year. The plan has infinite possibilities in the safeguarding of a citrus investment, and no doubt in the future mortgagees will insist that a crop be insured and when the time comes that the companies will consider tree insurance citrus property will take its place as security along with other real estate securities; stabilizing the industry; possibly making Government farm-loan funds more available.—*Florida Grower*, Nov. 28, 1921.

ARCADIA, Nov. 21.—The first frost insurance policy ever written in this city was written here Monday in favor of the Arcadia Citrus Exchange branch of the county organization for the amount of $75,000 to cover this year's crop from frost or freeze. The premium is 10 per cent of the gross amount of the insurance carried and will cost the grower members of the exchange $7,500, which is divided pro rata on the box basis, and will cost the 250 members 3 cents per box, basing the estimate on a normal crop.—*Tampa* (Fla.) *Tribune*, Nov. 28, 1921.

ATMOSPHERIC ELECTRICITY AND THE MOVEMENT OF DEPRESSIONS.[1]

By J. LACOSTE.

[Abstracted from *Comptes Rendus*, Nov. 7, 1921, pp. 843-845.]

Studies made during the summer of 1921 at the Geophysical Institute of Strasbourg, on radiogoniometry, have led to interesting meteorological relations between the direction of maximum intensity of "strays" and the movement and shape of depressions. The author has stated four tentative laws concerning this relation:

1. In the case of a well-defined circular depression, the maximum intensity of strays is observed in the direction of the southern or southeastern part of the depression: the change of this direction of maximum intensity serves to follow the movement of the depression.

2. In the case of an elliptical depression, less well marked, the maximum intensity, as in the first case, is observed to come from the southern or southeastern parts. This case is less satisfactory than the first.

3. In the case of secondary depressions, or the barometric fluctuations along squall fronts, the maximum is difficult to determine.

4. A squall close at hand gives violent strays.

These observations have permitted the author to follow the movements of known depressions, and also to forecast the arrival of those as yet unseen on the weather map. He also found a striking relation between observations of maxima in 1920 and the corresponding barometric distribution. This, he believes, points the way to a new viewpoint in the forecasting of weather.—*C. L. M.*

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ARTIFICIAL PRODUCTION OF RAIN.

By DR. HAROLD JEFFREYS.

[Reprinted from *Nature*, London, Nov. 3, 1921, pp. 313-314.]

In an article in the *Times* of October 17 an account is given of the achievements of Mr. Charles M. Hatfield in producing rain. The method used is not described in any detail. A tank filled with certain unspecified "chemicals" was exposed at a height of 25 feet above the ground, and it is claimed that this had the effect of producing 8 inches of rain in three months at Medicine Hat, 22 miles away. The theory of the method is that the apparatus draws clouds from other parts to the Medicine Hat district and causes them to precipitate their moisture there. No direct observations of the motions of clouds are mentioned in confirmation of this theory, though they should not have been difficult to obtain.

The official raingage at Medicine Hat during May, June, and July, the period of the contract, recorded 4.8 inches, which was 1.3 inches below the normal for the station for those months. Further comment on the success of the experiments is unnecessary.

The financial side of Mr. Hatfield's contract with the United States Agricultural Association of Medicine Hat is interesting, for the association was apparently prepared to pay Mr. Hatfield as if 8 inches of rain had fallen. Still more interesting is the fact that he was promised $4,000 for 4 inches and $6,000 for 6 inches. Since the normal rainfall is 6.1 inches Mr. Hatfield would have been much more likely than not to make a substantial profit even if he had done nothing at all.

It may be mentioned that at Calgary, Alberta, the rainfall was 3 inches below normal; at Edmonton, it was 3.1 inches above; and at Qu'Appelle, Saskatchewan, 300 miles to the east, it was 3.85 inches above normal.

It is also stated that at Los Angeles, in the first four months of 1905, Mr. Hatfield guaranteed 18 inches of rain, and that his own raingage showed 29.49 inches. If this is correct the rainfall must have been extremely local, for the official raingage at Los Angeles in those months, showed only 14.98 inches. Still, this was 4.4 inches above normal. At San Diego, however, which is 200 miles away, the excess was 4.6 inches, and it appears likely that the abnormality at both stations was due to more widespread causes than Mr. Hatfield's chemicals.

Attempts have on many previous occasions been made to produce rain by artificial means, but the results have been uniformly unsuccessful. The reason is not difficult to see. To make the water vapor in the air condense it is necessary to cool the air in some way to a temperature below the dew point. This may be done in two ways. One may cool the air directly, for instance by the evaporation of liquid carbon dioxide or liquid air. This certainly would produce a little condensation; the fatal objection to it is that it would be thousands of times cheaper to distil sea water. The other method is to raise the air. The pressure decreases with height, and to reduce the pressure on a particular mass of air is known to cool it. The difficulty is to raise it enough. To produce an inch of rain over an area of 100 square miles requires the condensation of 6,000,000 tons of vapor, and to achieve this some hundreds of millions of tons of air must be lifted up. The distance it must be raised depends on how nearly saturated it was originally, but it could not be less than a kilometer in ordinary fine weather conditions. We have no source of energy at our command great enough to achieve this.

It is often suggested that rain may be produced by exploding shells or otherwise agitating the air. The action is compared with that of a trigger, a large amount of energy being released by a small effort. An essential feature is, however, overlooked. For a trigger to work, there must be a large supply of potential energy only awaiting release. Precipitation from partially saturated air would require an actual supply of new energy. Therefore a trigger action can not produce precipitation.

Apropos of the above, the following account of rainmaker Hatfield's exploit in the State of Washington is not without interest:

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The people of Washington have taken a lively interest in the efforts of a professional rainmaker near Moses Lake, who was engaged by the Commercial Club of Ephrata to arrange for enough precipitation to insure bountiful crops this summer. Hundreds of visitors, bitten by

[1] Sur la relation existant entre les directions des dépressions et les directions des maximums des parasites atmosphériques.