large proportion of its original activity. On testing it, the activity was found to have reached a small and nearly constant value. Rough observations, however, which I had made from time to time indicated that the rate of decay of this polonium was certainly not very different from that of radium E. More accurate experiments will be required to settle the question definitely, but I think there is little doubt but that their rates of decay will be found to be the same.

Polonium, radio-tellurium, and radium E have very similar radio-active and chemical properties. Each gives out only α rays, and each is deposited on a bismuth plate placed in the active solution. The probable identity of their rates of decay, taken into conjunction with the similarity of their radiations and chemical properties, shows that the radio-active constituent present is in each case the same. We may thus conclude that the active substance present in polonium and radio-tellurium is a decomposition product of radium and is the sixth (or, as we shall see later, probably the seventh) member of the radium family.

The main objection, in the past, against the identity of polonium and radio-tellurium has rested on the statement of Marckwald that a very active preparation of his substance did not lose its activity to an appreciable extent in six months. Unless very special methods were employed, it would be difficult to determine with accuracy the variation of the activity for such very active material. The specimen of radio-tellurium obtained both by Meyer and Schweidler and by myself undoubtedly does lose its activity fairly rapidly.

I have recently examined more carefully the product radium D, and have found strong evidence that it is not a single product, but contains two distinct substances. The parent product, radium D, does not give out rays at all, but changes into a substance which gives out only β rays, and is half transformed in about six days. Unless observations are made on the product radium D shortly after its separation, this rapid change is likely to escape detection. The work on this subject is still in progress, but the evidence at present obtained indicates that the active deposit from the emanation, after passing through the three rapid stages, represented by radium A, B, and C, is transformed into a "rayless" product D, which changes extremely slowly. D continuously produces from itself another substance—which may for the time be termed D_1—which is transformed in the course of a few weeks and emits only β rays. This product D_1 gives rise to E (polonium).

Since the activity of D_1 reaches a maximum value a few weeks after the production of D, and will then decay at the same rate as D, the conclusion, previously arrived at, viz., that D is half transformed in about forty years, still holds good.

The view that radium D is the active constituent present in the so-called radio-lead of Hofmann has been very strongly supported by some experimental results recently obtained by Hofmann, Gonder and Wölfl (*Annal. der Physik*, vol. xv., 3, 1904).

They found that preparations of radio-lead continuously produced an α ray product, which could be separated on a bismuth plate. This active product is probably radium E, for they found it lost a large proportion of its activity in one year. They found, in addition, that by certain chemical methods another distinct product could be separated which gave out only β rays, and lost much of its activity in six weeks. This substance is probably the new radium product D_1 already referred to.

Debierne recently concluded that radio-lead and polonium were identical, and proposed that the name radio-lead should be dropped in favour of polonium. In the light of the above results, this position is not tenable. There is no doubt that the preparation of radio-lead in my possession, and also that experimented on by Hofmann, contains a distinct substance which, as the parent of polonium, has certainly as much right to a name as its offspring. The radio-active substance in "radio-lead" has no more connection with lead than Marckwald's active matter "radio-tellurium" has with tellurium. The names both arose because the active matter was initially found associated with these substances.

In order to avoid confusion, I have called the new radium product "radium D_1." If no further intermediate products of radium are brought to light, it would be simpler to call it radium E and to call the α ray product (polonium) radium F.

E. RUTHERFORD.

McGill University, Montreal, January 24.

Indian and South African Rainfalls, 1892-1902.

MR. J. R. SUTTON, of Kimberley, rendered a signal service to South African meteorology in his "Introduction to the Study of South African Rainfall" (*Trans.* S.A. Philosophical Soc., December, 1903), but when he states that south-east winds are rare on the south-east coast of South Africa, and that the rainfall of the greater part of the tableland and south-east coast comes from some northern direction (NATURE, November 3, 1904), it is difficult to follow his conclusions. Most, if not all, of those who have studied South African rainfall will, I think, agree with me that the facts do not bear this interpretation. Least of all is it the case that there has been nothing that can properly be called a drought, in the sense of Sir J. Eliot's address, within the past fifteen years in South Africa. In all the summer rainfall areas of South Africa, viz., over the bulk of the subcontinent, drought has prevailed during recent years, and in some localities it has been terribly severe.

During twenty years I have travelled over every part of South Africa except the desert areas, and I have resided continuously in those parts where there is most rain and forest. I have heard the rain and its mode of arrival discussed in every locality and from every point of view, and these facts have convinced me that the summer rains have their origin in the moist winds from the Indian Ocean. The precipitation of the moisture contained in these humid air currents is caused by barometric depressions with normal cyclonic wind circulation, and it is the winds proper to these depressions that give the appearance of rains coming from the north, north-west, west, &c.

The following gives a brief account of the various storm types. In Cape Colony storms travel from west to east at all times of the year. As one would expect, they are more regular and better developed in the south than in the north, and in Rhodesia than in the Northern Transvaal. In the north during summer they may be replaced by westward travelling tropical storms. Usually it is the secondary with its thunderstorms, a whirl within a whirl, which precipitates the greater amount of moisture. In the southern portion of the subcontinent these storms in most cases pass across from west to east with their centres to the south, and thus their wind circulation shows at first winds from the north and north-west, then from the west and south-west, and finally from the south and south-east. In summer, when the south-east trade blows on to the subcontinent with a monsoon effect, the wind remains longer in the south-east quarter, and heavy rains come frequently from the south-east or the south-west quarter The portion of the barometric depression and its accompanying circulation which brings the wind will depend on the position of the locality, but I have never known the facts not to conform more or less closely to this type of wind circulation. A range of mountains across the south-east rain-producing wind will, of course, increase the precipitation, and when once rain has started in the south-east quarter it will often continue for days with a steady south-east wind blowing like a south-west monsoon wind in India. All this takes place on the eastern side of South Africa. The rain is greatest in amount where the east wind from the Indian Ocean first strikes the highest eastern land, and the rain gradually decreases in amount until the western deserts are reached. It is generally the north-west wind which starts the precipitation, but it is quite certain notwithstanding that the humid currents do not come from the north-west. If, as Mr. Sutton has suggested, the high upper current of the north-west anti-trade were the source of South African rains, then it would be natural to suppose that the rains would be best developed on the north and western sides of South Africa, which is exactly the reverse of what actually takes place.

South Africa lies on the border of the south-east trade area. In summer South Africa, from Cape Town to the Zambezi, comes entirely under the influence of the south-east trade winds; but in winter the southern portion of

Cape Colony is subject to another type of weather, due to the passage of storms from the South Atlantic, the "roaring forties" of mariners. It is necessary very carefully to distinguish between these two weather systems. In the one the storms bring winter rains to a small part of the subcontinent, *i.e.* Cape Town and the south-west; in the other the storms precipitate the abundant moisture brought by the trade winds from the Indian Ocean, more or less over the whole subcontinent.

This much of explanation is necessary in order to understand clearly the connection between the weather of India and that of South Africa. In studying this connection we have at the outset to eliminate the winter weather of the south-west with its winter rains coming from the South Atlantic.

Sir John Eliot, in his reply to Mr. Sutton, very properly excludes the area of winter rains. I go further, and exclude what Mr. Sutton has termed the area of spring and autumn rains. The latter are areas where, with the winter storms still prevailing and the summer south-easters coming in from the Indian Ocean, there is the most marked precipitation in spring and autumn. We are not in a position to say how far these rains have been produced by the tail-end of the retreating Atlantic storms or by the head of the advancing humid south-east trade currents. The fertile country watered directly by the south-east trade is comprised in sections x. to xv. of Mr. Sutton's rainfall areas, viz. the east of Cape Colony, Kaffraria, Basutoland, the Orange River Colony and Natal, and, in addition, all the Transvaal, Rhodesia, and the Portuguese territory; in fact, it is the whole of fertile South Africa with the exception of the southern and south-west coasts. In the table below I give the mean of Mr. Sutton's figures for his sections x. to xv., comprising Eastern Cape Colony, Transkei, Basutoland, Orangia, and Natal, and I add the yearly rainfall from typical stations in the Transvaal and Rhodesia, as correct general average figures for these territories are not available.

Percentages of Rainfall in the Summer Rainfall Areas, 1891 to 1902: Mean of Sutton's Sections x. to xv.

	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901	1902
Per cent.	136	106	132	97	103	102	74	107	89	82	98	93

And correcting Sir John Eliot's table to purely summer rainfalls it will read thus:—

Period of general excess of rain.

Year.	Percentage variation Summer rainfall. India	S. Africa.
1892	12	+ 6
1893	22	+ 32
1894	16	− 3

Period of general deficiency of rain.

Year.	Percentage variation Summer rainfall. India	S. Africa.
1895	− 5	+ 3
1896 (famine)	− 12	+ 2
1897	normal	− 26
1898	1	+ 7
1899 (famine)	− 27	− 11
1900	− 1	− 18
1901	− 10	− 2
1902	− 5	− 7

These figures show more strikingly than those already quoted by Sir John Eliot the intimate connection between the rainfall of India and South Africa during the period 1892 to 1902, and the connection would have shown better if seasonal instead of calendar years had been taken, since the calendar year cuts into two unequal portions the South African summer rainfall. It will be noted that each Indian famine year has been followed by one or two particularly bad years of drought in South Africa.

It is a somewhat remarkable coincidence that, while the number of NATURE containing this discussion was on the sea on its way to the Cape, I prepared my yearly forecast of South African weather, and in that took occasion to point out the very close connection of the two rainfalls during this period. I may perhaps crave your indulgence to reproduce it, since it confirms so singularly Sir John Eliot's view. Speaking of certain typical stations I said:—

"Sir John Eliot's paper shows that 1892, 1893, and 1894 were years of good rainfall in India. These were the last years of general good rainfall we had in South Africa. In 1895 the drought set in at most South African stations. Further, in this droughty period there were two years of bad famine, viz., 1896 and 1899. These two years of famine in India were the two worst years of drought at many typical South African stations. At present we are not in a position to obtain average figures for the whole of South Africa, but nearly the same purpose will be served by taking certain typical stations thus:

"At Bulawayo (Hope Fountain), in 1890–1, there was the heaviest rain on record, viz., 45 inches; all the following years have been years of drought except three years when the rainfall was barely above the average.

"At Johannesburg there were good rains in 1894, when there were good rains in India, fair rains in 1895, and then drought, when there was drought in India. 1896 (one of the Indian famine years) was the worst year of drought in Johannesburg. The great Indian famine of 1899 was represented by a bad drought 1898–9 preceding the failure of the Indian monsoon by four months. . . .

"Natal rainfalls correspond closely with the Indian rainfalls. While 1899 was the worst famine for many years in India, 1899 and 1900 were the two worst years of drought ever experienced at Durban, in Natal, since meteorological observations were begun there in 1866. In 1900, the Durban rainfall was only 27 inches against an average of 41 inches. At Maritzburg, representing the inland Natal districts, 1899 was also a year of drought, but the greatest deficiency was registered the following year (probably chiefly due to the calendar year dividing the seasonal year).

"Again, at Grahamstown, Cape Colony, in 1899 there was under 20 inches against an average of 29 inches; at King William's Town in 1899, only 16 inches against an average of 25 inches; while at Graaff-Reinet in 1899 there was only 9 inches against an average of 15 inches. At all these South African stations, 1899, the great Indian famine year, was the worst year of drought in recent times!"

The rainfall curves for Umtata, Evelyn Valley, and Katberg show similar features, viz., severe South African droughts corresponding to the years of Indian famine, and a general deficiency of rainfall corresponding with the years of general deficiency of Indian rainfall. The rainfall curve of Evelyn Valley (Fig. 1), however, is very remarkable. This is a forest station, and the observer a particularly good one. I have elsewhere compared this station to Cherapunji, in India. I founded this station in 1887, and it has since shown the heaviest rainfall on the summer register. It lies in a *cul de sac* of the mountains facing the south-east at an elevation of 4200 feet. I have long regarded it as the typical southern station for the summer rainfalls. A study of its yearly rainfall curve shows how rain failed here in the most striking manner previous to the Indian famine of 1896, and during and after the Indian famine of 1899.

With regard to Mr. Sutton's statement that there has been no severe drought during recent years in South Africa, there is abundant evidence to the contrary.

A year ago I wrote: "In the Karoo the present drought is considered the worst during the last half-century. At Hanover (Upper Karoo) during nearly a year there has fallen only three-quarters of an inch, the normal yearly rainfall being 15 inches. The drought has lasted on and off since 1896–8, and during the worst years cattle and sheep have perished in millions. In British Central Africa the drought has lasted since about 1898; it is reported that the Shiré Lake is now nearly dry. Last summer's crops in the Transvaal, so sorely needed after the war, were a complete failure, while in Natal, Rhodesia, and the country to the north there was in many places famine, and people dying in places too remote to be reached by Government aid.

"When will the drought end? is now the great question for the country.

"Good rains have fallen recently all down the eastern side and on the south coast of South Africa. This rain has come as a precious mitigation of the drought. It may be looked on as a favourable indication for a good season —perhaps more favourable if it had come later.

"The local and other indications of an early ending of the drought are favourable. It has definitely broken up in Australia." (Weather forecast, dated November 23, 1903.)

Writing a year later, November 23rd, 1904, I said: "My weather forecast for last year (published in the *Cape Times* of November 23, 1903) indicated the expectation of a more or less complete break-up of the drought. This forecast has been fulfilled. In many parts of South Africa, particularly towards the north, the drought has broken, and good seasons were experienced last year. In other parts the rains were insufficient to really break the drought. This was the case in the fertile 'conquered territory' of Orangia, and over wide areas in Cape Colony. In the Transkei drought remains unbroken. It is described as a drought of terrible severity, and one that has stopped all ploughing and killed from 50 to 60 per cent. of the sheep in some of the districts. As was remarked by a correspondent in the *Cape Times* a few days since,

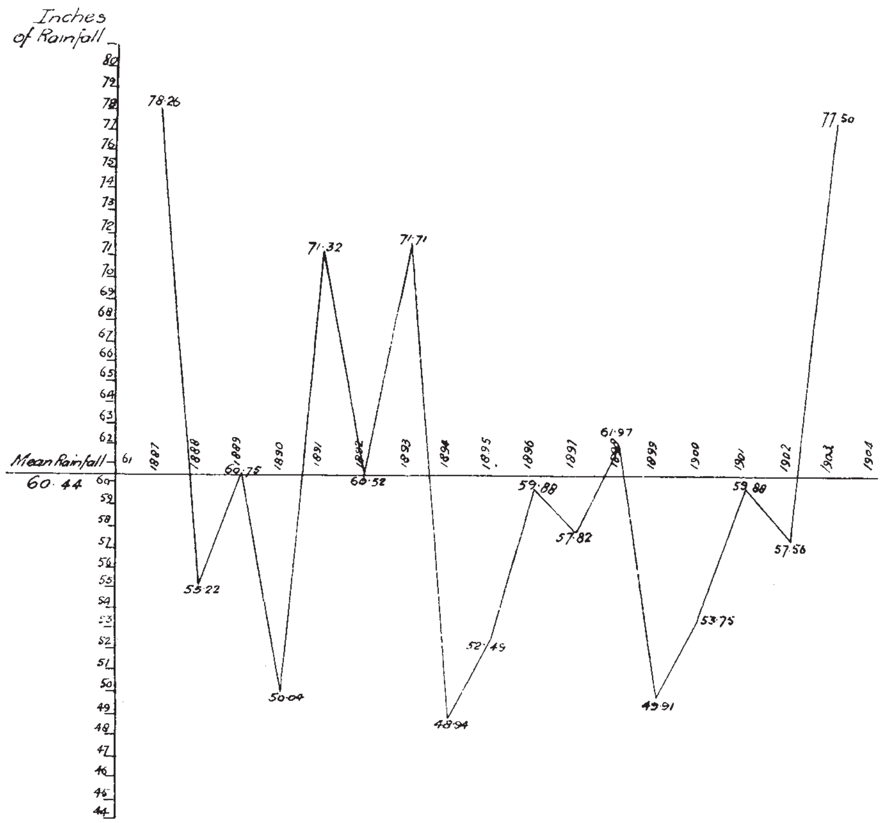

FIG. 1.—Rainfall, Evelyn Valley.

'No one not living here has any idea of the terrible condition existing in the Karoo and Eastern Province. The springs on most of the farms have utterly disappeared. On one farm in the Cradock district with large lands, orchards, and a water-mill at the junction of two kloofs in the Sneeuwberg, the river beds are as dry as a street; the farmer has sold all his stock, and I actually saw the water for household use brought some distance in a barrel. In former years the water-mill was in constant use for all the surrounding country.'"

Writing to me recently from Zomba, in British Central Africa, Mr. Clounie, the head of the scientific department, speaking of last summer's rains, says: "The wet season from November to April last has been remarkably good, and crops everywhere have been excellent. I think everything points to the end of the drought and a return to a period of good rains."

As regards the drought further north, the reader may turn to NATURE of November 3, 1904 (p. 15). I produce the extract for ready reference:—

"Appendix iii. of a report upon the basin of the Upper Nile, with proposals for the improvement of the river by Sir William Garstin, contains an interesting account of the variations of level of Lake Victoria Nyanza contributed by Captain H. G. Lyons, the director of the Survey Department of Egypt. This lake has a water surface of about 68,000 square kilometres, and is situated about 1129 metres above sea-level. It is believed to be of shallow depth, and lies for the most part of the year in the region of the equatorial rain and cloud belt, the excess water draining off at the Ripon Falls by the Victoria Nile. After reference to the geology and climate of the region, a brief historical summary is given of the early lake levels as observed by travellers and others visiting or residing by it; this is followed by a detailed study and discussion of the various gauges. Some of the results obtained are as follows:—The annual oscillation of the lake is from 0·30 metre to 0·90 metre. Between 1896 and 1902 there was a fall of 76cm. in the average level, since followed by a rise of 56cm. The epochs of high and low levels are given as:—1878, high level; 1880–90, falling level; 1892–5, temporary high level; 1896–1902, falling level; 1903, rising level."

The kernel of this quotation lies in the last six words: it shows the same correspondence with the Indian rainfall figures as the summer rainfall figures of South Africa.

D. E. HUTCHINS.

Cape Town, December 8.

Compulsory Greek at Cambridge.

SOME years ago a young lady who was studying at Girton came to Bristol to spend a part of her first vacation after passing the "Little-go." She had never learnt Greek at school, but had been coached by an elder brother, who was at that time in residence at Cambridge; in about two months she obtained a knowledge of Greek sufficient to meet the requirements of the authorities at Cambridge.

While she was with us we paid a visit to the neighbouring city of Bath, and I directed her attention to the motto which is inscribed on the Roman baths there, viz.:

ἄριστον μὲν ὕδωρ.

Remembering her recent success in the "Little-go," I jokingly asked her the meaning of this inscription—not imagining for a moment that Cambridge compulsory Greek would be unequal to such an easy task; she was, however, unable to give the meaning of the words; she did not think she had ever seen ἄριστον, but was of opinion that she had in the course of her reading met the word ὕδωρ, but did not remember what it meant.

It may be well to add that the lady in question has great linguistic ability, and in due course obtained a good place in the Modern Languages Tripos.

Do our ultra-classical friends really think that compulsory "Greek" of this type is worth preserving?

J. WERTHEIMER.

Merchant Venturers' Technical College,
Bristol, January 30.