On a Revised Map of Kaiser Franz Josef Land, Based on Oberlieutenant Payer's Original Survey

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be used; but things turned out far otherwise, the Nansen sledges taken were seldom available, and the want of Samoyede sledges added greatly to the difficulties of transport. It was found that the north and south parts of the island, except for a belt along the western shore of Wijde bay, were chiefly covered with immense accumulations of ice, while the central part was a region of boggy valleys and mountain ridges, with occasional more or less fertile slopes. As scientific interest centred in the latter, it was decided to depart from the original idea of crossing the island two or three times along widely separated lines, and to make a detailed study of a more restricted area. The expedition accordingly crossed from Advent bay to Klok bay, from Klok bay to Sassen bay, and from Sassen bay to Agardh bay on the east coast, and back to Advent bay.

The work done in the course of the traverses mentioned is summarized as follows: thirteen mountain ascents were made, including Mount Starashchin and Horn Sunds Tind; 600 square miles were surveyed in the heart of the island, and a rapid outline survey made on either side of Wijde Bay; the most complete reconnaisance of the coasts ever made was accomplished, the main island being almost circumnavigated; observations were made of the west, north, and south coasts of North-East Land; a landing was effected on the Seven islands, and Wiches Land closely approached. Some six hundred photographs were obtained, and scientific collections of great value, especially to the geologist, were brought home. The latter are deposited in the museums at South Kensington and at Kew, and are to be reported on later. The great scientific interest of Spitsbergen lies in the fact that it enjoys the most temperate of arctic climates, and its plateaux are accordingly undergoing erosion and denudation of the most vigorous kind, the process of cutting out valleys and mountain groups being exhibited in rare perfection. The promised scientific results must therefore be looked forward to as a great contribution to physical geography, and we shall then appreciate all the more this account of the difficulties and dangers encountered.

ON A REVISED MAP OF KAISER FRANZ JOSEF LAND, BASED ON OBERLIEUTENANT PAYER'S ORIGINAL SURVEY.*

By Professor RALPH COPELAND, Astronomer Royal for Scotland.

On the return of Dr. Nansen from his great journey across the arctic ocean, geographers learnt with surprise that the northern part of Lieutenant Payer's map of Franz Josef Land had proved of very little use to him on his journey southwards. This seemed to confirm the unfavourable opinion which had already been expressed by Mr. Jackson respecting the western part of the map, that persevering explorer having been unable to identify Payer's Richthofen peak, even when standing on the site of the mountain as laid down by the Austro-Hungarian expedition. This latter difficulty, however, admitted of a ready explanation: Richthofen peak had

* Map, p. 236.

been laid down by its discoverer from one point only, and from an estimated distance of about 60 miles. If, therefore, this distance had been over-estimated, the mountain would be not only misplaced on the map, but also exaggerated in height to a corresponding extent.

Nansen's case was altogether different; as is well known, he entered the region surveyed by Payer from the north-east, and found an open sea with a group of small islands where the Austrian explorer has placed a large glacier. Knowing Payer's great ability as a surveyor, from having been associated with him on the second German Arctic Expedition in 1869–70, I was painfully surprised at these extraordinary discrepancies.

On learning, however, that Payer had presented the original fair copy of his survey to the Royal Geographical Society, it occurred to me that I might possibly be able to trace the origin of the above-mentioned divergencies. My application to the Council of the Society for the loan of these valuable manuscripts was most courteously granted, and I was thus provided with the necessary materials for testing the accuracy of the Austro-Hungarian map.

It will be remembered how the *Tegetthoff*, imprisoned in the ice, was on August 30, 1873, carried within sight of the large group of hitherto unknown islands which its discoverers named Kaiser Franz Josef Land. For two months the floe carried the ship helplessly to and fro in the neighbourhood of the land, until it was finally frozen fast about 3 miles south of Wilczek island on October 31. During the two months' drift, bearings and sketches of the land were taken on eleven different days, beginning with the day of discovery. This section of the survey is recorded in twenty-seven lines on four sheets with Payer's usual pains-taking skill; it is useful in confirming the general accuracy of the southern part of the map, as well as in locating Lütke and Orel islands, the eastern part of Salm island, and Cape Höfer.

The darkness of winter allowed only of flying visits to the shore, but on March 10, 1874, the task of exploration was begun in earnest by Payer. Within six days he occupied three of the most important stations of the survey—the summits of Capes Tegetthoff and Littrow, and the west tongue of Wilczek island, at the same time deciding on the general plan of operations. Lieutenant Weyprecht, the nautical commander of the expedition, undertook the measurement of a base-line on the ice starting from the ship, together with the connection of this base with two conspicuous points settled on by Payer. These points were: first, the summit of a symmetrical rock about 30 metres in diameter, situated on the low tongue of land just mentioned as forming the western extremity of Wilczek island; it is designated "VII." in Weyprecht's triangulation. The other point, "T," is the outermost but one, and the most regular in form, of a line of basaltic rocks running out from Cape Tegetthoff; it is well shown in the woodcut on p. 49, vol. ii., of Payer's 'New Lands within the Arctic Circle' (London, 1876). Both objects are visible for a great distance to the west and the north-east. Together with these points should be mentioned "V," a large cairn on the southern headland of Wilczek island, in which are deposited sundry documents, as well as a minimum thermometer. In the mean time Payer was to conduct a sledge-party to the highest attainable latitude, keeping up a running survey of the route traversed. This survey is depicted in about twenty panoramic views, with accompanying theodolite and compass readings made at as many different stations, ranging from Cape Brünn to Cape Brorok. These sketches were copied by Payer before the abandonment of the *Tegetthoff* in lines upon ten sheets of paper about 14 inches by 10 inches. If placed end to end, they would extend to a length of fully 65 feet. Interspersed with these sketches are a number of effective drawings,

which convey a vivid impression of the character of the scenery. Two of these are interesting as having been made when the temperature was nearly 56° Fahr. below zero. Altogether about 750 theodolite or compass readings are entered on these survey sheets.

A full account of Weyprecht's base and the adjoining triangulation is to be found in his "Astronomische und geodätische Bestimmungen der österreichisch-ungarischen Arctischen Expedition, 1872–74," published in the thirty-fifth volume of the 'Denkschriften' of the Imperial Academy of Sciences at Vienna, 1878. A recomputation of Weyprecht's measurements confirmed his deductions in all respects, and finally 18052·1 metres was adopted as the distance VII.—T, with an azimuth of 162° 40·9′ from the south, referred to the meridian of VII. Weyprecht's values are 18049·0 metres and N. 17° 19·1′ W., quantities agreeing almost exactly with the foregoing, taking into account the nature of the survey. The only discrepancy noted seems to be merely a slip of the pen affecting the two adjoining angles V.—VI. and VI.—A, measured at station IV., where 3° 43·5′ and 42° 39·0′ are to be substituted for 3° 1·5′ and 43° 21·0′. The uncertainty mentioned by Weyprecht respecting the important angle T—VII.—A (= 146° 27·5′) measured by Payer, is to a great extent removed by an examination of measures taken under favourable conditions on April 30, 1874, which give a value of 146° 28·75′. I have made use of Weyprecht's figures. All the angles of the triangles were not measured, nor was the levelling-instrument used in the determination of the angles always exactly centred. Under these circumstances Weyprecht did not attempt an adjustment of the triangulation. Owing to the roughness of the ice, a direct measurement of the base was altogether impracticable; the lengths of the various sections were therefore found by means of a levelling-staff and the micrometer of a "Stampfer level." According to investigations made by Prof. Stampfer, the accuracy of a base measured in this way is somewhat greater than if carefully measured with a chain. In summing up the length of the base, the distance from the northern end of the base, the mizzen-mast of the *Tegetthoff*, to the first pole on the ice has been inadvertently omitted from the result stated by Weyprecht in Vienna fathoms, but the length of the base is correctly given in metres. The results for the azimuth of the base afforded by two instruments, were afterwards found to differ to the extent of 9·5 minutes of arc. Weyprecht decided to adopt the figures obtained with the more reliable instrument. The difference is of no great moment for a provisional survey of the kind contemplated.

The latitude and longitude of the observatory on the ice near the ship were determined by Weyprecht and Midshipman Orel in the most satisfactory manner. The longitude referred to the northern end of the base is 58° 46′ 39″ E. from Greenwich. These figures, however, have still to be corrected for the error of the lunar tables, which, according to Newcomb,* made the moon's right ascension too large by about 9·0″ in the winter of 1873-4. The corresponding correction to the above longitude is *minus* 4′ 6″, hence the final longitude of the northern end of the base becomes 58° 42′ 33″ E. The latitude is 79° 50′ 56″ N.,† whence Weyprecht's

* 'Investigation of corrections to Hansen's Tables of the Moon,' p. 12. 4°. Washington: 1876.

† The provisional position given in 'New Lands,' and used in the published map, is 58° 56·0′ E., and 79° 51·1′ N.; the difference in longitude from the corrected final value is therefore 2·74 statute miles, by which distance Franz Josef Land has been hitherto placed too far east on the map.

reductions give the following corrected positions for the fundamental points of the survey:—

V.	79°	53′	28″	N. lat.	and	58°	40′	0″	E. long.	(Greenwich).
VII.	79	55	57	„	„	58	7	48	„	„
T.	80	5	12	„	„	57	51	3	„	„

By far the greater part of the survey was accomplished by Payer on the long sledge journey on which he and Orel succeeded in reaching Cape Fligely, 134 nautical miles north of the ship. In the accompanying map, nearly every station where Payer set up his theodolite or azimuth compass is marked with a small triangle. These points were sometimes on the tops of commanding elevations, but more usually they indicate the spot where a halt was made for the determination of the latitude at apparent noon, or for the measurement of azimuths. In the majority of cases it was necessary to determine these points by means of Pothenot's problem, with or without the help of the observed latitude. A number of the best determined unvisited points are distinguished by a small circle. In criticizing the survey, it must not be overlooked that Payer's primary object on the second sledge journey was the attainment of the highest possible latitude. He was therefore under the necessity of deviating as little as possible from a direct north and south track. Under these circumstances, it was only possible to give continuity to the survey, by repeated bearings of conspicuous points at a distance to the right and left of the line of march. It is obvious that the best results can only be obtained when such lateral points are observed from at least three stations.

Frequently the compass azimuths of objects were read off in addition to their direction as shown on the circle of the theodolite. In these cases the true bearings of all the observed points could be deduced with the aid of the accompanying table of the variation of the compass.

MAGNETIC DECLINATION IN FRANZ JOSEF LAND, 1874·2.

The *minus* sign indicates that the compass needle pointed east of true north.

Latitude.	Longitude—55° E.	56°.	57°.	58°.	59°.	60°.	61°.	62°.	63°.	64°.	65°.
	Declin. ° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
85° N.	−10 20	−11 1	−11 43	−12 24	−13 5	−13 46	−14 27	−15 7	−15 47	−16 27	−17 7
	−86	−85	−82	−80	−78	−76	−73	−71	−69	−66	−63
84° N.	−11 46	−12 26	−13 5	−13 44	−14 23	−15 2	−15 40	−16 18	−16 56	−17 33	−18 10
	−80	−78	−77	−74	−73	−70	−67	−66	−63	−61	−57
83° N.	−13 6	−13 44	−14 22	−14 58	−15 36	−16 12	−16 47	−17 24	−17 59	−18 34	−19 7
	−73	−71	−69	−68	−65	−64	−62	−59	−56	−54	−53
82° N.	−14 19	−14 55	−15 31	−16 6	−16 41	−17 16	−17 49	−18 23	−18 55	−19 28	−20 0
	−67	−65	−63	−61	−59	−57	−55	−53	−50	−48	−48
81° N.	−15 26	−16 0	−16 34	−17 7	−17 40	−18 13	−18 44	−19 16	−19 45	−20 16	−20 48
	−61	−59	−57	−55	−53	−51	−50	−48	−46	−44	−43
80° N.	−16 27	−16 59	−17 31	−18 2	−18 33	−19 4	−19 34	−20 4	−20 31	−21 0	−21 31
	−54	−52	−51	−49	−47	−45	−43	−41	−42	−41	−38
79° N.	−17 21	−17 51	−18 22	−18 51	−19 20	−19 49	−20 17	−20 45	−21 13	−21 41	−22 9
	−48	−45	−43	−42	−41	−40	−39	−38	−37	−36	−34
78° N.	18 9	18 36	−19 5	−19 33	−20 1	−20 29	−20 56	−21 23	−21 50	−22 17	−22 43

This table was constructed by first computing the Gauss magnetic co-ordinates for the year 1829 for each 5° of latitude and longitude from Erman and Petersen's tables (*Astronomische Nachrichten*, No. 1900), and then filling in the intermediate values.* The difference (= −17° 51′) between the magnetic declination thus

* For the computation of this table, as well as for valuable assistance in drawing and lettering the map, I have to thank Dr. Halm of the Edinburgh Royal Observatory. —R.C.

obtained for the *Tegetthoff's* position and the mean declination found by Weyprecht and Brosch, added to each of the computed values, then gave the quantities in the above table. This process assumes, first, that Gauss's quantities give the correct declinations for 1829, plus or minus a constant, within the area dealt with; and, second, that the secular change in declination from 1829 to 1874·2 has been uniform throughout that area. The readings taken at the south-western extremity of Crown Prince Rudolf's Land may serve as an example of the use of this table.

STATION—CAPE BROROK, APRIL 11, 1874, NOON. LATITUDE BY OBSERVATION, 81° 40′ 14″ N. COMPASS DECLINATION BY TABLE = - 16° 41′.

Object.	Compass-reading.	Magnetic bearing.	Approximate bearing.	Theodolite reading.	Correction to theodolite-reading.	True bearing.
	°	° ′	° ′	° ′	° ′	° ′
Hohenlohe island, rock	S. 73° E.	= 287 0	303 41	148 20	+155 21	303 7
Hohenlohe island, west cape ...	S. 26½° E.	= 333 30	350 11	195 26	+154 45	350 13
Alexander Land, rocky cape 24 miles distant	S.W. (b. S.) ¾ S.*	= 25 19	42 0	247 44	+154 16	42 31
Mean correction to theodolite-readings					+154 47	

The theodolite readings for the remaining objects observed from this station, eight in number, increased by the quantity 154° 47′, give the following azimuths, which were employed, together with the three foregoing bearings, in the construction of this part of the map; at the same time, the greater estimated distances have been lessened by one-third:—

Object.	Theodolite reading.	True bearing.
	° ′	° ′
Hohenlohe island, summit	168 0	322 47
„ „ cape (4 miles) ...	172 40	327 27
Alexander Land, low cape	227 20	22 7
„ „ rocky cape (16 miles) ...	245 0	39 47
„ „ (very distant cape) ...	— —	— —
Very high land (70 miles)	322 20	117 7
Low cape (1 mile)	339 0	133 47
Brow of cliff (quite near)	50 0	204 47
Low cape (near)	128 0	282 47

There are some parts of the map for which the materials of the original survey are no longer to be found, if indeed they still exist. These are—Petermann Land with Cape Vienna in the extreme north; the western shore of Crown Prince Rudolf Land, for which only the observed latitude of Cape Germania and the estimated

* There is an obvious error of a whole point, 11¼°, in this reading, which I have not hesitated to correct. Almost without exception, the only errors in the survey occur in such magnetic bearings as are given in *points*. It is much to be wished that this antiquated notation should be avoided in future surveys.

latitude of Cape Fligely are available, Orel's compass bearings having unfortunately been lost or mislaid. The data for the true situation of Lamont island are also wanting, but they probably are to be found amongst the papers of the late Lieut. Weyprecht, who can hardly have failed to determine its position with all necessary accuracy at the time of its unexpected discovery on the retreat from the ship. The bearings and details of the Hayes islands are also wanting. There was, therefore, no option but to copy these features from the published map. The outline of King Oscar land has also been copied, but in this instance the bearing of the central peak, already given, serves to define its azimuth with respect to Cape Brorok.

On the other hand, Payer's survey enabled me to locate two islands which now for the first time appear in the map. With Payer's permission, they are named after Brosch and Orel, the two officers of the *Tegetthoff* who so ably contributed to the scientific results of the expedition. Of these, Brosch island is a bold rock or cliff to the south of Kuhn island, near which the survey shows a third very small island still unnamed. Orel island lies to the south-east of the Klagenfurt group; it is nearly covered with snow, through which a few rocks show on the side towards the south. It is well located by favourable bearings taken in part on October 19, 1873, at a time when the *Tegetthoff* seems to have remained stationary for a whole day in the well-defined position shown on the map. There is also a small island, or rather rock, in the strait between Schönau and Koldewey islands, scarcely worth mentioning did it not repeatedly occur in the survey. It occupies the centre of the cut on p. 106, vol. ii., of 'New Lands,' in front of Schönau island, Cape Berghaus lying to the right in the distance. The high ground far to the east in Wilczek Land, also now indicated for the first time, was seen by Payer from his station three-fourths of the way up Cape Tirol at 10 a.m. on April 18, 1874, its estimated distance being 40 nautical miles. I have not succeeded in making out the situation of the westernmost of the Hochstetter islands, for which the single bearing from Cape Frankfurt is therefore shown by a dotted line on the map. Every name used by Payer in his work, 'Die österreichisch-ungarische Nordpol-Expedition in den Jahren 1872–1874' (Wien, 1876), has been retained, excepting Cape Buda Pest, Rawlinson sound, and Braun island, the existence of which seems very uncertain. It is also far from certain that the northern part of Wilczek Land, as now drawn, is not made up of several snow-covered islands.

Certain lines in the sketches made at 7 p.m. on April 7, and at noon on April 9 seem to have been drawn under the impression that the land to the west was continuous right up to Prince Rudolf Land. This impression appears to have been first dispelled on the ascent of Cape Schrötter on the evening of April 9, by the discovery of the sound leading to the west between Karl Alexander Land and Prince Rudolf Land. Unfortunately, the survey leaves the latitude of the southern boundary of this sound more than usually uncertain.

Payer measured the heights of a number of the mountains, partly with the aneroid barometer and partly with the theodolite. The aneroid-readings for three points only are entered on the survey sheets, while there are twelve points for which theodolite elevations are available. These latter seem never to have been worked out, except in the case of Richthofen peak, the details of their computation may therefore not be uninteresting. In conformity with the notation of the original map, the heights are stated in Vienna feet, of which 3·1635 go to a metre; to reduce to British feet, multiply by 1·0371. The heights have been computed by the well-known formula:

$$h - h' = d \cos (z - \tfrac{1}{2}d' + \rho) \operatorname{cosec} (z + \rho)$$

where h is the height of the observed object; h', that of the instrument at the observing-station, both above sea-level; d, the horizontal distance between the station

and the object in terms of the unit of height; d', the same distance in arc; z is the observed zenith distance, and ρ the terrestrial refraction. If d' is expressed in minutes of arc, and d in Vienna feet, then $d = 5886{\cdot}4d'$ in the latitude of the southern part of the map. The coefficient of refraction has been taken at 0·0894, as derived from the observations of the second German arctic expedition. To keep well within the mark, I have assumed the height of the instrument to have been 15 feet above sea-level at the ship and also at the station on or near an iceberg on May 3, 1874. Whenever the height of the theodolite above the surface enters into the computation, it has been taken equal to 5 feet. In the third and penultimate columns of the following tables, it will be noticed that the quantity sought is the height of the observing-station.

It may be well to add a few words respecting the trustworthiness of these results. The heights of Salm island, Cape Brünn, and the corner of Cape Tegetthoff, being derived from favourable angles of elevation, must be very nearly correct; with one exception, they are the only altitudes obtained directly from observations near the level of the sea. The altitude of Cape Littrow, being derived from that of Cape Brünn, is naturally somewhat less certain, and this uncertainty is increased in the deduction of the height of the summit of Cape Tegetthoff; but as this comes out 229 feet higher than the well-determined corner of that promontory—a difference which must be very near the truth, to judge from the various sketches which show both these features—it may be inferred that no great error has crept in. The Wüllerstorf mountains being fully 30 nautical miles from Cape Littrow, the angles of elevation of their summits are necessarily small, and correspondingly uncertain; the theodolite, however, was read in both positions for the higher summit, thus excluding any considerable error. Furthermore, we have the operation on the summit of Schönau island on April 22, making that station 1893 feet lower than the highest of the Wüllerstorf mountains, or 516 feet above the sea. This result does not differ excessively from Payer's estimate of 400 feet, considering the very roundabout way in which the computed altitude has been derived—the line of sight having traversed 80 miles of air.

I come now to the much-criticized Richthofen peak. This mountain was seen and sketched by Payer, not only from the summit of Cape Brünn, but also from an indeterminable point several miles further west, where he obtained a better view of Markham sound than was possible from his trigonometrical station on the cape just named. The elevation of the peak from the summit of Cape Brünn was determined in both positions of the instrument, the readings being 0° 22′ and 0° 30′, giving 0° 26′ as the elevation. To make sure that the readings corresponded to an angle of *elevation* and not of *depression*, Payer made two diagrams of the relative positions of the nonius and the zero point of the circle. Half the difference of these readings gives an index correction of 4′, in fair agreement with other determinations about that date. It is subtractive for the position in which Payer generally used the instrument. The distance, d', I have assumed so as to locate the mountain on an island of unknown extent, described by Jackson as "high rocky." Its altitude then comes out 4296 Vienna feet, as entered on the new map. If the peak is assumed to be on the fifty-fifth meridian, the height will be reduced to 3330 feet, while it can be no more than 2880 feet if it is but 20 nautical miles from Cape Brünn. But it is not at all likely to be so near, or Payer could hardly have estimated its distance to be 60 nautical miles, when the Wüllerstorf mountains were distinctly visible, in nearly the opposite direction, at a distance which we now know to be 40 miles, and of which Payer must have had a good general idea. From these considerations it seems very probable that Richthofen peak is to be looked for at no considerable distance from the point indicated on the map, and that its height does not differ greatly from 4000 feet.

COMPUTATION OF HEIGHTS ABOVE SEA-LEVEL FROM MEASURES WITH THE THEODOLITE.

Station ...	Ship.	Ship.	Cape Littrow.	Cape Littrow.	Cape Littrow.	Cape Littrow.	Cape Littrow.	Cape Littrow.	Iceberg.	Iceberg.	Schönau island.	Cape Brünn.
Date	Aug. 31, 1873.	Aug. 31, 1873	March 13, 1874.	March 13, 1874.	March 13, 1874.	March 13, 1874.	March 13, 1874.	March 13, 1874.	May 3, 1874.	May 3, 1874.	April 2?, 1874.	May 2, 1874.
Object ...	Salm island.	Hall island, south-west cliff.	Cape Brünn.	Cape Tegetthoff, summit.	Wüllerstorf mountains (2)	Wüllerstorf mountains (3)	Hill near Cape Oppolzer.	Cape Triest.	Cape Brünn	Cape Tegetthoff, corner.	Wüllerstorf mountains (3).	Richthofen peak.
h'	15·0 ft.	15·0 ft	[1623·5 ft.]	1279·4 ft.	1279·4 ft.	1279·4 ft.	1279·4 ft.	1279·4 ft.	15·0 ft.	15·0 ft.	[2409·0 ft.]	1628·5 ft.
d' (arc) ...	0° 19·60′	0° 37·40′	0° 10·65′	0° 5·10′	0° 30·45′	0° 30·60′	0° 15·52′	0° 23·95′	0° 12·70′	0° 4·55′	0° 26·15′	0° 37·60′
ρ	0° 1·75′	0° 3·34′	0° 0·95′	0° 0·46′	0° 2·72′	0° 2·74′	0° 1·39′	0° 2·14′	0° 1·14′	0° 0·41′	0° 2·34′	0° 3·36′
z	89° 32·00′	89° 54·00′	89° 45·50′	89° 37·50′	89° 53·00′	89° 51·00′	89° 54·50′	89° 59·50′	88° 51·25′	87° 21·50′	89° 28·50′	89° 34·00′
$h-h'$ ...	1209·9 ft.	1367·9 ft.	−314·1 ft. / −5·0 ft.	214·7 ft.	1016·7 ft.	1129·6 ft.	315·4 ft.	424·0 ft.	1608·5 ft.	1250·3 ft.	−1887·8 ft. / −5·0 ft.	2668·0 ft.
h (Vienna feet) ...	1225	1383	Cape Littrow, 1274	1494	2296	2409	1595	1703	1623	1265	516	4296

Aneroid-readings were taken apparently on three ascents only—those of Capes Tegetthoff, Littrow, and Brünn—and only on the last occasion was the temperature of the air recorded both at the summit and at the base of the elevation. The available materials, interpolated where necessary, are shown below, together with the resulting heights, h, computed by Rühlmann's tables.

COMPUTATION OF HEIGHTS FROM ANEROID-READINGS.

Date.	Aneroid-reading.		Temperature.		$h-h'$	Assumed. h'	h		Eminence.
	Upper.	Lower.	Upper.	Lower.			By aneroid.	By theodolite.	
	mm.	mm.	C.	C.	feet.	feet.	feet.	feet.	
1874, Mar. 12	726·00	763·57	−31¼°	−31¼°	1128·1	15	1143	1494	C. Tegett., summit.
„ „ 13	736·00	770·50	−43¾°	−43¾°	971·1	15	986	1274	C. Littrow.
„ May 2	717·65	765·20	−21¼°	−12·31°	1520·5	15	1535	1623	C. Brünn.

It will be noticed that the heights are in every case much less than those obtained with the theodolite. The difference is most likely owing to the effect of the intense cold on the delicate mechanism of the instrument employed, for it is least in the case of Cape Brünn, which was ascended under more favourable conditions than the other summits, as far as mere temperature was concerned, although the wind made the ascent the most trying that Payer ever made. In the absence of any information respecting the temperature-coefficient of the particular aneroid used, it is obviously impossible to place any confidence in the heights obtained with it. The readings on March 13 prove, however, that the aneroid barometer still works at a temperature when the freezing of the quicksilver stops the action of the ordinary barometer. Future experiment must determine whether the indications of the aneroid at these low temperatures can be treated in such a way as to give the true pressure of the atmosphere.

The heights obtained with the theodolite have alone been entered on the map, from which I have omitted the heights given in the original, as these seem to have been merely estimated. It is by no means unlikely, however, that Schönau island is not so lofty as the computation makes it, but it seemed best to retain all the computed heights, as the actually measured differences of altitude cannot be far from the truth.

The accuracy of the survey is very different in different parts. In the south all the more prominent points are so thoroughly connected with each other and with the base by well-conditioned triangles, that errors so large as 200 metres are scarcely to be apprehended in the whole stretch from Cape Oppolzer to the Wüllerstorf mountains, Orel island, and the position of the ship on October 18 and 19, 1873. Fully as accurate are the stations on the ice on March 31, April 1, and May 3, as well as the station at the foot of Cape Frankfurt occupied on April 21. In this section the agreement between the new map and the original chart published by Payer is almost perfect in all essential particulars. In Austria sound considerable discrepancies between the two maps make themselves evident, probably the reason being that the Austrian cartographer who constructed the chart relied to a considerable extent on the estimated distances covered by the explorers on their marches, whereas I mainly based the reconstruction on the observed latitudes, adjusting these by the smallest possible quantities that served to bring them into practical agreement with the recorded azimuths. In this way, after repeated trials, I succeeded in obtaining a network of triangles embracing the various

stations on the ice as far as and including Cape Brorok. To judge by the agreement of the bearings, it does not seem that these stations can be in error to the extent of much more than a nautical mile either in latitude or longitude. Probably the same degree of accuracy will be found in the positions of the Stoliczka islands, of Kane island, Coburg island, Hohenlohe island, the eastern shore of Rainer island, and the eastern summit as well as the general outline of Becker island. On the other hand, Cape Tirol, having been passed in cloudy weather on the northward journey, and having been observed from Cape Brünn under unfavourable conditions as to the stability of the theodolite, may be several kilometers wrong in latitude, although its longitude is well defined by azimuths from the neighbourhood of Cape Frankfurt.

The following table shows the various observed latitudes,* together with the observations on which they are based, as well as the final adjusted latitudes used for the map. The greatest differences, M—O, between the map and observations occur on March 31 and April 1, for which the positions on the map are derived solely from that of the ship by means of the triangulation.

The greatest error in the original map is in the north-eastern part, where Payer shows the large Dove glacier extending far to the north, in place of the open sea with a solitary group of islands which Nansen found in that region. There seems little doubt that Payer on his northward journey mistook fog-banks on the eastern horizon—possibly in combination with the ice-hummocks, which would naturally be formed on the margin of the fiord ice—for an extension of Wilczek Land towards the north beyond the latitude of 81° 5′. This mistake is the more pardonable from the fact that Payer seems certainly to have obtained a glimpse of one of the islands just mentioned on the afternoon of April 7, 1874, which he named Freeden island, a name which has been very properly retained by Nansen. At 6.15 p.m., on the day in question, Payer made a halt on the ice, Cape Beuermann bearing west-south-west (true) at an estimated distance of half a nautical mile. At this point he noted that in exactly the opposite direction land was distinctly visible, which he described in these words: "The Ostland knoll 25–30 nautical miles distant—a cape, perhaps a north corner of an island jutting this way towards the west." † The atmospheric conditions were extremely favourable for seeing objects at a great distance. The day had been bright and clear, with a shade temperature of −16° R. at 8 a.m., rising to −13·1° R. at noon, as recorded on the survey sheet. The clearness of the air is attested by a black-bulb reading of +3·5° R. at 2.30 p.m. Under these circumstances, as the sunlight came more and more from the west the visibility of objects in the east would be increased and there would be every possibility of seeing land at the distance named.

The existence of Hoffmann island seems to be placed beyond doubt by two pairs of azimuths, observed at 8 a.m. and at noon, also on April 7, the island subtending angles of 23° 13′ and 26° 2′ respectively at the two stations. According to the sketches, it is completely covered with snow, and rises only slightly above the level of the sea. This may account for its not having been noticed by Nansen and Johannsen on their kayak voyage towards the west.

In the relative positions of the objects around Hohenlohe island, the new map differs considerably from its predecessor. In the original map the southern extremity of Crown Prince Rudolf Land is several minutes too far north. I have

* The latitudes are practically identical with the provisional results entered on one of the survey sheets.

† The words in the survey sheet are, "Die Kuppe des Ostlandes, 25–30 S. M. fern, ein Cap, vielleicht ein Nordeck einer Insel die nach W. hereintritt."

DETERMINATION OF LATITUDE FROM THE OBSERVED GREATEST ALTITUDE OF THE SUN'S UPPER LIMB.

Date, 1874 ...	March 31.	April 1.	April 3.	April 5.	April 7.	April 8.	April 9.	April 11.	April 12.	April 16.	April 17.
E. longitude ...	3h. 56m. 8s.	3h. 57m. 4s.	3h. 56m. 4s.	3h. 57m. 8s.	3h. 57m. 28s.	3h.57m. 38s. ±	3h. 56m. 8s.	3h 53m. 40s	3h. 50m. 40s	3h. 54m 4s.	3h. 54m. 44s.
ThermometerR.	−20·7°	−16·4°	−13·2°	−2·6°	−13·1°	−12·2°	−8·2°	−12 5°	−11·0°	−14 0°	−12·0°
Barometer ...	766 mm.	765·8 mm.	755·6 mm.	752·8 mm.	759·9 mm.	755·8 mm.	754·5 mm.	760·2 mm.	761·1 mm.	747·5 mm.	746·9 mm.
	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″
Refraction ...	+0 4 21·4	+0 4 10 8	+0 3 58·0	+0 3 37·0	+0 3 44·7	+0 3 39·1	+0 3 30 8	+0 3 27 8	+0 3 25·5	+0 3 0·5	+0 2 53·3
Parallax ...	−8 6	−8·6	−8·5	−8·5	−8·5	−8·5	−8 5	−8·4	−8·4	−8·3	−8·3
Reduction to meridian ...	−0·7	−0·7	−0·7	−0·7	−0·7	−0·7	−0·7	−0·7	−0 7	−0·6	−0·6
Sun's declination ...	+4 8 23·6	+4 31 33·0	+5 17 39·4	+6 3 21·8	+6 48 39·9	+7 11 9·1	+7 33 32·3	+8 17 56·0	+8 39 57 1	+10 6 19·1	+10 27 30·8
Sun's semid. ...	+16 2·1	+16 1·8	+16 1 3	+16 0 8	+16 0·2	+15 59·9	+15 59·6	+15 59·1	+15 58·8	+15 57·8	+15 57·5
Observed Zen. distance ...	75 47 30·0	75 31 0·0	75 11 8·0	74 37 45·0	74 14 45·0	74 0 30·0	73 44 15·0	73 3 0·0	72 58 15·0	70 47 15 0	70 14 0·0
N. latitude by observation	80 16 8	80 22 36	80 48 38	81 0 35	81 23 1	81 31 9	81 37 8	81 40 14	81 57 27	81 12 24	81 0 13
Latitude used in map ...	80 13·4	80 21 3	ditto	80 59·6	ditto	ditto	ditto	ditto	ditto	81 13·4	81 1·3
Map − Observation ...	−2·7	−1·3	—	−1·0	—	—	—	—	—	+1·0	+1·1

located Cape Brorok in accordance with the meridian observation taken there on April 11, together with various bearings of Hohenlohe island; that island in its turn being well determined by several bearings recorded on the 7th and 9th of that month, as well as the latitude of the latter date. Cape Rath, too, seems to be well defined, and there is just a possibility that Cape Buda Pest may also exist as a small island separated from the adjoining land by a narrow strait, somewhat uncertain indications of land in that position having been observed on two occasions.* Andrée island does not seem to exist, except as the eastern end of Karl Alexander Land, there being no certain traces of a strait in the survey. Indeed, the data regarding the whole eastern and south-eastern shores of that land are very uncertain, as the Austrians passed it, for the greater part, in foggy weather. I have marked by red lines those bearings which seemed the most reliable. Deak island is fixed solely by a single, but perfectly reliable, azimuth from the noon station of April 16. Dr. Nansen has kindly shown me his sketches of the southern part of Crown Prince Rudolf Land, together with photographs of the coast near Cape Felder; they confirm Payer's survey sheets in the most satisfactory manner.

In Markham sound the coast-line necessarily remains very uncertain, only a few of the principal capes being laid down from cross-bearings. In the south-west I have restricted myself to indicating the few azimuths that seemed likely to be useful to any future surveyor.

In bringing to a conclusion this endeavour to utilize to the utmost the cartographic materials collected by Payer and Weyprecht, I cannot but express my admiration for the skill and energy displayed by those distinguished explorers. To Weyprecht, geography is indebted for the thorough manner in which he imparted to the fundamental points of the map all the accuracy with which he had determined the position of his astronomical observatory. To Payer's daring in extending his survey to so great a distance from the ship, no less than to his skill and indomitable energy, we owe our first map of Franz Josef Land, in which, in spite of imperfections, the region traversed by him is laid down in such a way that any explorer following in his track will be able to correct the few oversights inevitably incidental to a first exploration.

THE NEW RAPID ON THE YANG-TSE.

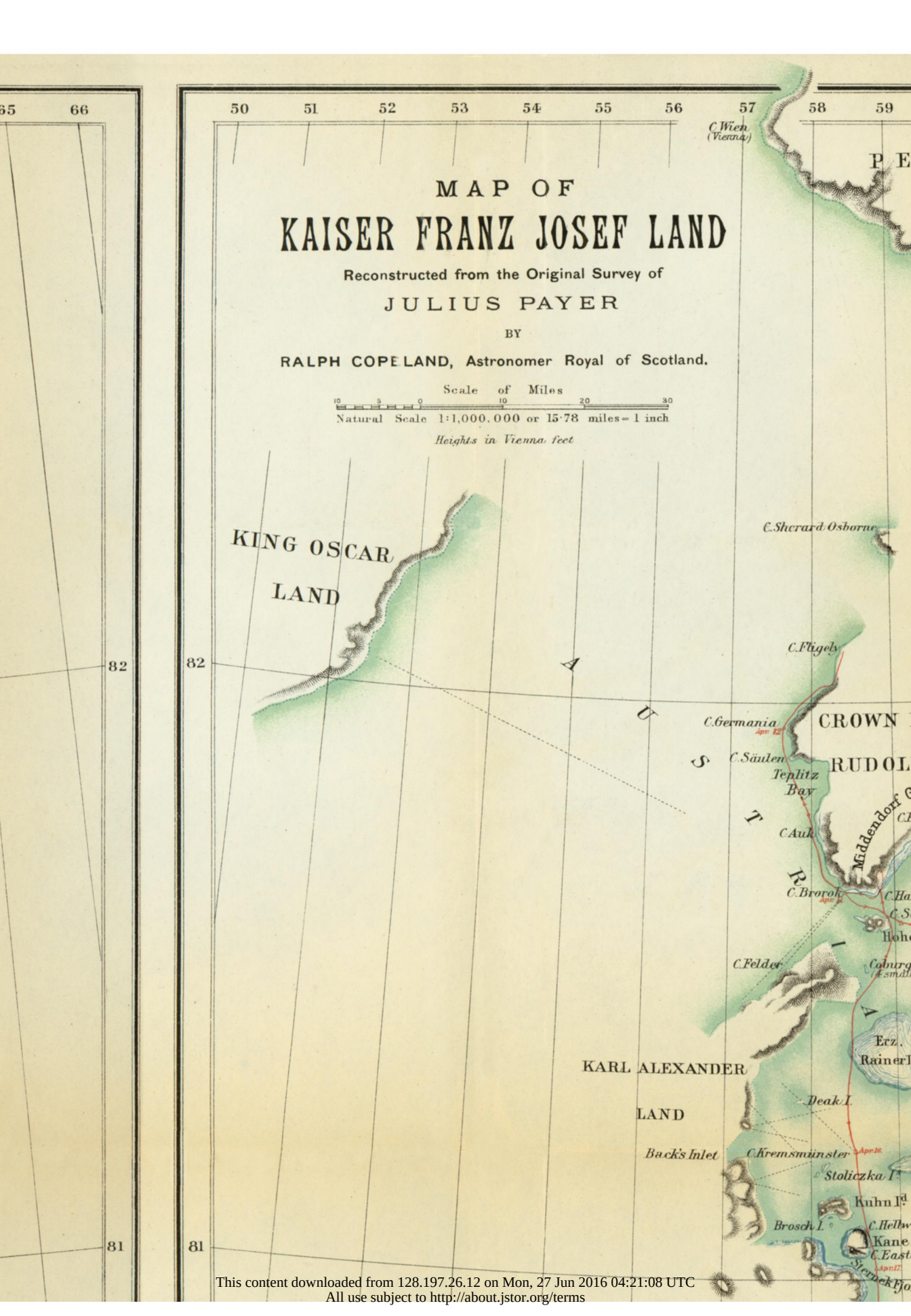
THE following extracts, giving some account of the new rapid on the Yang-tse, caused by a landslip, are from a letter from Mr. F. S. A. Bourne, H.B.M. Consul, who is in charge of the Blackburn Commercial Mission to China. It is dated—

On the Yang-tse off Feng-tu Hsien, December 18, 1896.

Messrs. Neville, Bell, and myself, accompanied by Mr. Cecil Hanbury, of Shanghai, whom I had invited to join us on the junk voyage from I-chang to Ch'hung-king, arrived at K'uei Fu in lat. 31° N. and long. 109° 30′ E. on December 1. We heard in more precise terms here news, the rumour of which had rather disconcerted us at I-chang, "that a hill had fallen into the river and made a fearful rapid that we certainly could not pass." On December 6 we reached the small town of Yün-yang, and learnt that the magistrate had that morning left for the new rapid.

The next day we left Yün-yang at dawn, and, after passing through high mountains

* The Norwegian explorers, however, who passed within about 15 miles of Cape Rath, saw no traces of any island in the position indicated.



55 56 57 58 59 60 61 62 63 64 65 66

C. Wien (Vienna)

PETERMANN LAND

EF LAND

Survey of

R

l of Scotland.

30

iles = 1 inch

C. Sherard Osborne

C. Fligely

82

C. Germania Apr. 12

CROWN PRINCE RUDOLF LAND

C. Säulen

Teplitz Bay

Middendorf Glacier

C. Rath

Island doubtful

C. Auk

C. Brorok Apr. 14

C. Habermann

C. Schrotter Apr. 9.

Hohenlohe Id

Freeden Id

C. Felder

Coburg I. (& small Islands near) Apr. 8.

7 p.m. 6·15 p.m.

C. Beuermann

Erz. Rainer Id. Apr. 7.

8 a.m.

Hoffmann Id

ARL ALEXANDER LAND

Deak I.

Back's Inlet

C. Kremsmünster Apr. 16.

Becker Id

Stoliczka I. Apr. 6.

Kuhn Id

Brosch I.

C. Hellwald

Kane Id

C. Easter Apr. 17.

C. Bates

La Ronciere

Lindeman Bay

81

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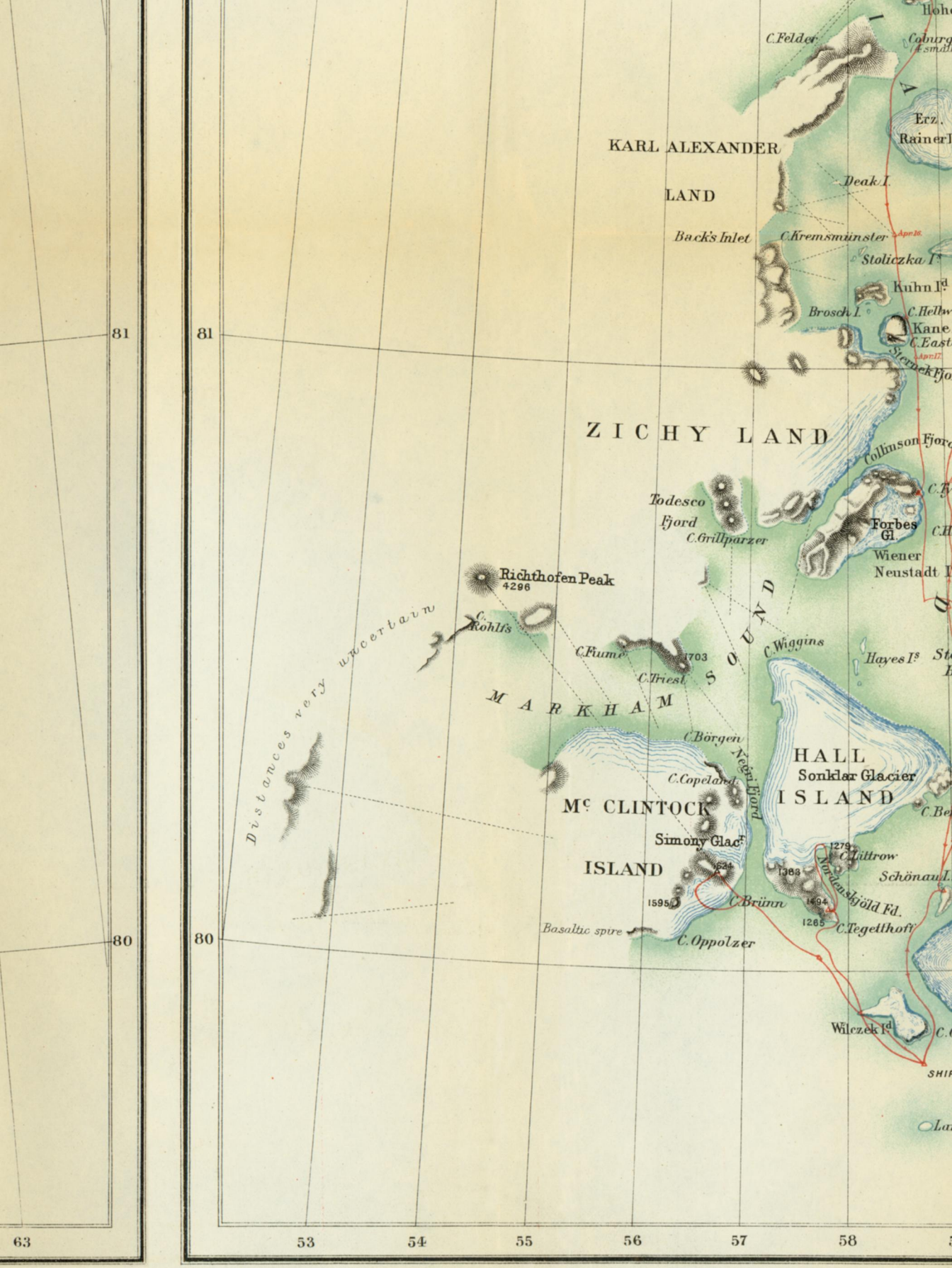

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