scientific and practical interest can best be solved by the cooperation of people with local knowledge—if, indeed, the word "local" can be applied to so large a part of the surface of the globe. The first Pan-Pacific Congress was held at Honolulu in 1920, on the initiation of the National Research Council of the United States, which issued the invitations and arranged the program. In commenting at the time on this striking evidence of the growing importance of the Pacific in the economy of the world and of the shifting of the center of gravity of American interests from the Atlantic seaboard, we remarked that the world was round, and that the congress at Honolulu would reach problems which the British Empire approaches from the other side.

We are the more glad to record the important step taken by Australia and to offer our best wishes for the success of the meeting this year. Although the United States and Canada, Australia, New Zealand, China and Japan have the more immediate interest in the science of the Pacific, there is no geographical limit to the advantages gained from the acquisition of knowledge. Not long ago it was thought, for example, that meteorology of the northern hemisphere could be investigated sufficiently without reference to what takes place south of the equator. But the world is an organic whole, and the storm centers, currents of the air and of the oceans, even the vibrations of the solid earth, have a general effect. The geology, the animals and plants, the races and the habits of men in any one part of the world must be understood if we are to advance in our knowledge of any other part of the world to comprehend the past, to adapt ourselves to the present and to make reasonable anticipations of the future. It is to be hoped that the leading scientific bodies in this country will send delegates to the Pan-Pacific Congress in Australia.—*The London Times.*

SCIENTIFIC BOOKS

THREE OF A KIND

Handbook of Meteorology, A Manual for Cooperative Observers and Students. By JACQUES W. REDWAY. John Wiley and Sons, 1921. 294 pp. Price $4.00.

The New Air World, The Science of Meteorology Simplified. By WILLIS LUTHER MOORE. Little, Brown and Company, 1922. viii + 326 pp. Price $3.00.

Climatic Changes, Their Nature and Causes. By ELLSWORTH HUNTINGTON and STEVEN S. VISHER. Yale University Press, 1922. xiii + 329 pp. Price $3.50.

The above three of America's latest book contributions to meteorology have a peculiar group distinction (that is why they are reviewed *en bloc),* the distinction of running from horrid to worse in whatever order one may read them.

Mr. Redway says that his book was written "for the use of cooperative observers and for the instruction of students in meteorology and aeronautics." But no such worthy purpose can be accomplished by a book that literally has more errors and loose statements than pages, especially when many of these errors are fundamental.

A few "horrid examples," selected from a very great number, will indicate, perhaps, what radical revision this book must undergo before it can be recommended for serious use:

Page 2: "Carbon dioxide is not observable above an altitude of two or three miles." But it is "observable" at much greater altitudes, as we know from those who have made such observations, and as we are compelled to assume from the fact that vertical convection keeps the atmosphere well mixed through a depth of six or seven miles.

Page 3: Here it is stated that at the surface of the earth ozone amounts to twelve parts (whether by weight or by volume is not stated) per million of the atmosphere. Presumably the author found this statement somewhere, but at the same time he had access to the results of those modern observations that have shown that the lower atmosphere contains no more than bare traces of ozone.

Page 6: "Strictly speaking, it is the vapor itself and not the space, nor the air, which is saturated." Obviously, the author got the idea in some way that it is not scientifically exact—and it is not—to say that the air is saturated, and then deliberately made a worse statement.

Page 12: The various statements on this page, largely mere jumbles of words, are good

examples of the way one is likely to write about force, heat, energy and power, when he has no clear conception of any of them.

Page 14: "If a given volume of gas—say a cubic foot of oxygen—be introduced within a container, its pressure or tension noted, the same volume of another gas having the same tension may be introduced without an increase of tension of the mixture." This deals with a fundamental property of gases, and is as wrong as it would be possible to make it. It is not a slip, either, for it is stressed by an example, wrong, of course.

Page 16: "as they [non-visible radiations] fall on the body, they produce the sensation of warmth, thereby stimulating the growth of living matter." Perhaps it might be a good exercise to grope one's way through this mental fog.

Pages 21-22: The "solar constant" is discussed on these pages, but in a sense (just what sense is not clear) entirely different from that of the authors cited.

Page 23: " . . . heat radiated from the earth's interior to the surface." What, indeed, does the author mean by "radiated?"

Page 41: "In centigrade terms, the increment is 0.00037 for each degree, measured from the absolute zero." This does not confuse, however much it may irritate, any one who knows that for "increment" he should say "coefficient of expansion"; that 0.00037 is one tenth the proper value; and that for "absolute zero" he should substitute "freezing point." But think of the predicament of the reader of this book who does not know these things!

Page 54: "This [condensation] liberates a great deal of latent heat, materially warming the air." But the air is not warmed by the setting free of latent heat. The upper portion of a cloud is always colder than its lower surface however much the condensation, and however great the liberation of latent heat.

Page 73: "One can not say why cloud matter floats in the air, apparently contrary to the laws of gravity." If he can not, and wants to know, why not ask the first physicist he happens to meet, or, one would think, most any one else?

Page 116: "The most extraordinary effects of lightning are the dark flashes occasionally caught in photographs of lightning." This is only a peculiarity of the photographic plate and not anything extraordinary about the lightning, as the author had every opportunity to know.

Page 121: "The simple halo is practically a rainbow." This is a good example of the exceedingly numerous loose and utterly misleading statements in this book. Certainly no one who understands the halo and the rainbow would dare say that they are practically the same.

Page 122: "They [iridescent clouds] may be due to causes similar to those which produce halos, but the causes are not known." They are not so produced, and their well-known cause has been widely published.

Page 158: "Possibly the conjunction of planets may affect the movement and formation of storms." Obviously, then, the author does not really believe that an effect must have had an adequate cause.

Page 255: "The convenient unit of magnetism is one which attracts or repels an equal quantity at a distance of one centimeter." "An ampere, the practical unit of current, is the electromotive force of one volt against a resistance of one ohm."

About as accurate as the schoolboy's definition of the equator—a menagerie lion running around the earth—and typical of the whole book from start to finish.

The best feature of the book, and that a commendable one, is its considerable number of good to excellent cloud pictures. The two or three faulty legends can easily be corrected.

The author of the second of the books here under review arouses the anticipation of something exceptionally fine by signing himself "Sc.D., LL.D., Professor of Meteorology George Washington University; eighteen years Chief of the United States Weather Bureau." But this promise is not kept, for neither the mere grammar-school grade of what follows, nor its scores of errors and numerous loose and inaccurate statements, are what would naturally be expected from one having such degrees and so long occupying the most important position in America in connection with the science he professes to be elucidating.

Time and again the matter under a sub-title is only an aimless ramble that explains nothing and has but little relation to the supposed subject.

But to cite specifically a few of the many errors—to note and explain all would require a book:

Page 8: "The atmosphere is thus by absorption of radiation warmed largely from the bottom upwards, which accounts for the perpetual freezing temperatures of high mountain peaks, although they are nearer the sun than are the bases from which they rise." This, as any physicist knows, is a wholly inadequate explanation of the phenomenon in question. Absorption at the surface in excess, on the average, of radiation; and radiation by each portion of the upper air, up to eleven kilometers, roughly, above sea level, in excess, on the average, of absorption, are the necessary and sufficient causes, through the convection thus maintained, of the practically continuous state of decrease of temperature, in this lower portion of the atmosphere, with increase of height.

Page 9: "The temperature at this altitude [100 miles] must be that of outside space, probably 459° F. below zero. Air liquefies at 312° below, and therefore it can not exist in the gaseous state in a region having a lower temperature. When it liquefies it has the color and general appearance of water, and about the same specific gravity."

The expression "temperature of outside space" is a familiar string of words to which, as a rule, no particular meaning seems to be assigned, nor, literally, has it any meaning. If we agree that it shall mean the temperature to which a small "black body" would come if placed at the point in question, then by terrestrial radiation alone the temperature one hundred miles above the surface of the earth would be, roughly, —70° F., and not —459° F.

This seems to be one of the author's favorite errors, for he repeats it in one form or another in several different places.

The temperature, —312° F., below which, it is stated, air can not exist in the gaseous state, is the boiling point of liquid air *at atmospheric pressure*. Air, therefore, can exist in abundance in a gaseous state at lower temperatures. In fact, at —346° F. it (at least the nitrogen) would exist in a gaseous state at a pressure one tenth that of a full atmosphere.

The density of liquid air is only 90 per cent., approximately, that of water, instead of "about the same."

Furthermore, the color of liquid air is a pale, steel blue, a color that does not pertain to water.

Page 9: "At this distance [fifty miles] from the earth there probably is no more air than would be found under the receiver of the best air-pump, and, the reader will be surprised to learn, darkness is practically complete, although the hour may be midday, for there are no dust motes to scatter and diffuse and render visible the rays of the sun."

This is another of the author's pet errors, often repeated, and of long standing. Why reflection, or scattering, is essential to render solar rays visible, is not explained. Seemingly, the author confuses transparency, absence of haze and "good seeing" with darkness!

Page 23: "The ingenuity of the Wrights transformed the weather man's kite, strengthened it, took out the ends, hitched on a rudder, and when the petrol engine had developed sufficient power with a given weight, installed it, and flew."

As the wag explained: From "Middletown" drop the "town," change "iddle" to "oses," and we get "Moses"!

Page 24: "As a result of the explorations of the atmosphere made by the institution at Mount Weather, there was ready for our fighting air men at the front, immediately on our entry into the World War, a fund of useful information concerning a region that but a short time before was entirely uncharted."

These excellent data were, indeed, much used in the United States, but it would be fair to infer from the above statement that no such information was available from any other source. As a matter of fact, there were many times as much information of this kind available from the immediate seat of the war, published, and, doubtless, in every meteorological library.

Page 25: "If the aerial explorer could stop his ship and keep it at an altitude of about one and a half miles for twenty-four hours he would be startled to find that the coolest time of the period was during the daytime, not

during the night, as he had expected to find it."

No doubt, and he would be even more startled if he had first studied the records and found, as he would have, that in general the lowest temperature at that level *is* at night, or, more exactly, at 5 to 6 A.M., substantially as at the surface.

Page 40: "Ozone is highly electrified oxygen."

News, presumably, to the chemist; and in excellent keeping with the rest of the nearly two pages under the subtitle *Ozone*.

Page 53: "The music of the spheres is not a myth; the lily or the rose as it opens its petals to receive the benediction of the morning sun may give forth a veritable pæan of joy. A rose-bush may be a grander symphony than anything that Beethoven ever wrote. What to us is the invisible light may be the illumination that guides the sweep of the angels' wings."

The reviewer prefers to let his reader say it!

Page 62: "Bodies or planets without atmospheres have temperatures approaching absolute zero. . . . Our moon is an illustration."

Indeed, an excellent illustration, and it tells a very different story.

Page 124: "But early in its [air of the anticyclone] descent it gains such heat as to melt and evaporate the ice spiculæ floating at the height of the fleecy cirrus clouds; then it evaporates and clears away the moist clouds lower down and finally creates such *diathermacy* that the heat lost by radiation to a clear sky causes what we call a 'cold wave.'"

This is meteorology simplified, indeed, but at the expense of facts, logic and the laws of nature.

Page 188: "If the surface of the earth were all land, and the axis of the earth's rotation were perpendicular to the plane of the earth's orbit . . . . there would be no wind."

What, then, does the author imagine would produce a wind?

Page 190: "With a water surface there would be an atmosphere nearly if not quite saturated with vapor of water."

Assuredly not, and for reasons any meteorologist can easily supply.

Page 226: " . . . snow knee-deep to a boy of ten hardly comes up to the ankles of a man of six feet two."

This, of course, is a mere trifle, but it is typical of the inaccuracies, apart from positive errors, that crowd the book from cover to cover.

Page 287: "There is a difference of opinion among meteorologists as to whether the thunderstorm whirls about a vertical axis, like the tornado and the hurricane, or whether it rotates about a horizontal axis."

There should not be, and is not, this difference of opinion, as the thunderstorm does not whirl or rotate about any axis.

Page 287: "One may well account for the formation of the hailstone by assuming that its alternating layers of snow and ice are caused by the horizontal roll of a thunderstorm."

The author's idea as to how a hailstone could go round and round in a vertical orbit, as he assumes, and not fly out on the first turn, would be interesting.

The chapter that tells how to forecast from the daily weather map is helpful, and would have been good if only the author had refrained from attempting to explain the phenomena.

The third of the books listed for this review is notable for two things: (*a*) The number of eminent scholars (the name of one of them wrong) listed in the preface as proof-readers, contributors and "almost co-authors"; (*b*) the fact that it is being offered to the public by the Yale University Press. It is notable in these respects because each would seem to guarantee reasonable accuracy, and a definite contribution to knowledge, whereas, in large measure, its broader conceptions are mere fantasies, while its details show little regard for facts and none for physics. Surely the authors of this book must be like the Scotchman who on looking over the doctor's bill inquired: "What is this item of five pounds for?" "For the advice I gave you." "Weel," said the Scotchman, "I niver took it!"

Frequent reference is made to a companion volume, *Earth and Sun*, said to be "in press" (a poetic license, apparently) for proof of this or that startling assertion, and one would like to see this first volume before reviewing the second. However, it would seem useless to wait for an alleged proof that two and two make a dozen before expressing an opinion on the subject.

The main hypotheses of the book are:

1. " . . . that the earth's present climatic variations are correlated with changes in the solar atmosphere."

But there remains to be proved (*a*) that the solar atmosphere has, in historic times, changed to a greater extent than it has, as indicated by spots, during the past century; (*b*) that the earth's climates have in the same time similarly changed; and (*c*) that these changes were causally related. The reviewer is unaware of any conclusive, or even strongly presumptive, evidence of such changes, or relation.

2. " . . . that variations in the solar atmosphere influence the earth's climate chiefly by causing variations in temperature, but also in storminess, wind and rainfall."

The change in the average temperature that parallels a sunspot cycle is known to be small, of the order of 1° C., and a physicist would look for the other weather elements, all of which depend upon temperature, or temperature differences, to be also but little affected. But the authors of this book are not physicists, so they can boldly conjure with electricity, or electromagnetism, as a variant, as the sorcerer used to with his "abracadabra," to make good their every climatic claim, nor do they ever save the reader's confusion by calculating magnitudes for him.

3. " . . . that if the climatic conditions which now prevail at times of solar activity were magnified sufficiently, and if they occurred in conjunction with certain important terrestrial conditions of which there is good evidence, they would produce most of the notable phenomena of glacial periods."

No doubt, and if a billy-goat were big enough and hitched tandem to an engine, the two might pull a train; however, this is no proof that billy-goats used to be giants, nor that trains ever were pulled that way.

In addition to the main hypotheses, there are several others, unessential, it is said, yet obviously cherished, as they bulk large in pages, and are to be further and chiefly discussed in "Earth and Sun." Together, these fancy that whenever we come within so many billions, or hundreds of billions, of miles of a fixed star (Alpha Centauri being the latest of the guilty), its electric state sets whirling the spots on our own sun; and that these spots in turn electrically, or electromagnetically, whichever reads best, drive our weather cyclones off their more peaceful paths and whip them up to higher speed and deeper intensity, thereby bringing on the storm and stress of an ice age, and, by shaking loose many a stalled earthquake, building the mountain chain. And there is a table, too, that conveniently tells us at what distance this and that type of fixed star would, in the above obvious manner, glaciate our globe.

The limit to Jules Verne's meteorology was the green ray, hence one can not but sympathize with the centenarian who said: "If the world continues to progress during the next hundred years as fast as during the last, I fear I may not keep up with it."

There are also numerous statements that range from the provokingly loose to the positively false, such as, among many others:

Page 8, and elsewhere: "The temperature of empty space is the absolute zero." This is an old stereotyped formula that, literally, is without meaning. If we agree that it shall mean the temperature to which a small object would come if placed there, then, to be at all definite, we must specify where the place is with reference to other bodies, and what the object is, conditions that would provide a range of thousands of degrees Centigrade, but in no case the absolute zero.

Page 9: " . . . the two most critical of all possible temperatures, namely, the freezing point of water, 0° C., and the temperature where water can dissolve an amount of carbon dioxide equal to its own volume." Passing over the questionable use of "where" in this quotation, and the vague concept implied by an amount equal to a volume, and assuming that in this case "amount" means volume, one is still puzzled to know why this *exact* equality, a function of both temperature and pressure, is so vital.

Page 12: "No other known compounds (than those formed by water and carbon dioxide) can give off or take on atoms without being resolved back into their elements." How about the numerous "-ous" and "-ic" compounds, for instance?

Page 12: " . . . the boiling point, where all water finally turns into vapor." Must we,

then, infer that a puddle will not dry up unless it is heated to the boiling point? The statement is vague also in other respects.

Pages 21-22: Here the idea is advanced that with greatly extended oceans the temperature difference from equator to poles would become much less and both the trade winds and the westerlies stronger. This might pass in a dream, but when awake we are confronted by the fact that the strength of these general winds, and most others, is proportional to the horizontal pressure gradient, and that this in turn is proportional, in general, to the corresponding temperature gradient. Perhaps the authors should be congratulated on their ability to keep their cake and eat it too!

Page 35: " . . . the hypothesis (Croll's) calls for the constant and frequent repetition of glaciation at absolutely regular intervals." It calls for regularly recurring advances and retreats of the ice front during irregularly recurring glacial epochs.

Page 48: Here the volcanic dust hypothesis is dismissed with the assertion that the Pleistocene glacial period, if so caused, would have required fully 75,000 volcanic explosions of the Krakatoa type, a far greater number than field data allow us to assume.

This would, indeed, be a staggering blow but for the fact that, in reality, the hypothesis does not demand even one in a hundred of this number.

Pages 51-63: The whole of this chapter, "The Solar Cyclonic Hypothesis," has so little and doubtful statistical support, and to such an extent explains (?) the little known by the wholly unknown, that any detailed criticism would be both tedious and useless. It can be recommended to those only who are fond of the curiosities of "cloister" science.

Page 113: "The marked increase in the number of tropical cyclones which accompanies increased solar activity (sun spots) . . . ." But in "Hurricanes and Tropical Revolving Storms," published by the British Meteorological Office, 1922, it is shown that no such relation exists in any part of the world, except, perhaps, in the region of Mauritius, and even there not for the severer storms.

Page 115: " . . . at times of many sunspots, as Kullmer has shown, the storm track tends to be drawn poleward, perhaps by electrical conditions." Professor Henry has explained, *Monthly Weather Review*, 49, p. 283, 1921, that the data used by Kullmer do not justify his conclusions. Then, too, why assert that such a shift, if it occurs, may be due to electrical actions? One gets impatient with assertions that are not backed up by logic and calculations.

Page 116: " . . . ice . . . is much more transparent to heat [than is water]." One must be excused for asking for the authority for this statement, especially as Bode, *Annalen der Physik*, 30, p. 326, 1909, found the difference, if any, to be very small.

Page 136: This page carries one of the few numerical calculations in the book—namely, 10,000/300; and the answer given is 40.

Page 174: "The existing abnormal changes, which we call weather, have their origin chiefly, if not entirely, in the variations of solar radiation." This is taken from another author, but adopted without question. It prompts one to ask whether, for instance, the eddies in the Niagara Gorge are due to variations in the amount of water passing over the falls.

Page 231: "Some such temperature (-273°C.) prevails a few miles above the earth's surface, beyond the effective atmosphere." Absolutely not, and far from it, as everyone knows who has any acquaintance with the theory of the isothermal condition of the upper air.

As already stated, the above quotations from this book are only samples of the many shocks and surprises it contains for any one accustomed to accuracy and to the notion that every effect must have had an adequate cause.

But bad as these books are they are only typical of that huge mass of toxic mental food so persistently thrust upon the public. "Yes, I know that," is the ready and common response, "but what can be done about it?" Anything we sufficiently want done. The packer is no more a chemist or bacteriologist or other kind of scientific specialist than is the publisher, and yet we have found a way, fair to all concerned, that insures to us reasonable purity and wholesomeness of our physical food; and the same can and should be done for our mental food, though better done by a different method.

W. J. HUMPHREYS