series shall we select for our graduations? Equal fractions of its length will never do—I mean such as one-tenth, two-tenths, &c. —because of the great inequality of the variation in different parts of the series, being insensible between those whose position is near its middle and great between those at either end. I propose to use a scale founded on the law of Frequency of Error, which gives a scale of equal parts wherever that law applies, and I use the "probable error" for the unit of the scale. Thus, in a row of a hundred individuals the graduations of + 2°, + 1°, 0°, − 1°, − 2°, respectively would be at the following places, in percentages of the length of the series :—2, 9, 25, 50, 75, 91, 98. We know that the law of Frequency of Error applies very closely to the linear measurements of the human form. Now suppose that I want to get the average height and "probable error" of a crowd of savages. Measuring them individually is out of the question; but it is not difficult to range them—roughly for the most part, but more carefully near the middle and one of the quarter points of the series. Then I pick out two men, and two only—the one as near the middle as may be, and the other near the quarter point, and I measure them at leisure. The height of the first man is the average of the whole series, and the difference between him and the other man gives the probable error. The question I put is, whether any more convenient subdivision of a series can be suggested for *universal use* than that above mentioned. Its merits are, that it applies very fitly to linear measurements of all natural groups; also to errors of observation, which are akin to many of the moral qualities, for the measurement of which the scale is especially needed. It would not apply to weight, but is less out of relation to it than most persons might think, because weights do *not* vary as the cubes of the heights. Tall men are often thin, and short ones are fat, and the curious fact seems thoroughly verified that the general relation between height and weight is *strictly* as the *squares*. (See Gould's "Sanitary Memoirs of the War of the Rebellion," Cambridge, U.S., 1869, p. 408—410.) If we arrange a series and graduate it according to equal differences of the squares of the heights of the men, we are not so far astray as if we had dealt with the cubes. But I cannot imagine any quality, unless possibly music and memory, to vary so rapidly towards the large end of the series as the latter division would show. To sum up: subdivision in *equal* parts is of no use practically, and is therefore out of the question; the law of error will do very accurately for many large groups of cases; the law of error modified by being brought into relation to bulk will rarely, if ever, be right for other qualities. It therefore seems to me reasonable to adopt the law of error series, as the best compromise, and to accept it as "the common statistical scale." If, for example, I estimate a soldier's energy at + 2° (S.S.), I state what everybody who cared to inquire into the subject would construe in exactly the same sense as I used the phrase, and he would also be inclined to believe, until better informed, that the difference between such a man's energy and that of a man of + 0° (S.S.) was twice as great as between him and a man of + 1° (S.S.).

Lastly, how can we best find individuals who represent the 0°, ± 1°, &c., of any and every quality, that they may be studied and their abilities illustrated and described, so as to serve as permanent standards of reference? These would gradually give us means of finding the equivalent of the S.S. graduation in the natural scale—as we might learn to say, + 4° (S.S.) of energy = + 3°·5 in the natural scale. Those who have to deal with bodies of men, whether as examiners, instructors, masters, overseers, or officers, could best tell. How about the ordinary subjects of competitive examination? Is there any optical observation made under (sensibly) identical circumstances and with (sensibly) identical instruments, of which the probable error of each observer is known? If one could only get two or three hundred nautical observers together, and make them take sextant angles of the same objects, and learn the probable errors of each, we should have data to give us once for all the values of the S.S. as regards ability to observe, in terms of absolute values. Can no drawing-master give accurate descriptions of the delicacy of touch of his pupils, corresponding to the graduations of the S.S. scale? How about mechanical manipulation among operatives? How about music and memory? Each separate quality requires and deserves a monograph, which, once thoroughly well done, would become a most valuable standard of comparison and check upon the S.S. scale, which it must be remembered is securely based on no ground except that of statistical constancy, but which, when it *proves* to be a scale of equal parts, is doubly acceptable.

I will not go on writing now, being rather desirous of raising discussion and learning more, than of saying all my say.

42, Rutland Gate, S.W. FRANCIS GALTON

Simultaneous Meteorological Observations

WITH reference to the scheme of international simultaneous observations proposed by the War Department of the United States and adopted by the Meteorological Congress at Vienna in September last, a provisional arrangement was entered into at Vienna, between General Myer and myself, at his desire, by which the Scottish Meteorological Society was to assist the American Government in carrying out the proposed scheme by an exchange of meteorological observations between the two bodies. At a meeting of the Council of this Society on February 9, a letter was read from General Myer, dated January 27, 1874, formally requesting the co-operation of this Society in carrying out the international scheme, which letter being identical with the one on the same subject published in NATURE (vol. ix. p. 300), it is unnecessary to subjoin.

A considerable number of observers have been already obtained in connection with the scheme, and copies of the American *Monthly Weather Review* and *Daily Meteorological Record* have, along with the special schedules for the observations, been sent to them, as an acknowledgment on the part of the American Government for their assistance in the work. The Council are ready to receive the assistance of others of their own observers, and of any other observers who may be willing to co-operate in this cosmopolitan scheme, from which cosmopolitan benefits may be confidently looked for.

ALEXANDER BUCHAN

Scottish Meteorological Society, Edinburgh, March 2

The Limits of the Gulf-stream

MUCH discussion has recently taken place respecting the limits of the Gulf-stream, and the Admiralty Chart of the North Atlantic, published last year, is supposed to embody all that is known of its boundaries. My observations, however, which have extended over a series of years, differ so widely from it that I am induced to send you an abstract chart of them.

In December 1872 I found the stream wedged in to a distance of fifteen miles off Cape Hatteras, and following the coast-line at that distance to Roanoke Sound. On arriving in Norfolk I found that the reports of several ships corroborated my observations.

The remarkable bend east of George's Shoals is confirmed by H.M.S. *Gannet*, and also by the Nantucket fishermen and pilots.

Maury, in his "Physical Geography of the Sea," makes the stream, in summer, wash the southern shores of Newfoundland, but in no month of the year have I found it so far north as the red line in the accompanying chart. I am of opinion that if it once passed over the bank every codfish would be destroyed. The highest temperature recorded by me in September on this line is 56°.

At the points of sudden change I have seen the ripples at the distance of a mile previous to entering them. Those which are recorded may be relied on to a mile, as I have discarded those made from dead reckoning. In every case the deep blue colour of the sea, the presence of sun-fish, Portuguese men-of-war, and numerous *débris*, confirmed the observations made with the thermometer, and I may add, what is of more importance to seamen, the strong easterly set.

The southern boundary of the stream is taken from the observations of five years. As summer advances it becomes more difficult, when east of Bermuda, to detect the line of demarcation, for the rays of the sun heat the water almost to Gulf-stream temperature right down to the limit of the trade-wind. From the data which I have been able to collect, as well as from personal observation, the limits of icebergs in the Admiralty Chart appear to be equally erroneous. To me it appears impossible that bergs could drift square across the heated waters of the Gulf-stream to lat. 39° N. almost in the teeth of the prevailing summer winds, and a strong north-easterly set of two miles per hour. The Admiralty Chart gives the current a higher velocity.

The most southern iceberg ever seen by a Cunard steamer (and there cannot be a higher authority) was in lat. 43° 10′ N., long. 49° 40′ W., and the most eastern, which has come under my observation, by the *Grace Gibson*, on June 11, 1868, which ship passed four between lat. 43° 15′ N. and 43° 20′ N. and long. 41° 20′

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