric motor in place of the older hand-swung motion, its registrations are absolutely accurate and consistent and admit almost no occasion for error. Especially suited for indoor use, it may be stationed upon a desk or table or be hung upon a wall. Too, it is nickel-plated to preclude the influence of heat radiation from surrounding objects.

Our motor ventilated Psychrometer is very compact and portable, measuring only 15 inches in height, the diameter of its base being $5\frac{1}{4}$ inches. A perforated helmet at the top covers a small motor which drives a specially designed fan, operating at a speed to make the velocity of the passing air 20 feet per second, thus insuring the completest evaporation possible. At the bottom of the instrument, there is a reservoir containing distilled water, and on the face two Thermometers are located, permitting the free circulation of the air. The Thermometer at the left with its bulb encased in a wick leading into the reservoir serves as the wet bulb Thermometer and the Thermometer at the right, marked "dry," indicates the room temperature. By reference to the tables supplied with the instrument, from the difference in the readings of the two Thermometers the observer may ascertain the relative humidity, the aqueous content, or the vapor pressure at any particular moment.

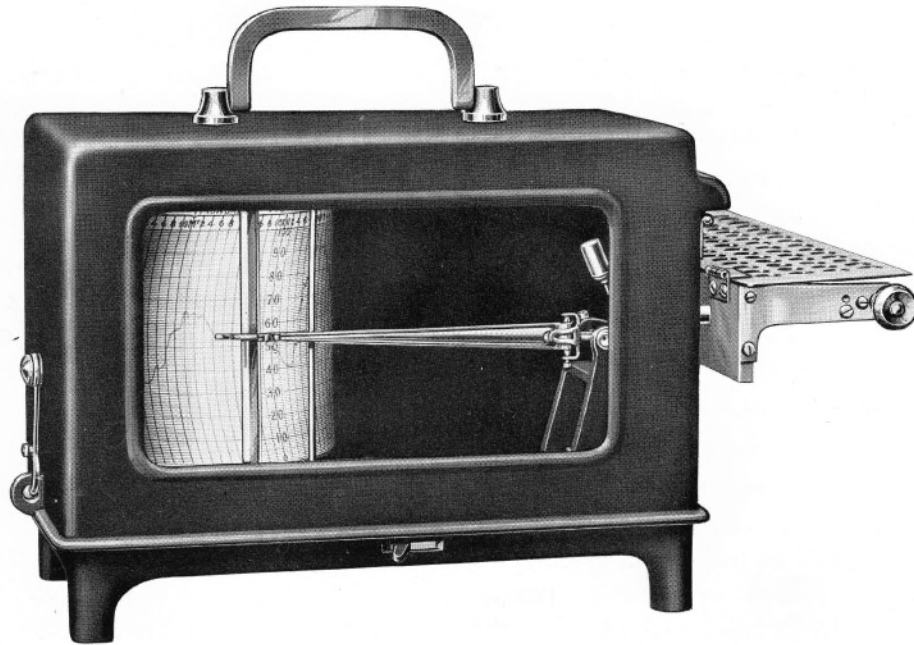
The motor is easily accessible for oiling and inspection and may be driven by either direct or alternating current of 110 volts.

The Thermometers used are stem-graduated, thoroughly seasoned and individually tested and in practical agreement with the Hydrogen scale of the U. S. Bureau of Standards.

NOTE.—In ordering replacement Thermometers for the Electric Aspirating Psychrometer, customers will avoid delays and misunderstandings by specifying with great clearness the Thermometer needed. It is best that the metal back on which the Thermometer was mounted be returned along with the broken Thermometer which is to be replaced. From time to time certain slight modifications have been made in the mountings of the Thermometers used, and the exact replacement can be made if the above instructions be observed.

HYGROGRAPH

Recording Hair Hygrometer



No. 580

No. 580—HYGROGRAPH (RECORDING HAIR HYGROMETER), U. S. WEATHER BUREAU MULTIPLE STRAND TYPE; 3½-inch chart; weekly clock movement. Instrument complete with pen, ink, and year's supply (55) *weekly* charts No. 58-B; range 0% to 100%...\$.
(Weight: gross, 27 lbs; net, 9 lbs.)

No. 581—HYGROGRAPH (RECORDING HAIR HYGROMETER), U. S. WEATHER BUREAU MULTIPLE STRAND TYPE; 3½-inch chart; weekly clock movement; chart cylinder, making one revolution in twenty-nine hours, is arranged for daily records. Instrument complete with pen, ink, and year's supply (375) *daily* charts No. 58-D; range 0% to 100%...\$.
(Weight: gross, 30 lbs; net, 9 lbs.)

HYGROGRAPH

Recording Hair Hygrometer

THE Standard U. S. Weather Bureau Hygrograph marks the climax in perfection of instruments recording humidity on charts adapted for either daily or weekly time-periods. Though the simplest of all instruments for such purposes, this Hygrograph surpasses all others yet devised, and we say this with an assurance resulting from years of experience, in the ease with which the charts may be read, in the long life of the instrument rarely impaired by mechanical disorders, in the accuracy of the clock movement, and in finished workmanship throughout. The humidity readings

are obtained directly from the chart; no recourse need be taken to tables of humidity, as is necessary in the various forms of Hygrometers and Psychrometers.

On account of these superior qualities, this Hygrograph has met with remarkable approval over a wide field, not only in scientific research, but in many branches of industry. Recording humidity in temperatures as high as $+140^{\circ}$ Fahrenheit, such exposure has not injured the clock movement nor caused any deterioration in the humidity registering element.

Human hair, fifty strands of equal length, makes up the very simple registering element. No other device approaches this peculiar one in unvarying sensitiveness. Subject to neither elongations nor shrinkage changes, throughout a long life it will constantly and uniformly manifest the same reaction to moisture and dryness. The strand held in position by bracket clamps is exposed on the outside of the instrument case to receive the free circulation of the air, with hinged guard above to shield it from foreign disturbances which might affect true registration. As the humidity increases, there is a corresponding increase in the length of the strands which causes the pen to rise on the chart. A decrease of humidity, or a drying of the air, shortens the hair and causes a corresponding fall of the pen.

The charts are ruled horizontally from 0 per cent to 100 per cent, representing complete dryness and complete saturation. Vertical lines denote the half-hour intervals on the daily chart (No. 581) and two-hour periods on the weekly chart (No. 580).

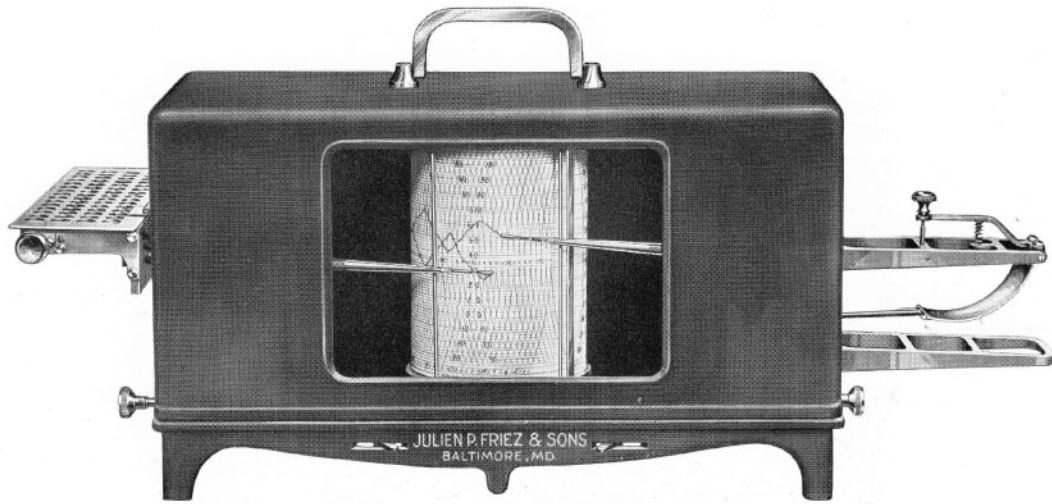
The base of the instrument is one-piece cast aluminum, to which is hinged a single glass-panel case, with a handle above for carrying purposes. An enamel finish not only adds to the appearance of the instrument but renders it serviceable for either indoor or outdoor exposure.

Complete instructions for the care of the Hygrograph are sent along with the shipment of each instrument. The following instructions regarding the wetting of the hairs after the instrument has been received are of utmost importance.

The strand of hairs should be wet by stroking them lightly and for their full length with camel's hair brushes provided for the purpose, previously saturated with distilled water. The brush must be absolutely clean and free from oil. Distilled water only should be used as other waters usually contain mineral and foreign matter in solution or suspension and would leave a deposit on the hairs and impair their sensitiveness.

The wetting process takes from three to four minutes, the pen meanwhile slowly rising toward the 100 per cent position of the chart. Saturation of hairs is indicated when the upward movement ceases, even after continued wetting of the strand. When hair strand is in thoroughly saturated state, turn the milled head on the spreader rod of the hair strand frame from right to left, until the pen indicates 90 per cent humidity. The instrument is now ready for service, and without further attention the pen will in the course of thirty minutes, or less, fall gradually to its proper position, and indicate the relative humidity due to evaporation of the moisture from the strand induced by the air circulation and ventilation.

MODEL A HYGRO-THERMOGRAPH

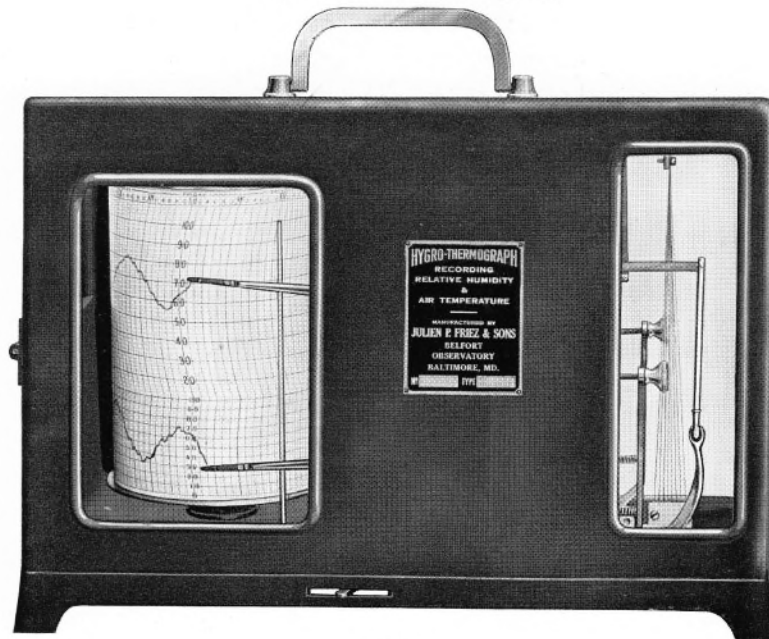


No. 592

- No. 590—HYGRO-THERMOGRAPH, Bourdon tube and multiple strand type; 3½-inch chart; weekly clock movement, complete with year's supply (55) *weekly* charts No. 1072-D. Temperature range +10° to +100° *Fahrenheit*, humidity 5 per cent to 100 per cent\$.....
 (Weight: gross, 32 lbs; net, 12 lbs.)
- No. 591—HYGRO-THERMOGRAPH, Bourdon tube and multiple strand type; 3½-inch chart; weekly clock movement, chart cylinder making one revolution in twenty-nine hours, is arranged for daily records. Complete with year's supply (375) *daily* charts No. 1072-H. Temperature range +10° to +100° *Fahrenheit*, humidity 5 per cent to 100 per cent\$.....
 (Weight: gross, 35 lbs; net, 12 lbs.)
- No. 592—HYGRO-THERMOGRAPH, Bourdon tube and multiple strand type; 5-inch chart; weekly clock movement, complete with year's supply (55) *weekly* charts No. 201-W. Temperature range -35° to +110° *Fahrenheit*, humidity 0 per cent to 100 per cent\$.....
 (Weight: gross, 32 lbs; net, 12 lbs.)
- No. 593—HYGRO-THERMOGRAPH, Bourdon tube and multiple strand type; 5-inch chart; weekly clock movement, chart cylinder making one revolution in twenty-nine hours, is arranged for daily records. Complete with year's supply (375) *daily* charts No. 201-D. Temperature range -35° to +110° *Fahrenheit*, humidity 0 per cent to 100 per cent\$.....
 (Weight: gross, 35 lbs; net, 12 lbs.)
- No. 598—HYGRO-THERMOGRAPH, Bourdon tube and multiple strand type; 5-inch chart; weekly clock movement, complete with year's supply (55) *weekly* charts No. 203-W. Temperature range -5° to +150° *Fahrenheit*, humidity 0 per cent to 100 per cent\$.....
 (Weight: gross, 32 lbs; net, 12 lbs.)
- No. 599—HYGRO-THERMOGRAPH, Bourdon tube and multiple strand type; 5-inch chart; weekly clock movement, chart cylinder making one revolution in twenty-nine hours, is arranged for daily records. Complete with year's supply (375) *daily* charts No. 203-D. Temperature range -5° to +150° *Fahrenheit*, humidity 0 per cent to 100 per cent\$.....
 (Weight: gross, 35 lbs; net, 12 lbs.)

MODEL B HYGRO-THERMOGRAPH

U. S. Weather Bureau Pattern



No. 594

- No. 594—HYGRO-THERMOGRAPH, Bourdon tube and banjo spread of hair; 5-inch chart; weekly clock movement, complete with year's supply (55) *weekly* charts No. 207-W. Temperature range +10° to +110° *Fahrenheit*, humidity 0 per cent to 100 per cent\$.....
 (Weight: gross, 30 lbs; net, 8 lbs.)
- No. 594-L—HYGRO-THERMOGRAPH, Bourdon tube and banjo spread of hair; 5-inch chart; weekly clock movement, complete with year's supply (55) *weekly* charts No. 209-W. Temperature range -30° to +70° *Fahrenheit*, humidity 0 per cent to 100 per cent\$.....
 (Weight: gross, 30 lbs; net, 8 lbs.)
- No. 595—HYGRO-THERMOGRAPH, Bourdon tube and banjo spread of hair; 5-inch chart; weekly clock movement. Chart cylinder making one revolution in twenty-nine hours is arranged for daily records. Complete with year's supply (375) *daily* charts No. 207-D. Temperature range +10° to +110° *Fahrenheit*, humidity 0 per cent to 100 per cent\$.....
 (Weight: gross, 33 lbs; net, 8 lbs.)
- No. 595-L—HYGRO-THERMOGRAPH, Bourdon tube and banjo spread of hair; 5-inch chart; weekly clock movement. Chart cylinder making one revolution in twenty-nine hours is arranged for daily records. Complete with year's supply (375) *daily* charts No. 209-D. Temperature range -30° to +70° *Fahrenheit*, humidity 0 per cent to 100 per cent\$.....
 (Weight: gross, 33 lbs; net, 8 lbs.)
- No. 596—HYGRO-THERMOGRAPH, Bourdon tube and banjo spread of hair; 5-inch chart; weekly clock movement, complete with year's supply (55) *weekly* charts No. 208-W. Temperature range -12° to +43° *Centigrade*, humidity 0 per cent to 100 per cent\$.....
 (Weight: gross, 30 lbs; net, 8 lbs.)
- No. 597—HYGRO-THERMOGRAPH, Bourdon tube and banjo spread of hair; 5-inch chart; weekly clock movement. Chart cylinder making one revolution in twenty-nine hours is arranged for daily records. Complete with year's supply (375) *daily* charts No. 208-D. Temperature range -12° to +43° *Centigrade*, humidity 0 per cent to 100 per cent\$.....
 (Weight: gross, 33 lbs; net, 8 lbs.)

HYGRO-THERMOGRAPH

TEMPERATURE and Humidity are air conditions so essentially interdependent that for many investigations a record of either is of little value without a continuous, simultaneous record of the other. The Hygro-Thermograph is an instrument for recording temperature and relative humidity simultaneously on a single chart. Many accurate industrial processes are dependent for their finest results upon a uniform temperature and a uniform moisture content of the surrounding air. The Hygro-Thermograph draws curves which provide an absolute check on the maintenance of the desired working conditions.

Hygro-Thermographs are made in two models, each characterized chiefly by the method of placing the record on the chart. Model A employs a chart using the same graduations for both temperature and humidity, a double set of lines interlacing on the chart. Model B employs a separate section of the chart for each record. The former provides a larger scale from which to read more accurately the temperature and relative humidity; the latter provides a scale more easily understood by the inexperienced as the curves are never superimposed.

Model B is a more compact instrument. Moreover, since the temperature and humidity elements are protected within the case, the instrument can be safely moved from one location to another.

CONSTRUCTION OF MODELS A and B

TEMPERATURE ELEMENT—The Bourdon tube has proved itself by far the best element for registering temperature accurately through a long period of time. Other temperature elements, which may be as accurate for a time, lose their accuracy in service. The tubes are our own careful manufacture, are filled with alcohol, and are gold-plated outside to offset corrosion or weathering.

HUMIDITY ELEMENT—Human hair sets, carefully selected of equal length and treated by our own process, are one of the chief features contributing to the success of the instrument. These hair sets are renewable if accidents or neglect shall render them faulty.

PENS—The pens are our own design and manufacture. They will write a week's record without refilling and trace a fine clear line. The pen-arms are constant-pressure type and require no adjustment to control the contact with the chart. Lift bars to raise the pens from the chart, operated from outside the case, are supplied with all types.

INKS—Inks are our own special formula especially adapted for recording instruments where a constant flow is required without congealing. Two colors, purple and green, to distinguish temperature and humidity, are supplied with Model A, and one color with Model B.

CASE—The base of the instrument is of cast aluminum, for lightness. The hinged metal cover has a glass window in front of the chart. Cases are beautifully finished in "Friez Brown" lacquer.

MODEL A HYGRO-THERMOGRAPH

Model A Hygro-Thermograph has its temperature and humidity elements and their respective mechanisms mounted on opposite sides of, and outside the case. The temperature and humidity curves are drawn on the same chart using the same graduations, the numeral 70 for instance standing for both degrees of temperature and percentage of humidity. This model is designed for two heights of chart, namely: 3½ inches and 5 inches. The height of chart determines the temperature range but not the humidity range. The 3½-inch chart provides a temperature range from +10° to +100° Fahrenheit or 90° total, with a relative humidity range from 10 per cent to 100 per cent. The 5-inch chart provides two temperature ranges, namely: from -35° to +110° Fahrenheit, or 145° total, and from -5° to +150° Fahrenheit, or 155° total, with the relative humidity range of 0 per cent to 100 per cent with either chart. The choice of chart height depends only on the more useful range of temperature since humidity ranges are practically the same on all charts. Model A can be supplied with either daily or weekly charts.

The Centigrade scale can not be used with this model.

MODEL B HYGRO-THERMOGRAPH

Model B Hygro-Thermograph has its temperature and humidity elements and their respective mechanisms mounted on the same side of the instrument. Compactness is thus attained and separate portions of the chart contain each record. The temperature and humidity elements are the same as in Model A but a different type of hair suspension termed, "multiple banjo spread" is used, wherein the groups of hairs are separated like the strings of a musical instrument. This arrangement has been found to increase sensitiveness to changes of moisture content. Model B can be supplied with either daily or weekly charts. Model B has a 5-inch chart. It is so designed that charts with a Fahrenheit temperature range of either +10° to +110° or -30° to +70° may be used on the same instrument by a simple adjustment which the user can make. Thus by employing two charts, the extreme summer and winter temperatures can be recorded. This model is also supplied with Centigrade scale from -12° to +43° or 55° total. The relative humidity scale is from 0 per cent to 100 per cent in all cases.

CHARTS

SERIAL No.	HEIGHT OF CHART	RANGE OF TEMPERATURE	SCALE	RANGE OF HUMIDITY	TIME	FOR INST. TYPE No.	MODEL	No. OF CHARTS PER SET	RENEWAL PRICE PER SET
1072-D	3½"	+10° to +100°	Fahrenheit	10% to 100%	Weekly	590	A	55	.....
1072-H	3½"	+10° to +100°	Fahrenheit	10% to 100%	Daily	591	A	375	.....
201-W	5"	-35° to +110°	Fahrenheit	0% to 100%	Weekly	592	A	55	.....
201-D	5"	-35° to +110°	Fahrenheit	0% to 100%	Daily	593	A	375	.....
203-W	5"	-5° to +150°	Fahrenheit	0% to 100%	Weekly	598	A	55	.....
203-D	5"	-5° to +150°	Fahrenheit	0% to 100%	Daily	599	A	375	.....
207-W	5"	+10° to +110°	Fahrenheit	0% to 100%	Weekly	594	B	55	.....
207-D	5"	+10° to +110°	Fahrenheit	0% to 100%	Daily	595	B	375	.....
208-W	5"	-12° to +43°	Centigrade	0% to 100%	Weekly	596	B	55	.....
208-D	5"	-12° to +43°	Centigrade	0% to 100%	Daily	597	B	375	.....
209-W	5"	-30° to +70°	Fahrenheit	0% to 100%	Weekly	594-L	B	55	.....
209-D	5"	-30° to +70°	Fahrenheit	0% to 100%	Daily	595-L	B	375	.....

OBSERVATORY AND MARINE MERCURIAL BAROMETERS



No. 750-B



No. 750

No. 750—MERCURIAL OBSERVATORY BAROMETER, fixed cistern type; highest grade with glass-enclosed scale graduated and marked to read in inches of mercury divided to twentieths of an inch and reading by vernier to one-five-hundredth of an inch. . . . \$
(Weight: gross, 75 lbs; net, 8 lbs.)

No. 750-A—MERCURIAL OBSERVATORY BAROMETER, fixed cistern type (No. 750); instrument mounted upon highly finished mahogany paneled board. \$
(Weight: gross, 78 lbs; net, 10 lbs.)

No. 750-B—MERCURIAL OBSERVATORY BAROMETER, fixed cistern type (No. 750); instrument mounted in all-metal highly enameled case with single glass panel. . . . \$
(Weight: gross, 80 lbs; net, 16 lbs.)

No. 751—MERCURIAL MARINE BAROMETER; fixed cistern type; highest grade with glass-enclosed scale graduated and marked to read in inches of mercury divided to twentieths of an inch and reading by vernier to one-five-hundredth of an inch, gimbal mounting with hinged arm to maintain vertical position of tube at all times. Exclusive of metal enclosing case \$
(Weight: gross, 80 lbs; net, 10 lbs.)

No. 751-B—MERCURIAL MARINE BAROMETER, fixed cistern type (No. 751) with hinged arm and gimbals; instrument mounted in all-metal, highly enameled case with single glass panel. \$
(Weight: gross, 85 lbs; net, 18 lbs.)

OUR fixed cistern Barometer illustrated here possesses two distinct advantages over all other kinds of Barometers. First, the readings of barometric pressure are made immediately and directly from the scales without any adjustment of the mercury level. Second, the design of the instrument makes safe shipment possible; something long desired by those who know the uncertainty experienced with other types of Barometers. Before shipment, the mercury of this Barometer may be forced out of the cistern until the glass tube is entirely filled, by screwing together the two halves of the cistern, which is adjoined by a dog-skin sleeve. No Barometer of ours has ever been received by the purchaser in an unserviceable condition.

MERCURIAL BAROMETERS

THE Mercurial Barometer of our manufacture is of the Kew pattern or fixed cistern type, the valuable characteristic of which is that a reading of the mercury level can be made at any time without adjustment of the mercury column, as is necessary in other types of Barometers. Our Barometer, we are proud to say, is of the very highest precision.

The construction of the Kew type of Barometer is based on this principle that the fall of mercury in the cistern coincident with its rise in the tube may be compensated for on specially calibrated scales, without using a mechanical means of lowering or lifting the mercury basin. In order that these special scales may be standard and interchangeable, it is necessary to dimension with extreme accuracy the steel mercury cistern and to use only glass tubes of selected measurements.

The steel cistern carefully machined and polished, is made in two parts, joined by a sleeve of dog-skin so that by means of an adjusting set-screw the cistern may be closed tightly to insure safe shipment of the complete instrument.

The tube is of lead-glass of bore of extreme selection. Only such tubes are used which warrant an accuracy of compensation within .012 of an inch per inch of mercury change. No tubes are installed which show any scratches, bubbles or defects of any kind. The tubes are filled by distilling chemically pure mercury into the tube under the best vacuum obtainable by a double stage mercury diffusion pump.

The tube enclosure and cistern enclosure are of brass, highly polished and lacquered.

The scales, enclosed in glass, are of German silver, each separately and carefully engraved for a range from 23 to 32 inches by twentieths of an inch. The vernier, of German silver, engraved to read to one five-hundredth of an inch is adjusted by a brass thumbscrew through a carefully fitted rack. A Thermometer mounted on a brass base is attached to the tube enclosure.

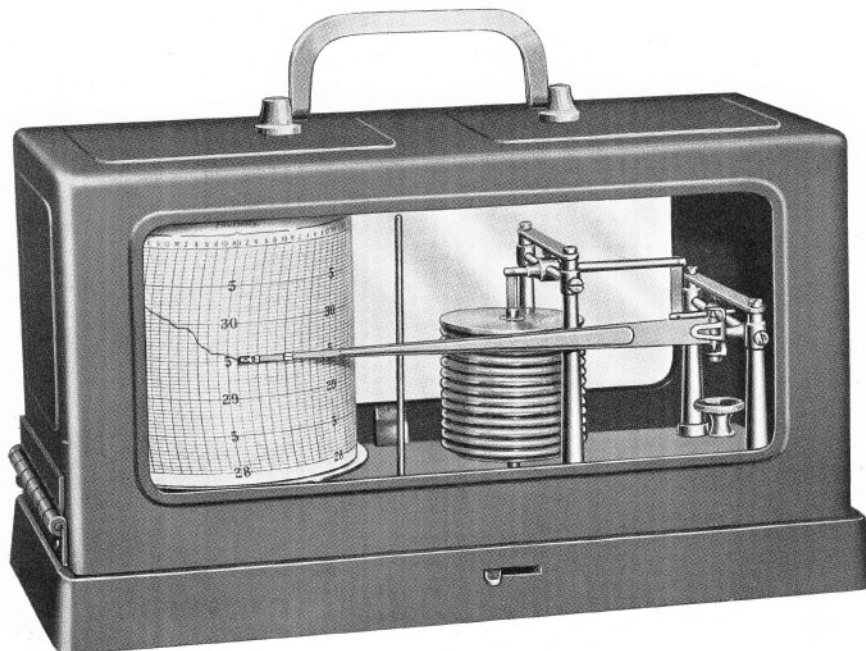
For shipboard this same type of a Barometer is made with a specially blown tube with capillary lower half and with an air-trap; thus pumping of the Barometer is estopped. Our special Marine Barometer is mounted in gimbals to maintain the vertical position of the tube.

We provide two types of mounting for Barometers. One mounting is an all-mahogany board on which the instrument is fixed with polished brass hardware. Where it is necessary to protect the Barometer from any tampering or injury, the instrument is suspended within an all-metal case with a full-length hinged glass door.



STATION BAROGRAPH

U. S. Weather Bureau Pattern



No. 620

No. 620—STATION BAROGRAPH, SYLPHON VACUUM CHAMBER, U. S. WEATHER BUREAU PATTERN: 3½-inch chart; weekly clock movement. Charts are graduated from 28 to 31 inches of mercury for elevations up to 1,000 feet. Double glass-panel all-metal case attractively finished. Instrument complete with pen, ink, and year's supply (55) *weekly* charts No. 1068. \$.....

(Weight, gross, 30 lbs; net, 8 lbs.)

No. 621—STATION BAROGRAPH: same as No. 620, except charts are graduated from 27 to 30 inches of mercury; for elevations between 1,000 and 2,000 feet. Instrument complete with pen, ink, and year's supply (55) *weekly* charts No. 1068-A.\$.....

(Weight: gross, 30 lbs; net, 8 lbs.)

No. 622—STATION BAROGRAPH: same as No. 620, except charts are graduated from 26 to 29 inches of mercury; for elevations between 2,000 and 3,000 feet. Instrument complete with pen, ink, and year's supply (55) *weekly* charts No. 1068-B.\$.....

(Weight: gross, 30 lbs; net, 8 lbs.)

No. 623—STATION BAROGRAPH: same as No. 620, except charts are graduated from 25 to 28 inches of mercury; for elevations between 3,000 and 4,000 feet. Instrument complete with pen, ink, and year's supply (55) *weekly* charts No. 1068-C.\$.....

(Weight: gross, 30 lbs; net, 8 lbs.)

No. 624—STATION BAROGRAPH. Same as No. 620, except charts are graduated from 24 to 27 inches of mercury, for elevations between 4,000 and 5,000 feet. Instrument complete with pen, ink, and year's supply (55) *weekly* charts No. 1068-D.....\$.....

(Weight: gross, 30 lbs; net, 8 lbs.)

No. 625—STATION BAROGRAPH. Same as No. 620, except charts are graduated from 23 to 26 inches of mercury, for elevations between 5,000 and 6,000 feet. Instrument complete with pen, ink, and year's supply (55) *weekly* charts No. 1068-E.....\$.....

(Weight: gross, 30 lbs; net, 8 lbs.)



STATION BAROGRAPH

Recording Barometer

STANDARD STATION BAROGRAPHS as produced by the Friez Laboratories represent the most accurate and the most satisfactory in every way of all similar instruments now in scientific and commercial use. Essentially they are aneroid Barometers registering atmospheric pressure by its influence upon an elastic metallic vacuum chamber. The sensitive element connected by suitable magnifying levers to a pen described continuously upon a chart the varying air pressures from one time-period to another. The charts are accurately ruled to denote inches of pressure according to the mercurial standard, and the hours of the day and the days of the week are printed at the top of each chart. The weekly clock employed is the best attainable with full-jeweled anchor escapement.

In place of the old-fashioned group of separate cells forming the heart of the Barograph, our Laboratories after many years' comparative study of all the various sensitive elements have incorporated the sylphon element as a featured specialty into all our Barographs. By this novel and unique device of a single corrugated tube, not only has the lag or hysteresis, or slowness of metal to respond to pressure changes been minimized and in fact for all needed purposes eliminated, but compensation for temperature has also been attained to a degree hitherto unknown. Records of daily variations, made by instruments of this type equipped with the sylphon element, will be found not only to be identical with one another but to agree also with the Standard Mercurial Barometer readings. A milled-head thumbscrew placed within easy reach on the top surface of the instrument base and controlling the movement of the sylphon element in a vertical line without strain or friction upon the various pivots enables the observer to set the pen for any pressure for any elevation up to 5,000 feet. This type of instrument is positively the last word in Barographs.

We have discontinued all other construction in our Barographs, except that which embodies an all-metal case and base. Experience has shown that the use of

wood in the case, and to a greater extent in the base of a Barograph brings in elements of deterioration from warping or other conditions which far outweigh any other considerations. Within an attractively finished glass-panelled case, the complete mechanism is carefully built and adjusted on an all-metal base.

The manufacture and especially the testing and calibrating of a Friez Barograph is costly. But the results obtained will warrant the care that is spent. A scientific, reliable instrument hereby is produced, which shows far less influence from temperature changes than is ever required, and a lack of lag that is not approached even in less expensive and less carefully manufactured instruments. Chiefly too to be noted is that minute changes in pressure will be shown on a chart made by a Friez Barograph that do not appear on charts from lower priced Recorders. Friez Barographs are not built down to a price, but are built up to a standard.

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INSTRUCTIONS FOR USE OF BAROGRAPHS, THERMOGRAPHS, AND HYGROGRAPHS

WE have deemed it useful to place here in our catalogue some general instructions for the installation and operation of our Barographs, Thermographs, Hygrographs and of all recording instruments of this class having vertical chart cylinders.

After unpacking raise the hinged cover case and remove carefully the strings that hold the parts in a firm position during shipment, viz: the pen-arms, the strand of hairs, and the projecting levers adapted to lift the recording pens from the chart.

To start or renew a record, lift the pens from the chart and take the cylinder from the upright shaft. The chart may be removed by pulling out the spring clip which holds it in place. Wind the clock and put on a new chart so that its lower edge rests upon the projecting rim of the cylinder; then replace the cylinder on its shaft and lower it gently until the gears at the bottom interlock.

Before returning the pens to the chart for a new week's record, the barrel of each pen must be partially filled with the special ink furnished with each instrument. A slip of hard paper may be drawn between the points of the pens to start the flow of ink. Do not allow dust or particles of paper to collect on the pens, and see that no ink remains upon their exterior surfaces. The pens should be taken from the pen-arms once in four months (or oftener if necessary) and carefully washed in warm water, taking special pains not to bend or distort the delicate points.

The pens are set to the proper time on the chart by turning the record cylinder in the same direction as when winding the clock spring. The pen-arm should always be outside of the vertical shift rod. Only a very gentle pressure of the pens is required

to produce neat and fine record lines. The pressure is regulated by a small thumbscrew near the axis end of each pen-arm. To obtain the proper pressure the thumbscrew is to be first turned to the left until the pen point is entirely away from the chart, and then is to be turned back to the right until the point of the pen just touches the chart; a further one-half turn of the thumbscrew will give the required pressure. The recording pens being returned to the chart, the automatic record for the ensuing week or day will begin. The chart will be replaced by another on the following Monday.

In the operation of Barographs, the gilded slyphon vacuum chamber should never be touched or tampered with. In starting Barograph records, the pen should be set to agree with the corrected readings of a Standard Mercurial Barometer by turning the vertical milled-head thumbscrew provided on the base-plate of the mechanism.

To set the pen of a Thermograph to agree with Standard Thermometer readings, a milled-head thumbscrew is provided on the outside of the instrument case on the frame supporting the Bourdon tube. Thermographs should never be exposed to direct sunlight, and operate best outdoors within a properly constructed instrument shelter.

To set the Hygrograph pen, first saturate the strands of hair with distilled water by stroking them with a clean camel's hair brush. By means of the milled-head nut on the outside of the case the pen should be then set at the 90 per cent line on the chart. Within thirty minutes or less, the evaporation of the water from the thoroughly saturated hairs will cause the pen to record within 3 per cent the relative humidity of the surrounding atmosphere. This method of setting the pen, by saturating the hairs, can be subsequently followed very advantageously each Monday if desired on the starting of a new record. *The pen should not be set according to the readings of a wet and dry bulb Psychrometer, but only in the manner just described. The relative humidity as given by a wet and dry bulb Psychrometer should be used only in check comparisons.*

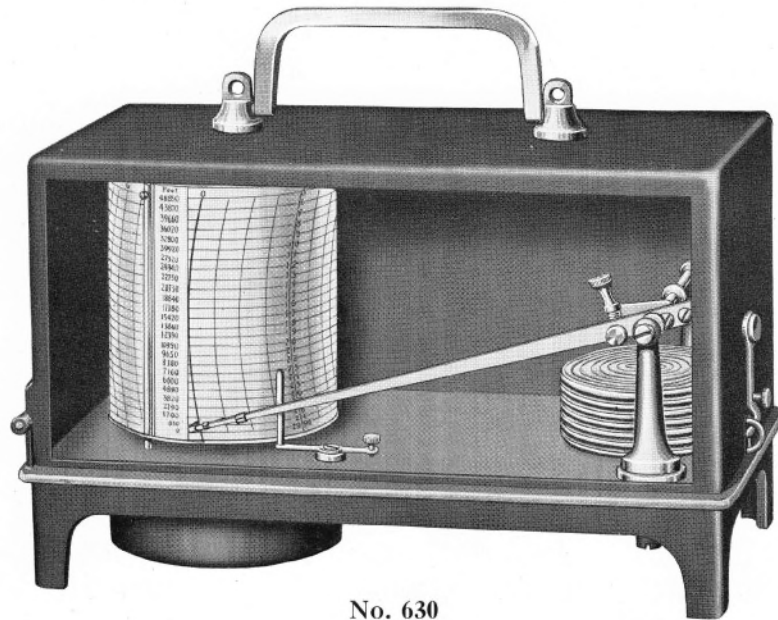
Before setting the pen of a Soil Thermograph, it is necessary to consider the particular range of temperature under investigation. For instance, if the temperature range is expected to be between 70° and 90°, the thermostatic bulb should be totally immersed in a pail of water, kept in motion at a temperature of 80° or half way between the expected extremes. This immersion should be continued for fifteen minutes before setting the pen; five minutes immersion, however, suffices with the radiator bulb type of Distance Thermograph.

Each instrument is most carefully tested, adjusted and regulated before being packed for shipment.



ALTITUDE BAROGRAPH

Direct Acting—Single Pen Traverse



No. 630

No. 630—ALTITUDE BAROGRAPH, DIRECT ACTING, SINGLE PEN TRAVERSE extensively used by U. S. Government Service. The chart cylinder revolves once each hour. Equipped with the syphon vacuum chamber and jeweled anchor escapement clock movement. Copper case, with glass panel, fitted with handle and suspension rings. Chart 3 inches high for pressure changes from 31 to 14 inches of mercury; for elevations up to 19,500 feet. Instrument complete with pen, non-freezing ink No. 20, and supply of 100 charts No. 1068-F \$

(Weight: gross, 25 lbs; net, 4 lbs.)

No. 631—ALTITUDE BAROGRAPH. All details of construction including the mercury range from 31 to 14 inches same as No. 630, except that the cylinder revolves once in six and seven-eighths hours. Instrument complete with pen, non-freezing ink No. 20, and supply of 100 charts No. 1068-6-F \$

(Weight: gross, 25 lbs; net, 4 lbs.)

No. 632—ALTITUDE BAROGRAPH. All details of construction including the mercury range same as in No. 630, except that the cylinder revolves once in twenty-four hours. Instrument complete with pen, non-freezing ink No. 20, and supply of 100 charts No. 1068-24-F \$

(Weight: gross, 25 lbs; net, 4 lbs.)

No. 650—ALTITUDE BAROGRAPH, same as No. 630 in general construction, adapted for pressure changes from 31 to 5 inches of mercury; for elevations up to 42,000 feet, equipped with cylinder making one revolution each hour. Instrument complete with pen, non-freezing ink No. 20, and supply of 100 charts No. 1068-G \$

(Weight: gross, 25 lbs; net, 4 lbs.)

No. 651—ALTITUDE BAROGRAPH, same as No. 630 in general construction, adapted for pressure changes from 31 to 5 inches of mercury; for elevations up to 42,000 feet, equipped with cylinder making one revolution in six and seven-eighths hours. Instrument complete with pen, non-freezing ink No. 20, and supply of 100 charts No. 1068-6-G. \$

(Weight: gross, 25 lbs; net, 4 lbs.)

No. 652—ALTITUDE BAROGRAPH, same as No. 630 in general construction, adapted for pressure changes from 31 to 5 inches of mercury; for elevations up to 42,000 feet, equipped with cylinder making one revolution in twenty-four hours. Instrument complete with pen, non-freezing ink No. 20, and supply of 100 charts No. 1068-24-G. \$

(Weight: gross, 25 lbs; net, 4 lbs.)

ALTITUDE BAROGRAPH

Direct Acting—Single Pen Traverse

THIS is our original altitude type Barograph, designed by the Friez Laboratories for the U. S. Air Service. Like all Barographs produced by us, it has as the sensitive pressure element a single corrugated metallic tube called the sylphon vacuum chamber in place of the older type of a stack of separate cells. Since there are no soldered joints on the elastic expanding and contracting edges of the sylphon, errors due to lag or hysteresis are obviated and compensation for change in temperature is completely attained. A single lever and link transmits the motion of the sylphon element directly to the pen-arm, thus reducing loose play and friction to a minimum. This direct action feature, due to the large expanding and contracting movement of the sylphon without distortion, is not found in any other make of Barograph. The outstanding feature and most important advantage of this and our other types of altitude Barographs is that they exhibit no lag or after effect, the pen returning immediately to the true pressure reading of the landing field, even when used over the total pressure range of the chart.

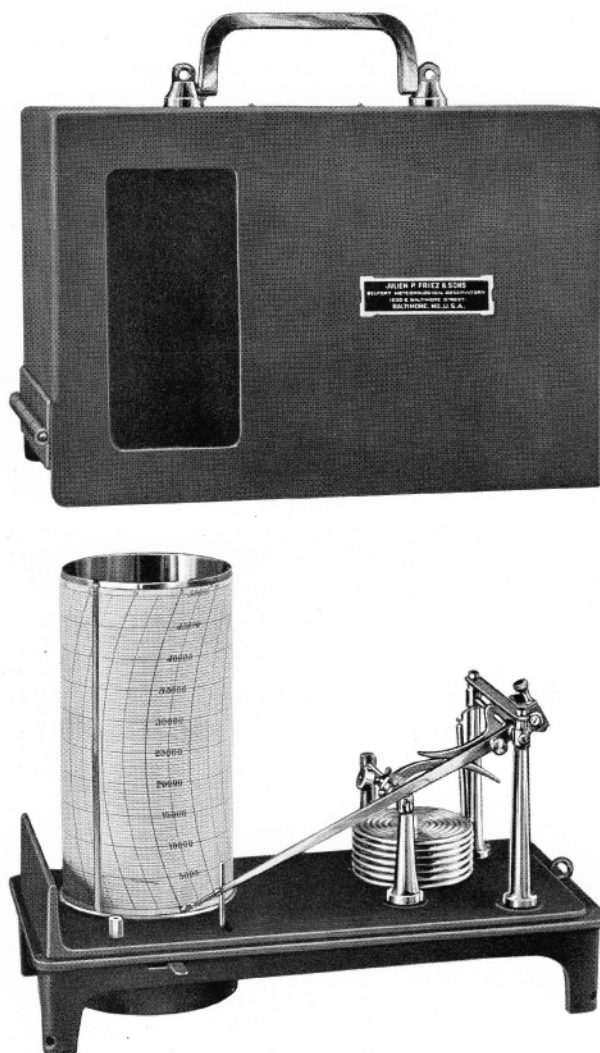
Instruments are equipped with either a one, six and seven-eighths, or twenty-four hour cylinder. A 3-inch chart with inches of pressure equally spaced throughout the scale records changes in pressure from 31 inches to 5 inches of mercury barometric pressure.

The clock used has a jeweled anchor escapement and is especially constructed to endure the low temperatures of high altitudes. Enclosed in a dust-proof case, the clock does not revolve with the chart cylinder, but is secured solidly under the base of the instrument itself, thus reserving the full strength of the clock for the movement of the chart cylinder.

The base of the instrument is of one-piece cast aluminum in which there can be no bending or distortion. A copper case with glass-panel front and fitted with handle and suspension rings encloses the mechanism. A non-freezing ink (No. 20) of our manufacture and suitable charts are supplied with each instrument.

ALTITUDE BAROGRAPH

Cam Control—Single Pen Traverse



No. 660

No. 660—ALTITUDE BAROGRAPH, CAM CONTROL, SINGLE PEN TRAVERSE, featuring the sylphon vacuum chamber, the best clock movement, aluminum base, copper cover, with handle and suspension rings. The use of a cam so controls the pen movement that the 5-inch chart may be graduated with progressively increasing intervals for pressure changes from 31 to 3.43 inches, giving an open scale reading for ceiling elevation records as great as 50,000 feet. Record cylinder makes one revolution each hour. Instrument complete with pen, non-freezing ink No. 20, and supply of 100 charts No. 1068-I. \$

(Weight: gross, 25 lbs; net, 5 lbs.)

No. 661—ALTITUDE BAROGRAPH, CAM CONTROL, SINGLE PEN TRAVERSE, same as No. 660, except that the record cylinder makes one revolution in $6\frac{7}{8}$ hours. Instrument complete with pen, non-freezing ink No. 20, and supply of 100 charts No. 1068-6-I. \$

(Weight: gross, 25 lbs; net, 5 lbs.)

- No. 662—ALTITUDE BAROGRAPH, CAM CONTROL, SINGLE PEN TRAVERSE, same as No. 660, except that the record cylinder revolves once in twenty-four hours. Instrument complete with pen, non-freezing ink No. 20, and supply of 100 charts No. 1068-24-I.....\$.....
 (Weight: gross, 25 lbs; net, 5 lbs.)
- No. 670—ALTITUDE BAROGRAPH, CAM CONTROL, SINGLE PEN TRAVERSE, general construction same as No. 660. The 5-inch chart, however, is graduated uniformly throughout the scale, with designations given in feet up to 50,000, corresponding to relative pressure changes. Record cylinder revolves once each hour. Instrument complete with pen, non-freezing ink No. 20, and supply of 100 charts No. 1068-J.....\$.....
 (Weight: gross, 25 lbs; net, 5 lbs.)
- No. 671—ALTITUDE BAROGRAPH, CAM CONTROL, SINGLE PEN TRAVERSE, general construction same as No. 660. The 5-inch chart, however, is graduated uniformly through the scale, with designations given in feet up to 50,000. Record cylinder revolves once in $6\frac{7}{8}$ hours. Instrument complete with pen, non-freezing ink No. 20, and supply of 100 charts No. 1068-6-J.....\$.....
 (Weight: gross, 25 lbs; net, 5 lbs.)
- No. 672—ALTITUDE BAROGRAPH, CAM CONTROL, SINGLE PEN TRAVERSE, general construction same as No. 660. The 5-inch chart, however, is graduated uniformly through the scale, with designations given in feet up to 50,000. Record cylinder revolves once in twenty-four hours. Instrument complete with pen, non-freezing ink No. 20, and supply of 100 charts No. 1068-24-J.....\$.....
 (Weight: gross, 25 lbs; net, 5 lbs.)

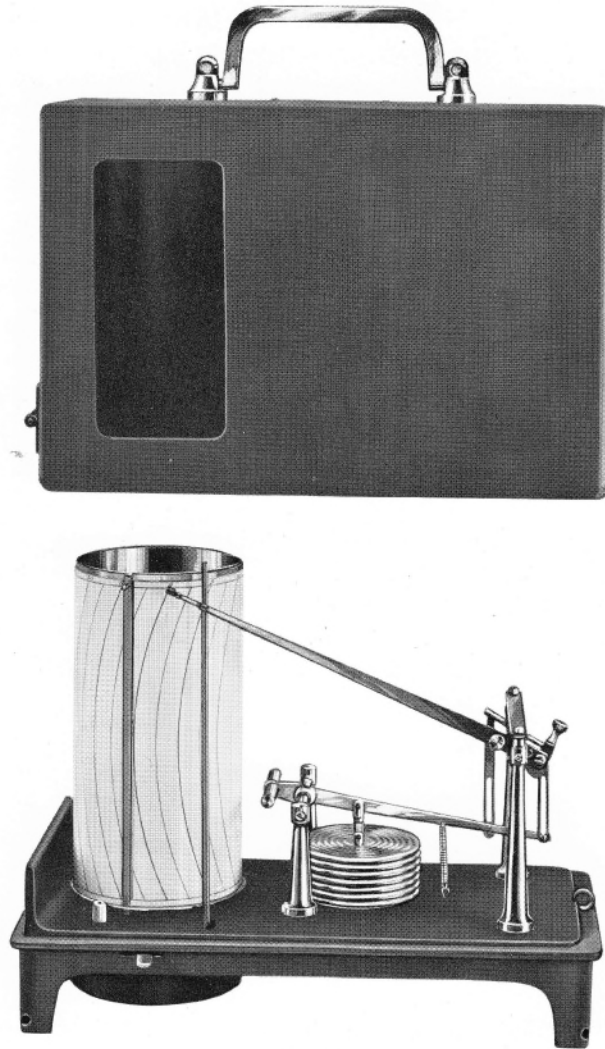
ALTITUDE BAROGRAPH

Cam Control—Single Pen Traverse

POSSESSING all the advantages of our original Altitude Barograph resulting from the use of the slyphon vacuum chamber, the fixed clock with the jeweled anchor escapement, the unbendable aluminum base, this type of Barograph, designed by the Friez Laboratories, transmits the movement of the sensitive element in a peculiar and original way. The movement of the slyphon, varying for different pressures, is so converted by a specially devised cam movement that the 5-inch height chart can be spaced with progressively varying intervals for all pressure changes, and hence the ceiling elevations can be read from an open scale. For those who desire their chart readings in feet and not in inches of mercury this instrument can be equipped with a chart with designations in feet representing the corresponding pressure changes, in which case the height intervals are equally spaced throughout the scale. Instruments are furnished with a one, six and seven-eighths, or twenty-four-hour chart cylinder; also pen, ink, and suitable charts accompany each Barograph.

ALTITUDE BAROGRAPH

Open Scale—Dual Pen Traverse



No. 680

No. 680-A—ALTITUDE BAROGRAPH, OPEN SCALE, DUAL PEN TRAVERSE, featuring the sylvphon vacuum chamber, one-piece aluminum base, best grade clock movement, with jeweled anchor escapement, copper cover, with handle and suspension rings, embodies the Fergusson link movement which affords through the reversal of the pen, a chart of equivalently 10 inches on a cylinder 5 inches in height, giving open scale readings for pressure changes between 31 and 9 inches of mercury; for elevations up to 30,000 feet. Chart cylinder revolves once each hour. Instrument complete with pen, non-freezing ink No. 20, and supply of 100 charts No. 1068-Q-1.

(Weight: gross, 25 lbs; net, 5 lbs.)

\$.....

No. 681-A—ALTITUDE BAROGRAPH, OPEN SCALE, DUAL PEN TRAVERSE, same as No. 680-A, except cylinder revolves once in $6\frac{7}{8}$ hours. Instrument complete with pen, non-freezing ink No. 20, and supply of 100 charts No. 1068-Q-6.\$.....

(Weight: gross 25 lbs; net, 5 lbs.)

No. 682-A—ALTITUDE BAROGRAPH, OPEN SCALE, DUAL PEN TRAVERSE, same as No. 680-A, except cylinder revolves once in twenty-four hours. Instrument complete with pen, non-freezing ink No. 20, and supply of 100 charts No. 1068-Q-24.\$.....

(Weight: gross, 25 lbs; net, 5 lbs.)

No. 690-A—ALTITUDE BAROGRAPH, OPEN SCALE, DUAL PEN TRAVERSE, general construction same as No. 680-A. Range of pressure changes, however, is between 31 and 5 inches; for elevations up to 42,000 feet. Chart cylinder revolves once each hour. Instrument complete with pen, non-freezing ink No. 20, and supply of 100 charts No. 1068-R-1.\$.....

(Weight: gross, 25 lbs; net, 5 lbs.)

No. 691-A—ALTITUDE BAROGRAPH, OPEN SCALE, DUAL PEN TRAVERSE, general construction same as No. 680-A. Range of pressure changes, however, is between 31 and 5 inches; for elevations up to 42,000 feet. Chart cylinder revolves once in $6\frac{7}{8}$ hours. Instrument complete with pen, non-freezing ink No. 20, and supply of 100 charts No. 1068-R-6.\$.....

(Weight: gross, 25 lbs; net, 5 lbs.)

No. 692-A—ALTITUDE BAROGRAPH, OPEN SCALE, DUAL PEN TRAVERSE, general construction same as No. 680-A. Range of pressure changes, however, is between 31 and 5 inches; for elevations up to 42,000 feet. Chart cylinder revolves once in twenty-four hours. Instrument complete with pen, non-freezing ink No. 20, and supply of 100 charts No. 1068-R-24.\$.....

(Weight: gross, 25 lbs; net, 5 lbs.)



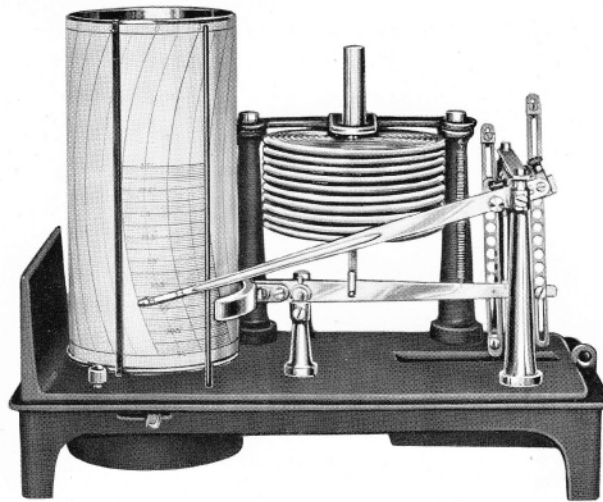
ALTITUDE BAROGRAPH

Open Scale—Dual Pen Traverse

THIS Dual Pen Traverse Open Scale Altitude Barograph, designed by the Friez Laboratories, while featuring all the peculiar advantages of the sylphon vacuum chamber, one-piece cast aluminum base, fixed clock with jeweled anchor escapement, embodies also the Dual Traverse link motion of Mr. S. P. Fergusson, of the U. S. Weather Bureau. The pen, with its unique reversing movement, which gives a chart of equivalently 10 inches height, records on an open scale pressures from 31 to 5 inches, so that with a pressure change of 1 inch of mercury, the pen traverses approximately four-tenths of an inch on the chart. The lever system with reclaiming springs is perfectly balanced, so that pressure readings taken when the instrument is inverted agree with those made by the Barograph when in its normal position. Instruments are equipped with either a one, six and seven-eighths, or twenty-four-hour time chart cylinder, and supplied with our No. 20 non-freezing ink, charts, and pen

ALTITUDE BAROGRAPH

Extreme Open Scale—Quadruple Pen Traverse



No. 700

No. 700—ALTITUDE BAROGRAPH, EXTREME OPEN SCALE, QUADRUPLE PEN TRAVERSE, featuring the syphon vacuum chamber, one-piece aluminum base, best grade clock-movement with jeweled anchor escapement, copper cover case with handle and suspension rings, embodies the Fergusson slotted link movement so adapted as to produce four traverses of the pen across chart giving extreme open scale readings on a chart equivalently 20 inches high for pressure changes between 31 and 4 inches of mercury; for elevations up to 47,000 feet. Chart cylinder revolves once each hour. Instrument complete with pen, non-freezing ink No. 20, and supply of 100 charts No. 1068-O.....\$.....

(Weight: gross, 25 lbs; net, 6 lbs.)

No. 701—ALTITUDE BAROGRAPH, EXTREME OPEN SCALE, QUADRUPLE PEN TRAVERSE, exactly the same as No. 700, except that the cylinder revolves once in $6\frac{7}{8}$ hours. Instrument complete with pen, non-freezing ink No. 20, and supply of 100 charts No. 1068-6-O. \$
 (Weight: gross, 25 lbs; net, 6 lbs.)

No. 702—ALTITUDE BAROGRAPH, EXTREME OPEN SCALE, QUADRUPLE PEN TRAVERSE, exactly the same as No. 700, except that the chart cylinder revolves once in twenty-four hours. Instrument complete with pen, non-freezing ink No. 20, and supply of 100 charts No. 1068-24-O \$
 (Weight: gross, 25 lbs; net, 6 lbs.)

ALTITUDE BAROGRAPH

Extreme Open Scale—Quadruple Pen Traverse

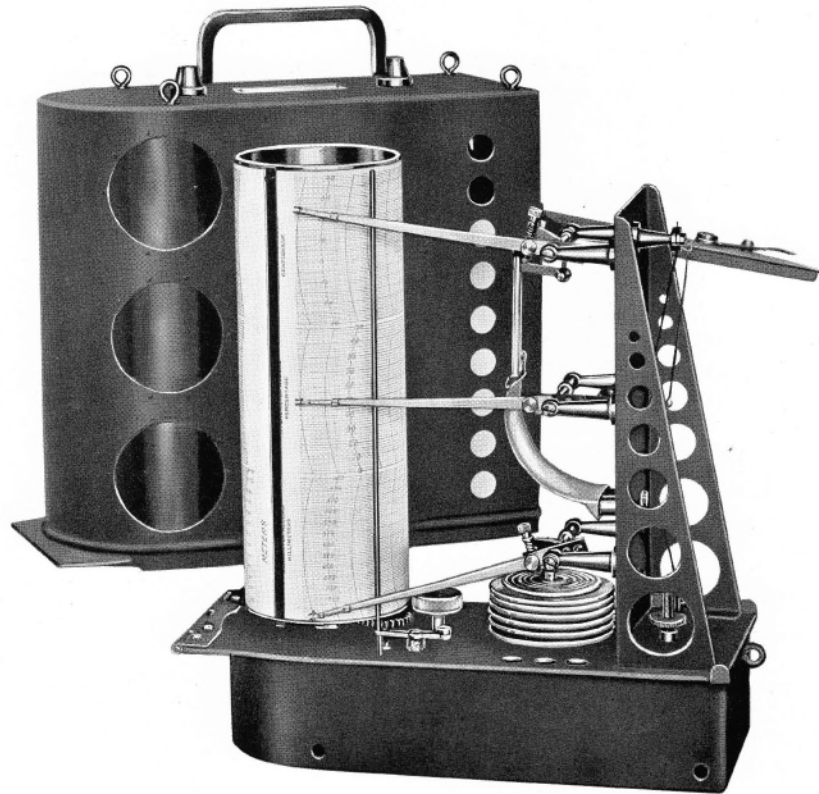
THE extensive use of air machines, traversing great heights with corresponding rapidity, has created a demand for a superior type of Barograph, affording a wide range of readings upon a compact chart. By making a record cylinder of excessive height, the wide range readings, of course, could be accomplished, but only by a bulky instrument and at a great sacrifice of space. However, by adopting the Fergusson device of double-ended slotted links, by which four traverses of the pen may be produced, a chart equivalently 20 inches high can be obtained, though a record cylinder of only 5 inches height be used. It is this result which has been attained in this extreme open scale barograph, and the advantages of such a chart so compact and yet so surpassingly legible cannot be hoped for in any other altitude Barograph.

The slyphon vacuum chamber, a feature of all our Barographs, is here increased in size, to afford the additional power required for the greater movement of the pen; in fact we have developed three times the power employed in our Dual Traverse Barograph. Moreover by the use of reclaiming springs, and by a perfect balance of the system of levers, all losses of motion and loose play of pivots have been completely excluded, so that the pen reverses at the extremes of the chart without pause or hesitation. The zig-zag tracing on the chart records variations in barometric pressure between 31 and 4 inches of mercury, accounting for ceiling elevation up to 47,000 feet. Even though the instrument registers altitudes hitherto unrecorded by any Barograph, yet after an ascension the pen will return to its ground position with absolutely no lag or after effect.

Carried upon a ball-pointed spindle resting on a steel plate, the record drum revolves uniformly at the rate of one revolution per hour and the clock movement, with jeweled anchor escapement, is especially constructed to withstand the extreme low temperatures of the upper air. A start-and-stop lever, easily accessible on the outside of the instrument case, controls simultaneously the action of the pen and the running of the clock.

AERO-METEOROGRAPH

(Thermo-Hygro-Barograph)



No. 710

No. 710—AERO-METEOROGRAPH (Thermo-hygro-barograph). Records simultaneously temperature, barometric pressure, and humidity. Record cylinder is revolved by the best grade of jeweled anchor escapement clock movement, once in six hours. The metal case is hinged to a rigidly designed base, and is perforated for ventilation; also a handle is provided for carrying purposes. Instrument complete with pens, non-freezing ink No. 20, and supply of 100 charts No. 700 \$

(Weight: gross, 25 lbs; net, 6½ lbs.)

No. 711—AERO-METEOROGRAPH (Thermo-hygro-barograph), for short period records of temperature, barometric pressure, and humidity. Record cylinder makes one complete revolution in two hours. Metal case is hinged to rigidly designed base and is perforated for ventilation; suspension eyelets for shock-proof mounting are provided. Instrument complete with pens, non-freezing ink No. 20, and supply of 100 charts No. 700-2 \$

(Weight: gross, 25 lbs; net, 6½ lbs.)

AERO-METEOROGRAPH

(Thermo-Hygro-Barograph)

THE Aero-Meteorograph designed by the Friez Laboratories for the U. S. Air Service records simultaneously three atmospheric phenomena: pressure, moisture, and temperature. It is adapted especially for use on airplanes and dirigibles. The illustration shows the instrument with its cover removed. The base, $9\frac{1}{2}$ inches long and 4 inches wide, is made of formed sheet brass and is constructed for greatest rigidity. To the underside of the base a clock is fastened which controls the time-movement of the upright chart cylinder to which it is directly geared. This cylinder revolves about a tapered shaft of phosphor bronze, securely clamped to the base. A chart engraved for a triple record is attached to the surface of the cylinder and is held in place by a metallic clip. The three pens which trace the three meteorgrams are accurately controlled in their true meteorological movement since the axes of the pen-arms are each supported on a tapering upright channeled column of sheet brass, precluding distortion or displacement.

THE BAROMETRIC ELEMENT. The actuating element, a single piece corrugated vacuum chamber such as is used exclusively in all Friez Barographs, is attached to the base of the instrument. Tests made by the U. S. Bureau of Standards show that this sensitive barometric element is far superior to any aneroid chamber now in use, and is accurately sensitive to all changes of altitude whether made rapidly or slowly. Its movement in this instrument is transmitted *directly* to the axis of the pen-arm, and records changes of pressure between 775 and 450 millimeters of mercury, corresponding to an altitude of about 4200 meters. A thumb nut conveniently located on the pen-arm controls the setting of the pen to agree with the pressure indication of a mercurial standard.

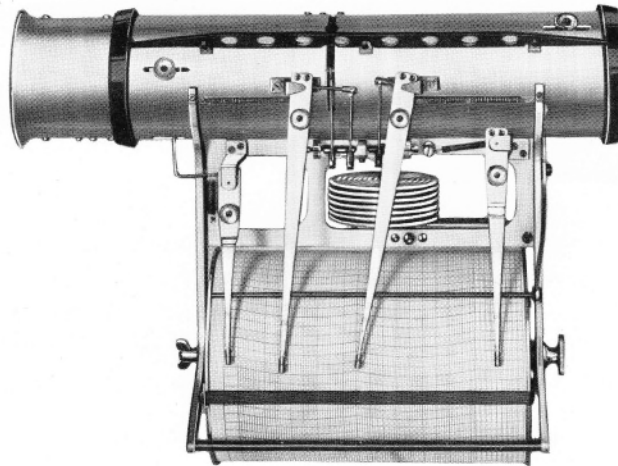
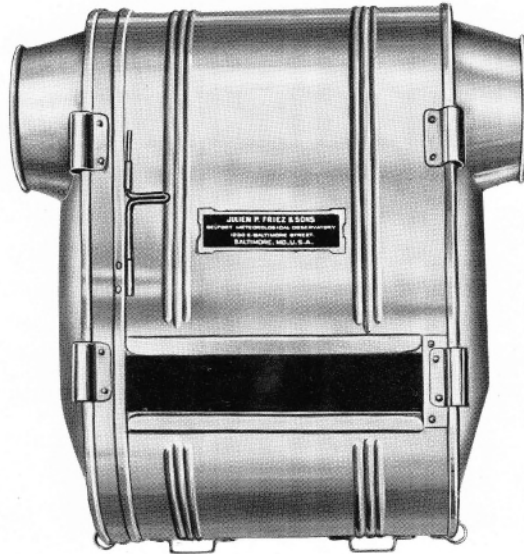
THE HYGROMETRIC ELEMENT. The actuating element is a multiple strand of human hairs specially treated, whose elongations and contractions are *directly* transmitted to the pen-arm. A thumb nut on the top surface of the instrument base allows the pen to be set to agree with the interpreted reading of a wet and dry bulb Hygrometer. The range of the readings is from 0 to 100 per cent of relative humidity.

THE THERMOMETRIC ELEMENT. The actuating element is a bimetallic strip. The folding and unfolding of this strip under temperature changes is *directly* transmitted to the axis of the pen-arm. There is a thumb nut on the pen-arm by which the pen may be set to agree with the reading of a mercurial thermometer. The temperature range is from 30° below zero to 40° above, Centigrade.

The complete mechanism is enclosed in a non-ferrous metal case, hinged to the base and perforated to allow free circulation of air, provision also being made for the suspension of the instrument in the cockpit of the plane by means of elastic cords.

KITE METEOROGRAPH

U. S. Weather Bureau Pattern



No. 720

No. 720—MARVIN KITE METEOROGRAPH, U. S. WEATHER BUREAU PATTERN, gives records in ink of four Meteorological conditions: temperature, pressure, humidity and wind velocity. Light construction for use in kite observation; chart cylinder revolves once in eight hours. Polished aluminum case. Instrument complete with pens, non-freezing ink No. 20, and supply of 100 charts No. 700-E.....\$.....

(Weight: gross, 10 lbs; net, 2½ lbs.)

MARVIN KITE METEOROGRAPH

U. S. Weather Bureau Pattern

THIS Kite Meteorograph designed by Prof. Charles F. Marvin, Chief of the U. S. Weather Bureau, is an ingenious combination of the most accurate devices used in recording temperature, pressure, relative humidity, and wind velocity of the upper air. A light, rigid, horizontal tube encloses the Anemometer, the temperature element and the Hygrometer hairs, while the pressure element is mounted on the frame beneath the tube. The recording pen-arms supported from above move through a vertical plane. The instrument is constructed, as far as possible, of aluminum and weighs less than two and one-half pounds, rendering it especially suited for kite observations.

The clock is of special design with full-jeweled anchor escapement and rotates the drum once in eight hours. The recording cylinder enclosing the clock is rigidly set within the frame of the instrument, but is easily removed in order to renew the chart by loosening the thumb nuts on each end of the axis, the thumb nut to the left serving also for winding the clock.

THE BAROMETRIC ELEMENT is the same slyphon vacuum chamber featured in all Friez Barographs, which for accuracy of record and heat-compensation is absolutely unsurpassed. While the recording pen-arm moving through an arc of fifty millimeters gives records of altitude up to five kilometers, a special adjustment allows it to be used also in record flights up to seven kilometers.

THE TEMPERATURE ELEMENT is a curved bimetallic strip of duplex metal prepared by permanently welding throughout their entire length two metals having widely different coefficients of expansion. The combination of metals used, Invar steel—an inert metal—and special brass, gives the greatest amount of deflection per degree of temperature change that can be obtained with reliability and sensitivity.

THE HUMIDITY ELEMENT is made up by sixteen single and separate human hairs, mounted longitudinally within the tube. They transmit their elongations and contractions directly to the pen-arm, while a reclaiming spring holds the hairs at a constant tension.

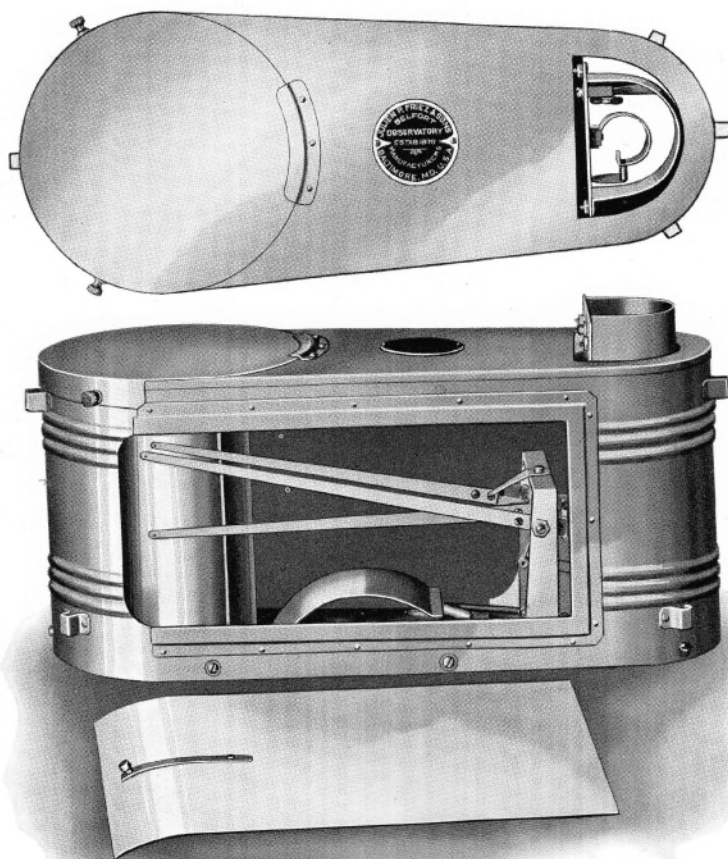
THE WIND ELEMENT is a small fan set in the wind-facing end of the tube, which communicates its rotation to a cam, moving the pen-arm to record thus directly and mechanically the wind velocity in miles per hour. The pitch of the fan-blades can be easily changed to give records in kilometers in place of miles.

The record sheet is an engraved paper chart with a separate space for each recording pen. Conveniently located adjustments make the pen-settings easy for the observer.

A light polished aluminum case shelters all parts except the inside of the screening tube and the Anemometer head.

BALLOON METEOROGRAPH

U. S. Weather Bureau Pattern



No. 730

No. 730—FERGUSSON BALLOON METEOROGRAPH, U. S. WEATHER BUREAU PATTERN, especially fitted by its size and weight for use with sounding balloons. Records temperature, humidity and barometric pressure. Extremely light clock movement, adapted to give records of actual flight exclusively. Charts are of aluminum sheet to be smoked before use. Fergusson link movement gives wide open pressure scale readings. A polished aluminum case with sliding door encloses the instrument. Complete with supply of twenty-five polished aluminum charts\$.....

(Weight: gross, 10 lbs; net, 6 oz.)

FERGUSSON BALLOON METEOROGRAPH

U. S. Weather Bureau Pattern

THE Balloon Meteorograph, designed by Mr. S. P. Fergusson of the U. S. Weather Bureau, is the lightest and most efficient instrument yet devised for obtaining simultaneous meteorological records of the upper air by means of sounding balloons.

Eight and one-quarter inches long, $3\frac{1}{2}$ inches wide, $4\frac{1}{2}$ inches high, with a total weight of only seven ounces or two hundred grams, this Meteorograph, when carried in its wicker frame attached to a parachute, returns to the earth with complete time-records of pressure, temperature and humidity, during the whole period of ascent and descent. Its simplicity and economy in construction, its strength and rigidity to withstand customary hard usage, its clear and accurate records mark it as the best instrument of its kind for aerological research.

THE CLOCK which rotates the time-cylinder, to which the meteor-chart is attached is especially constructed to reduce weight and is adapted to limit the revolutions of the cylinder to the time-period of the actual air-flight, thus preventing unnecessary and confusing ground-records after descent.

THE BAROGRAPH ELEMENT is a vacuum Bourdon tube chosen above all other barometric sensitive elements on account of its superior lightness combined with its elastic reaction. A specially contrived link-motion controls the arc of the pen-arm which with its peculiar reversing movement traces a record double the extent of the meteor chart, giving for higher altitudes on an open scale easy and accurate readings. This feature so much desired is found in no other Meteorograph. The range of the recording style is equivalent to the complete range of a Mercurial Barometer.

THE TEMPERATURE RECORDING PEN is actuated by a three-quarter cylinder of thin thermostatic metal, compact sheets of Invar and bronze. It is enclosed in a doubly insulated tube insuring protection from direct sunshine and from heat radiation. The scale here adopted is one millimeter of chart space to each 2° Centigrade.

THE HUMIDITY ELEMENT, consisting of ten separate strands of human hair with a reclaiming spring to maintain constant tension, is mounted and insulated in the same tube with the temperature element. The range through fifteen millimeters is from zero to 100 per cent of relative humidity. The record on a compact scale shows the direction rather than the amount of the humidity registration.

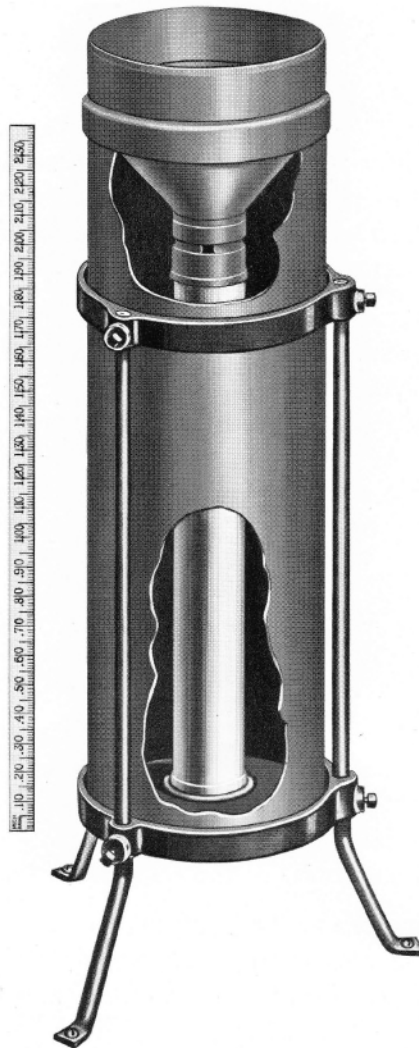
Those who are familiar with aerological research will understand that the chart used in this Meteorograph is not an engraved paper one, but is a smoked aluminum sheet, the observed tracings on which will be afterwards graduated by comparative tests in the laboratory. The chart cylinder itself is 3 inches in height and the axes of the three recording styles are so located at the same height above the base that the styles have the same time-arc on the rotating cylinder, which makes one complete revolution in one hour.

The whole mechanism is enclosed in a polished aluminum case, constructed with a sliding door to give easy access to the apparatus within and with an additional opening above, through which the record drum may be removed.



RAIN AND SNOW GAGE

U. S. Weather Bureau Pattern



No. 400

No. 400—RAIN AND SNOW GAGE, U. S. WEATHER BUREAU PATTERN, for direct measurement of rainfall and snowfall, non-recording and non-indicating type. An iron tripod supports an outer case, with measuring tube inside, into which water is funnelled from an 8-inch diameter rain collector at top. Instrument complete with brass measuring tube and graduated measuring stick \$

(Weight: gross, 32 lbs; net, 14 lbs.)

No. 400-A—RAIN AND SNOW GAGE, U. S. WEATHER BUREAU PATTERN, same as No. 400, except that the iron tripod support is omitted. \$

(Weight: gross, 16 lbs; net, 8 lbs.)

RAIN AND SNOW GAGE

U. S. Weather Bureau Pattern

THE simplest and most widely used instrument for measuring precipitation is the Standard Rain and Snow Gage (No. 400) in which the falling rain or snow is trapped and subsequently measured personally by the observer.

The rain is caught in a brass-rimmed collector 8 inches in diameter and is funnelled below into the measuring tube, the diameter of which is 2.53 inches, thus giving the ratio of ten to one between the surface area of the collector and the cross section of the measuring cylinder. Very heavy rainfalls, those, namely, exceeding 2 inches, will overrun the inside cylinder whose height is 20 inches, and the excess of rain will overflow into the outer tank and can be measured after it has been poured into the smaller tube once the latter's contents have been accounted for.

Snowfall is determined by using simply the overflow attachment for collecting it. By removing this snow container to a warm room the snow may be reduced to a liquid state, or better, the snow may be melted by pouring over it a quantity of warm water which will exactly fill the measuring tube to the brim. By pouring off this same amount after the melting has been effected, the quantity remaining represents the amount of snowfall.

A special rule is supplied with each gage for measuring precipitation. This is inserted into the measuring tube only when readings are taken. The rule, an unvarnished strip of straight-grained cedar, is graduated into inches, tenths of inches and hundredths of inches. Though 24 inches in length, it actually denotes but $2\frac{1}{16}$ inches of rainfall. It is plain, therefore, that measurements of precipitation are taken directly from the rule without recourse to any further calculation.

The complete gage is mounted on a standard iron tripod support which when erected upon a roof platform is easily secured by screws through the feet. For ground exposure three substantial wooden stakes, driven flush to the ground's surface, will suffice, to which the feet of the tripod may be secured.

NOTE.—The reader's attention is directed to Table IV, page 149, where the depth of precipitation corresponding to given weights is listed. The table is designed especially for snowfall and is compiled for use in connection with the 8-inch Rain and Snow Gage just described.

RAIN AND SNOW GAGE

U. S. Weather Bureau Pattern



No. 398

No. 398—RAIN AND SNOW GAGE (KADEL) U. S. WEATHER BUREAU PATTERN, 5.359-inch collector (one-hundredth inch equals one fluid dram), consisting of collector, copper body, glass jug receiver, 70 dram glass graduate. (No tripod or other support is included). \$.
 (Weight: gross, 15 lbs; net, 6 lbs.)

No. 398-A—GRADUATE FOR RAIN AND SNOW GAGE (KADEL), best grade glass marked and graduated in both drams and hundredths of inches of rainfall, capacity 70 drams (.70 inch of rain). \$
 (Weight: gross, 5 lbs; net, 1½ lbs.)



THE Kadel Rain Gage shown above is the simplest and least expensive of all Rain Gages of our manufacture. Measurements of rainfall are made by using a glass graduate supplied as a part of the Gage. No measuring stick is required. With ordinary care on the part of the owner of this Gage, there is no reason why it should not serve for many years continuously for measuring rainfall by a Gage whose design and manufacture have received the highest approval of the U. S. Weather Bureau. It is especially recommended for agricultural work.

RAIN AND SNOW GAGE

U. S. Weather Bureau Pattern

THE KADEL RAIN GAGE, designed by Mr. Benjamin C. Kadel, Chief of the Instrument Section of the U. S. Weather Bureau, follows the general principles of the Snowdon Rain Gage which is in quite common use in England. In lieu of measuring the depth of rainfall by a measuring stick, a liquid measure of standard graduations is employed.

The principle upon which the Gage is constructed is simply stated: a fluid dram of rain equals one-hundredth of an inch of rainfall, when the rain is caught in a collector whose diameter is 5.359 inches. The principle has been determined from actual experiments undertaken in rainfall of varying amounts and intensities. It has been found that by measuring rain by the fluid method, results are obtained which rival in accuracy those derived from using the measuring stick method.

The Gage is constructed of three principal units as shown in our illustration, page 108.

The body of the Gage is a sheet copper cylindrical can of 12 inches depth and of 5.359 inches diameter. At its top is a funnel collector, with a slope of 45° to a central outlet of brass tubing. The area of collection of the funnel is determined by a stiff brass ring, whose inside diameter is turned true to 5.359 inches.

The metal container can be used as a collector of snow by removing the funnel and the jug. After melting the snow so caught within it, measurements of the water content can be obtained from the fluid dram graduate, giving snowfall in rainfall units.

No Support for the Kadel Rain Gage is supplied, since a very simple and inexpensive method has been conceived and used for maintaining the Gage against disturbance by wind or other causes. A piece of terra-cotta pipe of 6-inch diameter may be inserted into the ground and after throwing in gravel or sand for proper drainage, the Gage may be handily located and sufficiently supported. Care should be taken, of course, that the top section of the Gage protrudes above the top of the terra-cotta pipe, and likewise that the Gage be stationed on a level.

A standard half-gallon glass jug catches and holds the rain that falls through the central outlet of the funnel. Should this jug or bottle be broken by accident or by freezing it can be easily replaced at almost any general store.

The graduate or measuring unit as supplied by us is of 70-dram size. This special measuring glass is graduated in fluid drams, and each line equals one-hundredth of an inch of rainfall as clearly shown on the graduate: the lower end of the graduate is tapered so that very small amounts of rainfall may be easily read. As shown in the illustration the glass graduate is supplied with a removable disc of such diameter that the graduate itself may be supported within the metal container in place of the jug. Only in very light rainfall is such a practice, however, advisable.

DIAL REGISTERING RAIN GAGE

Tipping Bucket Type



No. 401

No. 401—DIAL REGISTERING RAIN GAGE, TIPPING BUCKET TYPE (zero setting); enameled copper case, in two parts, the upper an 8-inch diameter collector and funnel, the lower a substantial case supporting the registering mechanism. Dial is graduated in inches and hundredths of inches \$.....

(Weight: gross, 20 lbs; net, 8 lbs.)

DIAL REGISTERING RAIN GAGE

Tipping Bucket Type

THE Dial Registering Rain Gage was designed in the Friez Laboratories for the needs and purposes especially of Meteorological Insurance, as well as for private observers interested in rainfall. It is compact in form, standing but 11 inches high and weighing but six and one-quarter pounds, giving in easy readings on a dial the rainfall up to hundredths of inches according to the standard units adopted by the U. S. Weather Bureau.

The instrument comprises a funnel at the top, a tipping-bucket mechanism enclosed in a copper case, a dial with the hands and graduations and the wide base below to serve as a firm support.

The brass funnel collector, 8 inches in diameter, the standard size adopted by the U. S. Weather Bureau in its rain gages, carries the water to the tipping-bucket mechanism. The bucket tips automatically on receiving each hundredth of an inch of rainfall and registers each tip on the dial. The weight of the water tips the bucket and the bucket in tipping actuates the dial mechanism, throwing the long hand one space forward for each tip of the bucket. The long hand of the dial registers hundredths of inches and the short hand inches of rainfall. The relation between the receiver and the tipping bucket is such that a depth of one one-hundredth of an inch of water caught in the receiver will tip the bucket when that quantity has accumulated therein.

The dial shows at any time the depth of rainfall since the last setting, or if rain be falling at the time, the depth up to the time of reading. Usually the instruments are inspected once each day at a specified hour and if rain has previously fallen the index hands are set back to the zero of the dial, by means of a thumb nut located on the axis of the hands. If rain is then falling, the setting of the hands is deferred until the next day or until after the rain has ended. Accumulated rainfall for any period may be determined by simply allowing the dial to register without any resetting of the hands.

The receiving tube of this Rain Gage is of brass and is attached to a copper funnel. The body of the instrument is a copper cylinder attractively finished. The dial is of white enamel with black figures and graduations and will not tarnish even under the outdoor conditions under which the instrument is used. Although this Gage obviates the need of measurement of rainfall by the ordinary graduated rule method, yet it can be placed on the top of the overflow tank of the standard 8-inch Rain and Snow Gage, and, when it is so stationed, an observer can get a good exposure of his instrument and at the same time will be able to make check comparisons with the standard Measuring Gage.



The dial reading Rain Gage shown here is the only indicating Rain Gage manufactured by us. Frequent inquiries are received by us for a Rain Gage of a type in which the rain caught upon the roof of a building would be funneled to a floor below. We have never attempted to build such a Gage, since we realize too well the inaccuracy inherent in such a method. The amount of rain which would adhere to the sides of the pipe through which the rain would pass would make any indications of true rainfall by such a method practically impossible. For remote records of rainfall, the standard instrument of the U. S. Weather Bureau is our Tipping-Bucket Transmitting Gage No. 405 which transmits electrically each one-hundredth inch of rainfall to a Rainfall Recorder, No. 406. See page 20.

WEIGHING RECORDING RAIN AND SNOW GAGE

U. S. Weather Bureau Pattern



No. 760

No. 760—FERGUSSON WEIGHING RECORDING RAIN AND SNOW GAGE, U. S. WEATHER BUREAU PATTERN, giving chart record of rainfall up to 9 inches for weekly period. Pen makes three traverses of chart affording a very open scale, each traverse representing 3 inches of rain. The case contains the rain collector, and the weighing and recording mechanism, accessible by means of a hinged door. The cylinder revolves by a weekly clock movement with full jeweled anchor escapement. Instrument complete with pen, ink No. 10, and year's supply (55) *weekly* charts No. 1015-F

(Weight: gross, 90 lbs; net, 30 lbs.)

No. 761—FERGUSSON WEIGHING RECORDING RAIN AND SNOW GAGE, U. S. WEATHER BUREAU PATTERN, same as No. 760, except that the chart cylinder makes one revolution in twenty-four hours for daily records. Instrument complete with pen, ink No. 10 and year's supply (375) *daily* charts No. 1015-G

(Weight: gross, 90 lbs; net, 30 lbs.)

FERGUSSON WEIGHING RECORDING RAIN AND SNOW GAGE

U. S. Weather Bureau Pattern

THE Weighing Recording Rain and Snow Gage, originally designed in 1888 by Mr. S. P. Fergusson of the United States Weather Bureau, has been recently reconstructed by the inventor and modified in accordance with long experience and new requirements for use in the Weather Bureau Service. As produced by the Friez Laboratories it embodies not only the principle of the original instrument but all features which practical experience has shown to be necessary to meet the demand for an accurate, self-contained apparatus of simple and inexpensive construction that will function properly under severe conditions of usage and exposure.

Of the many Recording Gages described in this catalogue or on the market, this is the only one manufactured that will record rain, dry or unmelted snow, hail or sleet with equal facility and in the same manner. The expensive and often troublesome devices for melting snow or sleet employed in other Recording Gages are entirely unnecessary in this instrument, and consequently it requires less attention and care than any other Recording Gage, particularly when precipitation is likely to change from rain to snow, and where a complete record of precipitation is desired.

The principle of this Gage is that of the Universal Scale, a well-designed spring balance in general use. The weight of rain or snow falling through the standard 8-inch collector into a receiver resting on the spring balance depresses the balance, the movements of which are transmitted by means of suitable levers and links to a pen-arm which makes a continuous record thereof upon an engraved chart secured to a revolving chart cylinder.

The receiver is of such ample dimensions that it will hold 9 inches of rain or approximately 1 foot of snow. Resting on a three-armed support secured to the weighing mechanism the receiver occupies at all times a central position within the instrument.

The mechanism is sensitive enough to indicate amounts smaller than five one-thousandths of an inch of rainfall although the smallest amount usually desired for record is one-hundredth of an inch. To check vibrations in the balance caused by high winds or other disturbances, a dash-pot is provided, the plunger of which, secured to the weighing mechanism, dips into a liquid in a cup attached to the base.

The instrument is equipped with Fergusson slotted links to obtain three vertical traverses of the pen across the chart. This method affords a very open scale reading for as much as 9 inches of rainfall. The cylinder in the standard type of Gage rotates but once in seven and one-quarter days, but for those who especially desire such a modification a clock cylinder rotating once every twenty-four hours may be furnished instead.

The difficulty arising from loss of actual rainfall through evaporation, experienced with other types of Rain Gages, is avoided entirely in the Fergusson type, since the record is made at the actual moment of precipitation. In fact, the amount of evaporation occurring in the interval between the cessation of rain and the actual reading of the record will be indicated upon the chart by a reversing of the tracing of the pen.

WEIGHING, RECORDING RAIN AND
SNOW GAGE

12-Inch Capacity



No. 762

No. 762—FERGUSSON WEIGHING AND RECORDING RAIN AND SNOW GAGE, latest model, giving chart record of rainfall up to 12 inches for weekly period. Pen makes three traverses of chart affording a very open scale, each traverse representing 4 inches of rain. The case contains the rain collector and the weighing and recording mechanism, accessible by means of a hinged door. Instrument is mounted on special tripod and is equipped with an extra overflow tank at bottom to catch rains in excess of 12 inches. Instrument complete with pen, ink No. 10, and year's supply (55) *weekly* charts No. 1015-0. \$

(Weight: gross, 200 lbs; net, 70 lbs.)

No. 763—FERGUSSON WEIGHING AND RECORDING RAIN AND SNOW GAGE, like above, except records are made for daily periods: pen makes three traverses of chart, each traverse representing 4 inches of rain for records of 12 inches of rainfall. Instrument complete with pen, ink, and year's supply (375) *daily* charts No. 1015-L. \$

(Weight: gross, 200 lbs; net, 70 lbs.)

FERGUSSON WEIGHING, RECORDING RAIN AND SNOW GAGE

12-Inch Capacity

SINCE the introduction and wide use of the Fergusson Weighing and Recording Gage, a demand has arisen in some localities for a Gage of greater capacity than 9 inches of rainfall.

Our latest type of Gage is, therefore, made to produce a record of 12 inches on either a daily chart or a weekly chart. The Recorder making a weekly chart is designated as No. 762, and the Recorder making a daily chart is designated as No. 763.

On the 9-inch rainfall Gage, the pen makes a traverse of the chart for each 3 inches of rain, and twice reverses itself automatically as the rainfall continues up to 9 inches. On the 12-inch Gage, the pen makes a traverse of the chart for each 4 inches of rain, so that three pen traverses give a record of 12 inches of rainfall.

The principle of this Gage and its design follow in all particulars the well-established principles of the 9-inch Fergusson Weighing and Recording Rain Gage. Parts of these two Gages, however, are not mutually interchangeable.

Snow and rain are caught through a standard 8-inch collector, and are delivered to a receiver resting on a spring balance. Amounts of rain as small as five-thousandths of an inch rainfall are sufficient to depress the balance, and to be recorded on the chart.

The recording mechanism, the pen, its axis and the link and leverage system, are of the same general design as is standard on similar Friez Recording Instruments.

The Gage stands 38 inches high and is 15 inches overall in diameter, exclusive of the spread of the tripod, and in addition to the especially large recording capacity of this Gage other features have been incorporated in it which are worthy of note.

In order to elevate the important parts of the Gage, a strong tripod support as shown in the illustration has been built as an integral part. To provide, too, for extraordinarily excessive rainfalls, an overflow receptacle, which will hold 10 inches of rain beyond the 12-inch capacity of the receiver, is built in below the receiver as an overflow removable basin, into which the water above the recorded 12 inches of rain is funneled by a tube connected through the bottom of the weighing receiver. This excess rain can be poured into a standard rain-measuring tube and measurements of it made by means of a standard rain-measuring stick. The measuring tube and measuring stick are furnished as accessories of this Gage. We have provided also a protecting mesh in front of the glass window of the Gage.

It is our belief that this large Fergusson Gage affords advantages which will be very much appreciated by those who experience great rainfalls through short periods, and for whom accurate and complete records are of immeasurable value.

SNOW WEIGHING BALANCE AND SAMPLER



No. 407

No. 407—MT. ROSE SNOW WEIGHING BALANCE (Zero Setting), equipped with suspending ring and double-pronged hook to accommodate sampler. Dial is graduated in inches and enclosed with glass with aluminum protecting cover. Exclusive of samplers or other equipment . . . \$

(Weight: gross, 20 lbs; net 4 lbs.)

No. 407-A—MT. ROSE SNOW WEIGHING BALANCE, same as No. 407, except that dial is graduated in centimeters. Exclusive of samplers or other equipment . . . \$

(Weight: gross, 20 lbs; net, 4 lbs.)

No. 408—MT. ROSE SNOW SAMPLER, of seamless steel tubing, in sections 6 to 10 feet in length exclusive of screw couplings. Price per foot \$

(Weight: gross, 35 lbs up; net, 2 lbs up.)

No. 408-A—SNOW SAMPLER SCREW COUPLING, of special design for uniting sampler tubes.
 Price each.....\$.....

(Weight: gross, 3 lbs; net 12 oz.)

No. 408-B—SNOW SAMPLER CUTTER, of steel with saw tooth cutting edge. Price each
 \$.....
 (Weight: gross, 2 lbs; net, 3 oz.)

No. 408-C—SNOW SAMPLER CUTTER, of steel with plain cutting edge. Price each
 \$.....
 (Weight: gross, 2 lbs; net, 3 oz.)

No. 409—SNOW SAMPLER ADJUSTABLE WRENCH, aluminum with malleable iron handles.
 (Weight: gross, 5 lbs; net, 2 lbs.) \$.....



MT. ROSE SNOW WEIGHING BALANCE AND SAMPLER

THE Mt. Rose Sampler, designed by Prof. J. E. Church, of the University of Nevada, is being used in the co-operative snow surveys of the States of Nevada and California, as well as by the Washington State Water Power Company, the Canadian Meteorological Service and by the Swiss Glacier Commission.

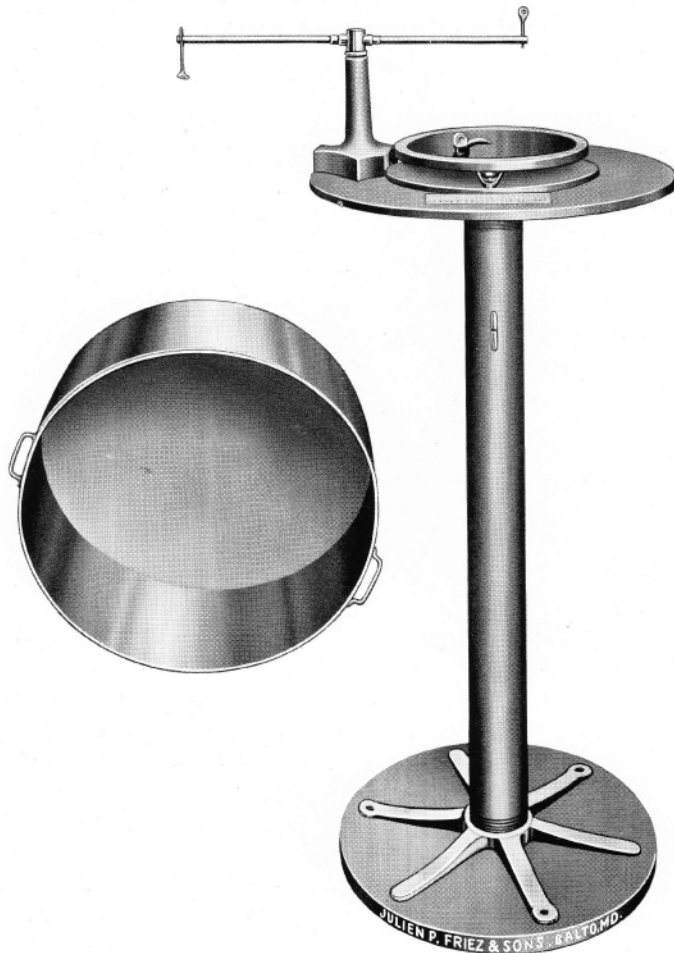
The Sampler proper is a steel tube furnished in one or more sections 6 to 10 feet in length united by screw couplings. A milled cutter and a special Adjustable Wrench on which the observer can stand and force the Sampler down almost like a human pile driver enables measurements to be taken of the deepest and the densest snow.

The Weighing Balance with the hook below, in which the Sampler rests when weighing, and the ring at the top for attachment to the staff that is to support the balance, is of very rugged, yet light, construction. This Balance will stand the hardest usage and yet, being made almost entirely of aluminum and weighing but two and one-half pounds, is easily portable by hand along the snow courses.

The dial of the Balance is about 6 inches in diameter and is silvered, with black graduations. It is covered with glass and is furnished also with a protecting cap of aluminum. One complete turn of the indicating hand is equivalent to 150 inches in rainfall. The index will make three revolutions while carrying a maximum load. The index of this instrument is so set that when carrying an empty Sampler tube it will read between 125 and 145 inches. An adjusting thumb nut allows one then to make a zero setting, so that, when the tube containing snow is placed within the hook, the reading from the dial will be directly the reading in inches of water for the snow contained. No account need be taken of the weight of the Sampler itself. The actual depth of the snow may be read from the scale engraved on the Sampler tube.

NEPHOSCOPE

U. S. Weather Bureau Pattern



No. 460

No. 460—NEPHOSCOPE, U. S. WEATHER BUREAU PATTERN; consists of three main parts, namely: the Nephoscope proper, a black mirror mounted in a graduated circular frame; movable stand with sighting eye-pieces; support or substantial iron flanged pedestal. Instrument complete with copper protecting cover, cloud image index, velocity scale, and illustrated chart showing International Classification of clouds. \$

(Weight: gross, 230 lbs; net, 140 lbs.)

No. 460-A—NEPHOSCOPE, U. S. WEATHER BUREAU PATTERN, same as No. 460, with the exception that the table or upper plate of the pedestal is provided with three leveling screws, the lower column and base-plate being eliminated. Instrument complete with copper protecting cover, cloud image index, velocity scale, and illustrated chart showing International Classification of clouds. \$

(Weight: gross, 85 lbs; net, 60 lbs.)

NEPHOSCOPE

U.S. Weather Bureau Pattern

THE great importance of a knowledge of the conditions prevailing in the upper atmosphere, for the purpose of Aviation, and for forecasting and research work, has made the Nephoscope a most important instrument for determining quickly and economically the direction of cloud movement and its velocity. The chief feature of this instrument is the ease with which the observations may be taken.

A blackened mirror, in which the image of the cloud is reflected, is set in a frame of non-corrosive metal with angular graduations on its rim. When originally installed, leveled and orientated, the mirror is clamped into a permanent position, provision being made, however, for removing the mirror for cleaning purposes, without disturbing its proper location. A movable sighting eye-piece stand is provided, consisting of a moderately heavy cast-iron base, whose purpose is to vary and maintain the two sighting eye-pieces always at the selected heights, $166\frac{2}{3}$ and $83\frac{1}{3}$ millimeters, respectively, above the surface of the mirror. Both the mirror and the sighting eye-piece stand rest upon a smoothly faced iron table rigidly fixed to and supported by a heavy cast-iron pedestal.

The direction of a selected moving cloud is determined by observing its image in the mirror through the eye-piece as a point of the cloud passes across the center spot of the mirror and along a radius which leads to a degree mark upon the rim.

The velocity with which a cloud is moving is determined by the distance in millimeters traveled by the cloud image across the mirror in an arbitrary period of time, one minute usually being chosen. Approximating the height of the cloud by means of a pilot balloon or by observation of its nature and type, the approximate velocity with which it is actually traveling may be readily calculated by a comparison of similar triangles.

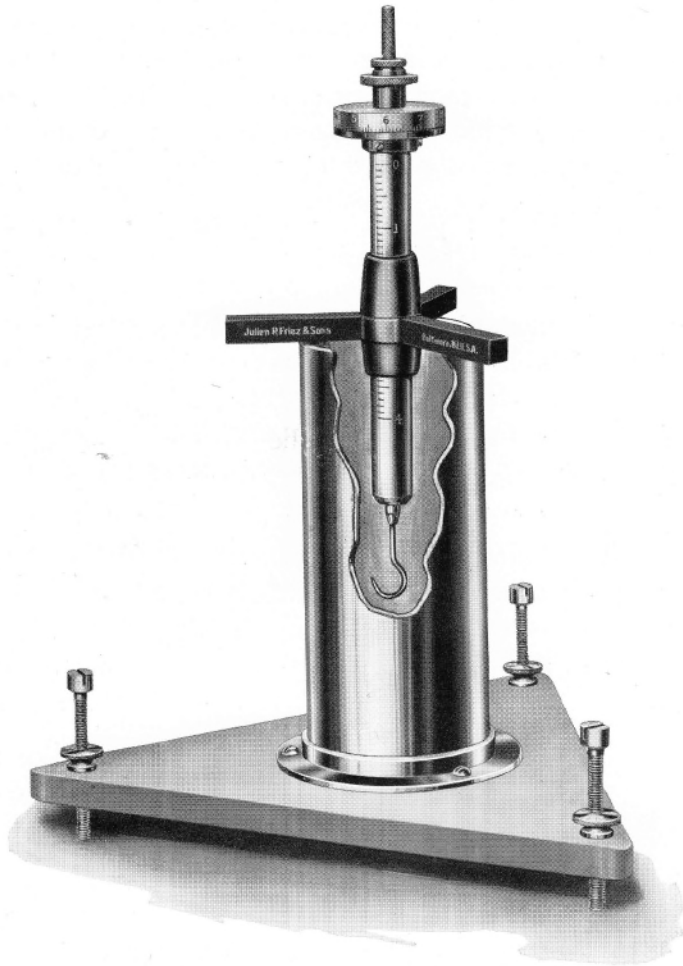
Since this instrument is set up in the outdoors exposed to the weather, all the observation mechanism is enclosed in a large copper drum-shaped cover.

We also supply accessory equipment for the Nephoscope, an index for marking the positions of the cloud images, a scale of velocities and an illustrated chart showing the International Classification of clouds. Further directions for the calculation of cloud velocity by means of the Nephoscope will be found in a leaflet of instructions, furnished with the instrument.

When desired the Nephoscope is furnished without the iron pedestal (No. 460-A). In its place three leveling screws are provided permitting it to be set up in a window and the observations to be taken without exposing the observer to cold and inclement weather, an important consideration in northern climates during the winter months.

EVAPORATION HOOK-GAGE AND
STILL-WELL

U. S. Weather Bureau Pattern



No. 740

No. 740—EVAPORATION HOOK-GAGE, U. S. WEATHER BUREAU PATTERN, for determining the amount of evaporation from surfaces of water. Comprises a vertical column of non-corrosive metal, graduated in inches and tenths of inches, with a micrometer screw-head, for readings to hundredths and thousandths of inches, and the hook below for obtaining surface contact \$

(Weight: gross, 10 lbs; net, 3 lbs.)

No. 741—EVAPORATION HOOK-GAGE, U. S. WEATHER BUREAU PATTERN, as above except readings on column are given in centimeters and millimeters, and on micrometer screw-head in millimeters and hundredths of millimeters. \$

(Weight: gross, 10 lbs; net, 3 lbs.)

No. 742—STILL-WELL, for use in combination with Hook-Gage, either No. 740, or No. 741, consisting of seamless brass tubing, 8 inches in height and 3½ inches in diameter, upon triangular galvanized cast-iron base, with leveling screws; complete. \$

(Weight: gross, 30 lbs; net, 13 lbs.)

EVAPORATION HOOK-GAGE AND STILL-WELL

U. S. Weather Bureau Pattern

THE comparative study of the various climatological conditions contributing to the phenomenon of evaporation, is carried on in the United States by numerous Class "A" Evaporation Stations, established and conducted by the Weather Bureau. Various other principal and accessory equipment are required for this important research work, but the instrument dealing directly with the actual amount of evaporation from the surface of water, is the Hook-Gage.

The water, the evaporation from the surface of which is being observed, is contained in a 4-foot evaporation pan, firmly constructed so that there will be no buckling of its bottom, a condition which would seriously interfere with the level of the surface of the water in the Still-Well and make any observations of evaporation worthless.

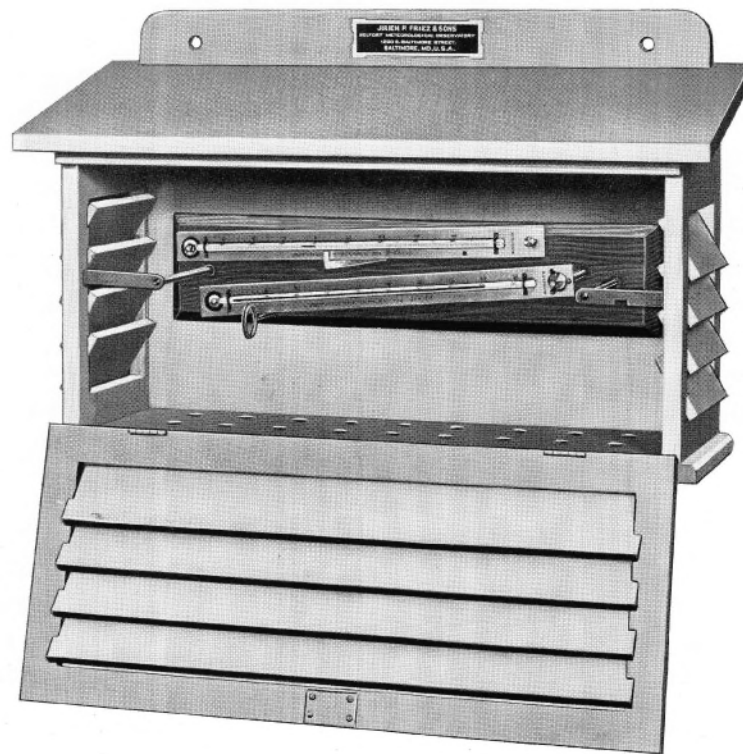
In this pan a Still-Well, to provide an unruffled surface of water is placed. It is made of seamless brass tubing, measuring 8 inches in height and $3\frac{1}{2}$ inches on its outside diameter. The Still-Well is mounted upon a triangular galvanized cast-iron base, with leveling screws 3 inches long at each corner. Water is admitted into the Still-Well from the evaporation pan by means of an $\frac{1}{8}$ -inch brass pipe extending through the cast-iron base.

The Hook-Gage, by which the difference in the levels of the water's surface before and after evaporation is measured, is so constructed that each complete revolution of a micrometer screw-head moves the hook in a vertical direction exactly one-tenth of an inch. The inches and tenths of inches are graduated on the column of the gage and the hundredths and thousandths of an inch on the micrometer screw-head. When a measurement is to be taken, the Hook-Gage is first placed upon the top of the Still-Well with the three projecting arms resting on the rim of the brass cylinder and the hook suspended near the center of the well. The graduated screw-head is then turned until the point of the hook disappears beneath the water, then by reversing the screw movement it is caused to move slowly upward until it just pierces the water surface. A reading is then made of the graduations on the gage. The difference of level in the water observed from a subsequent reading will be an index of the evaporation that has taken place during that interval, usually twenty-four hours.

Where the observations are made in metric measurement, No. 741 gives readings on the column of the gage in centimeters and millimeters, and on the micrometer screw-head in millimeters and hundredths of millimeters.



THERMOMETER SHELTER



No. 960

No. 960—THERMOMETER SHELTER, for housing Maximum and Minimum Thermometers, made of well-seasoned white pine, in standard dimensions, 21 inches long, 13 inches high, and 8 inches deep. Louvered sides, perforated floor and sloping roof. Pine-finished board for support and metal guide rods for thermometers included. \$

(Weight: gross, 30 lbs; net, 15 lbs.)

No. 961—THERMOMETER SHELTER, for housing wet and dry bulb Stationary Hygrometer. Material and general construction same as No. 960 \$

(Weight: gross, 30 lbs; net, 12 lbs.)

THERMOMETER SHELTER

FOR protecting the Maximum and Minimum Thermometers from rain or wind, while allowing the freest circulation of air, and principally to shield the instruments from direct or reflected sunshine and from radiation to and from the sky, an instrument shelter is absolutely indispensable. Our Shelter No. 960, 21 inches long, 13 inches high and 8 inches deep, with a sloping roof, a perforated floor, and with louvered walls on three sides, is in general use by co-operative observers. The Thermometer pine-board backing of the Maximum and Minimum Thermometers is set on two bronze guide rods, enabling it to be slid forward for observation of the readings

and for resetting of the Thermometers. The door of the Shelter is hinged at the bottom and can swing down to the vertical, giving free scope for the whirling of the Maximum Thermometer. The Shelter should be supported on an upright wall facing the North and the door when closed is locked by a small key. This Shelter is not adapted for use with the "Townsend" all-metal type of Maximum and Minimum Thermometers Support.

Identical in design and general construction with the above Shelter, but with slightly different dimensions, is a Shelter, No. 961, which is made for the exposure of Hygrometers. When thus exposed, not only may the Hygrometer be used for the observations of humidity, but the temperature readings of the free air may be taken from the dry bulb Thermometer of the instrument.

INSTRUMENT SHELTER

U. S. Weather Bureau Pattern

ALL instruments, used for observation of the free air in the outdoors, require some kind of shelter to shield them from the direct rays of the sun and from various other interfering conditions. Such protection is needed for Thermometers, whether Current or Maximum and Minimum, for Whirled Hygrometers and for all kinds of Thermographs or Hygrographs when such instruments are stationed outdoors.

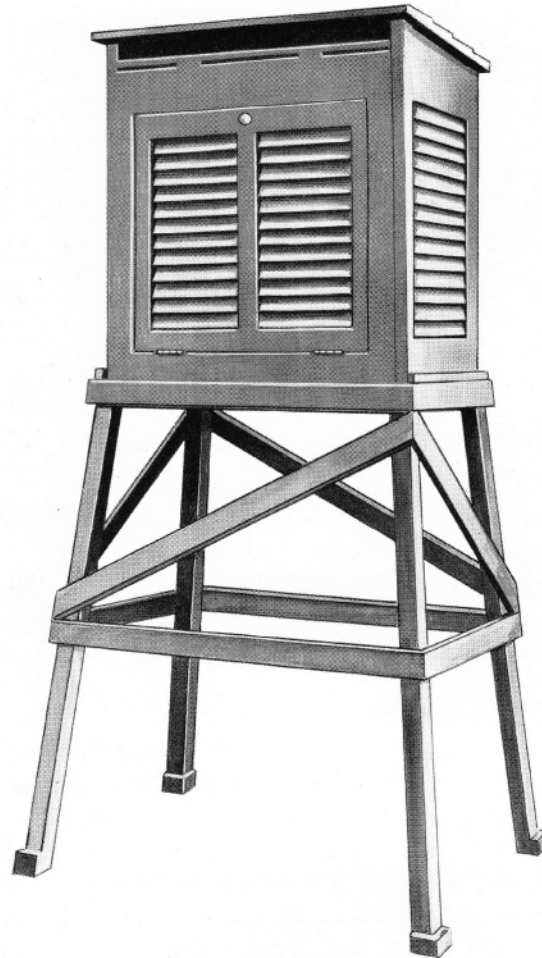
The U. S. Government Service has used for a long time a shelter such as we catalogue; co-operative observers have followed the lead of the Government Service in this regard, especially through the cotton-region belt of the Southern States and the fruit-growing sections of California.

The shelter is built out of the best grade of well-seasoned white pine. The sides are louvered and the floor is perforated to allow the freest circulation of air, and a double roof affords complete protection from the direct rays of the sun. The same type of shelter is manufactured in two sizes according to the kinds of instruments which are to be enclosed. The smaller type called the Cotton Region Shelter is used for housing a set of Maximum and Minimum Thermometers, or a Hygrometer, or a Thermograph, or a Hygrograph, or any one instrument of equivalent dimensions. This smaller Shelter measures 27 inches in width, is 18 inches deep, and 26 inches high. The larger Shelter will comfortably contain a whirling Apparatus and a set of Maximum and Minimum Thermometers, along with a Thermograph or a Hygrograph. It is this larger type which is used in all U. S. Weather Bureau Stations. It measures 39 inches in width, is 33 inches deep, and 36 inches high.



INSTRUMENT SHELTER

U. S. Weather Bureau Pattern



No. 970

No. 970—INSTRUMENT SHELTER, U. S. WEATHER BUREAU STATION TYPE, for housing Whirling Apparatus, a set of Maximum and Minimum Thermometers, and a Thermograph or similar instrument. 39 inches wide, 33 inches deep, 36 inches high. Louvered sides and perforated floor, and hinged door, opening downwards. Exclusive of support.....\$.....

(Weight: gross, 230 lbs; net, 200 lbs.)

No. 970-A—SUPPORT for Shelter No. 970.....\$.....

No. 980—INSTRUMENT SHELTER, COTTON REGION TYPE, for housing a set of Maximum and Minimum Thermometers, or any single instrument of corresponding size, as a Thermograph or Hygrograph. Width 27 inches, depth 18 inches, height 26 inches. Louvered sides and perforated floor, best seasoned wood, hinged door opening downwards. Exclusive of support.....\$.....

(Weight: gross, 185 lbs; net, 150 lbs.)

No. 980-A—Support for Shelter No. 980.....\$.....

RECORDER PENS, INKS AND CHARTS

PENS

ALL pens used on various Friez Instruments are of exclusive Friez Design, and each is suited for the particular instrument and type of record required.

On instruments for upper air investigations, such as the Fergusson Meteorograph, and Altitude Barographs, an inked record is neither desirable nor required. On such instruments it is common practice to use a smoked chart, and the tracing is made by means of a stylus, such as illustrated as No. 0.

For Thermographs, Barographs, and Hygro-Thermographs, and Weather Bureau type of Recorders, we have specialized on pens illustrated as No. 1, 2, and 3. These pens are made of nickel-silver and are drawn to a very fine point. Before starting a record the barrel of each pen must be partially filled with the special ink furnished with each instrument. A slip of hard paper may be drawn between the points to start the flow of ink. The pen should be removed from the instrument occasionally and washed in either warm water or alcohol, scraping the parts of the pen a little with a knife blade to remove dried sediment not washed off by the water. Also, to give most satisfactory results, the points must be kept quite sharp and they should very nearly touch each other, otherwise a heavy tracing will be made on the chart, causing blurred, indistinct records.

No. 1 Pen is designed for the vertical cylinder type of instrument, such as the Barograph, Thermograph or Hygrograph, whereas No. 2 is adapted for the horizontal cylinders of the other Recorders, such as the Wind Velocity, Sunshine, or Rainfall Recorders. In most instruments, the pen-arm is so constructed as to permit a variation and adjustment in the pressure of the pen; in some of our newest instruments, however, pen-arms with constant unvarying pressure do not need any adjusting, and thus the personal equation element that might affect the record is excluded.

No. 3 Pen can be used wherever No. 1 is used. It does not give as fine a tracing as No. 1 and is used especially in the Fergusson Recording Rain Gage and on Altitude Barographs, wherever inked records are desired. This pen allows rather a free flow of ink, a characteristic of advantage in the instruments for which it is especially desired.

No. 4 Pen is a glass reservoir pen, such as is sometimes used for records made by the Friez Anemograph No. 450, which more frequently is supplied with the well-known crow-quill pen.

No. 5 Pen is of special design of the glass reservoir type for use on the Au Water-Stage Recorder. Inked records for water stage are sometimes preferred to records made by pencil. The complete pen unit is of special design, and the glass reservoir alone cannot be substituted for the pencil supplied with the Au Recorder. A complete pen unit, including the glass reservoir, can be substituted for a complete pencil unit.

Pens Nos. 6 and 7 are of special design for inking records of wind direction and wind velocity on the Selsyn motor type of wind direction and wind velocity. They are used in conjunction with a metal reservoir for ink, and when adjusted as directed insure a clear tracing without danger of over-inking, and consequent smearing or blurring of the record.

•••

RECORDING INKS

Exhaustive tests and long usage have shown that the inks supplied by us for use with our recording pens cannot be improved upon. The colors are non-fading and the ink will not evaporate, a condition so necessary where the small supply in the pen is constantly exposed to the air for periods as long as eight days. Red, purple, green, and black are the four colors which we have found to be the most desirable for legibility and contrast. Our ordinary ink (No. 10) is non-freezing in temperatures as low as 40 below zero. A special ink (No. 20) which is absolutely non-freezing in the cold upper air regions, even in those as high as 50,000 feet, is prepared by us for use with our Altitude Barographs and Aero-Meteorograph. This ink (No. 20) comes in one color only, namely purple. All inks are shipped in one-quarter-ounce bottles with stoppers specially adapted for filling the small cisterns of the recording pens.

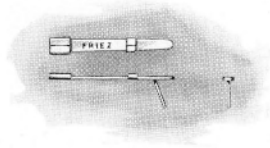
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RECORDING CHARTS

After years of experimentation with various kinds and qualities of paper, we have adopted for the charts used on all our Recorders a high grade of loft-dried all-linen ledger paper. It takes the inks without spreading and suffers the minimum of distortion under excessive moisture. The charts are .004 of an inch in thickness and, to ensure the highest accuracy, the master plate is prepared on a micrometer line grading machine, and the charts are printed with a non-hygroscopic, non-fading, orange-colored ink. Punch-holes suit them for modern filing methods, for which we supply the requisite binders.

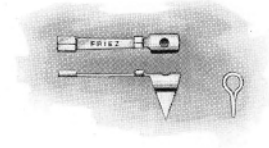
Our charts are packed in pasteboard mailing cylinders, and are so rolled therein that each chart may be easily slipped from the center of the roll; its curled condition making it best suited for snugly gripping the cylinder of the Recorder. Large supplies of daily charts, however, are packed in flat cartons. With these, on the original delivery of an instrument, we supply a special brass cylinder, in which an individual observer may roll a fifteen- or twenty-day supply of charts.

FRIEZ RECORDER PENS, INKS AND CHARTS



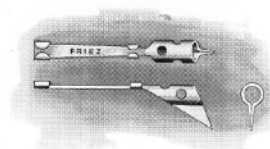
No. 0

No. 0—RECORDING STYLUS, for use on Friez Recording Instruments, when a tracing is to be made on a smoked chart.....\$.....



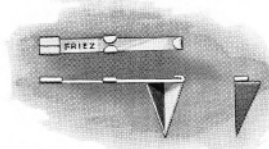
No. 1

No. 1—RECORDING PEN, used on all Friez Recording Instruments employing a vertical chart cylinder, except such as receive records from two pens.....\$.....



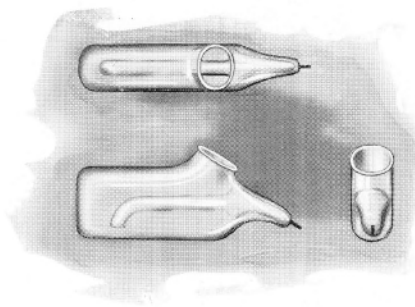
No. 2

No. 2—RECORDING PEN, used on all Friez Recording Instruments employing horizontal chart cylinders, or vertical chart cylinders which receive records from two pens.....\$.....



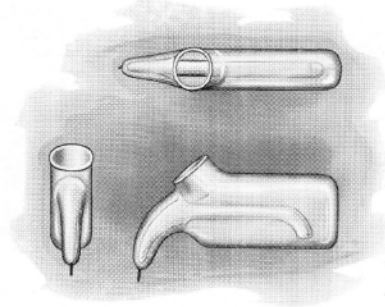
No. 3

No. 3—RECORDING PEN, used on single pen recording instruments with vertical cylinders, when very low temperatures are normally experienced...\$.....



No. 4

No. 4—RECORDING PEN, GLASS RESERVOIR TYPE, as sometimes used on Friez Anemograph No. 450.\$.....

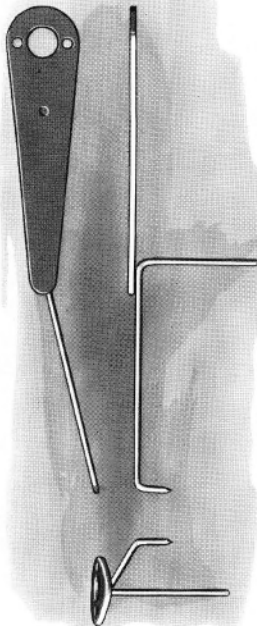


No. 5

No. 5—RECORDING PEN, GLASS RESERVOIR TYPE, used on pen unit of all types of Au Water Stage Recorder.\$.....

RECORDER PENS, INKS AND CHARTS

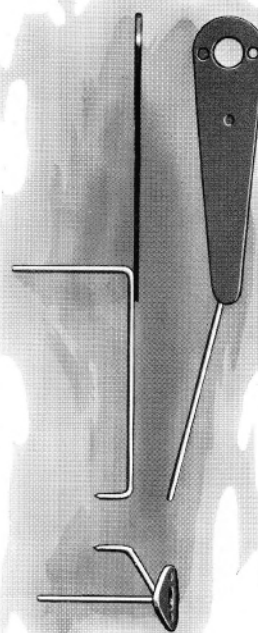
(Continued)



No. 6

No. 6—RECORDING PEN, used on Wind-Velocity Unit of Selsyn motor wind-direction and wind-velocity Recorder.

\$.....




No. 7

No. 7—RECORDING PEN, used on Wind-Direction Unit of Selsyn motor wind-direction and wind-velocity Recorder.

\$.....





AU
WATER STAGE
RECORDERS

AU WATER-STAGE RECORDERS

THE Au Water-Stage Recorder has won a place of unrivalled leadership for the measurement of the level of streams and reservoirs throughout our own country and in many foreign lands. It is the accepted gage of thoughtful design and of finished workmanship. Although the basic principles of construction are maintained throughout the various types of the Au Recorder, each type possesses certain characteristics of operation that are of especial value for various installations.

The Au Recorder, therefore, is made in three types, called the Au Fuzee Recorder, the Au Continuous Recorder, and the Au Drum Recorder.

The driving and measuring agent of the Au Water Level Recorder is a copper float, in the form of a double cone with a cylindrical band at the water-line to insure a constant sensitivity of the float-action. Floats are made of either 5, 10, or 20-inch diameter.

The float is suspended by a standard phosphor-bronze flexible cable of the smallest dimension consistent with the strength required.

The rise and fall of the float is transmitted through what is termed a positive drive grooved float wheel. Friction drive float wheels can be supplied, but serious errors appear in the record if the cable or tape, by which the float is suspended, slips or fails to seat solidly on the float wheel. In this Recorder slippage is prevented by wrapping the cable around the float wheel and attaching the end permanently to the wheel. Proper seating is insured by providing spiral grooves on the wheel which guide the cable and serve to separate the adjacent wraps. Separate cables are used for suspending the float and the counter-weight, both cables being individually attached to the float wheel at opposite edges of the wheel. As one cable reels from the wheel the other cable reels on, each cable following its own groove.

Since the revolutions of the float wheel are a measurement of the level change, the diameter of the wheel is an index of the relation of the actual water level to the written graph which reproduces it. Standard wheels are made for either 1:6, 1:12 or 5:12 ratios. In explanation, a wheel of 1:6 ratio indicates that 1 inch of chart record represents 6 inches of water level change, and a float wheel of 1:12 ratio signifies that 1 inch of chart record represents 12 inches of water rise or fall.

The width of the float wheel on which the cable wraps limits the maximum range of the record: our standard 1:12 wheel with $2\frac{1}{8}$ inches width, will suffice for 48 feet of water level change. A special wheel with a width of $3\frac{1}{2}$ inches can also be supplied at slight additional cost.

A very special feature of the Au Recorder is the pencil or pen-drive. Since the pencil is to reproduce accurately every movement of the float with a minimum of lost motion, the movement must be communicated in a positive manner through the least possible number of intervening parts. In this design only one part is used between the float wheel and the pencil carriage.

Directly connected to the float wheel, and inclosed to protect it from dirt, is a brass cylinder mounted on ball bearings, with a spiral groove in which rides a roller and swiveled slider called the "boat" connected to the pencil carriage. As the

cylinder, or endless screw, revolves, the carriage travels along the groove and, when the pencil reaches either edge of the chart, the carriage reverses its direction without lost motion or change in rate of lineal movement prior to the moment of reversal, and continues the graph in the opposite direction. This reversing feature, then, produces a record which takes care of unlimited changes of water level and at the same time permits ordinary changes to be recorded on a large scale.

Either a pen or a pencil-unit can be used for inscribing the record. Wood-encased pencils are usually supplied, but at a slight increase in cost, the Recorder is equipped with a Simplex glass pen for producing inked records.

On all types of the Au Recorder using a continuous chart the record is written directly on the supply roll, affording the distinct advantage that there can be no possible shifting of the chart on its guides. There is no other way in which the fixed datum line of record can be accurately maintained. The paper used by us is the very best moisture-resistant paper obtainable, and shows less variation under changing conditions of humidity than any other type of paper. We do not misname our paper "water-proof," since there is no paper suitable for water-level records which truthfully can merit this denomination.

The travel of the paper from the supply roll is controlled by a weight-driven Chelsea Clock with a jeweled movement. There are two drives by which the clock controls the travel of the paper strip: the Fuzee drive and the Continuous drive.

In the Fuzee paper-drive the chart is drawn off the supply roll by the take-up roll which is driven frictionally by the clock-weight cable passing over a slightly conical spirally-grooved pulley called a Fuzee attached to one end of the supply roll. At the start the clock cable is in the small diameter end of the Fuzee spiral. As the paper accumulates on the take-up roll the clock cable travels so as to run on an increasingly large diameter of the Fuzee. Thus the tendency of the paper to increase its rate of travel due to accumulation on the supply roll is overcome by a reduction in the speed with which the supply roll is driven.

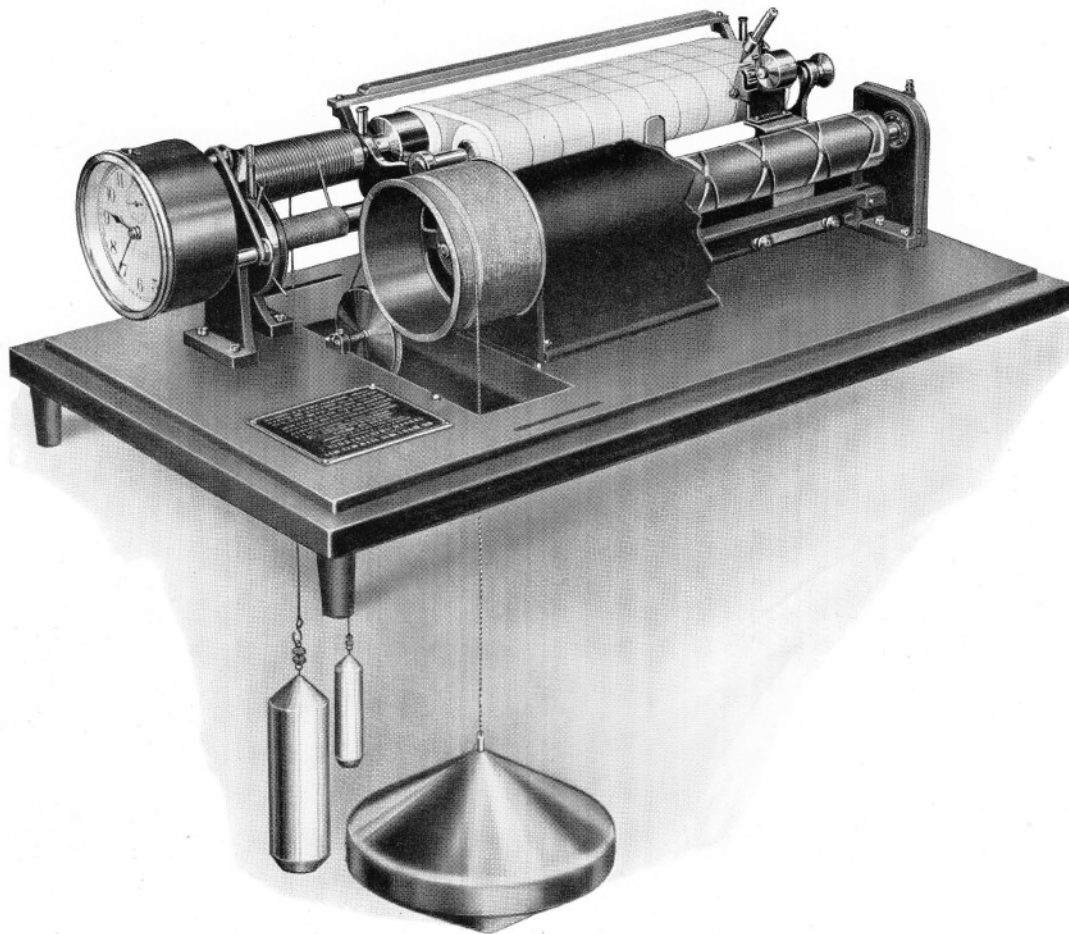
In the Continuous type of drive the paper is drawn off the supply roll by the friction of the paper against a roller driven by the clock-weight and controlled by the clock movement. A take-up roll, separate from the clock-driven roll and friction roll, is provided to wind up the paper. If the record is cut off daily it is not necessary to wind the paper on the take-up roll. It is possible, however, properly to adjust the Recorder to run for months without disturbing the paper adjustment; with the Fuzee drive it is necessary to reset and empty the take-up roll when the clock is rewound. As a special feature the continuous drive can be equipped with gears to provide three different paper travels.

The Au Drum Recorder is made to carry a short section of chart on a drum. This drum makes one revolution in seven and a half days.

NOTE.—All types of the Au Water Stage Recorder are manufactured under one or more of the following patents: 1,499,283; 1,604,732; 1,609,008; 1,645,273; 1,676,848.

AU FUZEE WATER LEVEL RECORDER TYPE FS

For Recording the Stage of all Impounded and Flowing Waters



FS-BT—AU WATER STAGE RECORDER, FUZEE PAPER DRIVE; time rate 0.1 inch per hour, 2.4 inches per day, equipped with instantaneous screw-driven pencil providing unlimited range of water level. Recorder complete with accessories listed below:

- Float Wheel—Positive drive for 1:6 or 1:12 gage height ratio.
- Cover—All-metal, two-piece, removable top.
- Float—10-inch copper with counter-weight and cable.
- Pencil—Gravity type for wood-encased pencil.
- Clock—Eleven-jewel, weight-driven, with dial.
- Chart—25-yard roll on brass core.

(Weight: gross, 150 lbs; net, 75 lbs.)

\$.....

THE FUZEE SCREW RECORDER

THE Recorder illustrated as the Fuzee Screw Recorder has been designed to meet the needs of those who desire the highest type of instrument for obtaining water level data. Of roll chart construction, the design provides operation for sixty days without attention, experience having shown that seldom are inspections delayed beyond sixty days, and usually they are made at more frequent intervals. By limiting the operation to sixty days an extremely simple construction has been attained with but two rolls and a minimum of moving parts.

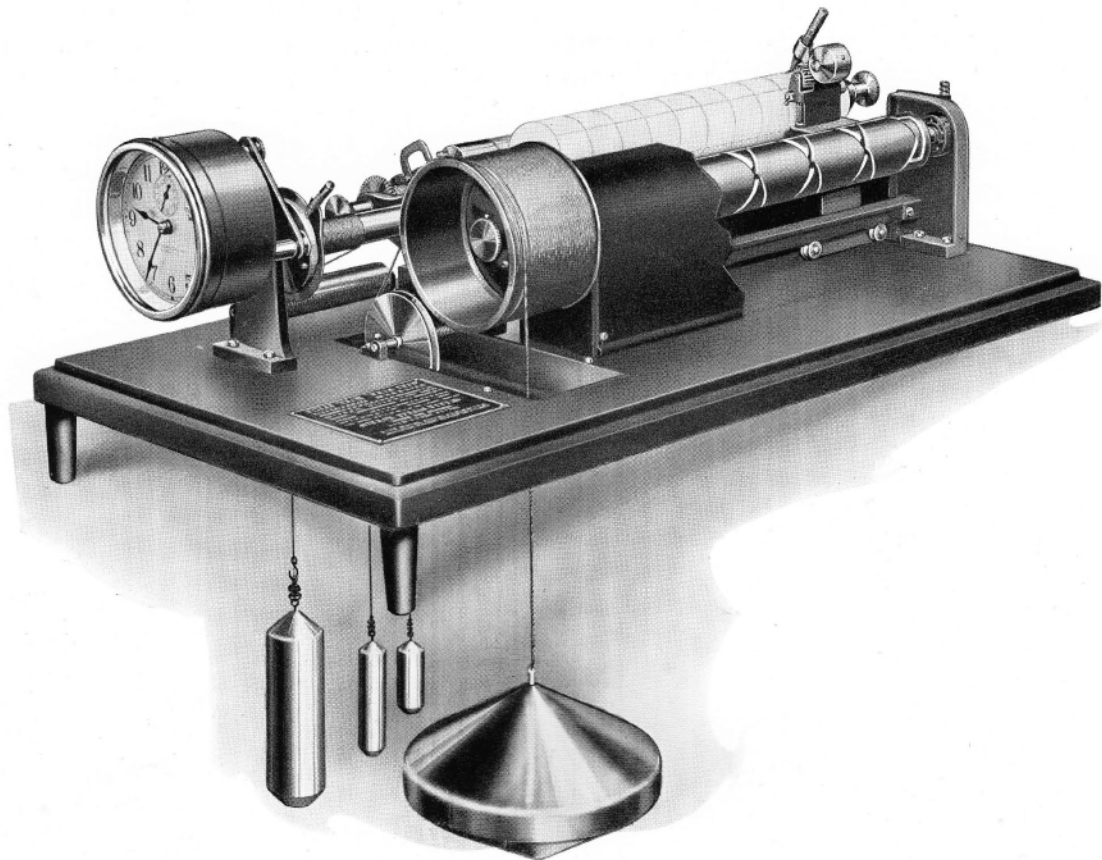
The Fuzee Screw Recorder is shown with its cover removed. The distinctive feature of the Recorder, and that from which it received its name, is the slightly conical, spirally grooved pulley shown at the left and back of the instrument, known in fine clock making as a "fuzee," the function of which is to drive the paper at a constant lineal speed. This is accomplished in the following manner: the fuzee is so shaped that its small diameter is equivalent to the diameter of the take-up roll (directly attached thereto), when there is no paper thereon, and the large diameter is the equivalent of the roll with sixty days' accumulation of paper. At the start, with one wrap of paper on the take-up roll, the clock weight cable is placed at the small end of the fuzee. As the weight falls the fuzee rotates, the take-up roll winds up the paper and the cable travels in the spiral grooves from the small to the large end of the fuzee, reaching the end in sixty days. At any moment during the sixty days the effective diameter of the fuzee at the point where the cable is in contact is equivalent to the diameter of the paper roll at that moment. The effect is the same as though the cable rested directly on the paper of the take-up roll, and as the cable is unwound by the clock at a constant speed, the paper must travel at a constant lineal speed also. With this construction only two rolls are necessary and the replacement of the paper is accomplished quickly, without inconvenience, even under most severe weather conditions.

We illustrate the positive drive float wheel with the two cables thereon, the endless screw mounted on ball bearings, with its cover partly removed to explain more fully the spiral groove and the reversal at the end of the screw, and the clock.

The cut also shows the two and only rolls used, one the supply roll and the other the take-up roll; the creasing bar at the rear of the take-up roll for accurately creasing the paper perpendicularly to the line of travel so that when it is inserted in the slot of the take-up roll it will be held flat against the roll; the winding clutch (behind the clock) with lever for winding up the clock weight; the clutch release, attached thereto, which permits the cable shaft to be moved in either direction; the pencil carriage with its adjustably weighted pencil; the metal base with its three point support and the counterweight cable sheave, on its threaded shaft, which displaces the weight laterally so it will pass the float in descending.

AU CONTINUOUS WATER LEVEL RECORDER TYPE CS

For Recording the Stage of all Impounded and Flowing Waters



CS-BT—AU WATER STAGE RECORDER, time rate 0.1 inch per hour, 2.4 inches per day, equipped with instantaneous automatic screw-driven pencil providing unlimited range of water level. Recorder complete with accessories listed below:

- Float Wheel—Positive drive for 1:6 or 1:12 gage height ratio.
- Cover—All-metal, two-piece, removable top.
- Float—10-inch copper with counter-weight and cable.
- Pencil—Gravity type for wood-encased pencil.
- Clock—Eleven-jewel, weight-driven, with dial.
- Chart—25-yard roll on brass core.

(Weight: gross, 150 lbs; net, 78 lbs.)

\$.....

AU CONTINUOUS WATER LEVEL RECORDER

THE Au Recorder, designated as the continuous screw type, receives its name from the continuity of water record, which can be taken from it. In general, it employs all the patented devices which have made the Au Recorder of supreme value in its field.

The Standard Fuzee Screw Recorder produces a record up to but not beyond sixty days' duration. The Drum Recorder makes a record on a seven and one-half day chart. The record made by a Continuous Screw Recorder is limited only by the length of the clock cable weight. For this reason it maintains favor for such isolated installations as can be visited only at long intervals as great even as six months.

As in all Au Recorders, the record is written directly on the supply roll, so that the original accuracy of the alignment of chart graduations is precisely maintained.

As the paper with the record written out leaves the supply roll, it passes around a driving roll with which it is held in contact by a solid brass friction roll of sufficient weight to preclude the need of springs. After passing between this pair of rolls, the chart is taken up by the receiving roll, which is weight driven. The driving roll described above is driven by a weight and its speed is controlled by a Marine clock movement. The take-up roll may be removed with the complete record on it.

This chart drive of the Continuous Recorder possesses three advantages that are distinctive of it.

1. Continuous records of long duration as great even as six months may be obtained from it, when the Recorder is properly installed.

2. Contrariwise, records of short duration on shorter sections of chart may be removed for any interval of time without rewinding or resetting the chart.

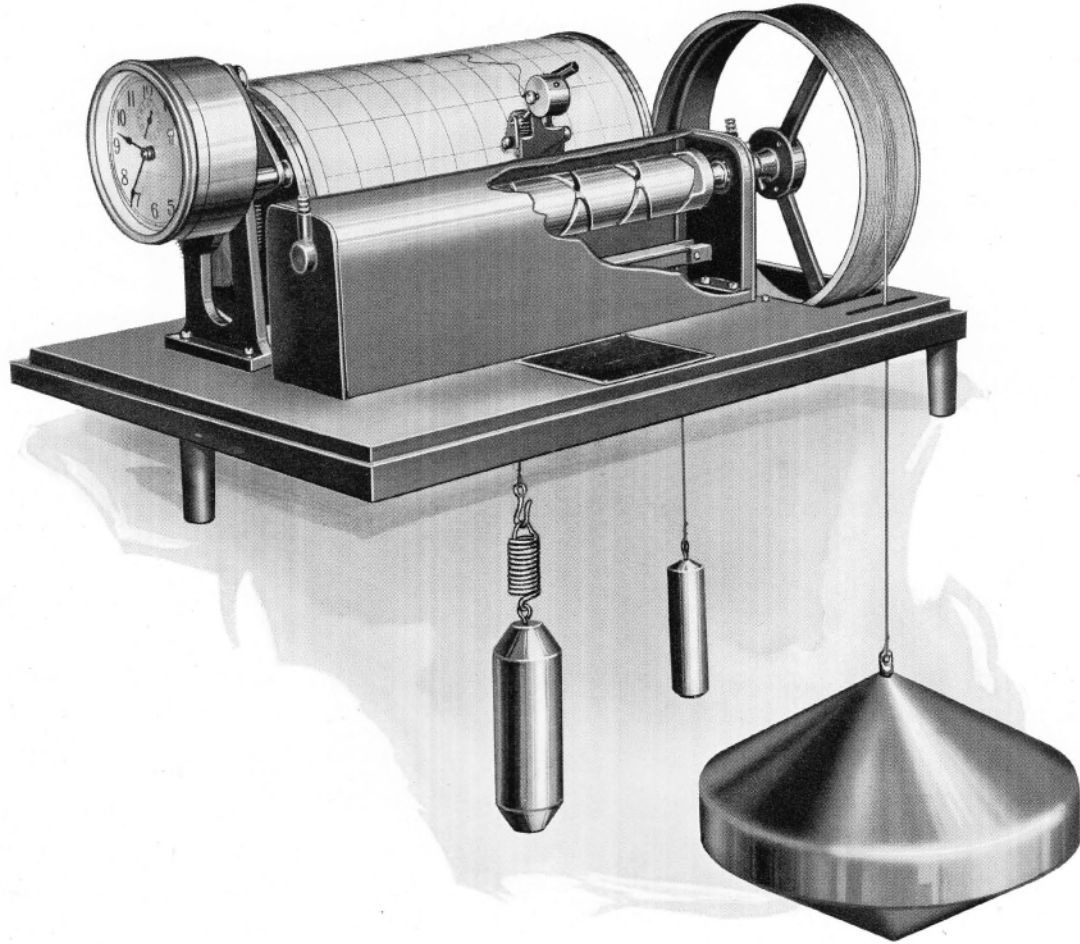
3. On special order, we can furnish the Au Continuous Recorder so arranged that by the insertion of special gears, various time speeds may be accomplished by the same instrument. These gears may be inserted in the field without special tools or need of expert handling.

The float used is the standard 10-inch copper double cone float. Float wheels can be provided for either a 1:6, 1:12 or 5:12 ratio of chart to water stage. The clock is a Chelsea Marine movement and is furnished with dial and hands. As in all Au Recorders unless otherwise specified the pencil unit with lead encased pencil is supplied. Pen units can also be supplied for records with ink. As is evident, the pen unit requires filling of the glass reservoir with ink at two-week intervals; hence for isolated installations the pencil unit must be used.

The complete mechanism of the Recorder is enclosed in an all-metal case made in two parts with a top that can be lifted off for inspection of the record or minor adjustments.

With each shipment we furnish a blue print showing the dimensions and preparation of the table on which the Recorder is placed above the water.

AU DRUM WATER LEVEL RECORDER
TYPE DS



DS-BT—AU DRUM RECORDER, seven-and-one-half day drum paper drive; time rate 0.1 inch per hour, 2.4 inches per day, equipped with instantaneous automatic reversing screw-driven pencil. Recorder complete with accessories listed below:

- Float Wheel—Positive drive for 1:6 or 1:12 gage height ratio.
- Cover—All-metal, two-piece, removable top.
- Float—10-inch copper with counter-weight and cable.
- Pencil—Gravity type pencil carriage and holder for wood-encased pencil.
- Charts—One year's supply *weekly* charts No. 300-W.
- Clock—Eleven-jewel, weight-driven, with dial.

(Weight: gross, 145 lbs; net, 66 lbs.)

\$.....

AU DRUM WATER LEVEL RECORDER

THE Au Drum Recorder adapts the chief patented features of the Au Water Level Recording mechanisms to a type of instrument making weekly records on charts that are to be replaced each week. Where the water level instrument is so located that it can be visited at short periods, the weekly drum type of instrument possesses the additional advantage that the charts may be easily filed for a study of water level changes.

The illustration shows this Recorder with its all-metal standard two-piece cover removed. The base of this instrument is of cast iron, which makes for sturdiness and security of the location of uprights and the permanent accuracy of the recording mechanism.

The float is the standard double-cone type of copper float used with all Au Water Stage Recorders. The float wheel shown in the illustration of this Drum Recorder is a wheel whose effective ratio is 1:12, that is 1 inch of record on the chart equals 12 inches of actual water change.

As in all Au Recorders, float wheels giving other scales are provided. The standard ratios are 1:6, 1:12 and 5:12. The float wheel is the positive drive type recommended above a friction drive type. The float cable, and the float counterweight cable are separately attached to the wheel, and the cable wraps in grooved channels, precluding either slipping or piling up.

The movement of the float wheel is communicated to the writing unit by the special automatic reversing screw mechanism, which makes a reversal of the pencil or pen unit without any lost motion. Great changes of water level can be thus recorded with a scale that is uniform and suited to the particular needs of the installation.

The clock is a Chelsea Marine movement and is provided with dial and hands.

The rotation of the chart drum is controlled by the clock. The time scale is around the drum and the water scale is across the drum. It can be seen, therefore, that a failure to remove the chart at the end of a weekly period will not stop the clock nor destroy the continuity of the water records. The drum will continue to turn and although there will be a double tracing, there is no difficulty in following the graph, since the chart drum makes one complete revolution in seven and one-half days, so that the overlap of record is clearly indicated.

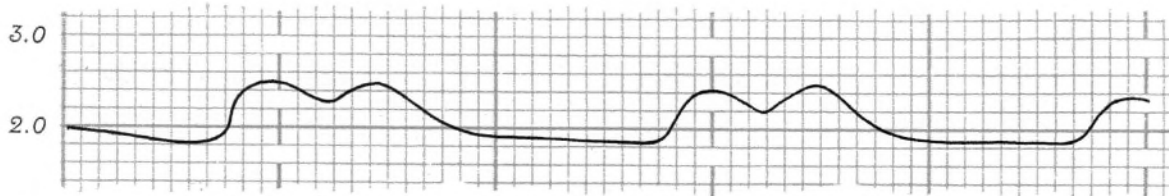
The standard time scale of the Au Drum Weekly Recorder is 2.4 inches per day, or .1 inch per hour.

The charts used are designated as No. 300-W and a year's supply of fifty-five is furnished with each instrument.

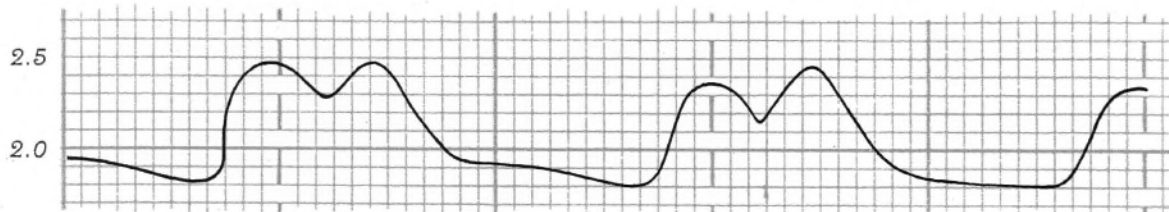
The standard equipment for writing is a pencil unit, provided with a wood encased lead. In lieu of the pencil unit, we can provide at slight additional charge, a complete pen unit, using a glass reservoir type of pen.

The complete mechanism of the Recorder is enclosed in an all-metal case made in two parts, with a top that can be lifted off for inspection of the record or minor adjustments.

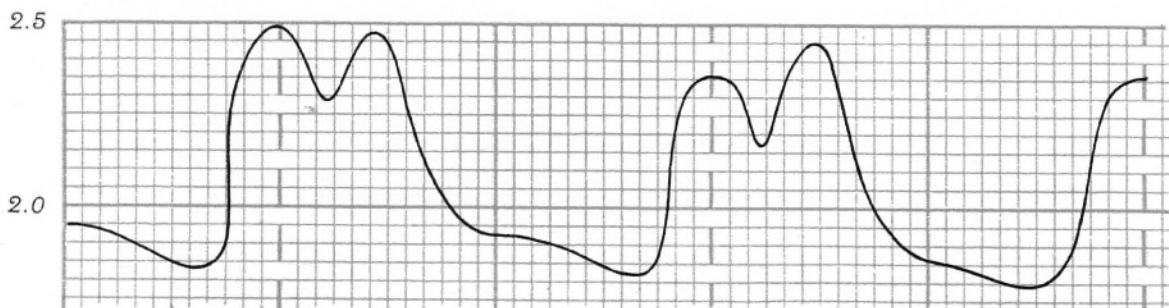
With each shipment, we furnish a blue print showing the dimensions and preparations of the table on which the Recorder is placed above the water.



Height scale: 0.5 inch on recorder sheet equals 1 foot change in stage: Ratio 1:24



Height scale: 1 inch on recorder sheet equals 1 foot change in stage: Ratio 1:12



Height scale: 2 inches on recorder sheet equals 1 foot change in stage: Ratio 1:6

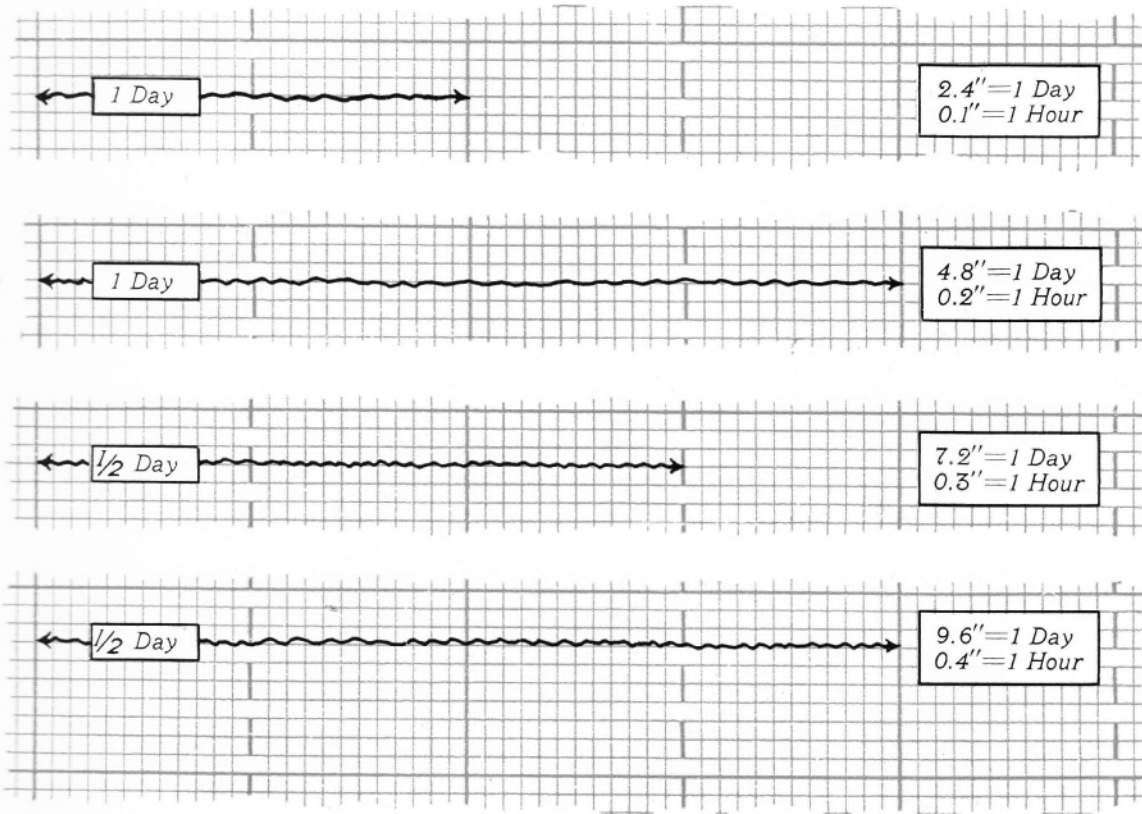
WATER HEIGHT SCALES

THE above illustration shows the same water stage reproduced in three full-size scales for the purpose of comparison. The top scale shows 0.5 inch (1/24 foot) of chart equivalent to 1 foot of water, or a reduction in the ratio of 1:24. The middle scale shows 1 inch (1/12 foot) of chart equivalent to 1 foot of water, ratio 1:12, and the bottom scale, 2 inches (1/6 foot) of chart equals 1 foot of water, ratio of 1:6. In all three cases a day's record occupies the same space on the chart, namely: 2.4 inches. The ratios usually selected are 1:6 or 1:12 shown as the two lower scales of the above illustration.

METRIC SYSTEM: by the use of a special float wheel a record is made from which the gage height may be read in the metric system. Two scales are provided, in one case the smallest scale division of the chart equalling two centimeters of water and in the other case four centimeters.

LIST OF WATER HEIGHT SCALES

RATIO	DESCRIPTION	RANGE IN FEET WITHOUT REVERSAL OF PENCIL
1: 24	0.5 inch of chart equals 1 foot of water	20 feet
1: 12	1.0 inch of chart equals 1 foot of water	10 feet
1: 6	2.0 inches of chart equals 1 foot of water	5 feet



TIME SCALES

THE space on the chart which one day's record will occupy will be determined by the speed at which the paper is unrolled. This is expressed as so many inches of chart per day or hour and is known as the *time scale*. The above *full-size* sections of chart show how much of the chart, measured on the long dimension of the roll, is actually occupied by one day's or one-half day's record.

Ordinarily the time scale of 2.4 inches per day, shown at the top of the illustration, is satisfactory. Special problems, however, may require larger scales when the time element is of great importance, as in hydro-electric operation, the study of tides and the flow in storm sewers. Three other scales are therefore shown in the above illustration for purpose of comparison and to assist in making a selection.

LIST OF TIME SCALES

INCHES PER DAY	INCHES PER HOUR	DAYS—25-YARD ROLL WILL LAST	CLOCK WEIGHT DESCENDS IN SIXTY DAYS
2.4	0.1	375	10 feet
4.8	0.2	186	10 feet
7.2	0.3	125	10 feet
9.6	0.4	94	10 feet

Time scales other than 2.4 inches per day are special construction for which there is an additional charge.

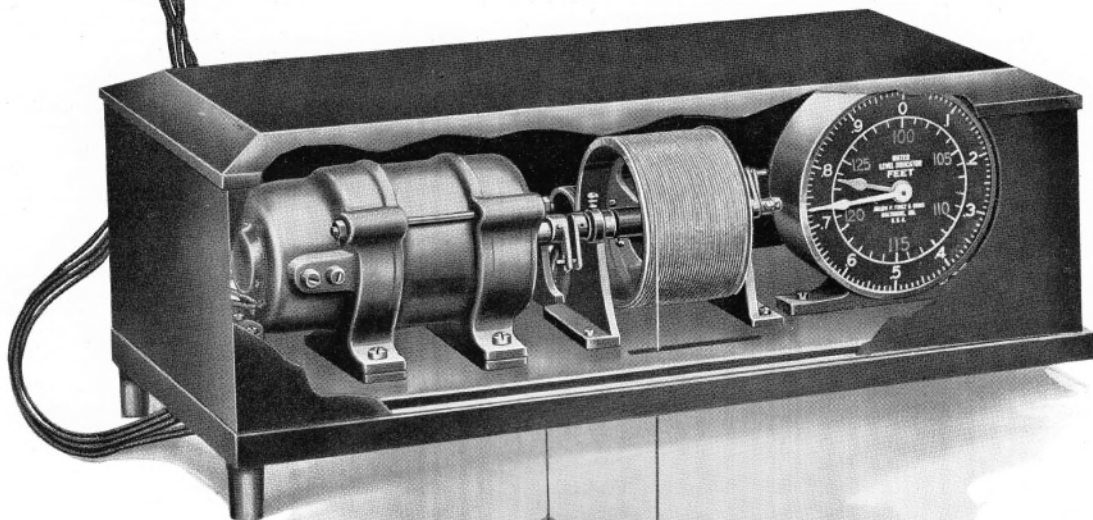
AU WATER LEVEL INDICATOR

For Remote Indications of Levels of all Impounded and Flowing Waters



INDICATOR

Placed at remote point where readings are desired



TRANSMITTER

Placed over Water Level to be measured

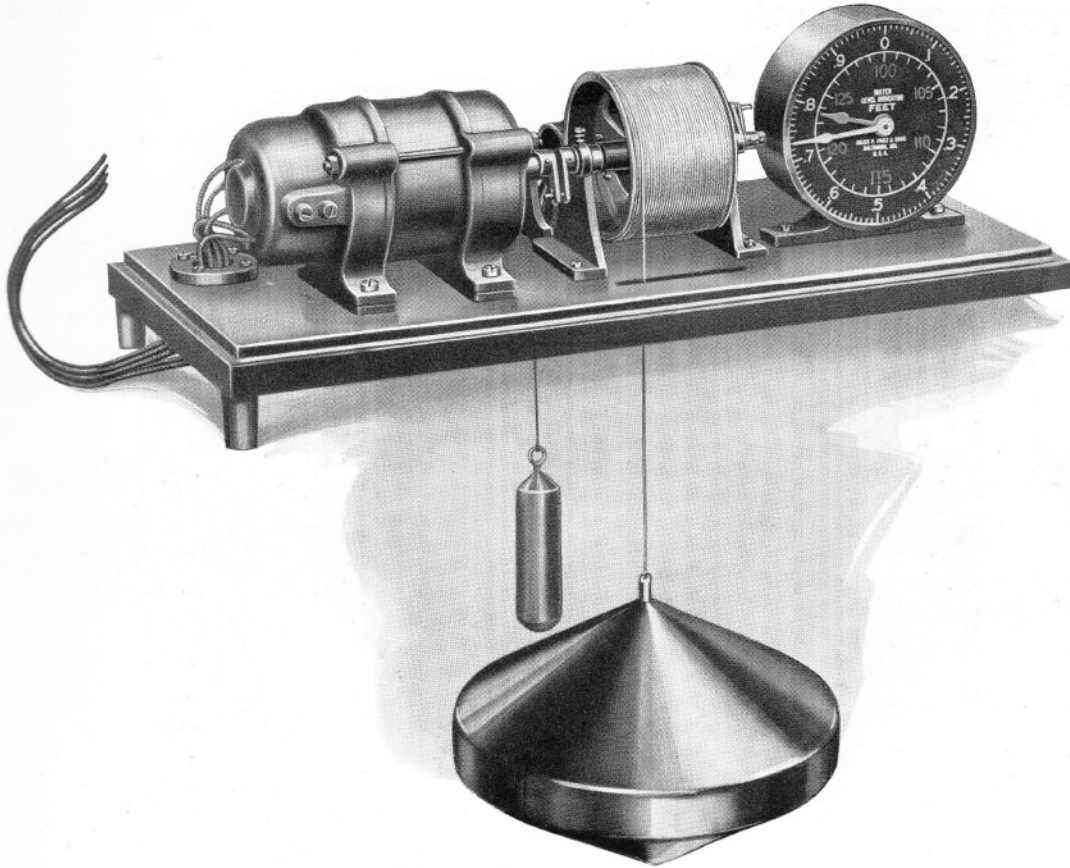
MODEL PT WATER LEVEL TRANSMITTER, with 10-inch float; float counter-weight; suspension cables; positive drive float wheel, 5-inch Indicator and self-synchronizing motor for operation of remote Indicator, all inclosed in metal case and Model PDW Au Distant Indicator with self-synchronizing motor, 12-inch dial, two concentric hands, outer circle reading in hundredths of a foot, inner circle marked to order; all above equipment complete, ready for installation.

(Weight: gross, 150 lbs (2 boxes); net, 79 lbs.)

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WATER LEVEL TRANSMITTER

MANY conditions exist where it is desirable to know the water level of a distant reservoir, lake, river, canal or condensing water basin without sending an observer to measure the level or to read it from a staff gage. For such purposes the Au Water Level Transmitter with Indicator is perfectly adapted.



TRANSMITTER

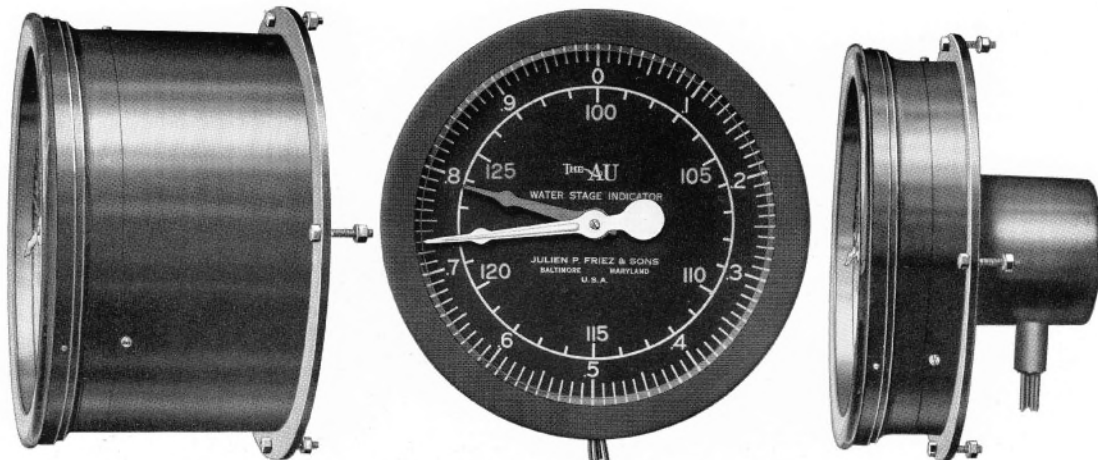
The Transmitter consists of a 10-inch copper float suspended in the water by a stranded copper cable, a positive drive float wheel, 5-inch dial for local indication of water level, graduated the same as the dial of the distant indicator and a self-synchronizing motor which transmits every movement of the float to the distant indicator through a similar motor within the case of the indicator.

The positive drive float wheel is so called because the construction absolutely prevents any slippage of the suspended cables or the seating of the cable on a part of the wheel which would materially alter the working diameter of the wheel and

hence cause an incorrect reading of the water level. Two separate cables are provided for the float and its counter-weight, each cable being separately attached to the spirally grooved float wheel. As one cable winds off the wheel the other winds on. In addition the counter-weight cable, to obviate any tendency of the counter-weight to swing, is guided into its proper groove by a traveling screw sheave. This arrangement insures a constant diameter of float wheel and, consequently, an accurate reading of level.

Non-corrosive metal is used for all working parts and the entire instrument is inclosed in a metal case with a glass window in front of the 5-inch dial.

AU WATER LEVEL INDICATOR AND DIALS



FACE TYPE
for Switchboard or Wall

SEMI-FLUSH TYPE
for Switchboard

INDICATOR

COUPLED directly to the float wheel of the Transmitter just described is a self-synchronizing motor of standard make, which imparts electrically every movement of the float to its companion motor in the indicator case, illustrated above. This method of transmission by synchronously rotating motors eliminates all make and break contacts, which have been the cause of so much trouble in step-by-step methods of transmission, and furnishes an absolutely dependable distant indication. Three wires connect the two motors, which are supplied with power at 110 volts, 60 cycles, from the power mains. This synchronous movement of the two motors may be effected over a distance of several miles provided the same source of power is available at both ends.

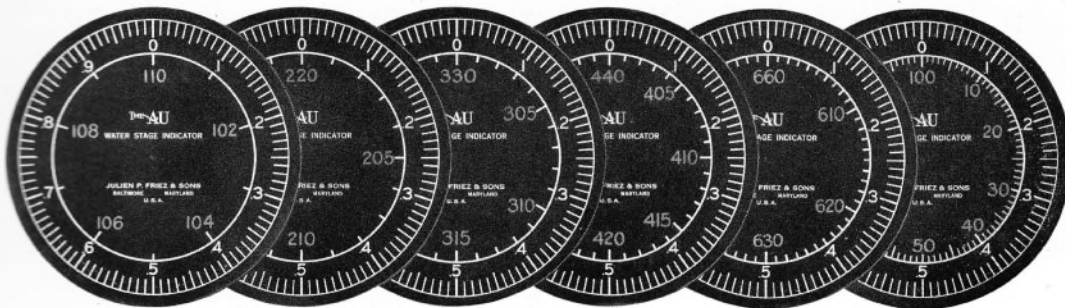
The Indicator has two hands, concentrically mounted; the inner hand indicates the stage in feet, and the outer hand in hundredths of a foot. The inner circle is marked to customer's order, and the hand for this circle is painted a distinguishing color. Indicators have 12-inch dials and are made in two types, one for face of board mounting, the other for semi-flush mounting, the latter requiring that the board be cut away for the motor casing which projects through it. Indicator cases are of cast aluminum, black enameled, and are weather-proof. The maximum outside diameter of the case, either style, is $13\frac{3}{8}$ inches. The face type projects 8 inches beyond face of board; semi-flush type $3\frac{5}{8}$ inches.

When board space is limited, a 9-inch Indicator can be supplied and when great visibility is desired, an 18-inch. The latter can also be furnished double faced, illuminated.

Two or more Indicators may be operated in parallel from the same Transmitter permitting the Indicators to be placed at several points where the information is needed.

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AU WATER LEVEL INDICATOR



10 FT. RANGE 20 FT. RANGE 30 FT. RANGE 40 FT. RANGE 60 FT. RANGE 100 FT. RANGE
 Style 10 Style 20 Style 30 Style 40 Style 60 Style 100

DIAL RANGES

The above illustrations show the graduations of the dial and the arrangement of the figures on the inner and outer circles. The marking of the outer circle (in hundredths of a foot) is standard and is etched on the dial plate. The inner circles of the dials, pictured above, are numbered for purposes of illustration only. They will be marked to customer's order with the water stage furnished. The marking of the 5-inch dial in the Transmitter is identical with the marking of the distant Indicator. The actual diameter of the dial plate is $12\frac{3}{8}$ inches for the 12-inch Indicator.

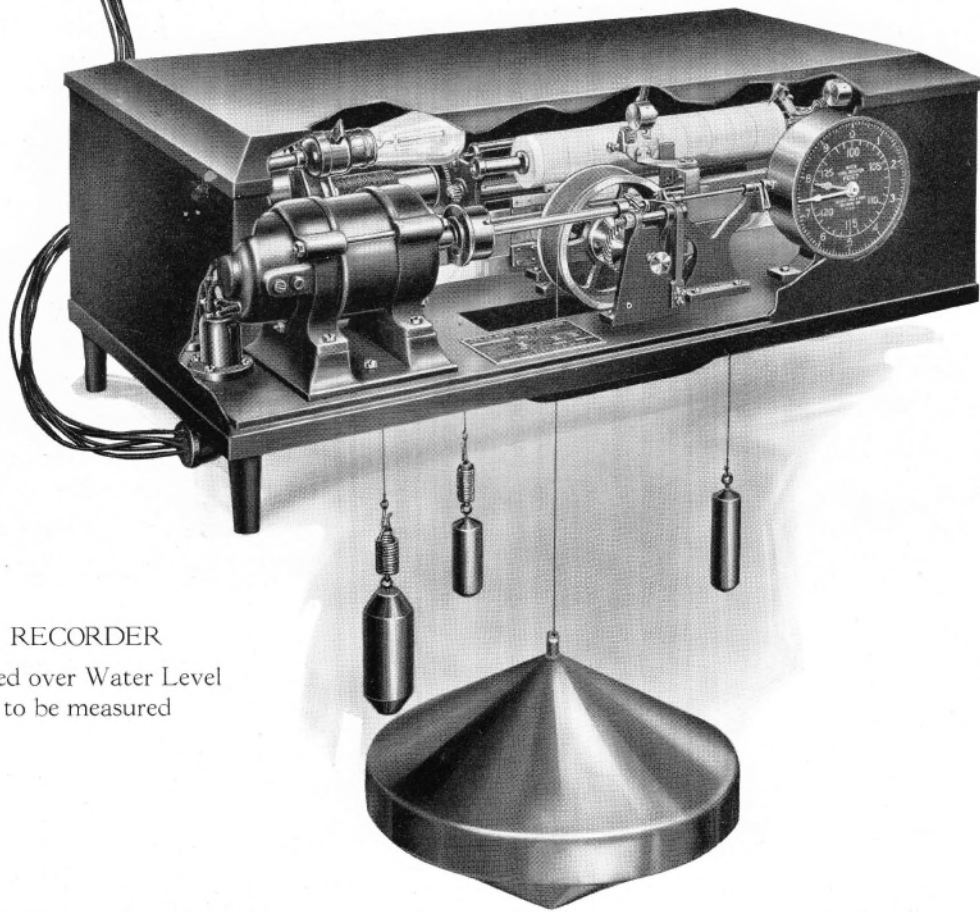
Fifty and 80-foot ranges are also available.

AU WATER LEVEL RECORDER AND INDICATOR

For Record and Remote Indication of Water Levels at Power Plants and Water Works



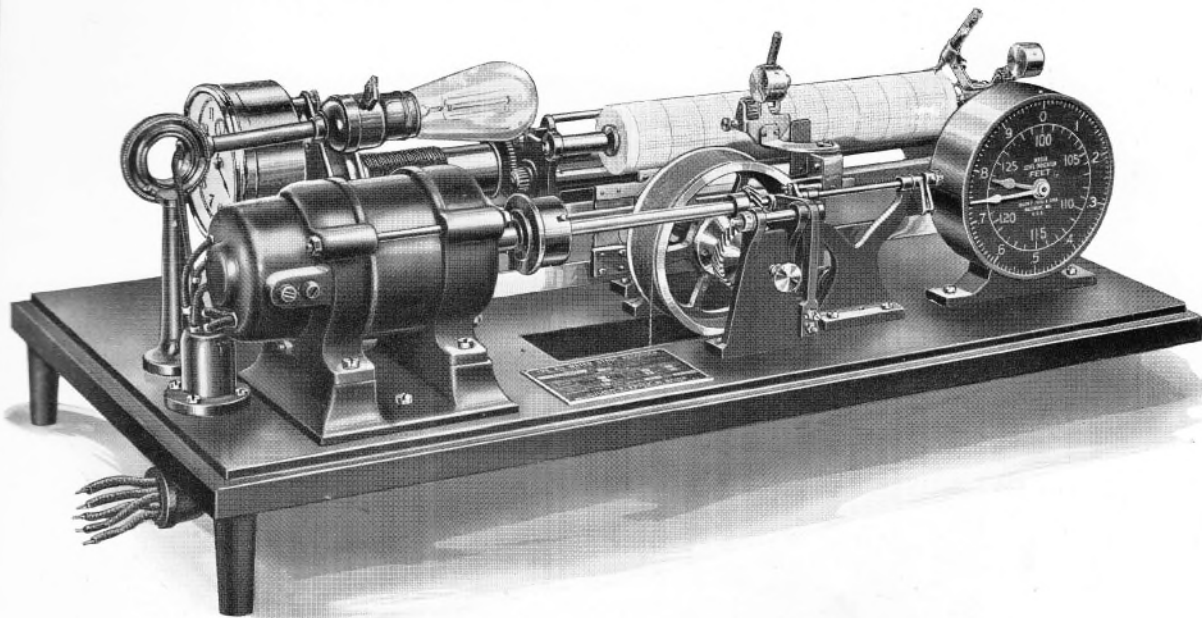
INDICATOR
Placed in Operating
Room of Plant



RECORDER
Placed over Water Level
to be measured

MODEL PCR AU CONTINUOUS RACK RECORDER complete with metal cover; jeweled clock movement; positive drive float wheel; 10-inch float; clock and float weights and cables; 5-inch Indicator attached to Recorder; self-synchronizing motor for operation of Indicator; pencils and one chart roll 25 yards long, and Model PDW Au Distant Indicator with self-synchronizing motor, 12-inch dial, two concentric hands, outer dial circle reading in hundredths of a foot, inner circle to be marked to order; all above equipment complete, ready for installation...\$.
(Weight: gross, 260 lbs (2 boxes); net, 34 lbs.)

RECORDER WITH SELSYN MOTOR TRANSMITTER



FOR power plant use we have selected as most applicable the continuous rack Recorder with two pencils, each recording a 20-foot range of level with a 40-foot maximum variation; a time scale of 0.4 inches to the hour or 9.6 inches per day and an optional water height scale of $\frac{1}{2}$ inch or 1 inch of chart equal to 1 foot of water.

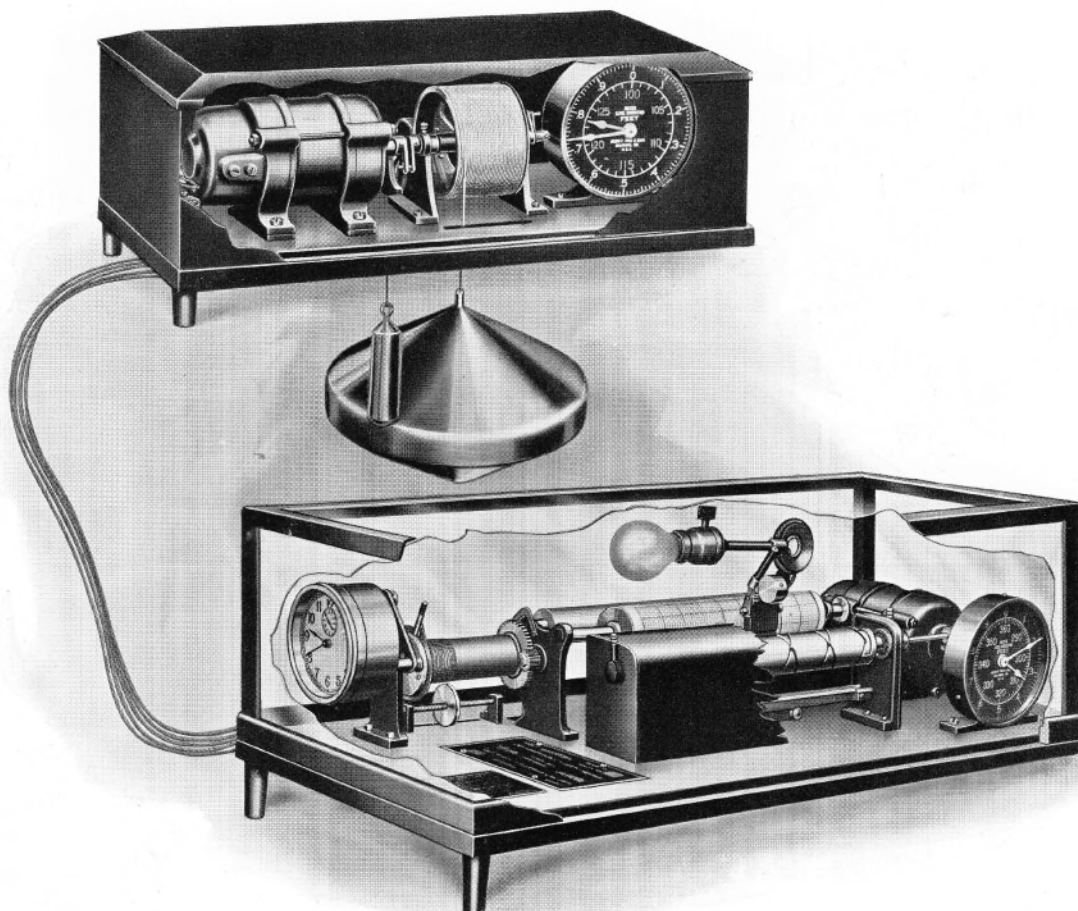
The pencil draws directly on the supply roll, precluding errors due to uneven tracking of the paper. Means of adjusting the paper are provided and a reference line makes it possible to correct errors arising from paper expansion and contraction.

Means are provided also for removing the record at frequent intervals if a continuous record is not desired, and a 5-inch dial permits local readings of water level without referring to the chart. Within the case is an electric lamp for illumination purposes. The float is of spun copper 10 inches in diameter and is suspended by a $\frac{3}{8}$ -inch bronze stranded cable, as are also the clock weights and float counterweight. Float wheel is *positive drive*, that is, the float wheel and counterweight have separate cables, both attached to the wheel. A metal case protects the interior parts from injury.

The value of water in hydro-electric plants and in all waterworks is becoming more and more appraised in small fractions of a foot. Records of these fractional fluctuations should be continuous and accurate throughout their entire range, and hence *autographic*, if fullest value is to be assured.

Where records are of prime importance, the Recorder itself is best located at the water, either of forebay or tailrace. Within the plant, Indicators duplicating the action of the Recorder and giving visual readings of the water movement, round out a very complete water measurement installation.

AU WATER LEVEL TRANSMITTER
WITH RECORDER REMOTELY LOCATED



MODEL PT WATER LEVEL TRANSMITTER, complete with Selsyn motor, float wheel and 10-inch diameter float; 5-inch dial mounted on base, gives direct readings of water level by two hands, in feet, inches, and tenths of an inch. \$
(Weight: gross, 140 lbs; net, 48.5 lbs.)

MODEL PCS AU WATER LEVEL REMOTE RECORDER, roll chart type; recording pen unit is operated by automatic reversing screw mechanism, driven by Selsyn motor; 5-inch dial mounted on base gives by two hands, direct readings of water level in feet, inches, and tenths of an inch. Electric lamp with goose-neck is provided for illumination and for reducing moisture. Instrument complete with all accessories, for use with Water Level Transmitter Model PT. \$
(Weight: gross, 200 lbs; net, 105 lbs.)

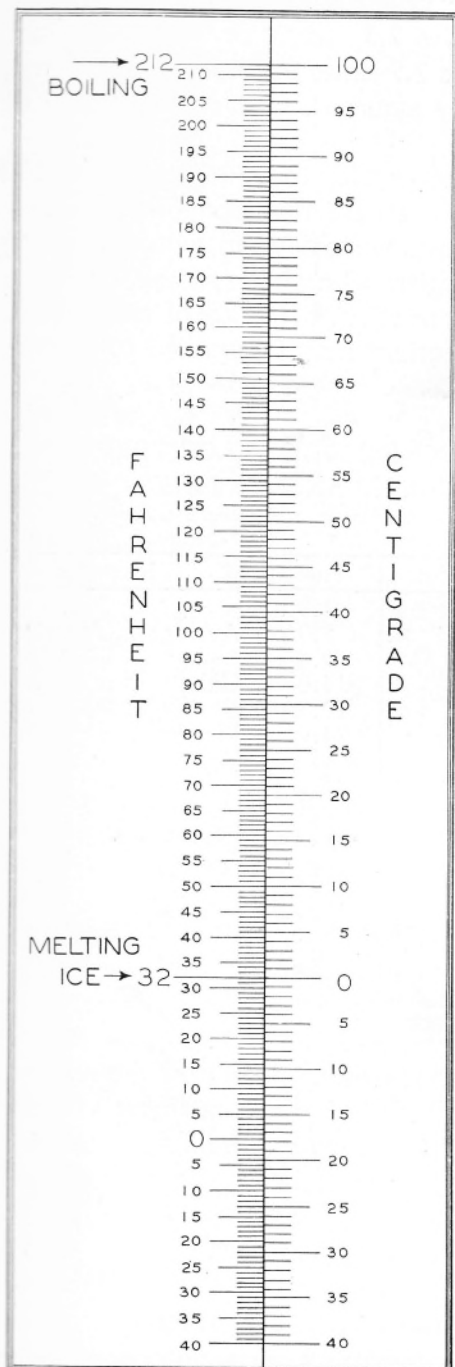


NOTE.—Each of the units listed and illustrated above is described in detail in the discussion of the various models of the Au Recorder.

USEFUL TABLES OF REFERENCE

Table I

COMPARATIVE TEMPERATURE TABLE



COMPARISON OF THERMOMETER SCALES

A little study of the accompanying information and diagram will enable any one to form a clear idea of the various thermometer scales and to convert temperatures from one scale to another.

Table of Fixed Points

Scale	Temperature of melting ice.	Temperature of boiling water.	Number of degrees between melting ice and boiling water.
Centigrade.....	0	100	100
Celsius.....	100	0	100
Reaumur.....	0	80	80
Fahrenheit.....	32	212	180

From the above it will be seen that the Celsius scale is not identical with the Centigrade, as is very generally supposed, but resembles it only in that it has the same number of degrees between the freezing and boiling points of water.

Thermometers are now, however, never graduated according to the Celsius scale, and the use of the word as synonymous with Centigrade is quite erroneous.

Only Fahrenheit and Centigrade scales are in general use, and the accompanying plate is designed to enable observers to convert temperature readings from one scale to the other without resorting to a mathematical formula.

For accurate and precise reductions between the different scales, the following rules should be used:

1. To convert Fahrenheit to Centigrade: subtract thirty-two and multiply by five-ninths.
2. To convert Centigrade to Fahrenheit: multiply by nine-fifths and add thirty-two.
3. To convert Fahrenheit to Reaumur: subtract thirty-two and multiply by four-ninths.
4. To convert Reaumur to Fahrenheit: multiply by nine-fourths and add thirty-two.
5. To convert Centigrade to Reaumur: multiply by four-fifths.
6. To convert Reaumur to Centigrade: multiply by five-fourths.

TABLE II

WIND VELOCITIES

THE new Three-Cup Anemometer, designed after conferences between Mr. Samuel P. Fergusson of the U. S. Weather Bureau and Dr. J. Patterson, Director of the Canadian Meteorological Office, has nearly the same dimensions as the former four-cup standard; the cups are 5 inches in diameter on arms 6.29 inches long and the spindle makes one revolution while the wind moves 2.5 metres or 640 revolutions to one mile of wind, assuming that the wind moves 2.5 times faster than the centres of the cups instead of three times as was originally assumed. The new instrument, therefore, is an International Standard.

The rate of the new Anemometer agrees so closely with the true velocity of the wind, that errors of the Anemometer itself are smaller than errors from other sources, such as the mechanical condition of the instrument, variability in velocity during the time period chosen, limitations of methods of registration and exposure, and data from the instrument may be accepted without correction. If data of the highest degree of accuracy are desired, the following corrections may be applied to records from instruments in good condition.

TRUE OR CORRECT VELOCITIES CORRESPONDING TO VELOCITIES
INDICATED BY NEW STANDARD THREE-CUP ANEMOMETER

IN MILES PER HOUR			IN METRES PER SECOND		
Indicated	True	Remarks	Indicated	True	Remarks
5	5.1		2	2.1	
10	10.1	Average in America	5	5.0	Average in America
20	19.6		10	9.8	
30	29.1	Gale	15	14.6	Gale
40	38.7		20	19.3	
60	57.8	Hurricane	25	24.0	Hurricane
80	76.5		30	28.7	
100	95.2		35	33.4	
120	114.8		40	38.3	
140	134.5	Highest Recorded	45	43.0	Highest Recorded
160	153.0		50	47.6	
180	172.6		55	52.3	
200	191.6		60	57.1	

TABLE III

WIND PRESSURES

RECENT experiments by the U. S. Bureau of Standards, to determine the relation between wind velocities and pressures on plates or plane surfaces exposed normally, *i.e.*, placed at right angles to the direction of the wind, indicate that wind pressures are not so great as generally computed by the Smeaton formula in use heretofore and are given quite accurately by the following equation:

$$P = .0032 \frac{B}{30} SV^2$$

S = Surface, in square feet

V = Velocity of wind in miles an hour

P = Pressure in pounds avoirdupois

B = Height of barometer in inches

For stations near sea-level where the barometric pressure does not differ much from

30 inches the ratio $\frac{B}{30}$ need not be considered, but at elevated stations a correction will be necessary; for example, at a height of 6,000 feet where the barometric pressure is 24 inches, the pressure of the wind at fifty miles an hour, which at sea-level is eight pounds per square foot, is $\frac{24}{30}$ of eight pounds or 6.4 pounds.

TABLE OF WIND PRESSURES (POUNDS PER SQUARE FOOT)

Velocity, Miles	0	1	2	3	4	5	6	7	8	9
0.....	.....	.....	.....	.....	.....	.08	.11	.16	.20	.26
10.....	.32	.39	.46	.54	.63	.72	.82	.92	1.04	1.15
20.....	1.28	1.41	1.54	1.69	1.84	2.01	2.16	2.33	2.51	2.69
30.....	2.9	3.1	3.3	3.5	3.7	3.9	4.2	4.4	4.6	4.9
40.....	5.1	5.4	5.7	5.9	6.2	6.5	6.8	7.1	7.4	7.7
50.....	8.0	8.3	8.7	9.0	9.4	9.7	10.0	10.4	10.8	11.2
60.....	11.6	11.9	12.3	12.7	13.1	13.5	13.9	14.4	14.8	15.2
70.....	15.7	16.1	16.6	17.1	17.5	18.0	18.5	19.0	19.5	20.0
80.....	20.5	21.0	21.5	22.0	22.6	23.1	23.7	24.2	24.8	25.3
90.....	25.9	26.5	27.1	27.7	28.3	28.9	29.5	30.1	30.7	31.4
100.....	32.0	.....	.....	.....	.....	.....	.....	.....	.....	.....

TABLE IV

Showing Depth of Precipitation Corresponding to Given Weights
(Computed for 8-inch circular collector; water at maximum density; 39° Fahr.)

Wgths. Rainfall (Inches)					Wgths. Rainfall (Inches)					Wgths. Rainfall (Inches)							
lbs.	oz.	0	¼	½	¾	lbs.	oz.	0	¼	½	¾	lbs.	oz.	0	¼	½	¾
	oz.	oz.	oz.	oz.	oz.		oz.	oz.	oz.	oz.	oz.		oz.	oz.	oz.	oz.	oz.
	0	.00	.01	.02	.03	1	13	1.00	1.01	1.01	1.02	3	10	2.00	2.00	2.01	2.02
	1	.03	.04	.05	.06	1	14	1.03	1.04	1.05	1.06	3	11	2.03	2.04	2.05	2.06
	2	.07	.08	.09	.09	1	15	1.07	1.08	1.08	1.09	3	12	2.06	2.07	2.08	2.09
	3	.10	.11	.12	.13	2	0	1.10	1.11	1.12	1.13	3	13	2.10	2.11	2.12	2.12
	4	.14	.15	.15	.16	2	1	1.14	1.14	1.15	1.16	3	14	2.13	2.14	2.15	2.16
	5	.17	.18	.19	.20	2	2	1.17	1.18	1.19	1.20	3	15	2.17	2.18	2.18	2.19
	6	.21	.22	.22	.23	2	3	1.20	1.21	1.22	1.23	4	0	2.20	2.21	2.22	2.23
	7	.24	.25	.26	.27	2	4	1.24	1.25	1.26	1.26	4	1	2.24	2.24	2.25	2.26
	8	.28	.28	.29	.30	2	5	1.27	1.28	1.29	1.30	4	2	2.27	2.28	2.29	2.30
	9	.31	.32	.33	.34	2	6	1.31	1.32	1.32	1.33	4	3	2.30	2.31	2.32	2.33
	10	.34	.35	.36	.37	2	7	1.34	1.35	1.36	1.37	4	4	2.34	2.35	2.36	2.37
	11	.38	.39	.40	.41	2	8	1.38	1.38	1.39	1.40	4	5	2.37	2.38	2.39	2.40
	12	.41	.42	.43	.44	2	9	1.41	1.42	1.43	1.44	4	6	2.41	2.42	2.43	2.43
	13	.45	.46	.46	.47	2	10	1.44	1.45	1.46	1.47	4	7	2.44	2.45	2.46	2.47
	14	.48	.49	.50	.51	2	11	1.48	1.49	1.50	1.51	4	8	2.48	2.49	2.49	2.50
	15	.52	.52	.53	.54	2	12	1.51	1.52	1.53	1.54	4	9	2.51	2.52	2.53	2.54
1	0	.55	.56	.57	.58	2	13	1.55	1.56	1.57	1.57	4	10	2.55	2.56	2.56	2.57
1	1	.58	.59	.60	.61	2	14	1.58	1.59	1.60	1.61	4	11	2.58	2.59	2.60	2.61
1	2	.62	.63	.64	.65	2	15	1.62	1.63	1.63	1.64	4	12	2.61	2.62	2.63	2.64
1	3	.65	.66	.67	.68	3	0	1.65	1.66	1.67	1.68	4	13	2.65	2.66	2.67	2.67
1	4	.69	.70	.71	.71	3	1	1.69	1.69	1.70	1.71	4	14	2.68	2.69	2.70	2.71
1	5	.72	.73	.74	.75	3	2	1.72	1.73	1.74	1.75	4	15	2.72	2.73	2.73	2.74
1	6	.76	.77	.77	.78	3	3	1.75	1.76	1.77	1.78	5	0	2.75	2.76	2.77	2.78
1	7	.79	.80	.81	.82	3	4	1.79	1.80	1.81	1.81	5	1	2.79	2.80	2.80	2.81
1	8	.83	.83	.84	.85	3	5	1.82	1.83	1.84	1.85	5	2	2.82	2.83	2.84	2.85
1	9	.86	.87	.88	.89	3	6	1.86	1.87	1.87	1.88	5	3	2.86	2.86	2.87	2.88
1	10	.89	.90	.91	.92	3	7	1.89	1.90	1.91	1.92	5	4	2.89	2.90	2.91	2.92
1	11	.93	.94	.94	.95	3	8	1.93	1.94	1.94	1.95	5	5	2.92	2.93	2.94	2.95
1	12	.96	.97	.98	.99	3	9	1.96	1.97	1.98	1.99	5	6	2.96	2.97	2.98	2.98
...	...	...	...	...	...	...	...	...	...	...	...	5	7	2.99	3.00	3.01	3.02

NOTE.—This table is designed especially for the measurement of Snowfall, and is compiled for use in connection with the standard U. S. Weather Bureau 8-inch Rain and Snow Gages.

TABLE V
APPROXIMATE HOURS OF POSSIBLE SUNSHINE

From 25° to 49° North Latitude, Inclusive
 (Use latitude nearest that of station, interpolating when necessary)

Date		25°	27°	29°	31°	33°	35°	37°	39°	41°	43°	45°	47°	49°
January	1.....	10.6	10.5	10.3	10.2	10.0	9.9	9.7	9.5	9.3	9.1	8.8	8.6	8.3
	11.....	10.7	10.6	10.4	10.3	10.2	10.0	9.8	9.7	9.5	9.3	9.1	8.8	8.6
	21.....	10.8	10.7	10.6	10.5	10.4	10.2	10.1	9.9	9.7	9.6	9.4	9.2	8.9
February	1.....	11.0	10.9	10.8	10.7	10.6	10.5	10.4	10.2	10.1	10.0	9.8	9.6	9.4
	11.....	11.2	11.2	11.1	11.0	10.9	10.8	10.7	10.6	10.5	10.4	10.3	10.1	10.0
	21.....	11.5	11.4	11.4	11.3	11.2	11.1	11.0	11.0	10.9	10.8	10.7	10.6	10.6
March	1.....	11.7	11.6	11.6	11.5	11.5	11.4	11.4	11.4	11.3	11.2	11.2	11.1	11.0
	11.....	11.9	11.9	11.9	11.8	11.8	11.8	11.8	11.8	11.8	11.7	11.7	11.7	11.6
	21.....	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2
April	1.....	12.4	12.4	12.5	12.5	12.6	12.6	12.6	12.6	12.7	12.7	12.8	12.8	12.9
	11.....	12.6	12.7	12.8	12.8	12.9	12.9	13.0	13.0	13.1	13.2	13.3	13.4	13.5
	21.....	12.9	13.0	13.0	13.1	13.2	13.3	13.4	13.5	13.6	13.7	13.8	13.9	14.1
May	1.....	13.1	13.2	13.3	13.4	13.5	13.6	13.7	13.9	14.0	14.1	14.3	14.4	14.6
	11.....	13.3	13.4	13.5	13.6	13.8	13.9	14.0	14.2	14.4	14.5	14.7	14.9	15.1
	21.....	13.5	13.6	13.7	13.9	14.0	14.2	14.3	14.5	14.7	14.9	15.1	15.3	15.6
June	1.....	13.6	13.7	13.9	14.0	14.2	14.4	14.6	14.7	14.9	15.2	15.4	15.7	15.9
	11.....	13.7	13.8	14.0	14.1	14.3	14.5	14.7	14.9	15.1	15.3	15.6	15.9	16.1
	21.....	13.7	13.9	14.0	14.1	14.3	14.5	14.7	14.9	15.1	15.4	15.6	15.9	16.2
July	1.....	13.7	13.8	14.0	14.1	14.3	14.5	14.7	14.9	15.1	15.3	15.6	15.8	16.1
	11.....	13.6	13.7	13.9	14.0	14.2	14.4	14.6	14.8	14.9	15.2	15.4	15.7	15.9
	21.....	13.5	13.6	13.7	13.9	14.0	14.2	14.4	14.5	14.7	14.9	15.1	15.4	15.6
August	1.....	13.3	13.4	13.5	13.6	13.8	13.9	14.0	14.2	14.4	14.5	14.7	14.9	15.1
	11.....	13.1	13.2	13.3	13.4	13.5	13.6	13.8	13.8	14.0	14.2	14.3	14.5	14.6
	21.....	12.9	13.0	13.0	13.1	13.2	13.3	13.4	13.5	13.6	13.7	13.8	14.0	14.1
September	1.....	12.6	12.7	12.8	12.8	12.9	12.9	13.0	13.1	13.1	13.2	13.3	13.4	13.4
	11.....	12.4	12.4	12.5	12.5	12.5	12.6	12.6	12.6	12.7	12.7	12.8	12.8	12.8
	21.....	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.3	12.3
October	1.....	11.9	11.9	11.9	11.9	11.8	11.8	11.8	11.8	11.8	11.7	11.7	11.7	11.6
	11.....	11.7	11.6	11.6	11.6	11.5	11.5	11.4	11.4	11.3	11.3	11.2	11.1	11.1
	21.....	11.4	11.4	11.3	11.2	11.2	11.1	11.0	11.0	10.8	10.8	10.7	10.6	10.5
November	1.....	11.2	11.1	11.0	10.9	10.8	10.7	10.6	10.5	10.4	10.3	10.2	10.0	9.9
	11.....	11.0	10.9	10.8	10.7	10.6	10.4	10.3	10.2	10.0	9.9	9.7	9.5	9.3
	21.....	10.8	10.7	10.6	10.5	10.3	10.2	10.0	9.9	9.7	9.5	9.3	9.1	8.9
December	1.....	10.7	10.6	10.4	10.3	10.1	10.0	9.8	9.6	9.5	9.2	9.0	8.8	8.6
	11.....	10.6	10.5	10.3	10.2	10.0	9.8	9.6	9.5	9.3	9.1	8.8	8.6	8.3
	21.....	10.6	10.4	10.3	10.1	10.0	9.8	9.6	9.4	9.2	9.0	8.8	8.5	8.2

NOTE—Compiled for use in connection with records obtained from Sunshine Recorders.

TABLE VI
TO DETERMINE NORTH AND SOUTH LINE WITHOUT
RECOURSE TO A COMPASS

SINCE most office buildings contain a great deal of iron, a magnetic compass in such conditions cannot be relied upon. The shadow, however, which is cast at true solar noon by any vertical column on a horizontal surface will be an exact north and south line. To learn the true solar noon the observer must ascertain the exact difference between the standard time in use at his station, and the true local time. To this difference must be added or subtracted, as the case may require, the so-called equation of time, which is the number of minutes before or after local noon at which the sun passes the meridian. The following table gives in minutes and seconds the equation of time for every day of the year.

Days	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.
1.....	+ 3 53	+13 50	+12 29	+3 53	-3 01	-2 24	+3 36	+6 06	0 09	-10 23	-16 20	-10 45
2.....	4 21	13 57	12 17	3 35	3 08	2 14	3 47	6 02	0 28	10 42	16 21	10 22
3.....	4 49	14 04	12 04	3 17	3 15	2 05	3 59	5 58	0 47	11 01	16 20	9 58
4.....	5 16	14 10	11 51	3 00	3 21	1 55	4 09	5 53	1 07	11 19	16 20	9 34
5.....	5 43	14 14	11 37	2 42	3 26	1 44	4 20	5 47	1 26	11 37	16 18	9 09
6.....	6 10	14 19	11 23	2 25	3 31	1 33	4 30	5 41	1 46	11 54	16 15	8 44
7.....	6 36	14 22	11 09	2 08	3 45	1 22	4 40	5 34	2 07	12 11	16 12	8 18
8.....	7 01	14 24	10 54	1 51	3 39	1 11	4 50	5 26	2 27	12 28	16 08	7 51
9.....	7 26	14 26	10 39	1 34	3 42	0 59	4 59	5 18	2 47	12 44	16 03	7 25
10.....	7 51	14 27	10 23	1 18	3 45	0 47	5 08	5 10	3 08	13 00	15 57	6 57
11.....	8 15	14 27	10 07	1 02	3 47	0 35	5 16	5 00	3 29	13 16	15 50	6 30
12.....	8 38	14 27	9 51	0 46	3 48	0 23	5 24	4 50	3 50	13 31	15 43	6 02
13.....	9 01	14 25	9 35	0 30	3 49	-0 11	5 31	4 40	4 11	13 45	15 34	5 33
14.....	9 23	14 23	9 18	0 15	3 49	+0 02	5 38	4 29	4 32	13 59	15 25	5 05
15.....	9 44	14 20	9 01	0 00	3 49	0 15	5 44	4 18	4 53	14 12	15 15	4 36
16.....	10 05	14 17	8 44	-0 14	3 48	0 27	5 50	4 06	5 15	14 25	15 04	4 07
17.....	10 25	14 12	8 27	0 28	3 46	0 40	5 55	3 53	5 36	14 37	14 53	3 37
18.....	10 44	14 07	8 09	0 42	3 44	0 53	6 00	3 40	5 57	14 49	14 40	3 08
19.....	11 02	14 01	7 51	0 56	3 42	1 06	6 04	3 26	6 18	15 00	14 27	2 38
20.....	11 20	13 55	7 33	1 09	3 39	1 19	6 08	3 12	6 40	15 10	14 13	2 08
21.....	11 37	13 48	7 15	1 21	3 35	1 32	6 11	2 58	7 01	15 20	13 58	1 39
22.....	11 53	13 40	6 57	1 33	3 31	1 45	6 13	2 43	7 22	15 29	13 42	1 09
23.....	12 09	13 32	6 39	1 45	3 27	1 58	6 15	2 27	7 43	15 38	13 26	0 39
24.....	12 23	13 23	6 20	1 56	3 22	2 10	6 16	2 11	8 04	15 45	13 08	-0 09
25.....	12 37	13 13	6 02	2 07	3 16	2 23	6 17	1 55	8 24	15 52	12 50	+ 0 21
26.....	12 50	13 03	5 43	2 17	3 10	2 36	6 17	1 38	8 45	15 59	12 31	0 51
27.....	13 02	12 52	5 25	2 27	3 04	2 48	6 17	1 21	9 05	16 04	12 11	1 21
28.....	13 13	12 41	5 06	2 36	2 56	3 00	6 16	1 04	9 25	16 09	11 51	1 50
29.....	13 24	.....	4 48	2 45	2 49	3 12	6 14	0 46	9 45	16 13	11 30	2 20
30.....	13 33	.....	4 30	2 53	2 41	3 24	6 12	0 28	10 04	16 16	11 08	2 49
31.....	13 42	.....	4 11	.....	2 33	.....	6 09	+0 10	.....	16 18	.....	3 18

NOTE—The equation of time changes slightly from year to year, but the values given in the table may be taken as a fair average of those that ordinarily occur.

When the equation of time is +, the sun is slower than the clock and the specified number of minutes must be added to the true local noon to give the time at which the sun passes the meridian, and, similarly, when the sign is —, the number of minutes must be subtracted from local noon.

For example, suppose the north and south line is to be located at some station about October 1st, and where the local time is twenty-four minutes faster than the standard time in use. Hence:

Difference between standard and local time = -24 minutes
 (Use + when standard meridian is east of station and — when west.)
 Equation of time, October 3rd = -11 minutes
 Total correction = -35 minutes

Therefore the sun will be exactly on the meridian at 12 o'clock, -35 minutes = 11:25 A.M., and the shadow of a vertical column at this moment will be in the true north and south line.

INDICES

WE present three indices for our catalogue. The first, which we call the Index of Elements, lists the various weather elements or conditions in the order in which the various apparatus for these conditions appear in the catalogue. The second index, called the Instrument Index, lists all our instruments, apparatus and accessories in alphabetical order according to the names by which they are universally known. The third index lists numerically all our instruments by their respective catalogue numbers.

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4	125	319	57	378	29	484	60
5	125	321	57	379	29	485	60
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710	100	1122	71	206-D	72	1068-6-N	97
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PRICE LIST
FOR
CATALOGUE No. 5
OF
STANDARD WEATHER
INSTRUMENTS

PRODUCTS OF
JULIEN P. FRIEZ & SONS, INC.
DIVISION OF BENDIX AVIATION CORPORATION
NORTHWEST CORNER BALTIMORE STREET AND CENTRAL AVENUE
BALTIMORE, MARYLAND, U.S.A.

✓

Previous Lists Cancelled
PRICES SUBJECT TO CHANGE WITHOUT NOTICE
EFFECTIVE FEBRUARY 1, 1931

CATALOGUE NUMBER	CATALOGUE PAGE NO.	PRICE F.O.B. BALTO.	CATALOGUE NUMBER	CATALOGUE PAGE NO.	PRICE F.O.B. BALTO.	CATALOGUE NUMBER	CATALOGUE PAGE NO.	PRICE F.O.B. BALTO.
0	125	\$ 1.50	330	57	\$ 14.00	398-A	108	\$ 3.25
1	125	1.65	331	57	14.00	400	106	29.00
2	125	1.50	332	57	14.00	400-A	106	19.75
3	125	1.65	333	57	21.00	401	110	58.00
4	125	2.50	334	57	14.00	405	20	105.50
5	125	2.50	335	57	19.50	406	22	168.50
6	126	5.00	336	57	16.75			
7	126	5.00	337	57	11.25	407	116	68.50
			338	57	16.75	407-A	116	68.50
11	58	5.50				408	116	5.00
13	58	5.50	340	10	76.00	408-A	117	18.00
15	58	6.25	341	10	76.00	408-B	117	15.00
17	58	6.25	343	10	79.00	408-C	117	10.00
19	58	8.50	343-N	11	79.00	409	117	26.50
21	58	8.50	344	13, 45	60.00			
23	58	8.50	344-K	13	60.00	415	20	105.50
25	58	9.00	345	13	15.00	416	22	179.00
27	58	7.00	347	10	79.00	417	22	168.50
29	58	10.50	350	14	163.50	418	22	179.00
31	58	12.00	351	14	174.00	420	24	168.50
33	58	11.25	352	14	163.50	421	24	179.00
35	58	9.75	353	14	174.00	422	24	189.50
37	58	9.75	354	14	168.50	423	24	200.00
39	58	9.75	355	15	179.00	424	25	189.50
41	58	11.25	356	15	168.50	425	25	200.00
43	58	11.25	357	15	179.00	426	25	189.50
45	58	14.00				427	25	200.00
47	58	16.75	360	42	55.00	440	26	458.00
51	58	5.50	360-A	43	60.00	441	26	463.50
53	58	5.50	360-B	43	65.00	443	26	410.50
55	58	7.75	360-C	43	70.00			
57	58	6.25	361	43	40.00	450	54	710.50
59	58	8.50	361-A	43	45.00	450-I	54	835.50
61	58	8.50	361-B	43	50.00	451	29	125.00
63	58	6.25	361-C	43	55.00	452	29	140.00
65	58	7.00	362	43	22.50			
67	58	8.50	365	44	150.00	460	118	174.00
69	58	14.00	365-A	45	85.00	460-A	118	153.00
71	58	14.00	366	45	60.00			
73	58	15.50	366-A	45	45.00	470	59	6.00
75	58	14.00	367	45	50.00	470-A	59	5.25
77	58	14.00	371	29	242.50	471	59	6.00
79	58	12.50	373	29	263.50	471-A	59	5.25
301	57	18.25	375	29	Apply	480	60	6.00
303	57	21.00	376	29	180.00	481	60	6.00
305	57	21.00	377	29	155.00	482	60	6.00
307	57	21.00	377-A	29	155.00	483	60	6.00
309	57	21.00	378	29	Apply	484	60	18.00
311	57	14.00	379	29	90.00	485	60	18.00
313	57	19.50				486	60	6.00
315	57	19.50	380	16	63.50	490	61	6.00
317	57	12.50	380-A	16	32.00	491	61	6.00
319	57	14.00	390	18	168.50	492	61	6.00
321	57	15.50	391	18	179.00	493	61	6.00
323	57	21.00				494	61	14.75
329	57	16.75	398	108	16.00	495	61	14.75

CATALOGUE NUMBER	CATALOGUE PAGE NO.	PRICE F.O.B. BALTO.	CATALOGUE NUMBER	CATALOGUE PAGE NO.	PRICE F.O.B. BALTO.	CATALOGUE NUMBER	CATALOGUE PAGE NO.	PRICE F.O.B. BALTO.
496	61	\$ 2.75	630	92	\$226.50	1061	40	\$632.00
500	64	97.50	631	92	226.50	1070	46	Apply
501	64	103.00	632	92	226.50	1071	46	Apply
502	64	97.50	650	92	226.50	1075	48	Apply
503	64	103.00	651	93	226.50	1076	48	Apply
504	64	97.50	652	93	226.50	1080	48	Apply
518	66	105.50	660	94	289.50	1081	48	Apply
518-A	66	110.50	661	94	289.50	1085	48	Apply
518-C	66	105.50	662	95	289.50	1100	68	116.00
518-D	66	110.50	670	95	289.50	1101	68	132.00
518-H	67	105.50	671	95	289.50	1102	68	116.00
518-I	67	110.50	672	95	289.50	1103	68	132.00
540	73	15.00	680	96	316.00	1104	69	158.00
540-A	73	5.50	681	97	316.00	1105	69	121.50
540-B	73	5.50	682	97	316.00	1106	69	137.00
541	73	15.00	690	97	316.00	1107	69	121.50
541-A	73	5.50	691	97	316.00	1108	69	137.00
541-B	73	5.50	692	97	316.00	1109	69	163.50
550	75	14.00	700	98	474.00	1120	71	158.00
550-A	75	5.50	701	99	474.00	1121	71	174.00
551	75	14.00	702	99	474.00	1122	71	158.00
551-A	75	5.50	710	100	368.00	1123	71	174.00
560	76	55.00	711	100	368.00	1124	71	158.00
560-A	76	5.50	720	102	526.50	1125	72	163.50
561	77	55.00	730	104	155.00	1126	72	179.00
561-A	77	5.50	740	120	79.00	1127	72	163.50
570	78	65.00	741	120	79.00	1128	72	179.00
570-A	78	7.50	742	120	31.75	1129	72	163.50
570-B	78	7.50	750	86	120.00	1200	50	174.00
571	78	65.00	750-A	86	138.00	1201	51	221.50
571-A	78	7.50	750-B	86	160.00	1210	49	258.00
571-B	78	7.50	751	86	135.00	1211	49	37.00
580	80	105.50	751-B	86	175.00	1220	52	63.50
581	80	110.50	760	112	205.00	1221	52	68.50
590	82	160.50	761	112	210.00	Au Water Level Recorders		
591	82	166.00	762	114	242.50	FS-BT	132	\$212.00
592	82	163.50	763	114	247.50	CS-BT	134	212.00
593	82	168.50	960	122	21.25	DS-BT	136	175.00
594	83	153.00	961	122	21.25	PT & PDW	140	450.00
594-L	83	153.00	970	124	68.50	PCR&PDW	144	750.00
595	83	158.00	970-A	124	Apply	PT & PCS	146	700.00
595-L	83	158.00	980	124	34.25	PDW	142	200.00
596	83	153.00	980-A	124	Apply	PT	140, 146	250.00
597	83	158.00	1020	38	289.50	PCR	144	550.00
598	82	163.50	1030	39	632.00	PCS	146	450.00
599	82	168.50	1031	39	685.00	Indicator Dials:		
620	88	116.00	1040	41	158.00	FLUSH TYPE	142	\$200.00
621	88	116.00	1050	41	158.00	SEMI-FLUSH	142	200.00
622	88	116.00	1051	41	158.00	Instrument Assemblies		
623	88	116.00	1060	40	632.00	A	7	\$1,471.00
624	89	116.00				B	31	2,736.50
625	89	116.00				C	8	954.00
						D	9	*1,066.50

* Approximate

CATALOGUE NUMBER	CATALOGUE PAGE NO.	PRICE F.O.B. BALTO.	CATALOGUE NUMBER	CATALOGUE PAGE NO.	PRICE F.O.B. BALTO.
Instrument Assemblies (Continued)			1015-J	14, 15, 18, 22, 24, 25	\$ 5.75
E	32	\$1,128.50	1015-L	114	10.00
F	33	1,392.50	1015-M	14, 15	7.50
G	34	2,024.50	1015-O	114	5.00
H	35	*2,134.50	1017	26	11.00
J	53	835.50	1017-B	54	12.50
Charts			1068	88	3.25
58-B	80	\$ 3.25	1068-A	88	3.25
58-D	80	7.50	1068-B	88	3.25
100-B	64	3.25	1068-C	88	3.25
120	64	3.25	1068-D	89	3.25
200-D	66-69	10.00	1068-E	89	3.25
200-W	66-68	5.00	1068-F	92	6.50
201-D	72-82	10.00	1068-6-F	92	6.50
201-W	71-82	5.00	1068-24-F	92	6.50
202-D	67-69	10.00	1068-G	92	6.50
202-W	67-69	5.00	1068-6-G	93	6.50
203-D	72-82	10.00	1068-24-G	93	6.50
203-W	71-82	5.00	1068-I	94	7.50
205-D	66-69	10.00	1068-6-I	94	7.50
205-W	66-68	5.00	1068-24-I	95	7.50
206-D	72	10.00	1068-J	95	7.50
206-W	71	5.00	1068-6-J	95	7.50
207-D	83	10.00	1068-24-J	95	7.50
207-W	83	5.00	1068-M	96	7.50
208-D	83	10.00	1068-6-M	97	7.50
208-W	83	5.00	1068-24-M	97	7.50
209-D	83	10.00	1068-N	97	7.50
209-W	83	5.00	1068-6-N	97	7.50
300-W	136	5.00	1068-24-N	97	7.50
700	100	7.50	1068-O	98	7.50
700-2	100	7.50	1068-6-O	99	7.50
700-E	102	7.50	1068-24-O	99	7.50
1015	14	7.50	1072	64	3.25
1015-A	22	7.50	1072-D	82	3.25
1015-B	18, 24	7.50	1072-H	82	7.50
1015-C	24	7.50	1072-J	64	7.50
1015-D	25	7.50	1072-K	64	7.50
1015-E	25	7.50	2040	40	1.25
1015-F	112	5.00	2050	40	1.25
1015-G	112	10.00			

Au Recorder (129-146): Rolls containing a year's supply 25 yards on brass roll for the Fuzee and the continuous recorder.....\$6.00

Record paper per roll, when brass rolls are supplied to us by customer.....\$5.00

INKS

No.	COLOR	¼ oz.	½ oz.	1 oz.
10	Red	\$1.00	\$1.50	\$2.00
	Green	1.00	1.50	2.00
	Purple	1.00	1.50	2.00
20	Black	1.00	1.50	2.00
	Purple	1.00	1.50	2.00
30	Red	1.00	1.50	2.00
40	Black	1.00	1.50	2.00
60	Purple	2 oz.	4 oz.	6 oz.
		\$1.50	\$3.00	\$4.00

Note: When ordering ink, unnecessary misunderstandings may be avoided by specifying the catalogue number and type of instrument for which it is intended.

In General: Ink No. 10 is recommended for use with all instruments except those listed below.

Ink No. 20 is used with all instruments exposed to extremely low temperatures, such as Altitude Barographs, Meteorographs and Recording Snow Gages during the winter season.

Ink No. 30 is used only with an Anemograph employing a glass pen.

Ink No. 40 is for use on the Wind-Direction Inking Pads of four-element Recorders.

Ink No. 60 is used with the Selsyn Motor Wind Recorder No. 1060.

* Approximate

NOTICE

SHIPMENTS—Unless otherwise specified, all shipments weighing less than 15 pounds are usually forwarded via parcel post; shipments over 15 pounds (where the contents are of a fragile nature) are forwarded via express. All parcels are insured against loss and damage, charges for insurance and postage being added to invoice.

CANCELLATION—Orders, which have been received by us and acknowledged, cannot be cancelled except on terms which will insure us against loss.

PRICES—Subject to change without notice. All orders are invoiced at price prevailing at time of shipment, unless preceded by formal quotations; such quotations are to be accepted within 30 days.

DELIVERIES—We stock a large number of instruments and supplies; invariably shipments are made without delay upon receipt of orders.

JULIEN P. FRIEZ & SONS, Inc.