bauer in Germany, and Sharp in England, and the general result in the Coleopterological world has been one of some confusion. These systems down to the present time have not been thoroughly adjusted and Mr. Leng had to make a compromise. This difficult work he has done in an admirable manner, as I am told by my expert friends and associates, and in his introduction he has discussed this subject at length. It is an enormous improvement upon previously published North American lists from the fact of this painstaking and enlightening discussion which must have taken an enormous amount of work, as well as from the bibliographical references to original descriptions of new species and genera and the further citation of synopses of monographs that have appeared. The reference system is well handled, and the bibliography, covering more than eighty pages, is remarkably complete and well arranged.

Of course, as one uses the catalogue from day to day in his work, points will be brought out which might suggest improvements, but none have occurred to me in turning the pages. Undoubtedly certain useful changes have occurred to the author and his colleagues in reading the proofs, but in the conditions in the printing trade at this time the expense of alterations is almost prohibitory; and at any rate the defects, if there be any, must be relatively unimportant.

I have talked with several of my associates who are intimately familiar with this group of insects, and all are enthusiastic in their praise of the book. Mr. Leng gives generous acknowledgment of assistance from such authorities as Messrs. Davis, Mutchler, Schwarz, Barber, Bequaert, Schaeffer, Lutz and Böving; and the fact that he has had the assistance of these men intensifies the confidence which we must have in his work.

Although the price of the volume seems high ($10), it is one of those absolutely indispensable things. Every entomologist, including the economic entomologist, must be able to consult it; and all libraries must have it.

The reviewer anticipates with assurance a greatly increased interest in the group of beetles. It is an order of the greatest interest. The specimens are easily collected and are easily preserved. Their compact form and durable structure renders them much more available for collections than any other group of insects. They are much less fragile than the others, and, while they apparently lack the esthetic qualities that attract people to butterflies and the larger moths, their structure is beautifully adapted to their methods of life, and they offer an easy field for the study of certain aspects of broad biological problems.

L. O. Howard

NOTES ON METEOROLOGY AND CLIMATOLOGY

METEOROLOGY AND BALLOON RACING

I am relieved from my anxiety by hearing that the adventurers descended well; . . . that they had perfect command of the carriage, descending as they pleas'd by letting some of the inflammable air escape. . . . Had the wind blown fresh, they might have gone much farther.—Franklin.

The International Balloon Race of 1920.—These words were written by Benjamin Franklin after witnessing one of the first free-balloon flights at Paris, and they are a quaint epitome of the sentiment of free-ballooning, both from the standpoint of the public and that of the pilot. When one has seen the start of a balloon race, with the great silk-skinned bubles rising in the glow of the lowering sun, and the ballast streaming down from the baskets like slender cascades of gold dust, then he may well appreciate the emotions of Franklin in his anxiety for the safety of the balloonists and in his admiration for the skill and judgment required of them. But it is the pilot who can best appreciate the significance of the last statement—"had the wind blown fresh, they might have gone much farther."

No more convincing proof of this can be adduced than that which lies in the distribution of landing points in the International Balloon Race for the Gordon-Bennett cup, which started from Birmingham, Alabama,

late in the afternoon of October 23, 1920. The balloons which departed from Birmingham within half an hour landed at various points along a general line from Mason City, Ill., to North Hero Island, in Lake Champlain. Why did the Belgian DeMuyter land his "glorious *Belgica*" (as he proudly and affectionately calls it)[1] in Lake Champlain, while the American, French and Italian entries were struggling with adverse weather far to the west? It was because DeMuyter found the level where the "winds blew fresh."

Mr. Ralph Upson, the pilot who brought the cup from Europe to America in 1913, has this to say relative to the rôle of meteorology in balloon-racing[2]:

> The history of balloon racing up to the present time shows conclusively that it is taking on more and more of a meteorological character. In the past, races have been occasionally won by mere practical skill in operation of the balloon, but the time when this is possible is rapidly passing, if indeed it has not already passed. In the future, meteorological knowledge instead of being a secondary factor in the assets of a team, will be absolutely the controlling factor.

But the success of DeMuyter did not lie alone in the fact that he is a meteorologist, and that, as he says, he made a careful and critical study of the prevailing types of weather in the United States during the months of October and November: it was also, and largely, because he was able to take advantage of the splendid analyses of the conditions in the upper-air that were made by the United States Weather Bureau observer, Mr. C. G. Andrus, who was detailed to Birmingham to make upper-air soundings for the race. Mr. Andrus has written an article in the *Monthly Weather Review* for January, 1921,[3] in which he discusses the nature of the service rendered to the aeronauts and the weather conditions occurring before and at the time of the race. One of the most striking points in Mr. Andrus' discussion is the agreement between the predicted path of the balloons and the actual paths they followed. A figure is given showing the landing points of the balloons with respect to the predicted path, and it appears that a smooth curve drawn through these points would agree almost exactly with the predicted course. This is remarkable when it is considered that to forecast the probable route of the balloon. it was not only necessary to forecast about two days in advance, but also to take into consideration the probable behavior of the upper winds at all levels during that time. Concerning the flights in general, Mr. Andrus says:

> The balloonists took off from Birmingham just before sunset of the 23d, and floated north-northwestward the first night at elevations averaging 1 kilometer. During the following day they made only moderate speed, mostly toward the north, at various elevations. The following night was the crux; at that time those balloonists who had made the least distance westward had entered the freshening winds of the southeast quadrant of a low-pressure area and rapidly spread away from those pilots who had not gained this advantage. The flying during the last 20 hours was for the most part made in clouds and occasionally in rain, these conditions finally requiring the balloonists to descend.

Upon what data were the conclusions of Mr. Andrus based? In part upon the observations of the Weather Bureau stations, both aerological and surface, these data being telegraphed to Birmingham. He was equipped with apparatus for making pilot balloon observations, also. But what is quite as interesting is that he interpreted these observations in the light of the studies of the Norwegian meteorologist, Bjerknes. The charm of the Bjerknesian interpretation is that it enables one to get a more satisfactory three-dimensional picture of the processes taking place in HIGHS and LOWS than has been usual.

[1] DeMuyter, E., "Comment j'ai gagné la coupe Gordon-Bennett," *L'Aerophile*, December 1–15, 1920, pp. 366–367.

[2] Upson, Ralph H., "Balloon Racing—a Game of Practical Meteorology," *Monthly Weather Review*, January, 1921, pp. 6–7.

[3] "Meteorological Aspects of the International Balloon Race of 1920," pp. 8–10.

It will be worth while, therefore, in these notes to give the salient features of the Bjerknes papers.[4]

The Bjerknes Lines of Discontinuity.—The changes of weather which are associated with the passage of HIGHS and LOWS in the temperate zone are found to depend largely upon a line of discontinuity which marks the boundary between polar and equatorial air. In an individual cyclone, this line of discontinuity consists of the steering line and the squall- or wind-shift, line. Considering as large a portion of the northern hemisphere as possible, this line of discontinuity can be traced from one storm to another so that there is little doubt that it is continuous around the world. North of this line the air is that which "has a low temperature for the latitude, shows great dryness, distinguishes itself by great visibility, and has a prevailing motion from east and north. On the southern side of the line, the tropical origin of the air is recognized by the corresponding signs—its generally higher temperature, its greater humidity, its haziness and its prevailing motion from west and south." This line is called the *polar-front line.*

Sometimes the undulations of the line are such as to cause loops which may represent the cutting off from the parent mass, masses of warm or cold air depending upon how far north or south the tropical or polar air may extend. If the warm air is cut off, the cyclone decreases in intensity and disappears; or, in the case of a new outbreak of polar air a new front is formed behind a too far advanced one; isolated masses of polar air are formed at lower latitudes. This is the formation of great anticyclones, which bring good weather.

[4] Bjerknes, J., "On the Structure of Moving Cyclones," *Monthly Weather Review,* February, 1919, pp. 95–99; "The Structure of the Atmosphere when Rain is Falling" (abstract), *ibid.,* July, 1920, p. 401; Bjerknes, V., "The Meteorology of the Temperate Zone and the General Atmospheric Circulation," *ibid.,* January, 1921, pp. 1–3; appeared also in *Nature* (London), June 24, 1920, pp. 522–524.

In the case of the individual cyclone, the phenomena along this line of discontinuity are about as follows: That part of the line which lies in a general easterly direction from the center of the cyclone is known as the *steering-line.* South of it the air is moving from the south; north of it the air is from the east. Along the line the warm southerly air rises over the denser easterly air. Passing through the center of the cyclone the line extends off in a southwesterly direction and forms the western boundary of the warm tongue of southerly air, and the eastern front of an advancing wedge of cooler northwesterly air. This line is known as the *squall line,* and its passage is frequently accompanied by considerable violence, with thunderstorms and sometimes tornadoes, but usually with only a strong blow, a rise of pressure, a drop of temperature, and, of course, a change of wind direction.

It was on the basis of the advance of these lines of discontinuity that Mr. Andrus was able to predict the path and advise the balloonists to make as little westerly progress as possible during the first night, to stay as far east and north as possible, even if it were necessary to disregard the usual practise in ballooning of staying as low as possible to avoid expenditure of ballast early in the race. The winner followed this advice and had landed in Vermont many hours before the others who had reached no greater distance than Illinois and lower Michigan. This fact demonstrates very clearly that, as Mr. Upson frankly confesses and as Mr. Andrus emphatically states, it was meteorology that won the race.

C. LeRoy Meisinger
Washington, D. C.

SPECIAL ARTICLES

THE CATALYTIC PROPERTIES OF THE RESPIRATORY METALS[1]

THE more important physical and chemical properties of the respiratory metals—iron, copper, manganese and vanadium—have long

[1] Contributions from the Bermuda Biological Station for Research, No. 123.