graphs of Messrs. Abraham with some suspicion, but in this book will find little to object to. If he does not like a climbing scene on Cyfrwy or another on Lliwedd, what can be simpler than to hold the book some 20° to 30° out of the perpendicular?

CORRESPONDENCE.

THE WATKIN ANEROID IN MOUNTAIN MEASUREMENTS: A REPLY AND A REJOINDER.

To the Editor of the ALPINE JOURNAL.

DEAR SIR,—In a letter appended to the paper of Dr. Longstaff in the 'Alpine Journal' for August (p. 227) Mr. Douglas Freshfield takes occasion to criticise certain passages by myself which appeared in the February number of the 'Journal.'

Will you allow me to say in reply that I made no 'comments, as Mr. Freshfield asserts, on Mr. Graham's statements. I have nowhere in print expressed any opinion as to Mr. Graham's statements, nor discussed them other than to mention, what all the world knows, that they have been disputed. One of the comments criticised by Mr. Freshfield refers to the statement of Professor Collie that Mr. Graham had climbed 20,000 ft. on A. 22 and reached 22,700 ft. on Dunagiri, objection being made to the use of these altitudes, which I understand to have been not measured but estimated, as the basis of his argument that Mr. Graham might have reached 24,000 ft. Estimates of altitudes reached, especially by those who have not had long experience in the Himalaya, are exceedingly unreliable.

It might have been further added that, even admitting the correctness of these estimates, the contention of Professor Collie that because a climber reaches 20,000 ft. or 22,700 ft. he can reach 24,000 ft. is not borne out by facts. There is always the chance of the climber succumbing, and that sometimes suddenly, to exhaustion or mountain sickness, and, if he does, this occurs at a certain altitude which varies with the individual. This altitude cannot be determined beforehand and may not be greatly above a point where he feels well. Time and again I have seen coolies perfectly fit at a given altitude entirely incapacitated by mountain sickness 300 ft. to 500 ft. higher. Last summer a European porter with us, who was apparently in excellent condition at 20,500 ft., gave out completely at 21,000 ft. In view of such facts this contention is not tenable.

Mr. Freshfield is also treading on dangerous ground when he reasons that because a man is 'exceptionally active' he can necessarily reach a greater altitude than persons of average strength. In asserting this he overlooks the two questions of endurance and mountain sickness. It is not always the most active men who have the most endurance, which counts for much in climbing at great altitudes; neither does the possession of 'exceptional strength and

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activity' exempt a man from a liability to mountain sickness. When this attacks such a man he becomes as prostrate and useless as the weakest. Among others which occur to me the porter above mentioned furnishes a case in point. He was one of our strongest porters and at lower altitudes carried the heaviest load. Exceptionally active men sometimes possess more speed than bottom, and their staying power may prove to be inferior to that of others of more moderate strength.

Mr. Freshfield's implication that Colonel Waddell, not being an authority on mountaineering, is not a competent critic is misleading. Colonel Waddell's objection to Mr. Graham's claim is made, if I remember rightly, on geographical grounds, which, if substantiated, effectively dispose of one of Mr. Freshfield's chief arguments in its favour.

The attentive reader will see that I did not compare 'Kabru to three sharp rock needles on the Biafo glacier,' as Mr. Freshfield says. These, which really are three separate peaks, distinct from one another but appearing from the glacier to be points of a single peak, were mentioned as an example of the difficulty of judging of the conformation of high Himalayan mountains, the reader being left to apply the example to the context. Mr. Freshfield has had, I believe, no experience in climbing high Himalayan peaks. If he had he would doubtless have found, as others who have tried them have found, that appearances are often deceptive, and one cannot be sure that any high peak is accessible, however easy its slopes may appear, until it has been ascended. In saying this I do not wish to be understood as saying that Kabru is inaccessible. I have not seen it from a point near enough to enable me to form any opinion regarding its accessibility; but, judging from a considerable acquaintance with other Himalayan peaks of over 20,000 ft., I consider I did not exceed the bounds of reason in asserting that it might present obstacles to an ascent that could not be discovered from below.

Lastly, Mr. Freshfield states his 'impression' that my remarks on Watkin aneroids are 'unduly depreciatory.' My paper in the February 1906 'Alpine Journal' is based on a large number of comparative observations at various altitudes, made in the course of actual exploration and mountaineering. The conclusions are such as logically follow from the facts observed. If these conclusions are considered depreciatory to the aneroid or the Watkin aneroid the behaviour of the observed aneroids must be held responsible.

My aim in writing the paper was to help, so far as my observations warranted, to assign its true value to the aneroid. If Mr. Freshfield's impression, or the confirming one of the person or persons whom he consulted at the Royal Geographical Society, is based on any similar comparative experiments with hypsometer and aneroid, it is to be hoped he or they will publish these for the benefit of other observers. Scientific inquiry is not promoted by impressions unless supported by adequate evidence, and evidence

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more or less in the nature of proof is usually demanded to command assent.

The accurate definition of the value and scope of the aneroid is important in view of loose statements as to altitude based on readings of aneroids in different ways, with which mountain literature is being flooded, which are likely in the future to give rise to endless confusion and dispute. All possible light which can be thrown on this subject should be welcomed. I do not claim to have said the final word, and hope further observations will be forthcoming, whether they tend to confirm my present conclusions or the contrary.

In view of the evidence now available it may be asserted with considerable certainty that the mountaineer who depends solely on the readings of unchecked aneroids for his calculations of altitude, whether these be compared with lower station readings or not, is not in a position to determine what altitude he has attained.

Since writing the paper referred to I have met a military engineer in India whose conclusions as to the value of the Watkin aneroid are more depreciatory than mine. He, after a careful trial with it in range-finding experiments, discarded it as absolutely valueless even in measuring differences of level at low altitudes.

During the past summer I have had the opportunity of making another extended series of observations with two hypsometers and three aneroids at various altitudes from sea level to 21,300 ft., and the results, though not yet collated, give me no reason to alter the conclusions stated in my paper.

WILLIAM HUNTER WORKMAN.

1 Savile Row, Burlington Gardens, London, W.
October 29, 1906.

SIR,—It will be, I think, to the advantage of your readers if I profit by your courtesy in communicating to me the above letter to reply at once to the several objections raised by Dr. H. Workman to my recent note. I will do so as briefly as possible, omitting minor points.

Dr. Workman objects to his letter of January last (p. 82) being described as 'a comment' on Mr. Graham's Himalayan ascents. He must, it seems to me, attach to the word a different sense to that in which it is generally used in this country by English writers.

Dr. Workman persists in the attempt to represent Mr. Graham's heights as doubtful altitudes. In the large majority of that climber's ascents they are heights calculated trigonometrically 'by a succession of most competent surveyors' (see p. 204).

Dr. Workman says I overlook 'endurance' and 'mountain sickness.' I have not done so. He assumes that Mr. Graham and his guides were not enduring: my information, and it was contemporary information, is to the contrary effect. My argument as to 'mountain sickness' was that after Dr. and Mrs. Workman's series of experiences in their repeated climbs over 23,000 feet it is

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impossible to regard that affection as an insuperable obstacle to the attainment of 24,000 ft., or even greater heights, by other climbers.

With regard to Colonel Waddell's criticisms, I have shown ('Round Kangchengjunga,' p. 209, footnote) that on the chief geographical point taken by that traveller ('Among the Himalaya,' p. 121), his argument rests on an obvious misunderstanding of Mr. Graham's narrative.

In conclusion I regret not to have made my passing reference to Dr. Workman's remarks on Watkin's aneroids more explicit. I gave as 'my impression' the result of my own experience and that of several friends. The 'confirmation' I received at 1 Savile Row was a statement that the paper published in this volume (p. 80) by Dr. Workman had been first offered to the Editor of the 'Journal of the Royal Geographical Society,' who had not accepted it in its then form, and the assurance of the Scientific Instructor that in the case of several travellers of repute the instrument has recently given very satisfactory results.

D. W. Freshfield.

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