(g) Since the direction of shock and direction of propagation do not always coincide, particular attention must be paid to the direction in which unsupported objects are overturned, or in which direction furniture is displaced, or in which direction hanging lamps or fluids oscillate. If clocks stop or pictures knock against the wall, the bearings of the walls should be given.

(h) With regard to the nature of the shock, it should be observed whether only one or several consecutive shocks were felt, and whether a jerky or wave-like movement or only a trembling of the ground was felt.

Other remarks concerning the composition of the soil, etc., must be left to the discretion of the observers.

6. QUESTION CARD.

Earthquake................(day of the week)................19
Place.
At what time? h m s (local mean time) (standard time)
A. M. or P. M.?
Where was the observer?
In the open air?
In a house?
In which story?
Number, duration of the shocks?
Direction of the shocks?
What effect had the earthquake?
Earthquake sounds?
Behavior of springs, wells, etc.
Other remarks.
Address of the observer.

7. SAMPLE OF EARTHQUAKE NOTICE.

Earthquake. Monday, January 19, 1889.
Place. Ascoli Piceno.
At what time: $8^h$ a. m. M. T. Rome.
Where was the observer? In the open air.
In which story? ———
Number and duration of the shocks: One shock; two seconds.
Direction of the shocks: E.—W. jerky, VIII.
What effect had the earthquake? Cracks in the walls.
Earthquake sounds. ———
Behavior of wells, springs. ———
Other remarks: Church bells began to ring. General flight from the houses.

*Data desired relative to seaquakes.*

1. Position of the ship at the time of the earthquake.
   What course was the ship sailing and how many knots was she making?
2. Place of the observer.
   Was the seaquake felt by the observer below the deck or on deck?
3. Time of seaquake.
   At what moment was the seaquake perceived?
4. Kind of motion.
   (a) Merely trembling or shaking or shocks?
   (b) Was the motion vertical or undulatory?
   (c) Were the shocks preceded by a trembling motion or were they followed by such a motion?
   (d) What is the motion to be compared to, and what impression did it make upon the observer?
5. Direction of the propagation of the motion.
   Was the direction of the motion from bow to stern or vice versa, or can a certain direction by the compass be stated?
6. The intensity of the earthquake is to be given in degrees of the following scale:
   I. Quite slight trembling, more like a noise; mostly heard only below deck (III of the Rossi-Forel scale).
   II. Slight trembling, by which a sleeping crew might be awakened (IV of the Rossi-Forel scale).
   III. Trembling of the whole ship, such as might be caused by large casks being rolled across the deck (IV of the Rossi-Forel scale).
   IV. Moderate shaking like that felt when the anchor cable is quickly slipped (IV of the Rossi-Forel scale).
   V. Rather a strong shaking, as if the ship were scraping on rough ground (IV of the Rossi-Forel scale).
   VI. Strong shaking by which light things may be moved; the wheel jerks in the hands of the steersman (V and VI of the Rossi-Forel scale).
   VII. Very strong shaking by shocks so as to make the timber work crack and to render it impossible to keep on one's feet (VII of the Rossi-Forel scale).
   VIII. Very strong shaking by shocks; masts and rigging as well as heavy things on deck are shaken (VIII of the Rossi-Forel scale).
   IX. Exceedingly strong shaking by shocks; the ship is thrown on its side, slackens, or is stopped (IX of the Rossi-Forel scale).
   X. Destructive effect; people are thrown down upon deck, the joints of the deck burst, the ship becomes leaky (X of the Rossi-Forel scale).
   Did the intensity vary with the single shocks or during the whole phenomenon?
7. Duration of the seaquake.
   (a) What was the duration of the shaking itself, apart from the noise, by which it was accompanied?
   (b) Were there single phases to be distinguished in the phenomenon?
8. Sounds.
   (a) Was a noise heard, and what was it to be compared to?
   (b) Did the noise precede the shaking, was it at the same time, or did it follow it?
9. Sea surface phenomena.
   (a) What was the state of the sea surface before the seaquake took place?
   (b) Did it remain in the same condition, or did any changes take place during the seaquake?
   (c) Was a single peculiarly high wave observed or a succession of them (height and length)?
   (d) Was the level of the sea, although smooth, raised, or did it bubble like boiling water?
10. The compass.
    Did a sudden variation of the needle take place during the seaquake?
11. Meteorological phenomena.
    (a) Was the temperature of the sea water higher after the seaquake than it was before?
    (b) What was the atmospheric pressure?
12. Extension of the seaquake.
    (a) Were any other ships near at the time of the seaquake, and if so, at what distance?
    (b) Was the seaquake perceived by them or not?
13. Earthquake and seaquake.
    In case the ship is lying in a harbor, inquiries are to be made on land concerning:
    (a) The beginning.
    (b) The intensity.
    (c) The duration of the earthquake.
    What difference was there between the earthquake and the seaquake as to these three points?
14. Condition of the sea in the harbor during an earthquake and a seaquake.
    (a) Had the shaking any influence upon the water in the harbor?
    (b) Did any breakers come in at the moment of the shaking or immediately after it, and if so, how many, how high, at what intervals?
    (c) Did the ship drag her anchor and were any currents perceptible.
    (d) Did a so-called earthquake tidal wave take place, and if so, how long after the beginning of the earthquake; how many waves, what height, at what intervals?

## INDIAN SUMMER.

A correspondent writes to inquire "the time and duration of Indian summer" for the latitude of Washington, D. C.

Indian summer is an extremely indefinite season as to its date and its character. There has never been any determination of its average date and duration so far as we know. It is often described as a warm, dry, hazy period after the first severe frost in autumn, but it often fails to come at all.

The date of the first severe frost at Washington has ranged, since 1871, from October 2 to November 15, and at Baltimore, during the same period, the range has been between October 6 and December 6. This might serve to fix the earliest possible date for the beginning of Indian summer.

The paper by Mr. Albert Matthews on "The Term Indian Summer," which appeared in the MONTHLY WEATHER REVIEW for 1902 on pages 19 and 69, is one of the most complete and exhaustive discussions of the subject and its perusal is recommended to those who take an interest in this subject.

## A LECTURE ON SNOW CRYSTALS.

Our esteemed correspondent, Mr. W. A. Bentley, of Jericho, Vt., whose beautiful photomicrographs of snow crystals are known the world over, devotes his whole thought to the prosecution of this work. Being unable to leave Jericho, owing to the illness of his mother, he therefore must cooperate with others by correspondence. Not long ago he wrote out an interesting lecture on snow crystals and sent it with many lantern slides to a friend at the Brooklyn Institute of Arts and Sciences, where the lecture was delivered with great success. This suggests that other instructors, lecturers, lyceums, etc., may also secure material for an interesting lecture on a new topic and thus interest the public in meteorological matters. We hope that the State superintendents of schools will take this matter up officially as a proper branch of nature study in school work.

## PHYSICAL SOCIETIES AND JOURNALS.

Many of the readers of the MONTHLY WEATHER REVIEW are deeply interested in those branches of the study of mathematics and physics that bear on meteorology, and desire to keep in close touch with the progress of our knowledge along these lines. This can be best accomplished by becoming an associate member of either the American Physical Society, the American Mathematical Society, or the Astrophysical Society. The first named offers special advantages, since its members receive Science Abstracts and the Physical Review regularly. These monthly periodicals bring to one's attention much of what is new in physical science. Those who wish further details should correspond with the Editor, or with the secretary of the American Physical Society, Prof. Ernest Merritt, Cornell University, Ithaca, N. Y.

A journal of scientific news is as essential to the student as a daily paper is to the business man. It would be convenient if all meteorological matters were published in one journal, but this has never yet been done, and one must read several in order to compass the field. The more important periodicals are the following:

IN ENGLISH.

American Journal of Science, New Haven.
Astrophysical Journal, Chicago.
Proceedings of the Royal Society, London.
Quarterly Journal of the Royal Meteorological Society, London.
Science, New York.
Symons's Meteorological Magazine, London.
Science Abstracts, London.
London, Edinburgh, and Dublin Philosophical Magazine.
Scottish Meteorological Magazine, Edinburgh.
Terrestrial Magnetism and Atmospheric Electricity, Baltimore.
Nature, London.
Physical Review, Lancaster.

IN FRENCH.

Annuaire de la Société Météorologique de France, Paris.
Archives des Sciences Physiques et Naturelles, Genève.
Bulletin de la Société Belge d'Astronomie, Bruxelles.
Comptes Rendus de l'Académie des Sciences, Paris.

IN GERMAN.

Annalen der Hydrographie und Maritimen Meteorologie, Berlin.
Physikalische Zeitschrift, Leipzig.
Gaea, Leipzig.
Das Wetter, Berlin.
Meteorologische Zeitschrift, Wien.
Naturwissenschaftliche Rundschau, Berlin.
Annalen der Physik, Leipzig.

## COLD AND HEAT.

The following inquiry, which seems to be going the round of the press in the West, has been forwarded to the Chief of the Weather Bureau with a request for an authoritative answer:

"How cold is it when it is twice as cold as two degrees above zero (Fahrenheit)?"

The expression "twice as cold" has no definite meaning and is not used in scientific language nor in rational popular English. We simply say "warmer" for more heat and "colder" for less heat.

It is customary to measure the condition of bodies only with respect to heat, not cold. The scale by which the relative hotness of bodies is measured is the scale of temperature, the starting point of which is the temperature at which the molecular vibrations that constitute heat cease. This point is called the absolute zero of temperature. The absolute zero of temperature is 459° below zero (—459°) on the Fahrenheit scale, at which temperature a body has no heat and is said to be at 0° on the absolute scale of temperature.

A body at +2° F. may therefore be said to have 461 Fahrenheit degrees of temperature on the absolute scale. "Twice as cold" might be considered to mean one-half as hot. If so, then anything that is twice as cold as something at 2° F. must have one-half of 461 degrees of temperature, or 230.5 degrees. The temperature on the Fahrenheit scale of a body having 230.5 degrees of temperature on the absolute scale is $-459° + 230.5° = -228.5°$, or 228.5° below zero Fahrenheit.

It is not possible to say anything more definite than this, as the expression "twice as cold" can have no real significance until a scale for measuring cold has been adopted. Heat is measured upward from the absolute zero of heat, but cold must be measured downward from some arbitrary point that has never yet been defined.

## METEORS: THEIR INCANDESCENCE AND THEIR NOISE.

In Nature for October 19, 1905, Mr. George A. Brown suggests that the incandescence of shooting stars has an electrical origin, or that the heat evolved is due to the passage of the meteor across the lines of force in the earth's magnetic field. To this Prof. A. S. Herschel replies that although such induced electric currents must exist, yet the heating effect must be extremely small and incomparably subordinate to the heat evolved by the adiabatic compression of the air against the front surface of the meteor. He calculates that—

> If the kinetic energy of translation in foot pounds of one pound of air at the meteor's velocity be divided by 330, the number thus obtained, 1,180,620, will be the number of centigrade degrees through which the air will be heated by the pure process of compression. This relates to the air in immediate contact with the front of the meteor, and lower temperatures would prevail in the layers outside of that.

He thinks that the induced electric and magnetic phenomena are unimportant for both the stony and the metallic meteors as compared with these enormous thermal effects, but he seems to suggest that electricity may explain the long enduring bright streaks left along the paths of all the brighter shooting stars and larger meteors.

The compression of the air in front of the meteor takes place so rapidly, owing to the great speed of the meteorite, that the gas has no time to dissipate in front or to spread out on all sides. It is compressed and intensely heated by the impact, but remains a perfect, frictionless, elastic fluid. Within this small mass of heated air the speeds of the sound waves differ from the speed of flow of air itself in proportions or ratios that diminish asymptotically toward the ultimate ratio $\frac{1}{\sqrt{5}}$. Within this mass of hot air are sound waves conveying the strokes and shocks of the collisions to and fro between the meteor's center and the surrounding quiet air. Such sounds begin, travel, and end within the moving field of heated, compressed air as if it were at rest, although really