INSTRUMENTS AND OBSERVING METHODS

REPORT
No. 2

INSTRUMENT DEVELOPMENT INQUIRY
(Third Edition)
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FOREWORD

In both 1968 and 1976 replies to questionnaires on instrument development were compiled by a rapporteur of the Commission for Instruments and Methods of Observation (CIMO) and were subsequently published as a WMO publication entitled "Instrument Development Inquiry", WMO - No. 232. The 1968 edition (TP.135) contained information from 25 Members on 243 items, while the 1976 edition contained new information on 142 items from 21 Members.

Following the endorsement by the Sixth Session of CIMO (Helsinki, 1973) of the publication as a useful means to make such developments known to the Members, providing it is updated frequently, the Seventh Session of CIMO (Hamburg, 1977) re-appointed Mr. M. Thaller (Israel) to prepare the third edition.

The rapporteur, working in close cooperation with the WMO Secretariat, produced a revised text which is now published as the "Instrument Development Inquiry" WMO - No. 232 (third edition). The format has been streamlined. A total of 14 Members have provided new information on 112 instruments under development.

I wish to take this opportunity to thank all those Members who contributed information and thus made possible this publication. I am especially grateful for Mr. Thaller's great contribution in planning the inquiry and editing the replies.

D. H. Champ
Chief, Instruments and Observing Techniques
INTRODUCTION

The format of the data is similar to that used in previous editions of WMO-No.232.

For ease of use, a fold-out page at the rear of the publication provides a key to the format. The categories of development are listed in the table of contents, while Table I provides a tabulation of the development categories for which information was received from the Members who responded to the inquiry.

It is indeed unfortunate that some of the Members who have vigorous development programmes did not respond to the inquiry.

Table I

<table>
<thead>
<tr>
<th>Member</th>
<th>Categories for which information was received</th>
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<td>6, 7.</td>
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<td>3, 5, 6, 7, 8, 11, 12, 13, 15, 17, 19, 21, 22.</td>
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</table>
Category Number 1

GENERAL (Pertaining to general requirements of meteorological stations)

The following countries* have reported developments concerning instruments in this category:

None

* For key, use fold-out page at rear of book.
Category Number 2

WEATHER OBSERVATIONS (techniques of observation)

The following countries* have reported developments concerning instruments in this category:

None

* For key, use fold-out page at rear of book.
The following countries have reported developments concerning instruments in this category:

CANADA
FRANCE
FEDERAL REPUBLIC OF GERMANY
INDIA
UNITED KINGDOM

1- Canada
2- "Humdinger BR-2" for measuring atmospheric pressure as station barometer.
3- Prototypes under test 1979
4- A vibrating wire, stressed by an evacuated bellows subjected to atmospheric pressure. Sensor output is a frequency near 400Hz, related to pressure. Power consumption 110mW. Size 90mm diameter, 400mm length. Weight 3Kg. Auxiliary readout provides visual display and ASCII output message, based on a 100-second averaging period and conversion to pressure units from a three point calibration.
5- 20 Pa (0.2 mb) over 100 KPa range; tests to date indicate objective will be met - long term drift is the main uncertainty.
6- a) $1000  
   b) $50
7- W.L. Clink, Atmospheric Environment Service, 4905 Dufferin Street, Downsview, Ontario. M3H 5t4 Canada
8- Major bibliographic references: A Barometer Development - W.L. Clink
    Fourth AMS Instrument Symposium, Denver, Colorado, April 1978
    Patents. Not established.

1- France
2- Absolute Pressure Sensor for automatic station use.
3- Production units under test 1979.
4- Aneroid principle, realized by a silicon crystal connected to resistance
   strain gauges in a Wheatstone Bridge circuit which is temperature compensated.
5- Overall accuracy 50 Pa; tests to date indicate objective will be met.
6- a) $1300  
   b) $50

* For key, use fold-out page at rear of book.
Category Number 3

7- J.L. Plazy, Centre Technique et du Matériel, BP 202, 78195 TRAPPES, France

8- No publications. Schlumberger Ltd. holds patent rights.

1- Federal Republic of Germany
2- Piezo-resistive Atmospheric pressure sensor.
3- Prototypes under tests in 1979; completion expected after 2 years.
4- Aneroid principle, realized by a silicon crystal in connection with a resistance strain gauge. The sensor is temperature compensated.
5- Not stated.
6- Not stated.
7- Deutscher Wetterdienst Instrumentenamt Hamburg, Frahmredder 95, D-2000 Hamburg 65, F.R.G.
8- None.

1- India
2- Linear voltage differential capacitor (LVDC) atmospheric pressure sensor.
3- Prototype under laboratory testing 1979.
4- An aneroid bellows drives a LVDC transducer which feeds an electronic circuit providing output DC voltage linearly proportioned to the pressure variations.
5- Overall accuracy better than 50 Pa. Tests are just beginning.
6- a) Not produced in quantity b) estimated to be small
7- The Director (Instruments)/Met.Office/Pune-5/India.
8- Publication being prepared. No patents.

1- U.K.
2- Static pressure head with non-rotating cowl for minimizing wind effects on sensed atmospheric pressure.
3- Prototype tested in wind tunnel; field tests to begin 1979.
4- No details given.
5- Wind effects to be kept below 20Pa; Wind tunnel tests confirm this goal.
6- a) $50 b) very small.
8- None given.
Category Number 4

MEASUREMENT OF TEMPERATURE

The following countries* have reported developments concerning instruments in this category:

BELGIUM
CANADA
FEDERAL REPUBLIC OF GERMANY
ISRAEL (2)

1- Belgium.
2- Air and soil temperature sensors for automatic stations
3- The initial equipment has been operational for four years (1979).
4- Platinum resistance bulbs (100J, nominal) digitized by digital voltmeter.
5- Better than 0.1°C; verified by four years' service.
6- a) and b) included in the station price - not available separately.
7- Dr. F. BULTOT, Chef de la Section d'Hydrologie, Institut Royal Météorologique de Belgique, 3, avenue Circulaire, 1180 Bruxelles - Belgique.
8- None.

1- Canada.
2- Climatological shielded electronic thermometer for storing maximum, mean and minimum temperature for up to ten days.
3- Fifteen prototypes built and under test in laboratory and in field (1979).
4- Platinum resistance thermometer samples temperature each 5 minutes. Daily averages (running), maxima and minima are stored for a total of four days. Readout is manually extracted from digital display on command. Power consumption 10mW (three readings daily).
5- Expected accuracy 1.0C, including shielding (worst case). Tests beginning.
6- a) $400. b) $150.
7- D.J. McKay, Atmospheric Environment Service, 4905 Dufferin Street, Downsview, Ontario, Canada, M3H 5T4
8- D.J. McKay, J.D. McTaggart-Cowan. An Intercomparison of Radiation Shield for Auto Stations WMO No. 480 (TECIMO July 1977)
Category Number 4

1- Federal Republic of Germany
2- Plastic thermometer screen for surface observations and radiosonde baseline checks.
3- Prototype built for tests in 1979.
4- Thermometer screen made of injection cast white plastic modules. Ventilated by electric fan for aerological purposes.
5- Expected to keep temperature errors within requirements. Not yet tested.
6- a) $600 to 800. b) nil
7- A. Süss, Deutscher Wetterdienst, Instrumentenanmt München, August Schmauss Strasse 1, D-8042 Oberschleissheim
8- None

1- Israel
2- Portable psychrometer, shielded and ventilated for measuring air temperature and humidity.
3- Prototype already tested for 3 years. Production model being developed, 1979.
5- Better than 0.1°C (depending on thermometer accuracy). Tests confirm this.
6- a) $350. b) Battery replacement (amount not specified).
7- M. Thaller, Israel Meteorological Service, P.O. Box 25, Bet Dagan.
8- None

1- Israel
2- Thermometer shelter for naturally ventilated psychrometer at a remote location (for air temperature and humidity measurement).
3- Prototype under test; to be concluded late 1979.
4- Shelter holds two electrical sensors and a reference mercury-in-glass thermometer. Not otherwise specified.
5- Compatible with the artificially aspirated psychrometer when winds exceed 2 m/s. Tests confirm this, although the extremes have not been tested yet.
6- a) $150. b) $15 approximately
7- M. Thaller, Israel Meteorological Service, P.O. Box 25, Bet Dagan.
8- An Intercomparison of radiation shields for automatic stations. D.J. McKay and J.D. McTaggart-Cowan, WMO-No.480
Category Number 5

MEASUREMENT OF ATMOSPHERIC HUMIDITY AND SOIL MOISTURE

The following countries* have reported developments concerning instruments in this category:

BELGIUM
FINLAND
FEDERAL REPUBLIC OF GERMANY
NETHERLANDS (2)
U.K. (2)

1- Belgium.
2- Wet bulb temperature sensor for automatic stations
3- The initial equipment has been operational for four years (1979)
4- Platinum resistance bulb (100Ω, nominal) digitized by digital voltmeter.
5- Better than 0.1°C; verified in service.
6- a) and b) included in station price - not available separately.
7- Dr. F. Bultot, Chef de la Section d'Hydrologie, Institut Royal Météorologique de Belgique, 3, avenue Circulaire, 1180 Bruxelles, Belgique.
8- None.

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1- Finland
2- HMP/HMI Hygrometers for air relative humidity.
3- In production, undergoing long term testing for meteorological applications (1979)
4- Thin film sensor - high speed response, small temperature dependence.
5- 1% relative humidity - no failures over 200 day test period.
6- a) $600     b) not available.
7- Vaisala Oy, PL26, 00421 Helsinki 42, Finland.
8- Patented - no details.

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* For key, use fold-out page at rear of book.
1- FEDERAL REPUBLIC OF GERMANY
2- IAH type, LiCl sensor for water vapour pressure.
3- Prototype under laboratory tests (1979).
4- Carbon electrode insensitive to chemical effects. A special heating system prevents formation of local sources and sinks on the sensor surface.
5- Dew-point error less than 0.3°C over 3 months. Tests continuing.
6- a) $1000    b) no estimate.
7- Deutscher Wetterdienst, Instrumentanamt, Hamburg, Frahmredder 95, D-2000 Hamburg 65, F.R.G.
8- None.

1- Netherlands.
2- High-speed psychrometer for wet- and dry-bulb temperatures for heat flux determinations.
3- Prototypes used successfully in projects (1979).
4- Chromel-alumel thermocouples. Time constant of wet bulb~1 sec with forced water supply. Cold junctions temperature-compensated by a thermistor. Electronics circuit provides direct read-out of temperatures.
5- Several tenths degree C absolute; Fluctuation sensitivity 0.01°C. Tests show wet thermocouple is limited to 200 useful hours due to corrosion.
6- Unknown - used for research and projects.
7- W.A.A. Monna, c/o Royal Netherlands Meteorological Institute, Post Box 201, 3730 AE De Bilt, Netherlands.
8- None.

1- Netherlands.
2- Wet-bulb temperature for psychrometer (humidity).
3- Prototype testing completed 1979.
4- A peristaltic pump provides a continuous non-superfluous supply of water to the wet bulb.
5- 0.1°C; tests indicate reliability with failure about one percent of time.
CATEGORY NUMBER 5

6- Unknown.
7- W.A.A. Monna, c/o Royal Netherlands Meteorological Institute, Post Box 201, 3730 AE De Bilt, Netherlands.
8- None.

1- U.K.
2- Infra-red humidiometer to determine air humidity fluctuations.
3- Pre-prototype under preliminary tests in 1979. Testing to be complete in 1981.
4- Fast response measurements of humidity fluctuations by infra-red absorption with electronic division to allow for medium term drift in source; detector efficiency to be capable of long term use in rigorous conditions.
5- Unspecified.
6- a) $800-1000,   b) $100
7- Dr. C.J. Moore, Institute of Hydrology, Wallingford, Oxon, U.K.
8- Patents to be applied for.

1- U.K.
2- PCRC-ll relative humidity sensor.
4- Resin-based electrolytic conductance element. Size 50 x 22 x 4 mm.
5- Field tests show standard deviation of four percent relative humidity. The sensor is very prone to contamination. Future investigations to examine the characteristics of various protective enclosures with special reference to effects on time constant and sea salt contamination.
6- a) $70. b) not estimated.
8- Patented by manufacturer.
MEASUREMENT OF SURFACE WIND

The following countries* have reported developments concerning instruments in this category:

AUSTRALIA
BELGIUM
CANADA
FINLAND (2)
FEDERAL REPUBLIC OF GERMANY (2)
HONG KONG
INDIA (2)
U.K.

1- Australia

2- Prototype maximum gust recorder for worst case data at remote sites.

3- Prototype development should be completed in 1981.

4- A trunnion-mounted drag sphere or cylinder arranged to mark a scratch plate. Expected range of operations 0-200 knots of wind. The scratch plate would be changed every 6 months.

5- Approximately 5 knots (above 50 knots). Repeatability is the main problem with feasibility models, due to diaphragm hysterisis and to the friction of the pointer on the scratch plate.

6- a) less than $200 b) $10. plus cost to visit semi-annually.

7- Director of Meteorology, Box 1289K Melbourne, Australia

8- Based on earlier design studies by Dr. R.D. Marshall of the U.S. NBS and Dr. G. Walker of James Cook University of N. Queensland - Australia. As far as is known this work has not been published.

1- Belgium.

2- Modified Feuss-type cupanemometer for mean wind run at 2m (automatic station).

3- The initial equipment has been operational for four years (1979).

4- The cup-wheel contacts have been replaced by a magnetically actuated switch. The pulses so produced feed an impulse counter which is read at each observing hour.

5- Resolution of data: one impulse per Decameter of wind.

For key, use fold-out page at rear of book.
6- a) and b) included in the station price - not available separately.

7- Dr. F. Bultot, Chef de la Section d'Hydrologie, Institut Royal Météorologique de Belgique, 3, avenue Circulaire, 1180 Bruxelles, Belgique.

8- None.

1- Canada.

2- Type 77C wind speed and direction sensor.

3- Prototype tested in laboratory; outdoor tests began 1979.

4- Shaft rate (wind speed) and shaft direction (wind direction) sensed optically using microprocessor-based low-duty cycle electronic processing which provides a serial digital data train to the receiver and readouts. Suitable for low power consumption and for use in severe environments.

5- One percent of reading (speed); \( \pm 5 \) degree direction (RMS) using 64 segment resolution; Tests confirm accuracy, even in severe condensing environment.

6- a) $1000 b) not stated.

7- Roger Van Cauwenberghe, 4905 Dufferin St., Atmospheric Environment Service, Downsview, Ontario, Canada M3H 514

8- Patents applied for.

1- Finland

2- Wind (mean and maximum) speed and direction system.

3- Tested since July 1977

4- Provides digitized mean and maximum wind speeds and directions over a period selectable from one to 60 minutes. A 64 place memory holds the data ready for polling. The system can be adapted to provide mean, max. and min. of many other variables (temperature, radiation, etc.).

5- Depends on sensors; The system has suffered 2 failures in 48 system-months of operation - one due to lightning.

6- a) $2000 (basic version) b) less than $200.

7- Dr. Seppo Huovila, Finnish Meteorological Institute, Box 503, 00101 Helsinki 10, Finland.

8- Only the system components are patented.
CATEGORY NUMBER 6

1- Finland.
2- WA surface wind sensors.
3- Under development 1979.
4- Cup and vane anemometer with digital telemetry facilities permitting formation of arrays.
5- Speed 0.1 m/sec; direction 5 degrees.
6- Not available.
7- Vaisala Oy, PL26, 00421 Helsinki 42, Finland.
8- None.

1- FEDERAL REPUBLIC OF GERMANY.
2- WIMEA wind speed and direction system.
3- Under field tests 1979.
4- Wind vane with potentiometer, cup anemometer with light barrier transducer. Electronic filters for continuously averaging both direction and speed. One 2-channel recording device for direction and speed (instantaneous values, means) Storage of extreme values (speed).
5- Speed, 0.5 m/sec; direction, 3.6 deg; Testing showed a starting threshold of 0.3 m/sec with standard bearings, reduced to 0.1 m/sec with special bearings. Low temperature tests are also promising.
6- a) $7500  
   b) low cost, depending on MTBF.
7- M. Hinzpeter, Deutscher Wetterdienst, Instrumentamt Hamburg, Frahmredder 95, D-2000 Hamburg 65, F.R.G.

1- FEDERAL REPUBLIC OF GERMANY
2- Electrically heated anemometer system for mountain use.
3- Prototype field tests underway at a mountain station (1979).
4- Anemometer with plastic cups and single-blade windvane. Most areas of the sensor surface are electrically heated.
5- Expect improvement on overspeeding, starting threshold and icing; wind tunnel tests are promising.
6- a) $2000 U.S. sensors only b) standard costs.

7- A. Sud, Deutscher Wetterdienst, Instrumentenamt München, August. Schauss Str. 1, D-8042 Oberschleissheim.

8- Patent depending for the method of data transmission.

1- Hong Kong.

2- Microprocessor-based horizontal wind shear analyser for airport use.

3- System development expected to be completed by 1979.

4- A microprocessor was used to accept wind direction and force data from five strategically located Mk 4A anemometers along the glide path of the Hong Kong International Airport. Data were sampled once a second. 2-minute mean wind, 10-minute mean wind, wind force along the glidepath and across the glidepath and horizontal wind shear along the glidepath were computed in real time. The results were displayed on a video display terminal in the Air Traffic Control Tower for dissemination to pilots. Anemometer outputs were linearized and digitised and were transmitted through telephone lines by frequency shift keying to a central control room at the airport. Both digital display and analog chart records were recovered there. Digital data were then fed into a microprocessor.

5- Limited by sensors; one-second resolution; tests confirm.

6- a) $10,000 excluding anemometers b) $1,000 excluding anemometers.

7- G.J. Bell, Director, Royal Observatory, Nathan Road, Kowloon, Hong Kong.

8- None.

1- India.

2- Mean wind speed indicator (two minutes)

3- Development completed

4- Two minute means are updated every ten seconds. Size 22 cm x 32 cm x 15 cm high; weight 5 kg.

5- Accuracy ± 1 knot; suitable for field conditions, long MBTF.

6- a) $1,200 b) not estimated.

7- The Director (Instruments), Met. Office, Pune 5, India

8- None.
CATEGORY NUMBER 6

1- India.
2- U-V-W wind recorders.
3- Development expected to be completed by 1980. Laboratory trials underway.
4- The three U, V and W components of wind are separately sensed by three lightweight air meters mounted on single shaft and recorded with suitable electronics.
5- Not determined.
6- a) $4,000  b) not estimated.
7- The Director (Instruments), Met, Office, Pune 5, India.
8- None.

1- U.K.
2- Ultra-sonic anemometer/thermometer for measuring near-surface wind vector fluctuations.
3- Pre-prototype undergoing preliminary test in the field. Completion scheduled 1981.
4- Low priced alternative to existing ultra-sonic anemometer-thermometer; based on a switched continuous wave principle, with phase shift detection of wind speed and temperature.
5- Not estimated.
6- a) $800-1,000  b) $100
7- Dr. W.J. Shuttleworth, Institute of Hydrology, Wallingford, Oxon, U.K.
8- Patents to be applied for.
Category Number 7

MEASUREMENT OF PRECIPITATION

The following countries* have reported developments concerning instruments in this category:

CANADA (2)
FEDERAL REPUBLIC OF GERMANY
HONG KONG
INDIA (2)
ISRAEL (2)
JAPAN
U.K. (5)

1- Canada.

2- Precipitation Occurrence Sensor System (POSS) to identify and classify precipitation occurrence and type.

3- Speculative development based on technology availability. Feasibility tests underway.

4- An inexpensive downward facing dopplar radar module (Gunndiode) has its output processed using spectral signatures to distinguish precipitation types by fall velocities and signal intensities.

5- To be discovered. Outdoor testing is going on to determine the signatures.

6- a) $500 b) Unknown

7- Mr. J.M. Cook, Room 2S150, Atmospheric Environment Service, 4905 Dufferin St., Downsview, Ontario, Canada M3H 5T4.

8- None

______________________________________

1- Canada.

2- Load cell weighing precipitation gauge.

3- Drawing board - prototype ready for test in 1979 or 1980.

4- Measures the weight of total precipitation using a strain gauge load cell and converts to engineering units, possibly processing for evaporation information.

5- Target .01 inches, -50°C to 50°C, MTBF unknown; not yet tested.

6- a) $2,000 b) $150.


8- None.

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* For key, use fold-out page at rear of book.
CATEGORY NUMBER 7

1- FEDERAL REPUBLIC OF GERMANY
2- Electric precipitation gauge for measuring both rain and snow
3- Early design stage - completion expected in 1979.
4- Volumetric measurement by cyclic draining, controlled by electronic detection of water level in reservoir and magnetic valve.
5- Not estimated.
6- a) $500-800  b) not estimated
7- A. Süß, Deutscher Wetterdienst, Instrumentenamt München, August Schmاع Str. 1, D-8042 Oberschleißheim
8- None.

1- Hong Kong
2- Remote recording digital raingauge.
4- A cannon calculator was modified to accept contact closures from a tilting-bucket raingauge through an electronic interface. Time information was provided via a real time clock interface. The time and the 15-minute rainfall were printed by the calculator automatically. Connection of the tilting bucket to the calculator interface was made via telephone lines.
5- Accuracy is same as that of the tilting bucket raingauge; no failures in 42 station-months.
6- a) $300  b) $80
7- G.J. Bell, Director Royal Observatory, Nathan Road, Kowloon, Hong Kong.
8- None.

1- India.
2- Automatic telemetering raingauge.
3- Development almost complete. Routine operation during monsoon season in river basins.
4- The remote station consists of a tipping bucket raingauge, a coding and programme unit and two HF transmitters for day and night operation. Transmission is automatic every three hours. Batteries operate the system for more than 6 months. The CW receiver located in the flood forecasting control rooms (up to 300 km distant) can be monitored by a relatively unskilled operator.
5- Accuracy within less than 10%; MBTF 2 months. Confirmed by testing in the 1975-1978 monsoon seasons.

6- a) not produced in quantity. b) $500.

7- The Director (Instruments), Meteorological Office, Pune-5, India.


(2) Automatic instrumentation for telemetering rain and river level data from remote stations (S.V. Datar and P.M. Pakir Mohamed) proceedings of WMO/UNESCO symposium on hydrological forecasting Tech. Note No. 92/1967.


1- India.

2- Electronic precipitation intensity gauge.

3- Development complete. Suitable for field operations.

4- An electronic distant - reading rainfall intensity recorder capable of measuring minute to minute values of the intensity of rain and recording them on a strip-chart recorder. The system measures the intensity of rainfall by converting rain water into drops of equal size and counts the number of drops by an optical-cum-electronic device. The number of counts during every minute interval are recorded. Total rainfall during any given interval of time also recorded.

5- System has a resolution of $\frac{1}{2}$ mm of rain/hour. In total rainfall 1 mm of rain accuracy; accuracy maintained over long periods.

6- a) $1,200 b) $150.

7- Director (Instruments), Meteorological Office, Pune-5.

8- None.
 CATEGORY NUMBER 7

1- Israel.
2- Hailstorm recorder. Also measures rain.
3- Prototype ready for test. Expected completion 1980.
4- Rain and hail are differentiated; collects and indicates quantity and time of storm occurrence. The gauge has a perforated plate which deflects hail onto a sensitive damped weighing mechanism while the liquid component goes into the normal collector.
5- Not estimated; lack of occurrence of hail has led to inconclusive tests.
6- Unknown
7- Robert Kastell, Israel Meteorological Service, Bet Dagan.
8- None.

1- Israel.
2- Small orifice raingauge for sites with high evaporation rates.
3- Tests completed 1979.
4- Small orifice gauge particularly suited for windy exposures due to extremely small evaporation factor and at sites with difficult access for daily measurement.
5- Compatible with 200 cm
\(^2\) gauge exposed at a height of 100 cm. The latest model has performed well exposed at a height of 60 cm.
6- a) $7  b) Cost of inner vessel, if broken.
7- M. Thaller, Israel Meteorological Service, P.O. Box 25, Bet Dagan.
8- J.D. Kalma, J. Lomas, Y. Shashoua: Brief reports, Volcani Institute of Agricultural Research, Israel.

1- Japan.
2- JMA-77 type snow-depth telemeter
3- Installed in the field in November 1978.
4- The telemeter composed of supersonic transmitter-receiver and transponder is capable of measuring snow depth with 1 cm resolution in the range of 0-5 m at intervals of specified hours, converting the measured values into digital signals and transmitting the values as BCD signals with recording in situ.
5- \(\pm 3\) cm; winter field tests at 12 stations confirmed operation (1977-78).
6- a) $11,000  b) $500.
CATEGORY NUMBER 7

7- International Cooperation Unit, Planning Division, Japan Meteorological Agency
1-3-4 Ote-machi, Chiyoda-ku, Tokyo, Japan.

8- A report written only in Japanese (Sokkigijutsu-siryo No. 4224); some parts
made under patent.

1- U.K.

2- Simple raingauge as part of a simple instrument system.

3- To be completed in 1979.

4- All plastic construction; completely encapsulated electronics for data storage
and read-outs (using liquid crystal display). The system is manually read.
Maintenance is by replacement.

5- Similar to standard tipping bucket gauges; tests are beginning.

6- a) $240  b) depends on number requiring replacement.

7- Mr. I.C. Strangeways, Institute of Hydrology, McLean Building, Wallingford,
OXON, OX10 8BB, U.K.

8- Not yet.

1- U.K.

2- Dual polarization radar to determine drop size distribution and to discriminate
the phase in the melting region of rain cells.

3- Completion expected in 1979.

4- A 10cm radar measures the reflectivity of rain in horizontal and vertical
polarizations for input to theoretical relationship between the drop-size
distribution parameter and the differential reflectivity of the two
polarizations. Radar antenna is a 25m diameter parabolic reflector with a
prime focus feed. Wavelength 10cm. Pulse Repetition rate 610Hz. Peak power
500KW. Beamwidth (3dB), 16 arc minutes. Pulse width 0.5 microseconds. Data
recorded digitally on magnetic tape.

5- Error factor reduced from 2 to 1.3 by use of differential reflectivity data
measured to ±0.2 dB. Tests on many rain cells during April-May 1978 showed
that the method did meet specified results with practical time averaging of
the order of 640ms.

6- Not applicable - research tool.

7- M.P.M. Hall, Appleton Laboratory, Ditton Park, Slough SL3 9JX, U.K.

1- U.K.
2- Gravimetric raingauge.
3- Field evaluations started.
4- Continuous weighing by servo-controlled beam balance. Capacity 100 mm; resolution 0.05 mm.
5- Results of field tests will lead to a specification.
6- a) $4,000 b) not estimated
7- Dr. J.S. Foot Met O 16A, Meteorological Office, Beaufort Park, Easthamstead, Wokingham, Berks.

1- U.K.
2- Tipping bucket rain gauge.
3- Field test completed 1978.
4- Redesign incorporating jewelled bearings with a 0.2 mm tip.
5- Better repeatability over long time periods.
6- a) $500 b) not estimated
7- Dr. J.S. Foot, Met O 16A, Meterorological Office, Beaufort Park, Easthamstead, Wokingham, Berks.
8- None.

1- U.K.
2- Marine raingauge
3- Continuing - collection efficiency being assessed (1978).
4- Volumetric measurement by peristaltic pump
5- Not estimated
6- a) $500 b) not estimated
7- Dr. J.S. Foot, Met O 16A, Meterorological Office, Beaufort Park, Easthamstead, Wokingham, Berks.
8- None.
Category Number 8

MEASUREMENT OF EVAPORATION

The following countries* have reported developments concerning instruments in this category:

U.K.

1- U.K.
2- Eddy-correlation evaporation sensor
3- Preprototype; anticipated completion 1981-1982.
4- Microprocessor based real-time computation of evaporation deduced from latent heat flux determinations using inexpensive ultrasonic anemometer/thermometer and infra-red absorption humidiometer for sensing simultaneous air motion and humidity fluctuations.
5- Not stated. Feasibility being determined.
6- a) $1,000 to 2,000  b) not estimated.
7- Dr. W.J. Shuttleworth, Institute of Hydrology, Wallingford, OXON, U.K.
8- Patents to be applied for.

* For key, use fold-out page at rear of book.
Category Number 9

MEASUREMENT OF RADIATION AND SUNSHINE

The following countries* have reported developments concerning instruments in this category:

BELGIUM
FRANCE
FEDERAL REPUBLIC OF GERMANY
GERMAN DEMOCRATIC REPUBLIC
INDIA (3)

1- Belgium.
2- Radiation Flux Divergence Meter
3- Operational since 1975, small changes are expected.
4- The computations are based upon the application of the mathematical formulation of divergence in a regular tetrahedral volume.
5- Resolution 1 W.m⁻³; relative accuracy 10%. Continuous observations are available from a climatological site since 1975.
6- Not stated; research instrument
7- D. Crommelynck, Institut Royal Météorologique de Belgique, 3, avenue Circulaire, Bruxelles B - 1180

1- France.
2- Compensated pyrradiometer for measuring total downward radiation. (Q↓).
3- Production model expected late 1979.
4- Two Moll thermopiles and thermistors are used. One thermopile makes the actual measurement; it is protected by a hemispherical window of polyethylene (Lupolen-H). The other thermopile is mounted similarly, but the window is painted matte black with white lacquer added on the outside face. The pile itself is connected to work in opposition to the first one. The thermopile emissions are compensated by a thermistor attached beneath a blackened metal surface under a clear window, while temperature compensation is accomplished

* For key, use fold-out page at rear of book.
using a second thermistor. The whole unit is mounted in a dessicated watertight brass enclosure which is purged with dry air.

5- Better than five per cent, borne out by tests.
6- a) $5,000  b) $100
7- P. Gregoire, Centre Technique et du Matériel, BP 202, 78195 Trappes Cedex, France.
8- None.

1- FEDERAL REPUBLIC OF GERMANY
2- Sunshine duration recorder, type IAH.
3- Prototype under test; completion expected 1980.
4- Response is independent of solar elevation angle. The threshold can be selected in units of mW.cm⁻². The device will be further modified to allow illumination measurement as well. No other details given.
5- Not available; the amount of duration depends on the threshold selected.
6- a) $2,000  b) not estimated.
7- Deutscher Wetterdienst, Instrumentenanamt Hamburg, Frahmredder 95, D-2000 Hamburg 65, F.R.G.

1- GERMAN DEMOCRATIC REPUBLIC
2- Ultraviolet radiation meter.
3- Prototypes are under field test; completion expected in 1980.
4- Photocell sensor with filters.
5- To be specified, based on test results.
6- Not estimated.
7- Dr. Grasnick, Meteorological Service of the G.D.R. - Meteorological Main Observatory, DDR-15 Potsdam, Telegraphenberg.
8- None.
CATEGORY NUMBER 9

1- India.
2- Digital sunshine duration recorder.
3- Prototype under test.
4- A sunshine switch enables clock pulses to feed a binary counter when the threshold is exceeded. The display provides hours and minutes of bright sunshine for today and yesterday.
5- Resolution 1 minute. Tests in the laboratory were satisfactory.
6- Not estimated.
7- The Director (Instruments), Met. Office, Pune-5, India.

1- India.
2- Global and diffuse solar radiation integrator (IMD)
3- Prototype under test; completion expected early 1980.
4- A voltage controlled oscillator feeds an electromechanical counter and printer via an electronic circuit.
5- Not estimated. Tests not yet analysed.
6- Not estimated.
7- The Director (Instruments), Meteorological Office, Pune-5, India.
8- None.

1- India
2- Net pyradiometer (IMD).
3- Completion expected late 1972. Prototype under field test.
4- A rectangular copper-constantan thermopile drives a potentiometric recorder or a recording millivoltmeter. No other details given.
5- Not estimated.
6. a) $200   b) not estimated.
7- The Director (Instruments), Meteorological Office, Pune-5, India.
8- None.
Category Number 10

MEASUREMENT OF VISIBILITY

The following countries* have reported developments concerning instruments in this category:

FEDERAL REPUBLIC OF GERMANY
NETHERLANDS

1- FEDERAL REPUBLIC OF GERMANY

2- Background luminescence sensor, type IAH, for background luminance.

3- Two prototypes under field test; completion expected in 1979.

4- A photocell with appropriate filters and having an aperture of 10 degrees measures in the range $3.10^{-1}$ to $1.10^5$ cd.m$^{-2}$; the actual analogue current produced is approximately proportional to the logarithm of the background luminance.

5- In accordance with ICAO recommendations; test results not analysed yet.

6- a) $2,500 b) not estimated.

7- Deutscher Wetterdienst, Instrumentenamt Hamburg, Frahmredder 95, D-2000 Hamburg 65, F.R.G.

8- None.

1- Netherlands.

2- Background light sensor (background luminance)

3- Tests to be completed early 1979. Ten to be installed late in 1979.

4- A photocell detector is logarithmically amplified. A voltage to frequency conversion outputs pulses to a line with $800\Omega$ impedance. Power consumption 50 W.

5- One percent. MTBF unavailable. Tests for one year.

6- a) $1,000 b) $50 for power.

7- Dr. J.H. Rietman, c/o Royal Netherlands Meteorological Institute, Post Box 201, 3730 AE De Bilt, Netherlands.

8- None.

* For key, use fold-out page at rear of book.
Category Number 11

CLOUD OBSERVATIONS

The following countries* have reported developments concerning instruments in this category:

FRANCE
JAPAN
U.K. (2)

1- France.
2- Watersonde for cloud droplet distribution measurements.
3- Prototype tested in laboratory and in two field trials. Completion scheduled for April 1979.
4- This aeroplane-borne sonde optically determines droplet size distributions through clouds. Data is telemetered at 400 MHz for recording at the ground or on board the 'plane. (Diameter 20 cm., weight 2 kg.)
5- Droplet count accurate to ±5%, diameter determination to ±10%. Tests confirm.
6- a) $1,400  b) consumables depend on number and duration of flights.
7- J.L. Champeaux, Météorologie Nationale Centre de Recherche de Magny-Les-Mameaux, 78470 Saint-Remy-Les-Chevreuse, France.
8- La Météorologie No.10, V. Klaus, J.L. Champeaux - L'Aquasonde; Anvar patent pending.

1- Japan.
2- Pulse ceilometer to measure cloud height.
3- Complete. Operational since March 1978.
4- Pulsed laser radar. The transmitter is a 400W laserdiode with 100 Hz repetition rate. The receiver antenna is a 340 mm. diameter parabolic reflector. Digital display of cloud height and strip chart record. Range 30 to 1,500m (100 to 4,800 feet).
5- Cloud height: ± 50 ft. below 500 feet; ± 10% above 500 feet. Successful tests at Haneda Airport during April-May 1977.
6- a) $60,000  b) $1,500
7- International Co-operation Unit, Planning Division, Japan Meteorological Agency, 1-3-4 Otemachi, Chiyoda-ku, Tokyo, Japan.

* For key, use fold-out page at rear of book.
CATEGORY NUMBER 11

8- Sakkigijutsu-siryo No. 5215 (Japanese only); Patent pending on parts of circuitry.

1- U.K.
2- Cloud water droplet sampler.
3- Prototype tested in wind tunnel.
4- Passive cyclone principle for collecting cloud water droplets. No other details.
5- Droplets of diameter greater than 5 mm collected with high reliability. Design principle confirmed in the wind tunnel.
6- a) $2,000    b) not estimated.
7- Mr. P.T. Waltera, Central Electricity Research Laboratories, Kelvin Avenue, Leatherhead, Surrey, England.
8- None yet.

1- U.K.
2- Laser ceilometer for cloud base height measurement.
3- Completion expected 1979.
4- Low power eye-safe pulsed laser. No other details.
5- Resolution ± 15 m. Tests indicate satisfactory reliability and performance.
6- Not estimated.
Category Number 12

MEASUREMENT OF UPPER WIND

The following countries* have reported developments concerning instruments in this category:

FINLAND (2)
FRANCE
ISRAEL
U.K. (2)

1- Finland.
2- NAVAID wind finding system (further development) for upper air winds.
3- Testing of prototype software changes.
4- Further refinements were made to the CORA Automatic Radiosonde System using the NAVAID principles.
5- Approximately ± 1 m/s average wind error; tests show good results.
6- (a) $100,000  (b) low - semi-skilled operator required.
7- Vaisala Oy, PL 26, 00421 Helsinki 42, Finland.
8- Patented.

1- Finland.
2- ME Radiotheodolite for upper air windfinding.
3- Final development testing in 1979.
4- Automatic balloon tracking by means of a radiotheodolite system. Secondary function is to receive radiosonde telemetry.
5- Not available
6- (a) $30,000  (b) not available.
7- Vaisala Oy, PL 26, 00421 Helsinki 42, Finland.
8- None.

* For key, use fold-out page at rear of book.
1- France.
2- SONATE B for measuring low level wind and turbulence.
3- Expected completion late 1979.
4- The system calculates the two Cartesian components of the wind between 30 and 1,000 m., using the doppler shift of the returned acoustic signals to the trimodal acoustic radar receivers. The electronics weighs 50 kgs; the antenna, 230 kgs.
5- Estimated to be at least 0.5 m/s per component.
6- a) $32,500   b) $1,500
7- A. Estival ou JP. Picquenard, Etablissement d'Etudes et de Recherches Météorologiques, 78470 St. Remy-les-Chevreuses.
8- La météorologie, Novembre 1975. A. Estival, M. Aubry, La mesure de profils des vents des basses couches par SODAR DOPPLER.

1- Israel.
2- Digital timer for facilitating theodolite readings during pilot balloon determination of upper winds.
3- Completion late 1978.
4- This electronic instrument will replace the mechanical timers in use. It consists of 2 timer units integrated in one chip, RC556. A signal of 5 seconds duration is given every minute so the observer can center in on the balloon and note the position.
5- 0.5% of time.
6- a) $30,   b) Unknown.
7- H. Kaloff, Israel Met Service, P.O. Box 25, Bet Dagan, Israel.
8- None.

1- U.K.
2- Radtrack Automatic data processing system for upper winds and other upper air data.
3- Completion scheduled 1979.
4- Automatic data processing system for use with Plessey windfinding radar and VIZ radiosonde.
CATEGORY NUMBER 12

5- Not applicable.
6- Available on request.
8- None.

1- U.K.
2- Location of balloon borne passive reflector by primary radar.
3- Operational, but with continuing development.
4- Primary radar with automatic tracking of passive reflector. Data transfer to RS 3 radiosonde computer every eight seconds. Statistical running averages over nine readings used to provide a 64-second wind every eight seconds. Automatic selection of standard and significant level winds and production of PILOT or TEMP messages.
5- Standard deviation of single readings ± 0.07 degrees ± 15 m. Statistical averaging over nine readings should enhance resolution three times. No tests.
6- Not estimated.
7- Dr. A.C.L. Lee, Meteorological Office (Met 0 16), Beaufort Park, Easthamstead, Wokingham, Berks. U.K.
8- None.

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Category Number 13

RADIOSONDE TECHNIQUES

The following countries* have reported developments concerning instruments in this category:

FINLAND
FEDERAL REPUBLIC OF GERMANY (3)
ISRAEL
JAPAN
U.K.

1- Finland.
2- Further development of radiosonde (upper air pressure, temperature, humidity).
3- Engineering testing.
4- Aim to improve accuracy and handling characteristics.
5- Improved.
6- Comparable to present sondes.
7- Vaisale Oy, PL 26, 00421 Helsinki 42, Finland.
8- Patents apply.

1- Federal Republic of Germany
2- Low-level radiosonde model TDFS-76Q.
3- Completed. Industrial engineering underway.
4- 400 MHz quartz controlled transmitter, Sensors: wet/dry bead thermistors, aneroid capsule; time sharing transmission; altitude capability 3 km.
5- Temperature ± 0.4°C; pressure ± 1.5 mb; relative humidity ± 8% (all RMS); Extensive testing programme confirms the results.
6- a) $90.  b) unknown.
7- A. Kölbl, Deutscher Wetterdienst, Instrumentenamt München, August Schmaü Str.1 D-8042 Oberschleißheim.
8- None.

* For key, use fold-out page at rear of book.
1- Federal Republic of Germany
2- Radiosonde Model RSG78 redevelopment.
3- Completed. Industrial engineering underway.
4- 400 MHz quartz controlled transmitter, data transmission in time division multiplex mode. Sensors: wet/dry bead-thermistors, aneroid capsule. Altitude capability 30 km.
5- Temperature ±0.2; pressure below 200mb ±0.5mb; relative humidity ± 5% all RMS; Extensive testing programme confirms the results.
6- a) $125. b) unknown.
7- A. Kölbl, Deutscher Wetterdienst, Instrumentenamt München, August Schmaug Str. 1, D-8042 Oberschleißheim.
8- Patents pending for the pressure transducer on manufacturing firm.

1- Federal Republic of Germany
2- Ground-based equipment for radiosonde model RSG78.
3- Complete. Industrial engineering underway.
4- Directive, manual or radar-controlled antenna; UHF-Receiver, data decoding unit and processor to automatic computation of data and analysis for standard message.
5- No degradation of radiosonde accuracies. Borne out in tests.
6- a) $75,000 including computer       b) unknown.
7- A. Kölbl, Deutscher Wetterdienst, Instrumentenamt München, August Schmaug Str.1, D-8042 Oberschleißheim.
8- None.

1- Israel.
2- Planetary Boundary Layer Meteorological Profiler to provide continuous simultaneous measurements of pressure, temperature and humidity.
3- Prototype being developed; completion expected in summer 1979.
4- No switching device is required because the concept of frequency division multiplexing (FDM) is applied for continuous transmission of several variables.
5- Low inertia sensors will provide high precision and sensitivity.
- 33. -

CATEGORY NUMBER 13

6- Not yet estimated.
7- A. Manes, Israel Meteorological Service, P.O. Box 25, Ben Dagat, Israel.
8- None.

1- Japan.
2- Type RS II-80 rawinsonde for upper air data.
3- Prototype under field tests at Teteno. To become operational January 1980.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Sensors</th>
<th>Ranges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>Thermistor</td>
<td>+40 to -85°C</td>
</tr>
<tr>
<td>Pressure</td>
<td>Constant elastic modulus alloy</td>
<td>1 to 1040 mb</td>
</tr>
<tr>
<td>Humidity</td>
<td>Carbon Hygrometer</td>
<td>0 to 100 %</td>
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<tr>
<td>Carrier frequency;</td>
<td>1680 + 4MHz</td>
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</tr>
<tr>
<td>Modulation frequency;</td>
<td>50 to 2,000 Hz</td>
<td></td>
</tr>
<tr>
<td>Output of transmitter;</td>
<td>0.6 W</td>
<td></td>
</tr>
<tr>
<td>Type of emission;</td>
<td>ICW</td>
<td></td>
</tr>
<tr>
<td>Source;</td>
<td>20 V, 150 mA or less</td>
<td></td>
</tr>
<tr>
<td>Weight;</td>
<td>About 500 g including battery</td>
<td></td>
</tr>
</tbody>
</table>

The signals of the rawinsonde are received by automatic data processing equipment for aerological observation.

5- Unstated as yet - depends on test results.
6- Unknown yet.
7- International Co-operation Unit Planning Division, Japan Meteorological Agency, 1-3-4 Ote-machi; Chiyoda-ku, Tokyo, Japan.
8- Some reports written only in Japanese (Sokkojiho Vol.41 Nos. 2 & 3, Vol. 42 No. 3). A part of circuits made under patent.

1- U.K.
2- United Kingdom Mk.3 Radiosonde System (pressure, temperature, humidity).
3- Operational with continuing development
4- Operating Range + 50 to -110°C; 1% to 99% RH (+ 50 to -40°C); 1050 mb to 2 mb. Transmitter 27.5 to 28.0 MHz modulated at 3.5 to 6.5 KHz; electric motor-driven switch; ground station automatically carries out pre-flight calibration, in-flight signal reception, all data calculations and compiles standard TEMP messages and detailed archival summaries. Special pulses synchronize ground stations.
CATEGORY NUMBER 13

5- Accuracy relative to other operational sondes (systematic difference) will be determined by the CIMO Working Group on Upper Air Systems. Operational results at five stations over five months indicate close agreement with other national sondes (low systematic difference) and a very low variability between sondes.

6- Unknown yet.

7- Dr. A.C.L. Lee, Meteorological Office (MET 0 16), Beaufort Park, Easthamstead, Wokingham, Berkshire, England.

8- None.
Category Number 14

The following countries* have reported developments concerning instruments in this category:

None

* For key, use fold-out page at rear of book.
Category Number 15

OBSERVATION OF ATMOSPHERICS

The following countries* have reported developments concerning instruments in this category:

ISRAEL

U.K.

1- Israel.
2- Close and medium range lightning detection and ranging systems (LDAR) using sferics detection.
3- Prototype tests to begin 1978/1979; completion due in 1980.
4- At a single station the azimuth angle of discharge is determined using a modification of Krider's system (bibliography). Range is determined using a statistical analysis of spectral amplitudes of the sferics as a function of range.
5- Not determined.
6- a) 10,000. b) Unknown.
7- A. Manes, Director of Research and Development Division, Bet Dagan, P.O.B. 25, Israel.

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1- U.K.
2- Location of lightning by analysis of vertical electrical field changes at a number of stations.
4- Lightning waveforms recorded and timed at several stations. Data sent to a central station where the location of the flash is deduced.
5- Unknown.
6- Not estimated.
7- Dr. A.C.L. Lee, the Meteorological Office (MET 0.16), Beaufort Park, Easthampstead, Wokingham, Berks, England.
8- None.

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* For key, use fold-out page at rear of book.
Category Number 16
INSTRUMENTS AND OBSERVATIONS AT AERONAUTICAL METEOROLOGICAL STATIONS

The following countries* have reported developments concerning instruments in this category:

FINLAND
FEDERAL REPUBLIC OF GERMANY
INDIA
JAPAN

1- Finland.
2- Small airport weather station.
3- First station to be installed early 1979.
4- Low Cost system similar in concept to the MIDAS automatic stations in use since 1976. Includes machine METAR message editing, data logging and distribution.
5- As required by Finish Meteorological Institute. MIDAS operations indicate success.
6- a) $50,000 (excluding some sensors) b) Unknown.
7- Vaisala Oy, PL 26, 00421 Helsinki 42, Finland.
8- None.

1- Federal Republic of Germany
2- ASDUV for automatic aerodrome weather observations.
4- Automatic system for collecting and telemetering aerodrome meteorological data in real time. Display terminal for users. Ability to manually insert selected information.
5- In accord with relevant ICAO, WMO recommendations. Positive experience with early prototypes (one month).
6- a) $200,000 for full station b) not estimated.
7- Deutscher Wetterdienst, Instrumentenamt Hamburg, Frahmredder 95, D-2000 Hamburg 65, F.R.G.
8- None.

* For key, use fold-out page at rear of book.
1- India.
2- Digital current weather instruments system for measurements for aeronautical use.
3- Completed.
4- Air and dewpoint temperatures and wind speed and direction representative of the touch-down/take-off points of the runway are electrically sensed and feed an A/D converter through an analogue multiplexer. The digital multiplexer then feeds the digital display panel with a serial message.
5- Air temperature ± 0.5°C; dewpoint ± 1°C; wind speed ± 0.5 Kt below 20 Kt and ± 5% above 20 Kt; wind direction ± 1 degree; Suitable for field operations as it is stable over long periods.
6- a) $10,000 excluding cabling and installation  b) $500.
7- Director (Instruments), Meteorological Office, Pune - 5, India.
8- None.

1- Japan.
2- Observing equipment for aeronautical meteorology (wind, temperature and pressure)
3- Operational since March 1978.
4- Parameters | Sensors | Display
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind direction/speed</td>
<td>Propeller anemometer and vane</td>
<td>Digital display and analog recorder of average wind speed calculated</td>
</tr>
<tr>
<td>Air temperature</td>
<td>Platinum resistance</td>
<td>Digital display to 0.1°C</td>
</tr>
<tr>
<td>Atmospheric pressure</td>
<td>Aneroid</td>
<td>Digital display of values reduced to m.s.l. with QNH converter</td>
</tr>
</tbody>
</table>

5- Wind direction: ±5° wind speed: ± 0.5 m/s below 10 m/s; ± 5% above 10 m/s, temperature: ± 0.3°C, pressure: ± 0.5 mmHg. The pressure sensor was new, and showed well in tests. The other sensors are proven.
6- a) $35,000.  b) $500.
7- International Co-operation Unit, Planning Division, Japan Meteorological Agency 1-3-4 Ote-machi, Chiyoda-ku, Tokyo.
8- A report written only in Japanese. Pressure-measuring part made under patent.

* For key, use fold-out page at rear of book.
Category Number 17
MARINE OBSERVATIONS

The following countries* have reported developments concerning instruments in this category:

FRANCE
INDIA
SEYCHELLES
U.K.

1- France.
2- MARISONDE for measuring sea-surface temperature.
3- Fifty prototypes are under test; almost complete.
4- A copper thermoressitive sensor is used. It has a nominal resistance of 2330 $\Omega$ at 0°C and a linear change of resistance of 10 $\Omega$ per °C. The electronic transducer provides a continuous voltage output which changes linearly with temperature.
5- Accuracy $\pm 0.1^\circ C$ between -10°C and 50°C; a years' tests at fifty sites confirm this.
6- a) $700$. b) not stated.
7- Chief Projet MARISONDE, Centre de recherche Atmosphérique de Magny-Les-Hameaux, 78470 Saint-Remy-Les Chevreuses, France.
8- None.

1- India.
2- Buoy orientation sensor to provide the buoy heading so that wind direction can be sensed.
3- Engineering prototype being tested in the laboratory.
4- The orientation of a north-seeking magnet is measured using an optical system (light emitting diodes and photosensing diodes) with a grey coded output which is changed to analogue before use.
5- Accuracy about $6^\circ$.
6- Not known.
7- The Director (Instruments), Met Office, Pune - 5, India.

* For key, use fold-out page at rear of book.
CATEGORY NUMBER 17

8- A simple technique for the measurement of wind direction from a free floating or drifting automatic weather data platform buoy, NAL seminar in signal conditioners and data loggers, Feb. 1977.

1- Seychelles.
2- Remotely displayed sea temperature sensor.
3- Operational.
4- A thermistor in a protective jacket is suspended from a tethered buoy 2 feet below the surface in about 30 feet of water. A cable carried data to the Meteorological Office.
5- Accuracy ± 0.5°C from 20°C to 35°C. Testing has shown some success. But more work will be done to improve accuracy and life span.
6- a) Unknown b) cost of batteries.
7- Chief Meteorological Officer, P.O. Box 181, Mahe, Seychelles (for relevant circuit diagram etc.)
8- None.

? U.K.
2- U.K. Data Buoy - ODAS10 for measuring air and sea temperatures, wind speed and direction, pressure and humidity.
3- Completed.
4- Automatic measurement of above parameters at hourly intervals. Transmission of data by HF Radio (Piccolo System) to shore station; Data processing by computer. 7.6 m Discus Hull.
5- Accuracy of system 0.1%. Eighteen months of tests inshore were successful except for transmission difficulties - four months of testing 170 miles offshore has given high data yields.
6- Not estimated.
7- Mr. M.J. Kerley, Met O.16a(2), Beaufort Park, Easthamstead, Wokingham, Berks.
8- Patent information available from U.K. Dept. of Industry.
Category Number 18

METEOROLOGICAL OBSERVATIONS FROM AIRCRAFT

The following countries* have reported developments concerning instruments in this category:

NONE

* For key, use fold-out page at rear of book.
Category Number 19

MEASUREMENT OF MULTI-MEDIA POLLUTION (sea, air and inland waters)

The following countries* have reported developments concerning instruments in this category:

U.K.

1- U.K.

2- Differential absorption Lidar (DIAL) for measuring atmospheric concentrations of \(\text{SO}_2\), \(\text{NO}_2\) and \(\text{O}_3\).

3- Prototypes developed and tested to confirm theoretical performance (1979).

4- Atmospheric backscatter of laser radiation synthesized.

5- Resolution of a few tens of ppb at a range of one kilometer. Confirmed by tests.

6- a) $200,000    b) not estimated.

7- R.H. Varey, Central Electricity Research Laboratories, Leatherhead, Surrey, U.K.


* For key, use fold-out page at rear of book.
Category Number 20

MEASUREMENT OF OZONE AND ATMOSPHERIC ELECTRICITY

The following countries* have reported developments concerning instruments in this category:

BELGIUM (4)
GERMAN DEMOCRATIC REPUBLIC
INDIA (3)

1- Belgium.
2- Electrometer for measuring the vertical conduction current.
3- To be completed in early 1979.
4- An operational amplifier circuit converts current to voltage.
5- Accuracy 0.01 pA/m² ± 5% of reading. The tests showed that the low impedance circuitry avoids contamination of the data by the sensor.
6- a) $700   b) $200.
7- K.M.I. dept. Aérométrie. Ringlaan 3, 1180 Bruxelles
8- Technical note in preparation.

1- Belgium.
2- An aspirated electrical capacitor is used to measure atmospheric electrical conductivity.
3- Expected completion early 1979.
4- Aspirated capacitor method, use of electrical "guarding" and microphonics measures to improve sensitivity. Low impedance inputs.
5- Resolution, 5.10⁻¹⁶ Ω⁻¹ m⁻¹ ± 5% of reading.
6- a) $1,700   b) $200
8- Technical note in publication.

* For key, use fold-out page at rear of book.
CATEGORIE NUMBER 20

1- Belgium.

2- Aspirated capacitor for measuring the ionization of the air.

3- To be completed 1979.

4- Aspirated capacitor method, use of electrical "guarding" and microphonics measures to improve sensitivity. Low input impedance $<10^4\Omega$.

5- Accuracy $\pm 10$ ions. cm$^{-3}$ $\pm 5\%$ of reading. Feasibility was proven by a year's testing.

6- a) $1,700$ b) $200$


8- Technical note in publication.

1- Belgium

2- Solid-state Electrometer 73 for measuring atmospheric electrical potential at a height of 1 m.

3- To be completed in 1979.

4- The electrical potential is measured using an americium radioactive source as a collector for space voltage.

5- Better than 1% accuracy expected. A years' tests indicate that "guarding" is more important than isolation.

6- a) $1,600$. b) $200$.


1- German Democratic Republic

2- Surface ozone recorder for measuring ozone partial pressure.

3- To be completed 1979.

4- Electrochemical principle according to Brewer's bubbler method.

5- Not yet determined. Laboratory tests show feasibility.

6- Not yet available.

7- Dr. Grasnick, Meteorological Service of the GDR - Meteorological Main Observatory, DDR-15 Potsdam, Telegrahpenberg.

1- India.
2- Surface electrical conductivity recorder.
3- Prototype completed.
4- The conduction current in an aspirated cylindrical capacitor kept at constant voltage is recorded.
5- ± 10% of reading. Tests show the apparatus to be field-worthy and to maintain long term accuracy.
6- a) $1,500 b)$500.
7- Director (Instruments), Meteorological Office, Pune-5, India.
8- None.

1- India.
2- Surface potential gradient recorder.
3- Prototype completed.
4- A radioactive collector quickly attains the ambient space voltage which feeds a recorder via electronic circuitry.
5- ± 10% of reading. Tests show the apparatus to be field-worthy and to maintain long-term accuracy.
6- a) $1,200 b)$400.
7- Director (Instruments), Meteorological Office, Pune-5, India.
8- None.

1- India.
2- Surface ozone concentration recorder.
3- Completed.
4- Electrochemical principle following Brewer's bubbler method.
5- Not estimated. System reliability is good.
6- a) $1,000 b)$100.
7- Director (Instruments), Meteorological Office, Pune-5, India.
8- None.
Category Number 21

AUTOMATION OF OBSERVATIONS

The following countries* have reported developments concerning instruments in this category:

BELGIUM
CANADA
FINLAND (2)
FRANCE
INDIA (3)
ISRAEL
U.K. (3)

1- Belgium.
2- Automatic station for recording measurements of wet and dry bulb air temperature, soil temperatures, precipitation and wind.
3- Complete. Installations commencing across the country.
4- A central control unit interrogates the sensors at predetermined times and registers the readings on a mini-cassette in ASCII code. Line power is used, backed-up by a battery. The mini-cassettes are centrally read into computer-compatible 9-track magnetic tape for analysis.
5- Precision of readings better than 0.1°C for temperatures and than 0.1 mm for precipitation. Wind precision not mentioned.
6- Not estimated.
7- Section d'Hydrologie, Institut Royal Météorologique de Belgique.
8- Not mentioned.

1- Canada.
2- Modular acquisition and processing system (MAPS). An automatic battery powered weather station for use in remote areas.
3- Operational

* For key, use fold-out page at rear of book.
4- Functional selection of parameters by appropriate module selection, interconnection standardization between modules, component independence inside modules to limit impact of technological change.

5- Accuracy of the stations is determined by the accuracy of the sensors, which is typical of standard meteorological sensors. 20 system-years tests in adverse northern climate yielded 5 failures and 94% data recovery.

6- a) $5,000 to $20,000 depending on options  
   b) $1,000 to $20,000 depending on location.


8- Trade Mark "MAPS".

1- Finland.

2- MILOS Automatic weather station (low cost)

3- Operational testing.

4- A low cost low power station capable of withstanding extreme environmental conditions. Includes microcomputer. Observes maxima, minima and averages in addition to instantaneous readings. Includes a data logger and/or telecommunications interface (radio or line). Particular sensor suite not mentioned.

5- Accuracy dependent on sensor array. Field tests indicated good reliable performance.

6- a) $13000 including a typical sensor suite  
   b) not estimated.

7- Vaisala Oy, PL 26, 00421 Helsinki 42, Finland.

8- Low power microcomputer AWS MILOS, Vaisala News 75 - 1977.

1- Finland.

2- Tower automatic weather station for measuring boundary layer gradients of wind, temperature and humidity.

3- Prototype in operational use.

4- Wind, temperature and humidity parameters are measured. Gradients of these parameters are computed. System is designed for operation in high electrical interference conditions, such as broadcasting antenna towers.

5- Not estimated; prototype system performed "satisfactorily".
6- a) $60,000. b) not estimated.
7- Vaisala Oy, PL 26, 00421 Helsinki 42, Finland.
8- Patented.

1- France.
2- MINICLIM for measuring pressure, temperature and humidity.
3- Prototype has been tested for six months in laboratory and in the field.
4- A thousand channel battery powered portable miniaturized climate station; ventilated radiation screens; omnidirectional wind sensor has starting threshold of 0.35 m/s.
5- Temperature ± 0.3°C (-20 to +40°C); humidity ± 3% (10-100%) and wind 0.1 m/s. Tests confirm.
6- a) $2,400 b) $200.
7- S. Wagner, Etablissement d'Etudes et de Recherches Météorologiques, 78470 St. Remy-les-Chevreuses.
8- None.

1- India.
2- Land line weather data logging system for temperature, humidity, wind, pressure, rainfall and sunshine duration.
3- Concluded. Field tests successful.
4- Multi-channelled mains-powered land lines data logger; output in engineering units every 10/15 minutes (quartz clock); sensors can be remoted.
5- Temperatures 0.5°C, wind speeds 1 knot, wind direction 5 degrees, pressure 1 mb., rainfall 2 mm; sunshine 3 minutes.
6- Not estimated.
7- The Director (Instruments), Met. Office, Pune - 5, India.
8- Report on EOLE experiment jointly by CNES (France), ISRO and IMD of India in 1972/73.

1- India.
2- Telemetering Automatic Weather Station for temperature, humidity, wind, pressure
3- Under development - prototype undergoing tests.
4- Battery operated multi-channelled data telemetering unit; receiving station prints output on a teleprinter.
5- Temperatures 0.5°C, wind speeds 1 knot, wind direction 5 degrees, pressure 1 mb, rainfall 2 mm; sunshine 3 minutes.
6- Not estimated.
7- The Director (Instruments), Met. Office, Pune - 5, India.

1- India.
2- Satellite weather data collection platforms for temperature, humidity, wind, pressure, rainfall and sunshine duration.
3- Eight prototypes being made for tests in 1979.
4- Ten channel DCP transmits via Indian satellite for Earth Observation (SED). Self-timing and pseudo-random bursts are features.
5- Temperatures 0.5°C, wind speeds 1 knot, wind direction 5 degrees, pressure 1 mb, rainfall 2 mm; sunshine 3 minutes.
6- Not estimated.
7- The Director (Instruments), Met. Office, Pune - 5, India.
8- SAC COURIER of March 1978.

1- Israel.
2- Automatic Weather Station using the telephone network to transmit data on temperature, humidity and wind.
3- To be completed in 1979.
4- Automatic weather station which measures four parameters: Air temperature, atmospheric humidity, wind force and wind direction. The system consists of the Analog Devices Data Acquisition system DAS 1128. A very low speed modem (approx. 20 bits per second) is used to transmit the data accurately through a noisy telephone network.
5- Temperature ± 0.5°C. Humidity ± 3% RH - wind speed ± 3% of F.S. ±1 knot in the range from 5 to 50 knots.
6- a) $1,000    b) $200.
CATEGORY NUMBER 21

8- None.

1- U.K.
2- Automatic Weather Station for use in icing conditions. Measures solar and net radiation, temperatures, wet bulb depression, wind and rainfall.
3- To be completed 1980 - 1981.
4- The purpose of the project is to develop techniques that will allow the Institute of Hydrology AWS to operate under conditions of severe icing and as a spin-off, in other contaminating environments.
5- Not estimated; 2½ winters of testing completed.
6- Not estimated.
7- Mr. I.C. Strangeways, Institute of Hydrology, Maclean Building, Wallingford, OXON, OX10 8 BB, UK.

1- U.K.
2- ODA. 2 automatic station for measuring air and sea temperature, wind, pressure and humidity.
3- Completed.
4- 3-hourly automatic measurement, plus command facility of above parameters. Transmission of data by VHF radio link to shore station thence by telephone lines to collecting centre. For use on inshore buoys/platforms.
5- Electronics accuracy ± 0.1%; tests indicate success.
6- a) $100,000 b) not estimated.
7- Mr. M.J. Kerley, Met O 16A(2), Beaufort Park, Easthamstead, Wokingham, Berks.
8- None.
1- U.K.
2- Solid State data logger.
3- Prototype tested for one year. Five more to be installed in 1979.
4- No details given.
5- Not estimated.
6- Not estimated.
7- Mrs. M. Turner, Institute of Hydrology, McLean Building, Wallingford, OXON OX10 8BB, U.K.
8- None.
Category Number 22

OTHER

The following countries* have reported developments concerning instruments in this category:

CANADA
FINLAND
FRANCE
U.K. (2)

1- Canada.
2- Completed.
4- Prediction of solar power available from photovoltaic devices, using RFI data.
5- Not applicable; 20 system years service - no failures.
6- Not estimated - reducing with technology growth.
7- Mr. Roger Van Cauwenberghe, AIDS, Atmospheric Engineering Service, 4905 Dufferin St, Downsview, Ontario, Canada M3H 5T4.

1- Finland.
2- Rime sensor.
3- Tested since 1973 - ready for mass production.
4- A grooved aluminium cylinder collects rime. Shape and direction of formation available visually. Water equivalent measured by melting and accumulating the water.
5- Resolution ± 0.1 mm; 5 years tests satisfactory.
6- a) $60  b) little outlay.
7- Mr. Kari Ahti, Finnish Meteorological Institute, Box 503, 00101 Helsinki 10, Finland.
8- On the formation and measurement of rime in Finland. Report No. 61 from the Väriö Subarctic Research Station of the University of Helsinki, 1976.

* For key, use fold-out page at rear of book.
1- France.
2- SONATE "A" for observing the thermal structure of the lowest layers of the atmosphere and the height of inversions.
3- Prototype testing has lasted one year.
4- A monostatic vertical acoustic sounder senses the back-scattering of sonic waves by atmospheric inhomogeneities. The returns are recorded continuously. Frequencies 1200 Hz, 2000 Hz. Domaines 500 m and 1 km.
5- Height of inversion ± 17 m. Tests indicate success.
6- a) $10,000     b) $400.
7- Madame Estival ou Monsieur Picquemard, Etablissement d'Etudes et de Recherches Météorologiques, 78470 St-Remy-les Chevreuses.
8- La Météorologie Juin 1976, A. Estival, M. Aubry, Interprétation des échos SODAR en terme de stratification atmosphérique. Licence météorologie nationale/CNET.

1- France.
2- Optical lightning detector.
3- Prototype under test.
4- Battery operation. Electronic circuitry detects the coincidence of two impulses from two separate photovoltaic cells to determine the existence of a flash of lightning.
5- Not estimated. Testing indicates a measure of success as compared to other methods.
6- a) $1,800     b) $100.
7- M. Olivieri, CTM/T/RTS, Centre Technique de la Météorologie, BP 202, F-78195, Trappes, CEDEX, France.
8- None.

1- U.K.
2- Colour scan display system for precipitation radar.
3- Completion expected 1979.
4- Micro processor based colour display systems for use with Plessey and other weather radars.
5- Not applicable
6- Not provided (available on request)
7- P.J.P. Rodwell, Marketing Manager, Meteorological and Environmental Systems
8- None.

1- U.K.
2- C-Band Radar for precipitation measurement.
3- One system to become operational late 1979.
4- Determination of precipitation over a defined catchment area for the purpose
   of controlling reservoirs and river flow; determination of probable flooding
   in defined areas. Processing and transmission of data over telephone lines
   (or radio links) to control centre or to other users. Programmes to take
   account of permanent echoes, occlusion, "bright band" effects.
5- Within 20% of precipitation measurement by conventional raingauge networks;
   extended trial period took place in Dee Valley (Wales).
6- Not provided.
7- C.G. Collier, Meteorological Office Radar Research Laboratory, RSRE,
   St. Andrews Road, Malvern, Worcestershire, U.K.
8- Dee Weather Radar and Real Time Hydrological Forecasting Project (Report by
   Steering Committee); 1977; various papers by Harrold, English, Nicholass,
   Collier, Kitchingman. "Potential Benefit from a National Network of
   Precipitation Radars and Short Period Forecasting", Bussel, Cole and Collier.