appointed professor at the University of Lund, where he carried out pioneer work in several branches of natural history and took the initiative in the foundation of the Royal Physiographical Society; he also founded a family which has produced several prominent natural scientists.

Although the manuscript here mentioned can scarcely be counted as particularly remarkable, the discovery must yet from a Swedish point of view be considered as valuable. For Sweden's national treasure of Linnæan manuscripts was, as is generally known, in the year 1784 so greatly reduced through the indifference of the Swedish authorities and the enthusiasm of James Edward Smith, that every addition is welcomed with satisfaction.

KILIMANJARO: CRATER FUMAROLES OF KIBO AND SEISMIC ACTIVITY DURING 1942-45

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IN view of the interest aroused by the activity of Kibo, after several groups of fumaroles had been located in its crater in 1942, it may be useful to give an account on further developments which have taken place on Kibo lately. Full reference to the activity of Kibo's fumaroles in October 1942 and their increased number in February 1943 (see Fig. 2) was made by the writer in a paper on Kibo, past and present, which was sent for publication in July 1943 to the *Journal of the East African Natural History Society*. This paper is as yet unpublished, through printing delays due to the War.

The occasional observations of 1942–43, made in spare time, and the scanty information obtained from the few mountaineers who visited the true crater, were of little value. Only patient observations, requiring time, would permit more precise deductions on events on Kibo. Despite great difficulties attached to regular observations made on a mountain nearly 20,000 ft. high, the indispensable periodical readings of the fumaroles temperature of Kibo were arranged at the beginning of 1944. I was greatly assisted in this by the honorary secretary of the Mountain Club of East Africa, Mr. J. W. Smethurst of Marangu, who put at my disposal the well-known guide Johane, who accompanied me to Kilimanjaro on several occasions. Johane and an assistant, after having been shown how to take temperatures, ascended Kibo once every month (weather permitting) to record temperatures at five selected spots in the crater. They also checked up the amount of precipitation from four rain-gauges or totalizators installed by me in 1943 on Kilimanjaro, after consultation with Group-Captain A. Walter and suggestions made by Mr. C. Gillman in 1938. These rain-gauges were situated at altitudes of 7,200 ft., 9,400 ft., 12,500 ft. and approximately 16,000 ft. The instrument at 16,000 ft., being unsuited for the collection of snow, was brought down this year at 14,000 ft., on the saddle west of Mawensi, and I took up and installed on March 10, 1945, two snow-gauges at 16,000 ft. and 19,100 ft. for the British East Africa Meteorological Service.

The readings of the temperatures of the five fumaroles mentioned will be extended to nine in future. These five fumaroles were selected, among other reasons, for their positions south, south-east, south and west in different sectors of the crater, rather than for their high temperatures. These regular readings are sufficient to indicate important changes, should these take place. The monthly readings in 1944 give the averages shown in curve *A* of Fig. 3.

The slightly fluctuating curve shows a maximum temperature of 67° C. in February 1944 and a minimum of 47° C. in April 1944, making a difference of 20° C. The variation in temperature between the first and the last month of the readings is 6° C. (lower). When the precipitation figures *B* from the two highest stations—Peters hut, 12,500 ft., and Kibo hut, 16,000 ft.—are examined, it would seem that in the first months, the fumaroles, in other words, the thermic gradient of the volcanic plug of Kibo on the periphery of which (with the exception of fumarole No. 1) the fumaroles are placed, were affected by weather fluctuations. This is most unusual on deep-seated fumaroles as against so-called 'secundary fumaroles' the temperature of which may change very much according to the amount of precipitation. For Kibo, however, this seems disproved by the behaviour of the fumaroles later in the year.

The approximate upper-air temperatures (curve *C*) taken 20,000 ft. above Nairobi on the same dates as the temperatures of the fumaroles are unlikely to have been very much different from those prevalent above Kilimanjaro. They give the same evidence: that the outside influence on the fumarole temperatures is mere coincidence.

The figures obtained from the fumarole temperatures cover too short a period to allow a definite interpretation at this juncture. One has to keep in mind that fluctuations of a still greater order than

Fig. 1. TOP OF KIBO, CALDEIRA AND NORTHERN CRATER IN 1943. PHOTO: E. ROBSON, NAIROBI.

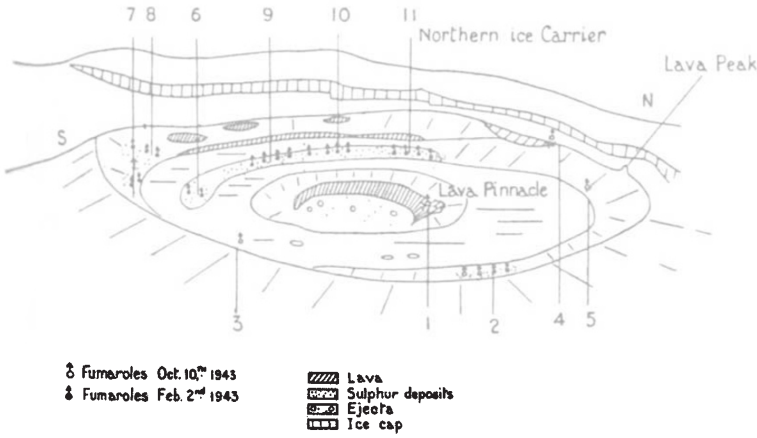
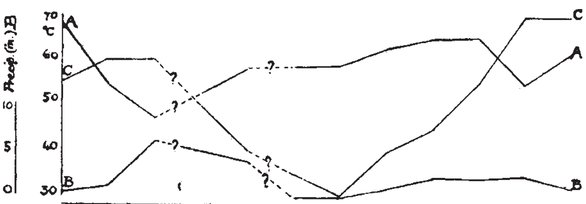


Fig. 2.



	1944 Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan. 1945
Av. temp. (*A*)	68	54	47	—	58	—	59	63	65	65	55	62
Rainfall (*B*)												
Kibo hut	0	0	4·0	1·0		0	0	0·20	0·60	0·50	0·70	0·40
Peters hut	0·40	0·10	6·0	4·0		0	0	1·0	2·30	2·10	2·50	1·40

Fig. 3.

those found in 1944 may have occurred before. We know next to nothing of the behaviour of the crater even since the year 1927, when Dr. R. Reusch first entered it, or in 1930, when Mittelholzer flew over Kibo and published the first photographs of the crater. We have only Tillman's evidence of 1933 of "sulphur fumes discharging from the outer rim on the south side". My personal, general impression on March 10, 1945, was that of a diminution of the activity of Kibo crater since 1942. This is corroborated by the temperature readings in 1942 and in 1945. I recapitulate here some facts, for what they are worth, as evidence for the present :

On October 10, 1942, the temperatures of the eastern fumaroles, No. 2 (absent in June) averaging 91° C., were high. On February 2, 1943, the four points of issue of the fumaroles were much less marked and the fumes replaced by a light screen of water vapour involving only a small part of the slope. The average temperature was only 53° C. during 1944, 52° C., on March 10, 1945.

The south-eastern fumarole, No. 3, showed a temperature of only 37° C. in March 1945, compared with 60° C. in February 1942.

While in February 1943 the upper part of the southern slope was alive with fumes from fumarole groups 6, 7 and 8, there was very little vapour to be seen during March 1945. Temperature, February 1944, 90° C. ; March 1945, 71° C.

The western fumaroles Nos. 9–11, when allowing for periodic small fluctuations as mentioned, showed approximately the same temperatures throughout 1944. In March 1945 they were of very similar aspect to that of 1942–43. This is also shown by photographs taken then and now.

Fumaroles 4 and 5 in the northern sector of the crater were in existence in October 1942 and February 1943. Their temperature was not measured, but in 1945 they do not appear to have changed from their behaviour of two years ago.

Spink's paper in the *Geographical Journal* of May 1944 mentions a temperature of 62° C. for the south and an average temperature of only 78° C. for the north-west fumaroles in July 1943.

From written evidence found in the Kibo hut book, I mention that of Lieutenant I. H. Ash, dated October 17, 1943. He "found no cause to put in further pegs to demarcate fresh volcanic activity". "Personally," he wrote, "I should hesitate to say the crater is becoming increasingly active to the point of eruption."

The above data are sufficient to suggest a striking decrease of activity between 1942–43 and 1945.

A fact worth mentioning is the seismic activity reported from Kilimanjaro at the end of 1943 and in the first months of 1944. Two tremors felt at the Kibo hut were recorded by several mountaineers. One, a vertical shock, took place on January 17, 1944 (report by Miss E. Lany). Another fairly strong one in the night of February 21–22 at the Kibo hut (report by Dr. Bucher) was noticed simultaneously at Peters' hut (report by guide Johane). More reports of tremors reached me during the beginning of 1944. Four of these were felt at Mashame, south-west of Kibo. The first occurred in mid-December 1943, the second in the night of January 10–11, 1944, the third in the night of January 28–29, 1944 (reports by Dr. Reusch), and a short tremor was felt at Mashame by Mr. R. Cunningham on April 9, 1944. These tremors were not reported from other localities in the vicinity of Kilimanjaro and were apparently local. At the dates mentioned, only microseisms, varying from extremely slight to slight, were recorded by the seismograph at Entebbe, often at different hours from the Kilimanjaro shocks. The epicentres of the local shocks are unknown, but may well have been on Kilimanjaro itself. This seismic unrest ceased as suddenly as it had started, and no new reports have come in during the last twelve months.

In January 1944 news came through that after the tremor of mid-December 1943 and the one of January 10–11, 1944, one or more long radial crevasses had been seen, from a distance, in the north-west glaciers of Kibo. Longitudinal or radial crevasses, apart from those appearing when a glacier, having been squeezed in a narrow bed, spreads out again, are most unusual. To see what had happened, I undertook an ascent from Mashame, between January 31 and February 4, 1944, along Jeager's route of 1906. A fissure such as reported could only have occurred in conjunction with tilting movements of the strata under the glaciers on the north-west flank of Kibo. During an extensive tour (which will be described elsewhere) nothing of an alarming nature such as disturbances of tectonic or volcanic origin could be detected. A rocky spur newly denuded of ice and snow was, however, apparent. This spur, about 500 yd. long, could easily be mistaken for a fissure in the ice, when seen at a certain angle, from a great distance. It was situated between Drygalski and Credner glaciers to the north of another patch bare of snow, above Penck glacier, where not long ago only a rock appearing through the ice, known in the past as Ravenstein, was in existence. These denudation effects are caused by the increasing rate of the diminution of the glaciers, a well-known phenomenon, as Meyer, Jeager, Klute, Gillman, Geilinger and others have pointed out during the past forty-five years. They are quite natural features in the prevailing climatic circumstances.

Observations on Kibo, both meteorological and volcanological, are continuing, and it is hoped that more data, together with those obtained from other volcanoes in East Africa, will prove useful in the future.

EMBRYOLOGY OF ANGIOSPERMS AS A FIELD FOR RESEARCH*

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IN the history of angiosperm embryology there have been three distinct periods : the first, in which the chief aim was to unravel the chief facts regarding the development of the pollen and embryo sac, and the processes of fertilization and seed formation ; the second, in which interest centred largely round a study of comparative embryology and an evaluation of the data thus obtained for the improvement of the existing systems of classification ; and the third and latest in which embryology has become an experimental subject like cytology and physiology, where one tries to study the optimal conditions for the storage of the pollen and its germination ; the receptivity of the stigma, fertilization and fruit-setting and how far the normal processes of development can be influenced or altered by a change in the environment.

Descriptive Embryology

Most of our facts relating to the course of development of pollen, embryo sac, endosperm and embryo became clear towards the close of the last century through the researches of Amici, Schleiden, Hofmeister, Strasburger, Treub, Guignard, Nawaschin and others, and are now a commonplace in all text-books of botany. Very good summaries of this work were given by Coulter and Chamberlain[1] and Schnarf[2]. Little that is fundamentally new has been discovered during recent years, but there were several errors and misinterpretations made by previous workers which have been corrected and a mass of valuable information added regarding the structure and development of the male gametes, the types of embryo sac development, the process of fertilization, the origin and function of the endosperm haustoria and the development of the embryo[3]. Further work of this type would be welcome ; but results of greater value are to be obtained if attention is now focused on a comparative study of only one aspect of the life-history at a time, namely, male gametophyte, embryo sac, pollen tube, apomixis, polyembryony, the role of the endosperm in embryonal development, etc. Each of these requires the study of a vast amount of literature and often a technique somewhat different from that used for the rest. Finn's work in the Ukraine on the male gametophyte and that of Souèges in France on embryogeny are notable examples of what can be achieved by this method.

Phylogenetic Embryology

In the second period, which may be said to have commenced with the beginning of this century, embryology began to be used as a tool for the improvement of the existing systems of classification, the most important contributions in this line having come from Sweden, Germany, Austria and the United States. A great impetus was given to such studies by the publication of Schnarf's handbook entitled "Vergleichende Embryologie der Angiospermen", in which the author has summarized the existing state of our knowledge of the embryology of each family and added a number of valuable suggestions and comments at the end of each order.

That embryology can be a valuable tool for the systematic botanist may now be considered as established beyond doubt, for if we assume phyletic trends in the external morphology of the flower it is only natural to expect them also in such internal structures as pollen grains, embryo sacs, endosperm and embryo. Indeed, as a very competent embryologist[4] has recently remarked, the resemblances and differences in the embryological characters of the members of a family, although sometimes of such a fine type that they cannot be brought out either in words or in drawings but can only be appreciated under the microscope, are nevertheless of distinct value in delimiting the smaller groups and in determining their interrelationships within each order.

To mention certain specific instances where embryology has rendered an important service in the determination of the proper position of a family, we may first take the Empetraceæ, a family which has been placed by some authors in the Sapindales, by others in the Celastrales and by still others in the Monochlamydeæ. Samuelsson's work[5] has definitely shown, however, that its proper place is with the Bicornes, a group characterized by a number of well-marked embryological features which are also seen in the Empetraceæ : (1) presence of a fibrous layer in the anthers ; (2) presence of a glandular tapetum which does not become amœboid ; (3) pollen grains remaining together in tetrads ; (4) ovule with single integument and an ephemeral nucellus which disappears in later stages so that the embryo sac lies in direct contact with the integumentary tapetum ; (5) absence of parietal cells in the ovule ; (6) embryo sac of the monosporic eight-nucleate type with small ephemeral antipodals ; (7) a fluted hollow style which connects the lumen of the ovary with the outside and along which the pollen tubes make their way into the ovary ; (8) a cellular endosperm, with the first two divisions transverse and giving rise to a row of four cells placed one above the other ; (9) the formation of endosperm haustoria at both ends of the embryo sac, micropylar as well as chalazal ; (10) a single-layered seed-coat formed

* Abridged and modified from the presidential address delivered to the Indian Botanical Society, January 1945.