—— Ueber den Ursprung des Wortes "Barometer." Pp. 332–333.
—— Resultate meteorologischer Beobachtungen zu Hanoi (Tonkin). Pp. 333.
Memorie della Società degli Spettroscopista Italiana. Catania. Vol. 32.
Ricco, A. Le protuberanze solari nell' ultimo periodo undecennale. Pp. 157–162.
Wiener Luftschiffer-Zeitung. Wien. 2 Jahrgang.
—— 7280 Meter hoch. Ein neuer Weltrekord mit dem 1200 Kubik-Meter-Ballon. Ergebnisse der internationalen Ballonfahrt vom 4. Juni 1903. Pp. 137–138.
Hemel en Dampkring. Amsterdam. Augustus 1903.
Linden, H. v. d. Iriseerende wolken. Pp. 248–253.

NOTES AND EXTRACTS.

THE "GUNS" OF LAKE SENECA, N. Y.

In the MONTHLY WEATHER REVIEW for September, 1897, page 393, we have given some account of the "barisal guns," the "mistpouffers," and similar phenomena whose origin is as yet not certainly understood. The following letter describes an analogous phenomenon in Seneca Lake, N. Y., and it may well be that the barisal guns have their origin in the escape of bubbles of gas just as do the "guns" of Seneca Lake.

Mr. Wm. A. Prosser, of Dresden, Yates County, N. Y., writes as follows, under date of August 18, 1903.

So far as I am personally concerned I know of no explosions of inflammable gas, and the newspaper stories are fabrications in this respect.

The "lake guns" are evidently caused by gas escaping from the sand at the bottom.

Long Point is situated about 15 miles south of Geneva, N. Y., and about 25 miles north of Watkins, N. Y., on the west side of Seneca Lake. Directly off the Point the water is very deep. Heavy currents pass either north or south at regular intervals. A heavy wind for a few hours will change the position of the extreme end of land (which extends 1½ miles eastward) several rods. When the swell is not too heavy you can always see the gas rising in bubble form, which, as a rule, makes very little noise, but larger eructations evidently produce these "lake guns." The sand would not stay in place were it not for the water holding it there at the extreme point. Large steamers can land there with but the aid of an ordinary gang plank.

I do not know that the gas is inflammable, but I could easily ascertain if it is of any special interest to you. Natural gas is found in considerable quantity within 3 or 4 miles of the point, on the outlet of Keuka Lake, but hardly in paying quantities. However, I am told that a company has been formed that will exploit the gas along the outlet, but not at the Point.

VARIATION OF GRAVITY OVER THE DEEP SEA.

The last annual report, 1902–3, of Professor Helmert, as Director of the Royal Geodetic Institute of Prussia, mentions the result of the work of Professor Dr. Hecker on the measurement of gravity on the open ocean by the comparison of two methods of determining atmospheric pressure, viz, the observation of the mercurial barometer whose records are affected by gravity, and the determination of pressure by the use of the boiling point thermometer, whose indications are not affected by the variation of gravity. Of course, the aneroid barometer could be used instead of the thermometer, but it is not considered to be so reliable. In fact the temperature of the boiling point can not be determined with sufficient accuracy unless every known source of error is most carefully investigated. Professor Hecker's revised computations give the following results: The excess of pressure shown by a mercurial barometer over the pressure shown by the thermohypsometer, is greater when sailing over the shallow part of the ocean than when sailing over the deep sea between Lisbon and Rio Janeiro. On the voyage southward this excess expressed in millimeters of the mercurial column was $+ 0.017^{mm} \pm 0.015^{mm}$; on the return voyage northward the excess was $+ 0.048^{mm} \pm 0.034^{mm}$. Combining these two results into one average and converting that from millimeters of barometric pressure into centimeters per second, as the unit of the force of gravity, Professor Hecker's observations show that in general, in this part of the ocean, gravity over shallow seas is greater than that over the deep sea by $+ 0.028^{cm} \pm 0.018^{cm}$. The standard force of gravity is 980.6 centimeters per second, so that the diminution over the deep sea is about 0.00003 of gravity, or 3/1000 of one per cent of its full value. From a geographic point of view this result seems to confirm the isostatic hypothesis of Pratt as to the elevations and depressions on the earth's surface. From a meteorological standpoint we see that this change in the force of gravity, as we sail over the ocean, can have but very little influence on the motions of the atmosphere. It is, in fact, of the same order of importance as the gaseous viscosity of the atmosphere, which is sometimes introduced into the equations of motion as friction, but which can be neglected in comparison with the great resistances offered by land *versus* water, mountains *versus* plains, vortical *versus* rectilinear currents, and the mixture of slow moving lower air with rapidly moving upper strata.

WEATHER BUREAU MEN AS INSTRUCTORS.

Mr. Charles Stewart, Observer, Spokane, Wash., under date of July 9, reports visits from schools and teachers as follows:

January 22, 1903.—The class in physical geography of the Spokane High School.

March 28.—The pupils and teachers of the Holmes Grammar School.

April 10.—A number of the teachers attending the Teachers' Institute.

April 11.—A second visit from the members of the Teachers' Institute.

April 20.—The first section of the class in physical geography of the Spokane High School.

April 24.—The second section of this class.

In all cases the instruments and methods of the Weather Bureau and the determination of atmospheric moisture by the whirled psychrometer were fully explained. These visits and explanations are highly appreciated by the community.

THE DROUGHTS OF 1901-3.

The distressing drought in Australia has been relieved in many localities but in others it still continues. Mr. Andrew Noble, of Rozelle, near Sydney, New South Wales, calls attention to the fact that we must study the origin or cause of this drought in connection with antarctic conditions "as bringing about a variation in pressure distribution favorable to drought." The following is an extract from his letter of July 4, 1903:

The late drought has had such far-reaching effects in both hemispheres, as shown by the famine in India and Russia,[1] the lowness of the Nile inundations,[2] and the drought in England,[3] that the student will need to look further and deeper for the solution of the whole problem, and your article on the "Physical basis of long-range weather forecasting (MONTHLY WEATHER REVIEW, December, 1901) shows what a complex problem that is. Dealing with the subject as it seems to affect Australia we find that anticyclones are the controlling force[4] determining our weather, that they are characterized by a steady eastward motion, and that their normal path varies with the sun's apparent journey north and south.

The cyclone only occasionally reaches a full development in our latitude, its place being generally supplied by the V-shaped depression, which remains more or less upright [i. e., capital V with its apex south] if it comes on to our mainland from the Tropics, but inverted [i. e., a capital Λ with apex north] when it approaches us from the southern

[1] The Russian government has to face the problem of feeding 15,000,000 hungry peasants scattered over central and eastern Russia and partly in the southeast and along the Volga; £200,000 worth of rye has been sent out, and the government has bought an additional £1,500,000 worth of rye and wheat for the same purposse. Cattle are dying by the thousand. (Despatch from St. Petersburg, dated December 27, 1902, reproduced in Sydney Daily Telegraph of February 16, 1903.)

[2] The annual inundation of the Nile has taken place and the flood is the lowest that has ever been recorded. (Cablegram in Sydney Daily Telegraph of August 7, 1902.)

[3] This is the seventh year in which metropolitan rainfall has been less than the average. Such a prolonged period of drought is not recorded since 1845. (English Mechanic, December 13, 1901.)

[4] Vide Russell in Quar. Jour. Roy. Met. Soc., Vol. XIX, No. 85, January, 1893.

ocean. These depressions generally bring what rain is deposited in Australia, and their intensity seems to depend largely upon the energy of the anticyclone which controls their eastward motion. Even in time of drought the currents circulating around these depressions are not always dry; cloudy skies sometimes giving a drop or two of rain, and recurring day after day at certain inland stations, form a peculiar feature during our monsoon period, but during such dry periods adjacent anticyclones are always more or less inactive. Amid all the variations of pressure distribution during the late prolonged drought two types seem to have been especially pronounced, i. e., (1) a succession of extensive and close-moving anticyclones during the winter months; (2) long and shallow barometric gradients during the monsoon period; the latter were very noticeable during the summer of 1899-1900, and Mr. Wragge, in his almanac for 1901, supplies a chart where the range, over a distance of approximately 3000 miles, from center of depression to center of anticyclone, does not exceed three-tenths of an inch. Both these types seem to be unfavorable for useful rains; the first, or winter type, will not allow rain-bearing depressions to penetrate to the mainland, and the second, or summer type, is generally associated with irregular or indefinite monsoonal depressions in which thunderstorms sometimes give rise to more or less sporadic rains. Inland local whirlwinds have formed another special feature during the late drought, and tornadoes also seem to have been more prevalent during long dry periods, although owing to our comparatively sparse settlement the effect produced by the latter is not always so disastrous as in the United States of America.

It would be interesting to know whether variation in the antarctic ice limit really has any effect upon our seasons, but it would probably take a long record to prove or disprove this theory. It is a remarkable fact that at the commencement of our late prolonged drought, i. e., 1895, icebergs were unusually prevalent in the southern ocean. Allingham[5] writes: "During the four years, 1892-1895, the height, area, and numbers of icebergs in the southern ocean probably exceeded all previous records." During this period bergs were met with 600 miles beyond the usual limit.

Mr. Russell's two papers[6] supply ample evidence as to numerous bergs appearing far beyond the limit set down on the Admiralty Ice Charts; in the first paper he writes: "We have had within the last two years an extraordinary accession of icebergs between the Cape of Good Hope and Australia." One is surely safe in assuming that the recorded number of bergs represents only a mere fraction of those floating in still higher latitudes, and that the amount of ice freed from the antarctic sheet must have been very unusual during these years. Now the melting of this ice must have a marked effect upon the temperature of the water and consequently on the air pressure above the water in these latitudes, and as the compensation principle is always working, the intensity of pressure over Australia would propably be indirectly affected. This view seems to be supported by the researches of H. N. Dickson,[7] and his suggestion is even more applicable to the Southern Hemisphere, because the antarctic ice cap is infinitely larger. It remains to future investigation to show what the effect on our seasons really is, but it may operate in two ways, i. e., to cause a variation in the distribution of pressure over Australia, or, other conditions being favorable, to assist toward a partial displacement in the paths followed by anticyclones. We have an example as to what such displacement might mean in the short but memorable drought of 1888. At the end of that year Mr. Ellery, then government astronomer of Victoria,[8] said: "The present dry season may be explained by the fact that the northwest monsoons have come very far south, and have forced off the region of high pressure which usually lies over the southern portion of Australia." Referring to Australian droughts in general Mr. Russell said: "The real cause is a variation in the position of the monsoonal winds or dry wind belt."

In studying this important and fascinating subject, one must be careful not to confound cause and effect. Thus, consider the fact that unusually cold west or southwest winds bring icebergs unusually far northward into the south Indian Ocean. Such cool winds, when they flow over land areas, grow warmer and drier as they approach the equator, and are therefore intrinsically less favorable to production of rain. If they flow over snow or ice or water they become moister and in general also warmer. We see no important causal connection between the ice and the drought. Similarly, in the Northern Hemisphere, the cold, dry, northerly winds blow from the ice and snow of the arctic regions, and we get light rain from such winds when they are forced up over mountains; we get heavy rain from them only when they underrun, lift up, and mix with warm, moist air coming from equatorial regions, and even then we attribute the rain to the equatorial winds, as these contribute most of the moisture. If we follow the equatorial winds, whether at sea level or in the upper strata, we find them cooling as they proceed poleward, forming rain or snow, cloud, and fog. Eventually they must return from the polar regions as cold, dry winds. They leave their moisture behind in the shape of snow and ice, icebergs and icefloes; blowing past these, they come to us as very cold winds, generally far colder than the mass of snow and ice they have left behind. They owe their low temperature to the direct radiation of heat from the hazy, dusty air itself; to the loss of a little heat given by conduction to the cold surfaces of ice, snow, and frozen ground, and to the evaporation of a little water at low temperatures from these icy surfaces. They owe their dryness not only to the fact that the air is usually descending on a gentle gradient to the ground, warming up dynamically, but also to the fact that the air is moving into warmer latitudes, where the sun has more power. The conduction of heat from beneath the surface of the ground to the air is too slow a process to be important, although often so referred to; it is the solar heat returning from the surfaces of the ground and clouds and ocean and the evaporation from these surfaces that are the important processes in warming the atmosphere.

We do not think it proper to say "the melting of this ice must have a marked effect upon the temperature of this water and consequently on the air pressure above the water." The ice melts by absorbing heat from the surrounding sea water, from the sun, and from the air; the process tends to keep both sea water, ice water, and air near the temperature of 32° F. until all the ice is melted. The resulting fog or saturated air at 32° F. is more favorable to rain than the original dry air at the same temperature. We do not see how the temperature of the free air can directly affect its barometric pressure. In general the temperature of the free air does not affect its barometric pressure directly; pressure is not dependent on the density of the air, but, on the contrary, temperature and pressure control the density. If cold winds replace warm winds, we expect the barometer to rise. This is the usual sequence, but it is not the cold that has caused the higher pressure; there are several intervening considerations. Either there must be more air above the barometer, so that the latter indicates an increase in pressure due to increased weight, or else there must be a movement of the air, or a change in movement, or a stoppage, so that the barometer indicates increased pressure as a dynamic effect. The barometer measures atmospheric pressures that are determined by various different processes, all of which are usually found combined in various proportions in meteorological phenomena. In no case is it proper to say that the barometer rises simply because cold air is denser than warm air; the same quantity of air will weigh the same no matter what its temperature or pressure or density. The elastic pressure within a mass of free air, as measured by a barometer, depends on all the conditions surrounding that air and keeping it in place.

The interesting collocation of droughts mentioned by Mr. Noble may be restated thus:

1. Unusual prevalence of icebergs in the southern Indian Ocean during 1892-1895.
2. Deficient rain in England for seven years, culminating in 1901.
3. Deficient rain in Australia since 1895, culminating in 1903.
4. Deficient rain in the watershed of the Nile in the spring of 1902.
5. Deficient rain in central and eastern Russia in the summer of 1902.

Droughts must be studied by first examining the general movement of the air. Dry air is due to the descent of upper strata to the ground, or to the movement of polar air equatorward. Both of these are phenomena of descending currents, but they imply ascending currents elsewhere, and generally

[5] Marine Meteorology, 1900.

[6] Roy. Soc. of N. S. Wales, September 4, 1895, and October 6, 1897.

[7] Quart. Jour. Roy. Met. Soc. Vol. XXVII, No. 119, July 1901, p. 193.

[8] Sydney Daily Telegraph, December 29, 1888.

we find an excess of cloud and rain on the equatorial sides of the respective localities where droughts occur.

The Annual Report for 1901 of the Meteorological Commission of Cape Colony shows that in general, over South Africa, the rainfall of 1901 was normal or above, the excess being decidedly large in September and October. Did this excess continue over into the spring of 1902 when the watershed of the Nile had a deficiency? The deficits of 1901 and 1902 in England and Russia were accompanied by excess in parts of the Mediterranean basin.

It may be anticipated that, in general, the areas of excess of rainfall that accompany and really result from the conditions that cause a given area of deficiency will develop at irregular times and places depending on favorable local circumstances, although, in general, subsequent to and on the equatorial sides of the droughty regions.

Thus an unusual movement of ice northward into the south Indian Ocean, due to an unusual southerly component of the wind in that region brings excess of rain to South Africa. But this unusual southerly component over the Indian Ocean, or this outflow from the Antarctic, must be accompanied by either a corresponding northerly component in some higher stratum above this region, or an unusual flow in the lowest stratum from the equator over some other region, possibly on the opposite side of the Antarctic Circle, and this latter would bring about an unusual rain and snow on that side of the antarctic region. As there is a large part of the ocean from which we rarely receive any meteorological information, it is not surprising that we are not yet able to elucidate all the intricacies of the geographic distribution of the areas of excess and deficit of precipitation. Already the Australian drought has been generally succeeded by bountiful rains in many districts and droughty conditions are passing away.

THE RAIN MAKER IN AUSTRALIA.

In connection with the droughts in Australia we have received abundant details of the efforts made to force rain from the unwilling clouds.

At a meeting of the Chamber of Commerce of Broken Hill, Thursday, July 2, the mayor submitted the formula given by Mr. A. J. J. Phelps, of Sydney, and his method was indorsed by several. The formula consists in using sulphuric acid and zinc, the hydrogen set free ascends with aqueous vapor "in spiral columns which are hollow when they reach the rain belt in the atmosphere, and the cold air in that region rushes down to the warmer air below."

Any one can try this simple well-known chemical experiment for making hydrogen, but we have every assurance that no rain will result and no cold air will rush down and no rain belt will be found in the atmosphere. This, in fact, was the experience of Mr. Allen and the Australian committee at Stephens Creek, which reported that "the experiments were not successful, owing to there being rather too much wind to allow the column of gas to ascend perpendicularly."

The failure of Mr. Allen was complete; the excuse was quite unphilosophical and unnecessary.

Previous to Mr. Allen's *fiasco*, a much more imposing attempt had been made by Dr. C. DeLacy McCarthy, who is said to be "a graduate of Trinity College, Dublin, and who spoke with the utmost confidence on the question of the production of rain, saying: 'I will start to work on Wednesday, and you will have rain by Saturday.'"

The Government of South Australia, the Chamber of Commerce, and the water companies of Broken Hill had united in bearing the expense of a special train to bring Dr. McCarthy and five assistants and apparatus from Petersburg. He did not wish the details of his method known except that in general—

> He forces chemical fumes into the air for a great distance which create a vacuum in the fourth, fifth, and sixth strata of air. The center of a heat storm is thus formed and the cold air descends, resulting in a heavy tropical rain. The secret of the chemicals was given him by a man in America. He had improved on the system with the aid of a clever Japanese chemist. He changes his methods to suit varying conditions. It may require thirty-two hours of continous work to achieve success. He produced rain in twenty-two hours in Victoria.

Dr. McCarthy delayed three days before beginning; meantime the sky clouded over and predictions were received from Mr. Barrachi, Director of the Meteorological Office, at Melbourne, forecasting rain within three days. McCarthy's experiments began on Wednesday, a furious dust storm prevailed with northwest winds; although the wind and dust were distressing, he announced that "the vacuum is working still far up." But the wind veered to the south and all chance of the predicted rain from the west seemed to disappear. Eventually, "on July 3, Dr. McCarthy suspended operations, saying that conditions were all against him." He expected to resume when favorable predictions should be published by the Meteorological Office.

A few days before this Mr. Rutter, with several local chemists, "Had sent up a column of hydrogen which was followed by clouds and light rain, and they felt certain that a heavy downpour would have resulted had they continued their efforts." Probably, they realized that the clouds and light rain really had nothing to do with their hydrogen gas.

In their extremity the Broken Hill people naturally clutched at the flimsiest straws, "listening even to Mr. F. J. Mars, engineer of the local electric light works, who urged that huge kites should be sent up carrying dynamite to be fired by electricity."

We have given much space to this interesting episode in the great Australian drought, as we hope it may prove to be the last occasion on which the rainmakers will attempt to delude the suffering people with their chemicals, their upper vacuum, their dynamite, and their false theories.

The time has not yet come when man may plow the atmosphere for rain as he plows the soil for crops. If mines must be worked and towns built in arid regions, let the promoters of these schemes be required to build aqueducts and bore wells sufficient in advance to supply the needed water, not waiting until droughts come and the people die. Every place on this globe has its rainy years and its dry years. Areas of cold and heat, wind and calm, rain and drought appear and move and disappear in irregular succession. We must prepare for them and provide against disaster. We can not control the weather, but we may control ourselves.

METEOROLOGY IN THE UNIVERSITIES.

We are pleased to learn that the higher problems of meteorology are treated in the course on "Mathematical Physics" at Cornell University. The last catalogue at page 147 has the following item:

> Advanced course open to juniors, seniors, and graduates. No. 45, Mathematical theory of fluid motion, including the mechanics of the atmosphere and vortex motion. Assistant Professor James McMahon.

The Department of Geology and Geography at Harvard University offers the following courses in meteorology and climatology during the coming year.

> *Geology B*, [2]*hf.*—Meteorology (elementary course): Lectures, written exercises, observations, and laboratory work. Half-course (second half year): Laboratory work (two hours a week). Assistant Professor R. DeC. Ward.
>
> The lectures present the subject under the following headings: The earth's atmosphere: its composition, temperature, pressure, and general circulation. The moisture of the atmosphere: dew, frost, clouds, rainfall. Storms: cyclones, thunderstorms, tornadoes. Weather. Climate.
>
> The laboratory work consists chiefly in the construction and study of weather maps; practice in the use of ordinary meteorological instruments; individual record of observations; weather forecasting, etc.
>
> *Geology 1*, [1]*hf.*—Meteorology (second course): Lectures, observations, and reports. Half course (first half year). Assistant Professor Ward.