for $5 to members or others who subscribe for it before its issue.

2. 'The Evolution of Mine-Surveying Instruments.' This will be a volume of about 400 pages, issued in the same style as the foregoing, and containing the original paper of Mr. Dunbar D. Scott on that subject (*Transactions*, XXVIII.), first published in 1898, together with later papers continuing the same subject, and discussions thereof, by Hoskold, Lyman, Davis and many others. Subscriptions will be received for this volume in advance of its issue at $3, under the conditions already stated above.

DISCUSSION AND CORRESPONDENCE.

WEATHER CONTROL.

A CHARACTERISTIC of storms which meteorologists do not perhaps sufficiently consider is that they are the falling down or collapsing of unstable states of the atmosphere. Such phenomena in thermodynamics are called reversible processes; let us call them *sweeping processes* or simply *sweeps*. The trend of a sweeping process may be affected to any extent, however great, by a cause, however insignificant, provided the cause acts at the critical initial stage of the sweep. For example, a mere breath may determine whether a brick chimney shall fall harmlessly into a vacant lot or with unmeasured calamity into an adjacent factory, or, to take an example from meteorology, an unstable state of the atmosphere over the United States may lead to a cyclonic movement the effects of which may differ enormously according to the time and place that the unstable state begins to break, and in the limiting case the flight of a grasshopper in Colorado or Montana may be the determining factor.

If the cyclonic movements of the atmosphere which have so much to do with the distribution of rainfall are ever to be controlled by the infinitesimal means at the disposal of man it must be by the proper application of these means during the early and exceedingly sensitive stages of these vast sweeping processes. How, when and where to apply our puny power is a matter of detail, of experiment and study.

We must study the initial phases of cyclonic movements in their relations to subsequent trend and character, and we must devise means for inaugurating these initial phases in a way which will lead to desired results. This study has been pursued by the scientists of the Weather Bureau for many years and is the basis of the weather forecasts issued daily by this great scientific department of the government. As to the means for inaugurating at will the storm movements of the atmosphere the smoke-ring cannon of Burgomaster Stiger is the most rational that has yet been suggested, as will be explained later.

Weather control is, however, not so simple a matter as would appear from the above statement. It is a well-known fact that two cyclonic movements initially alike may have very great differences of trend and character. The explanation of this fact will be made clear by considering a simple mechanical analogy. Imagine a great number of dominoes to be stood on end not in a simple row but in a very complicated network of rows and imagine slight disturbances to be produced over the entire system; for example, a number of grasshoppers might be turned loose into the dominoe enclosure! Now there might be one particular region where the dominoes are more sensitive than elsewhere so that collapse would usually start in this region and spread over the system, but the ultimate trend and character of the collapse would depend not only upon its initial phases but quite as much upon whether a particularly vigorous grasshopper had happened to kick over a dominoe or two in regions remote from the starting point of the main collapse. The driving energy of the dominoe storm at any given place is derived from the falling of the dominoes at that place and not at all from the remote source of the storm, and if we could imagine the spreading dominoe storm to gradually make the dominoes just ahead of it taller and taller then there would be local displays of excessive violence as these tall dominoes fall. It is scarcely necessary to alter the wording of the above statement, so evident is its application to a vast stretch of atmosphere over a sun-heated continent. The dry arid regions where the sun beats down without hindrance are the regions in which the atmosphere

most quickly reaches a very sensitive state of instability and perhaps the sun-heated air on the rising slope of a mountain may determine the start of the atmospheric overturn. As the atmospheric collapse spreads over the continent its character may be greatly influenced by the degree of instability existing in the regions over which it passes and by the existence of independent storm movements. Furthermore it is known to be the case that a typical cyclone in the United States causes a great mass of warm air to be gathered near the earth's surface on its southeast front and when this mass of warm air and the overlying cold air make a summersault a tornado (cyclone, popularly called) or severe local disturbance is the result.

Our dominoe storm, to carry our analogy further, might be inaugurated with indefinitely small effort at a time when the system is ready for a more or less complete collapse, and the trend of the collapse could be controlled not only by choice of time and place of starting the collapse, but also by starting independent collapses at other times and places, and the control of weather must likewise consist of proper starting of storm movements and of their proper modification by independently inaugurated movements.

Reports are coming to us from southern Europe of the control of hail storms by means of a special form of cannon which throws a large vortex ring at high velocity into the upper atmosphere. In many details these reports are absurd, while in other details they are by no means absurd, although it must be admitted, if we credit the reports, to be a very remarkable fact that this first crude trial to control the weather—for it is the first that conforms at all to the physical requirements of the case—should be in so large a measure successful.

The problem is to upset the increasing instability of the atmosphere on a hot summer's afternoon before the beginning of that particular type of collapse, whatever it may be, that constitutes a hail storm, to set the sky off half-cocked as it were, and it is hard to think of a better means for starting a collapse of an unstable atmosphere than the smoke-ring cannon of Burgomaster Stiger. A simple concussion or loud sound is not at all effective. The thing that is necessary is not a momentary to and fro motion of air such as accompanies a sound wave and which is very slight even in a sound wave of exceedingly great intensity, but an actual transfer of air from one place to another, such as is produced near the muzzle of a gun in what is called the blast, or such as is produced by a vortex ring.

It seems to be within the range of possibility that Stiger's cannon may be a means for controlling all kinds of storm movements.

W. S. FRANKLIN.

REVIEW OF TWO RECENT PAPERS ON BAHAMAN CORALS.

TO THE EDITOR OF SCIENCE: It was my pleasure to visit the American Museum of Natural History in New York during the first week of September, and through the courtesy of Professor Whitfield to examine the recent species of West Indian corals in that institution.

I saw two specimens that have recently been described by Professor Whitfield, and after having received copies of his papers, desire to make some remarks on them.

The first paper is entitled, 'Notice of a Remarkable Case of Combination between Two Different Genera of Living Corals,' *Bull. Amer. Mus. Nat. Hist.*, Vol. XIV., Art. XVII., pp. 221, 222, pls. XXXI., XXXII. (date, July 29, 1901). Professor Whitfield considers his specimen a combination of *Meandrina labyrinthica* and a *Ctenophyllia* which he says is perhaps nearest to *Ctenophyllia quadrata* Dana.

Are two genera represented? Most emphatically no! The *Meandrina* of Milne-Edwards and Haime (not Lamarck, 1801) is characterized by possessing distinctly toothed septa and a spongy columella, in which may be a lamellar element connecting one calicial center with the next; the series are variable in length, often very long, and usually sinuous. The wall between adjoining series is simple (not double as in *Diploria*). The septa and wall are imperforate. Pali may or may not be present; they are not of specific value in this genus. An examination of plate XXXII. will show that there are no generic differences in the specimen figured.