from two inches to two feet in diameter. From the driving park to Chapin street the whirlwind passed over a section practically uninhabited.

From Chapin street to Front street the whirlwind covered only a narrow strip on the right bank of the river. Several houses near the river bank were slightly damaged, and many trees were broken off.

At Front street the whirlwind crossed the river again and passed over the Withington place a hundred feet south of the left bank, uprooting and breaking off a number of large trees ranging from six inches to two and one-half feet in diameter.

After passing the Withington place the tornado left the narrow flood plain on the left river bank, ascended a gentle slope, and suddenly began to do serious damage; four houses and one barn were more or less demolished, three houses were unroofed, four were badly shifted on their foundations and a number were slightly damaged, and many trees uprooted.

From Mill street to Telegraph street the whirlwind ascended a rather steep slope, uprooting many trees and doing the damage described in the preceding paragraph. A few hundred feet from Kress street it passed over the only hill in its track within the limits of Binghamton, the summit of the hill being 150 feet above the street and 300 yards distant. Not the slightest damage was done to the small trees covering the west side and summit of this hill, but about halfway down the eastern side of the hill the storm passed over a vacant house, known as the Eaton place; this house was completely wrecked and the débris carried to a considerable distance toward the northeast.

From the Westcott place to the Withington place the whirlwind followed the river, passing over a water surface and a nearly uninhabited land surface. After passing the Withington place the storm passed over a comparatively thickly settled territory. With the few exceptions, noted above, the damage done by the whirlwind over a path from 170 to 600 feet wide and about one and one-third miles in length, from the Withington place to the Eaton place, where it passed beyond the city limits, consisted of shade trees uprooted, houses slightly disturbed on their foundations, chimneys blown down, and walls and roofs damaged by flying débris. More than half of the houses that were in the path of the storm escaped without the slightest damage and less than 15 per cent of the trees in the path were damaged.

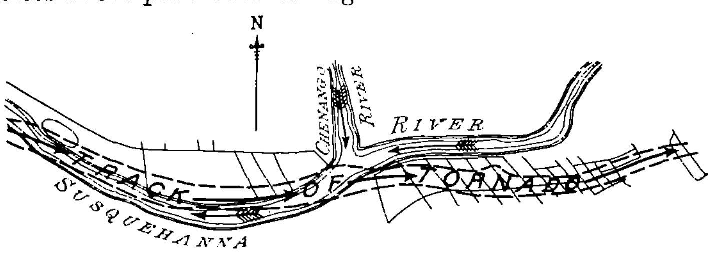

FIG. 2.—Track of tornado in Binghamton, N. Y.

Although intense darkness prevented direct observation of a funnel-shaped cloud, the characteristics developed indicate that the storm was tornadic. It passed over a path 170 to 600 feet in width and about two and seven-tenth miles long (see fig. 2). Its destructive force was spent in the middle of its narrow path and diminished laterally so rapidly as to leave houses and trees uninjured at a distance of 60 feet to the right and left of houses that were shattered. At the Eaton place the storm passed over a hill, leaving undisturbed the trees that covered the summit, descended 80 feet and completely wrecked a house that would have been completely protected by the hill had the storm been a straight blow. The general direction in which trees and débris lay in the center line of greatest destruction further confirms the opinion that this storm was a tornado.

Notwithstanding its destructive violence not a person was seriously injured by the storm. The total damage to property in Binghamton is estimated at $15,000.

A NOVEL TYPE OF RECORD SHEET ADAPTED TO SEISMOGRAPHS, AERIAL METEOROGRAPHS, ETC.

By CHARLES F. MARVIN, Professor of Meteorology, U. S. Weather Bureau.

Many difficulties are encountered in securing records from the automatic instruments sent up on kites and balloons. This is especially the case with sounding balloons which often reach very great elevations and enter strata, the temperature of which is many degrees below zero. Temperatures more than 100° Fahrenheit below zero have been observed. Inks are almost certain to fail by freezing or thickening, and, in addition, are likely to be much affected by conditions of extreme moisture or rain, as, for example, when the instrument is carried through clouds or exposed to rainfall. After the balloon and instruments return to the earth, many days, even weeks, elapse sometimes before they are discovered, during which time the precious record is constantly liable to obliteration and destruction.

In one of the best methods of registration thus far employed the surface of the record sheet is covered with a coating of soot deposited by a smoky flame. Thin aluminum foil, or similar metal sheets, are far more durable and moisture proof than paper and are generally employed. Such recording surfaces offer exceedingly slight resistance to the stylus of the recording pen, and are unaffected by cold, moisture, etc., but a serious difficulty is presented in the facility with which the records may be obliterated and the smoked surface destroyed by accident or inadvertence in handling before the records are finally secured and varnished so as to render them permanent.

A novel modification of this method of registration has been recently devised by Mr. R. Nimführ, the assistant in the Central Institution for Meteorology and Geodynamics, of Austria. A short account of this was presented by Dr. J. M. Pernter at a meeting of the Mathematical Section of the Imperial Academy of Science in May, 1905, and the following is a translation of his paper:

A NEW METHOD OF FIXING THE RECORDS FROM SOUNDING BALLOONS, AND A NEW DEVICE TO AUTOMATICALLY DISENGAGE THE RECORDING PENS AFTER LANDING.

Heretofore smoked glazed paper or aluminum foil has commonly been employed for meteorograph records of sounding balloons. The soot coating is fixed or rendered permanent at the end of the journey by dipping the record cylinder in a solution of shellac.[1] This mechanical fixing of records of the registration apparatus is nevertheless accompanied with many disagreeable consequences. In the first place the original curves by the mere act of measuring are scratched and obliterated in the most undesirable manner. Again, it not infrequently happens that by an accidental touch of the cylinder before fixing, the record is effaced and can not possibly be reproduced.

I have now succeeded in finding a new method for fixing the records that is not open to the defects mentioned, and in addition has several advantages over the usual methods of fixing the soot coating.

I place upon the record cylinder common photographic printing paper (celluloid paper) and smoke the same in feeble daylight in the usual way. When the apparatus returns to the central station after the ascension, the cylinder is removed, exposed to light, and the coating of soot removed by means of a cloth; the paper is now removed and washed and handled

[1] A very superior varnish for fixing record sheets of this character has been extensively employed at the Weather Bureau for varnishing records from the Bosch-Omori seismograph. This consists of a solution of about 15 grams of celluloid in 100 cubic centimeters of acetone which is subsequently diluted with about 400 cubic centimeters of amyl acetate. Alcohol may be used as the solvent as well as acetone. From 24 to 48 hours, with frequent shaking, are required to thoroughly digest the celluloid and reduce it to a homogeneous, viscous liquid. Large record sheets of paper may easily be varnished on the face only or both front and back as desired. For this purpose the varnish is placed in a small shallow tray. The sheet is held at each end in a deep J-formed loop and the surface touched carefully to and drawn over the varnish and laid out flat to dry, or better, dried by gentle heat from a steam radiator or small gas heater.—*C. F. M.*

as in making photographic prints. After fixing and washing the records appear as brilliant, brownish-black lines on a white ground. The curves are of exceptional fineness.

At the last international ascension on April 5, 1905, from the Central Institution for Meteorology and Geodynamics of Austria, located on the Hohewarte, near Vienna, a test was made simultaneously of the above-described new fixing method and a new device constructed by me for automatically lifting the recording pen after the landing.

The principle upon which my automatic engaging and disengaging arrangement is based is briefly as follows: As long as the protecting case in which the registering apparatus is installed rests upon the ground, the marking pens are lifted from the cylinder, but when the basket is lifted from the ground by the balloon, its weight stretches a spiral spring. This turns the disengaging lever upon its axis and permits the recording pens to touch the drum in a writing position. So long as the apparatus remains floating in the atmosphere, that is to say, throughout the whole duration of the ascension, the spiral spring is held in this strained condition. The recording pens rest, therefore, upon the drum and trace the record. But at the moment when on landing the basket again rests upon the ground, the pull exerted by the supporting balloon is withdrawn from the line joining the balloon and basket, thereupon the force of the spiral spring again comes into action and turns the disengaging lever back again to the position of rest, whereby the writing pens are lifted from the drum and remain lifted. Heretofore a scratching and partial obliteration of the original curves was inevitable because the pens continued writing for many hours after landing, and through the unavoidable movement of the pen levers backward and forward in consequence of agitation during transportation. The exact evaluation of the curves is made extremely difficult on this account. By using my automatic device the scratching of the original trace, or the obliteration of the zero line, is practically impossible, since the writing pens rest on the recording drum only while the apparatus floats in the air.

In addition to the advantages thus mentioned which the automatic device possesses over the usual method heretofore followed, the manipulation of the registration apparatus before the ascension is essentially reduced and simplified by its use as we shall briefly set forth. Heretofore it was necessary immediately before the ascension to adjust the time lines and arrange the zero line of the pen levers. Not until then could the apparatus be placed in the basket and secured therein. This whole procedure requires about fifteen to twenty minutes of time, and, especially in winter or rainy weather, is often decidedly unpleasant, as naturally most of the work must be done in the open air. A further objecton to the old method is that the pens remain in a writing position during the whole time that elapses between the preparation of the apparatus and the liberation of the balloon, and, by the unavoidable jarring of the apparatus, the soot coating of the recording drum is badly scratched. All of these disadvantages are wholly avoided by employing the automatic engaging and disengaging device. The meteorograph can be fully installed and secured in the basket the day before, or still earlier, and nothing remains to be done before the ascension but to wind the clock-work by means of a special key. Since the writing pens begin to write only at the moment the basket swings free in the air, therefore, the beginning of the registration and the zero line for the reduction of the curves start off simultaneously.

The curves obtained in the international balloon ascents during April and May, 1905, as produced by the new photographic method and with the automatic pen lifter, were laid before the academy.

There is undoubtedly much merit in both these developments by Mr. Nimführ, and the writer was at once led to employ the new photographic method in a different way from that mentioned by Doctor Pernter, namely: To make seismic records by it from instruments adapted to mechanical registration. Even ordinary blueprint (ferro-prussiate) paper is found to produce very clear records by this method, in fact the only objection which might be urged against the use of the large-sized record sheets required with the seismograph and such instruments is the item of cost for the paper and the trouble in toning and fixing the photographic prints.

There is a kind of record sheet still different from any of these that is especially appropriate for the kite and balloon meteorographs and where ink records can not be used for one reason or another. The method however requires the use of glass or celluloid or metal foil sheets. Instead of coating the sheet with soot a uniform coating of black printer's ink is applied by means of the usual hand roller. With a few simple facilities for the purpose an exceptionally fine writing surface can be produced. The record is traced on this surface in the usual way by means of a fine, smooth-pointed stylus. After 24 hours, more or less, according to the quality of ink used and the amount applied, the sheet and its record will dry hard and firm. If desired, the drying of the record may be hastened by a gentle heat carefully applied. The writer has not had an opportunity to actually test this manner of securing records, but it does not appear to present any serious difficulties; ink coatings on glass have been tried in connection with certain engraving processes with very promising results.

OBSERVATIONS OF ATMOSPHERIC ELECTRICITY AFTER THE ERUPTION OF MOUNT PELÉE, MAY 8, 1902.

By Prof. ARTHUR W. WRIGHT. Dated New Haven, Conn., June 22, 1905.

During the recent visit of Prof. Cleveland Abbe to the Sloane Physical Laboratory certain observations of atmospheric electricity, which had been made here just after the great eruption of Mount Pelée, were referred to in a conversation with him by the writer, and at his request the following account is communicated:

This laboratory was one of the stations established in 1884, under the direction of the Chief Signal Officer, for the study of atmospheric electricity, and systematic observations were carried on for nearly two years by Mr. O. L. Fassig, the observer detailed for this work. After the suspension of operations on the part of the Government observer, the work was continued in the laboratory, and since then the observation of atmospheric electricity has been one of the regular exercises of the physical laboratory, and, with few exceptions, each student makes the observation in the ordinary course of his laboratory work. This part of the electrical work is usually taken up during the months of April, May, and June. In consequence of this arrangement it resulted that in the laboratory exercises of May 8 and May 9, 1902, observations of the electrical condition of the atmosphere were made by students assigned to the work, and the records preserved in their note books, with curves showing the course of the changes in the atmospheric potential during the period of the exercise.

The curves thus obtained are reproduced in figs. 1 and 2. The actual time of the observations was between the hours of 10 and 11 a. m., the measurements beginning at the former hour, approximately, and continuing at intervals of three minutes for the time indicated in the figures. Other work in the measurement of potential, with the quadrant electrometer, ordinarily precedes the observation of atmospheric potential, so that the time given to the latter is limited somewhat and varies from one occasion to another.

Fig. 1 represents the observations of May 8, 1902, as made by Mr. Frank J. Sladen and Mr. Norman C. Thorne, of the class of 1902. The curve does not show very marked deviation from the normal or the average of those generally obtained here, except that the changes are somewhat more rapid and abrupt than is usual.

The curve reproduced in fig. 2 was drawn by Mr. W. W. Duncan, of the same class, from his observations made on the morning of May 9, 1902, the day following the eruption of Mount Pelée. It is remarkable in several particulars, but especially for the fact that it indicates a considerable negative potential for the greater part of the period of observation. This is more remarkable, as on that day the weather was fine and clear. Mr. Duncan's note upon this is to the effect that it "was a bright, clear day, with no signs at all of thunderstorms or electrical disturbances." In this respect the observation is unique among those made here during the past twenty years, as during all this time the atmosphere has uniformly shown a positive charge in fair weather, except perhaps a mere momentary dipping below the zero line in a few instances. Strong and sustained negative potential has never been observed here, except on occasions of heavy rain or snowfall. The result obtained on May 9 was so striking and unusual that several observations were made later in the day. The potential remained strongly negative during most of the