Cloud Observations 1927.
(Met. Office)

From Wm. H. Hobbs
Ann Arbor, Mich.

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~~D.C.~~

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The instrumental outfit for aerological and meteorological work consisted of the following instruments:

1	Mercurial Barometer
3	Aneroid Barometers
3	Self recording barographs
2	Thermohygrographs
1	Single register, for recording wind velocity
1	4 Ft standard wind vane
2	Nephoscopes
4	extra sets anemometer cups.
1	New type three cup anemometer
1	German precision Hygrometer
1	U.S. Weather Bureau hygrometer
	maximum thermometers,
	minimum thermometers.
	exposed thermometers,
	wet bulb thermometers,
	water thermometers.
1 C	Complete Solar Radiation outfit.

The Aerological instruments were as follows:

1	Buff and Buff theodolite
1	Definite light balance
3	Fergusson Meteorographs
1	Captive balloon reel and 3000 meters .010 wire.
2	Paterson type hydrogen generators,
	calcium hydride.
	6" pilot balloons, assorted colors
	1½ meters captive balloons.

Observations were made at the Observatory by the Aerologist, a trained Weather Bureau man. Owing to many duties devolving on the small party left at Mt. Evans many observations that had been planned were not attempted. Observations were made regularly and systematically in consequence of which a complete record has been obtained.

On arrival at the base camp, Camp Lloyd, all supplies were unloaded from the shooner "Hvalrossen" and a temporary camp erected. As all the meteorological equipment was packed in small packing cases it was thought best to leave all met-

The theodolite stand was an old two man carrier that had been used for handling rocks. The three legs of the tripod had been nailed to this carrier and then large rocks weighted it down so it resembled a huge cairn rather than a stand.

The Buff & Buff theodolite no 13047 was always left mounted on this stand and this was covered with a large sounding balloon. The theodolite and stand withstood all the high winds and the theodolite never was taken indoors. As is customary in that climate all guns, camera, and metal instruments wer left outdoors. To bring any metal object from the cold outdoors to the warm interior would have caused the formation of condensation or frost. This would melt in a few moments and the metal would soon become rusty or deteriorate. To bring the thodolites indoors would have caused the same trouble, so it was always left outdoors mounted on the stand.

The rain and snow gauge was secured in an open spot, well exposed to all winds. The snow gauge was at one time blown away and it became necessary to call into use the reserve one. The first was eventually found five miles away from the Observatory. The snow readings were measured by Weather Bureau methods, that is, first measuered with the measuring stick and then again melting the snow and measuring again for the water content. The readings by m measuring stick were alwyas verified by readings at, from 3 to 10 places around the region of the gauge. The water content, taken by measuring the snow on the lake and obtaining the water content, px showed this ratio, 1 to 10 (that is ten times the depth of water gave depth of snow). This verification was made several times during the season and the same result obtained.

The nephoscope was placed on a small stand about 2½ ft. above the ground and was used to determine direction only. The cloud observations, by use of the nephoscope, had been one of the studies that had been planned but had to be abandoned. The nephoscope was used only for verification purposes and used about 4 times daily. On cloudless days the nephoscope was taken off the stand and the solar radiation instrument placed on it.

One end of the meteorological observatory was called the meteorological corner. It was here, on an improvised stand, that the various meteorological instruments were located. The single register was securely fastened to the top of this stand. The wiring from the anemometer passing thru the outer wall, connected to dry batteries and then to the register. The single register record was always visible and easy to read. The sheets were changed at twelve noon daily. If a long trip to the lower camp had been planned, the sheet would be taken off at time of departure, and an extra sheet placed on the cylinder and this was replaced by the reular sheet upon the return to the observatory.

Captive balloon equipment ~~balloon~~, together with 3 Fergusson meteorographs were included in the Expeditions equipment. These captive balloons would inflate to a 1½ meter diameter. To fill that large a balloon it would require enought hydride to fill ten pilot balloons.

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One of the main essentials in the taking of aerological amd meteorological observations is to obtain a continuity of observations. With the small amount of hydride on hand and with the long winter ahead of us it was decided to abandon the captive balloon work and concentrate on pilot balloon observations. This plan proved very wise, because when the new Assitant Aerologist arrived in May 1928 with a new supply of hyrdide only one half can of the 1927 supply remained on hand.

This eliminated the loss of record and from the time the clock was first started up until the departure of the Aerologist on May 26th, 1928, no wind record was lost.

The mercurial barometer was securely fastened to a "2 X 4" and suspended from leather straps. The braograph whoch at first had been placed close to the mercurial barometer was later placed in the inner storeroom. The heat from the stove affected the barograph considerably so it was necessary to place it where the temperature remainded constant.

The arrow on the shaft of the wind vane was made of light metal. This arrow would always point out the direction of the wind to the eight cardinal points.

All these meteorological instruments were so placed that the Aerologist could lie in his bunk at night and read the instruments. The anemometer directly overhead kept an incessant rattle and chattering during the storms and would, during the severest ~~stroms~~ storms, roar so loudly that sleep was impossible.

The observations of wind direction were made every hour ~~hxxxxn~~ by eye. This observation was jotted down on standard forms. Even during the nightthe habit of reading this wind vane became so automatic, that ~~the~~ together with the radiomans assistance not one hours observations was missed.

The self recording barograph, thermohygrograph and single register recorded the pressure, temperature, humidity, and wind velocity, continually. These records were carefully verified twice daily by eye observations and proper corrections have been entered on the proper sheets.

Cloud observations were made every second hour from eight am to eight pm. The amount, kind, and direction, were noticed and when any direction was doubtful the direction was verified by the nephoscope.

Aerological observations in the Arctic regions being very scarce, it was one of the chief purposes to obtain upper air data.

The 6" pilot balloons were always inflated to a definite lift of 180 meters per minute. This lift was determimed by use of the U.S. Weather Bureau definite lift balance.

Hydrogen was generated by the mixture of calcium hydride and water. A small generator that had been perfected by Dr. Patterson of the Canadian Meteorological Service proved successful except in extremely cold weather. The hose leading from the generator to the definite lift balance would accumulate water vapor. This would freeze solid and a passage for the hydrogen would be blocked. This difficulty was overcome by using the outer storeroom. The Delco power unit being in this storeroom, would when running, heat up that room considerbaly. It was then only necessary to inflate the balloon in that storeroom and force it thru the narrow door.

ecrological equipment intact until the permanent site for the winter camp had been selected.

In order to obtain the highest perfection of aerological and meteorological work it was of course necessary to be very careful in the selection of a site. An unobstructed view of the horizon, together with a nearby essential water supply xxxxx and an accesible trail had to be looked for. With these three essentials in mind, we finally agreed on Mt. Evans.

The Mt. Evans peak was 1294 feet above sea-level, had an unobstructed view in all directions and a trail altho three miles long led up to it and afforded one fairly good walking. A lake not more than 50 meters away contained water of good taste and no saline efflorescence. The top of the peak was flat and covered about two acres of tundra and flat rock.

All supplies were carried to the summit on the backs of the members of the Expedition and Eskimo laborers. It was not until July 20th that the Observatory was ready for meteorological equipment.

It had been my plan to connect up the wind velocity recorder on that date but the recording sheets had been left at the lower Camp and it was decided to ppx postpone it until the next day.

That whole day had been cloudless and wind had been really calm. No outside indications had shown any evidence of a storm but still there seemed to be a feeling or an insight that a storm was in the brewing. This feeling could not be shaken off and to satisfy my own curiosity a special trip was made to the lower camp for the records. The sheets were placed on the cylinder and the first mile recorded at 6:10PM. XXX After 8PM the wind became increasingly gusty and all during that night a xxxxmstorm that recorded 81 mph. kept up. The three cup anemometer was expected to blown off the post but it worked admirably and a complete record was obtained. from that time on.

During the next few days an instrument shelter, similiar to the old French pattern, was made from old scraps and boards. TThis was securely guyed down at all corners and weighted with large rocks. It faced North and was well ventilated. In it were installed the wet bulb, maximum ad minimum thermometers, together with a German precision hygrometer and our best thermo-hygrograph.

The new three cup anemometer was securely fastened to a "four by four," twenty four inches above the top of the northeast end of the roof and connected electrically to the single register. A 4 Ft. standard wind vane was mounted on bearings in the center of the roof, a shaft extending thru the roof into the interior.

CLIMATE OF INLAND GREENLAND

During the special trip of July 27 - August 17 to the Inland Ice the writer was requested to make meteorological observations to supplement those made in 1909 (June 26-July3) by Otto Nordenskjold (1) and to lay out a basis for further studies in the future.

The presence of the sea on the west and the Inland Ice to the east made such a study attractive not only because it represented the green portion of Greenland but because it offered an experimental field for the study of the Anticyclonic High.

The methods employed were typical of reconnoissance work. The Danish weather station at Holstensborg was again used as a basis of comparison but with the addition of the balloon station at Camp Little as an intervening point. The records at the former station represented readings taken daily at 8:00 A.M. and 9:00 P.M. Those at Camp Little were continuous traces of temperature, pressure, and humidity, while the readings on the Inland Trip were taken every 3 hours throughout the 24 hour period. A sling psychrometer, aneroid barometer, anemometer, and pocket compass made up the outfit. Except for four days at the Inland Ice, the party was practically in constant motion. However, the topography was not sufficiently diverse to prevent the combination of the daily readings into individual groups.

Because Greenland has been rated as semi-arid rather than moist, comparison is further made with the hill country at Lake Tahoe and Reno on the eastern slope of the Sierra Nevada which forms the western edge of the Great Basin.

Individual but similar periods rather than normals are compared. The period for Greenland covers July 27-August 17 and for the Sierra Nevada, August entire. The evaporation studies, however, cover the period of August 18-September 2 after the return from the Inland Ice.

(1) Geog. Zeitschr. XX 9-11, 1914 ff.

I. Temperature

The disparity of 11.9 F found by Nordenskjold to exist between Holstensborg and Inner Greenland sinks to 1.4 F under a longer comparison and more frequent readings. However, the temperature shows a steady though slight increase from the ocean to the Inland Ice. Length of record and lack of space will force the use of means and extremes in this and other tables:

	Holstensborg	Camp Little	Inland	Sierra Nevada (Reno)
Mean Daily Temp.	47.8[1]	48.6	49.2	69.6
Max. Temp.	57.6	69.0	64.0[2]	97.0[3]
Min. Temp.	39.7	32.0	31.0	36.0
Mean Daily Range	9.6[4]	17.8	18.7	34.6

1. Reduced from 49.4 on the basis of more numerous daily measurements at Camp Little.
2. Possibly lower than at Camp Little because of increase in elevation.
3. Maximum temperature on Mt. Rose (10,800 ft.) near Reno 72.3 degrees, or practically that at Greenland.
4. Uncorrected range 4.4 degrees, caused by lack of minimum temperature in record. Minimum occurs approx. 2:00 a.m.

On the basis of the mean of 48.4 degrees F for June-July 1909, quoted by Nordenskjold, the present season in Greenland could not have been abnormally warm. The only abnormal element must have been the lack of precipitation or wind, the lack of either of which would increase human comfort noticeably.

II. Relative Humidity

The relative humidity of Inland Greenland is only slightly less than at the head of the fiords. However, it is lowest at the edge of the Inland Ice, thus indicating a gradual decrease inward from the sea. Unfortunately, no humidity measurements at Holstensborg are available.

	Holstensborg	Inland	Sierra Nevada(Reno)
Mean Daily Humidity %	70.6[1]	63.7	25.3
Mean " Max. " %	86.9	78.9(Tasersuak)	39.3
Mean " Min. " %	52.4	44.7(Edge Inland Ice)[2]	16.3

1. This represents a correction of approx. 7% for instrumental error. If applied throughout the entire series the mean would have been 2% higher still.
2. The mean for 3 days at Inland Ice was 51.9%, thus substantiating the statement of Captain Kock, regarding the heavy disposition of frost on garments on the trip across.

III. Precipitation

Unfortunately, sufficient data are lacking for the study of relative precipitation between sea and Ice Cap. The following annual means for Godthaab and Kornok, the latter somewhat farther inland than the former, indicates diminution of precipitation with distance from the sea.

Godthaab	Kornok	Sierra Nevada
		Tahoe (6,225 ft) 31.40 in.
26.50 in.	15.0 in.	Reno (4,500 ft) 8.35 in.1

1. Lower and farther from the sea.

The following records, though scanty, indicate an interrelationship between the coast and interior with decrease inland, if the average of all storms is taken.

	Holstensborg	Inland
Aug. 10	0.20	0.03
Aug. 15	"Taage"=Fog	0.01

Except for condensation showers, mainly on the flanks of Mt. Pingo, precipitation appeared to be borne inland from the sea. This is quite in keeping with the lower humidity at the Inland Ice and the drying effect of the foehn or stroph. A series of snow surveys from the sea inland should quickly settle the question.

IV. Wind Movement and Cloudiness

The wind movement in summer is apparently sluggish, yet its mean compares favorably with that in the foothills of the Sierra Nevada, Holstensborg is added for such value as its Beaufort Scale may have. An anemometer has more recently been installed there by the Expedition. Owing to lack of continuous records of wind movement at Camp Little during the inland trip, records for Aug. 18 to Sept. 2 are used.

1 - Wind Movement

Holstensborg	Camp Little	Inland	Sierra Nevada
Mean Hourly velocity 2.5 (Beaufort)	At Beach 2.8 mi. (surface of tundra) On Radio Hill 6.9mi (450ft. above fiord)	3.9 mi.	Reno 8.0 mi. Tahoe 3.2 mi. (protected)
Max, Hourly velocity 6. (Beaufort)	. , , ,	11.0 mi. (3 hr. period) Prob. 25 mi. in gusts.	

2 - Wind Direction

During the brief trip in late June and early July by Nordenskjöld, the wind direction was generally east. Longer observations, but later in the season, indicated that the wind is controlled somewhat by the wide area of warmer land between the sea and the Inland Ice, the movement being west at the sea and east at the Ice Cap. The common frontier when conditions approach balance or tranquility seems to lie slightly above Tasersuak.

The prevalence of the west wind was particularly noticeable in the orientation of the snow cornices at the mouth of Ikertok Fiord, upon the north arm of which Camp Little is situated, and in the sand erosion at the head of its central arm, known as Akudglek. On the other hand, at the head of Kangerdlugssuak, (Sondre Stromfiord), which extends through the land barrier to the edge of the Inland Ice, the prevalence of the east wind or its power is strongly marked, according to Nordenskjold, by the absence of lichens on the eastern face of the rocks. The winter freezing and consequent cooling of this land area, should cause the prevalence of east winds to the sea, quite irrespective of the marked contrast in temperature in sunless winter between the Ice Cap and the open sea.

3 - Cloudiness

The increase in cloudiness from 28.0 per cent at Holstensborg to 38.1 per cent Inland may indicate the meeting of the moist wind and the drier and colder east. (1) However, this does not harmonize with the decrease in precipitation eastward already noted. On the other hand, the actual appearance of stratus clouds near the wind frontier with clear skies over both sea and Inland Ice seems to illustrate the principle but probably under tranquil conditions. In the case of the more vigorous stroph the resulting precipitation should occur nearer the sea.

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(1) The mean daily temperatures at Holstensborg and the Inland Ice Aug. 4-8, was 52.5 degrees F and 46.7 F; 55.6 F and 48.7 F; 54.5F and 52.5 F; 54.3 F and 48.1 F; 53.1 F and 47.3 F respectively. Even if the readings at Holstensborg are reduced 1.6 degrees to make them more comparable with those taken on the Inland trip, they would still be higher than the latter.

V. The Stroph

The characteristics of a foehn or stroph, set forth vividly by Rink (Hobbs, Glacial Anti-Cyclone, p.68) were repeated in the experience of August 5-9 at the Inland Ice.

At noon of August 5, the day after our arrival, the barometer began falling, attaining its maximum fall of 0.17 in. by 9:00 o'clock in the afternoon and then slowly rising until the following morning, but recovering entirely by 3 o'clock noon of the 8th, when the return trip was begun. The east wind, which had prevailed thruout August 5, increased in intensity during August 6, attaining an average hourly velocity for the 24 hour period of 11.8 mi. and a maximum of probably 25 miles in the gusts, the wind then dying down thruout August 7 to half the velocity or an average of 6,6 miles.

The cloudiness increased from 5 per cent on the morning of the 5th when the stroph began, to 90 per cent at 9:00 p.m. that evening and continued thru the 8th, with average cloudiness of 72.9, 83.3 and 96.6 per cent for the three days. The cirro-stratus clouds which developed immediately over the Ice on the 5th, became lenticular with cirrus background on the 6th, attaining large size and number at the apex of the stroph.

Consequent upon the foehn character of the stroph, the mean temperature Aug. 6, when the stroph was most active was 52.5 degrees F compared with 48.7 and 48.1 of the day immediately preceding and following. Likewaise the relative humidity fell from 53.9% on August 5 to 44.7% on August 6, but recovering to 57.1% on the following day.

Late on August 7, as the stroph waned, the sky suddenly became overcast and continued thus until the morning of the 9th, with light precipitation. At the time of overcasting a west wind was blowing aloft, and a west wind blew at the surface from midnight until morning of the 8th.

A similar phenomemon was noticed at the head of Akugdlek, August 24-27, when with a falling barometer a clear wind blew from the east, oscillating with rising barometer to the west and accompanied by heavy precipitation. In the latter case, the stroph operated nearer the sea with consequent increase in precipitation. Herein possibly lies the explanation of the anomaly that the weather at Camp Little is fair with falling barometer but stormy with rising.

An unexplained anomaly in connection with the stroph of August 5-9, however, is the close agreement of pressure changes at the Ice Cap and Camp Little, 70 miles apart, and the divergence of Holstensborg, less than half as far to the west (see appended chart). Is this divergence an error or did the low fade out abruptly?

VI. Water and Soil Temperatures

1-Water

A series of measurements inaugurated during the trip to the Inland Ice indicates that the soil rather than the Ice Cap is the cause of the low water temperatures which prevail, aided somewhat by supercooling at night.

The following measurements out of many will illustrate:

Water Flowing from Inland Ice

	Degrees
Water flowing over surface of Inland Ice	32.0 F
Water flowing over rocks one-fourth mile down stream from Ice	42.0
Water in Glacial Lake (Lake Yost) fed by above stream	50.0

Waters Unconnected with Inland Ice

Lake Off~~ley~~ielt - water under tundra on hillside	36.0
Lake Off~~ley~~ - water in lake	55.0
Semi-underground stream from Off~~ley~~ielt to Aussivigsuit Tasiat	46.0
Outlet of Aussivigsuit Tasiat	55.6
Tasersuak (20 mi. long) In blue water	69.0
Camp Little - Bog	33.0
Camp Little - Water Fall Creek	42.0

2 - Soil

The reason for these persistently low temperatures was traced to the eternal frost that exists even at the end of the season at the depth of 16 to 23 inches beneath the surface. The following observations, among others, were made at Camp Little:

July 10	Remnant of ice found at 6 in. depth under tundra	
Aug. 19	5 1/2 in. In humus above clay soil	42.0 F
	7 in. In clay	36.2
	16 in. Clear Ice	

In northern Greenland, the frost line is said to exist only one foot beneath the surface, while at Godthaab, 200 mi. south of Camp Little, the soil temperature in August even at the depth of 1 meter (or more than twice that of the frost line at Camp Little) is 12.1 degrees F above freezing.

VII. Evaporation

Quite in keeping with the low temperature of air and water and the relatively high humidity is the low rate of evaporation/and transpiration found to exist, the former being approximately 1 inch compared with more than 7 inches at Lake Tahoe. Furthermore, the period represents one of the two warmest months in an apparently dry summer. Thus the enigma of light precipitation and vigorous growth becomes explicable. The experiment was conducted with Mt. Rose apparatus and methods used in studying evaporation of snow. Owing to lack of space, only the following summary is given:

Camp Little (August 18-September 2) Water (in)	Camp Little Tundra (In)		Sierra Nevada Lake Tahoe (August) Water (In)	
Evap. -0.553 in.	Transpiration and Evaporation	-0.416	Evap.	-7.330
Condensation(dew) +0.103 in.	Condensation (dew)	0.132	Mean temp. of air	60.0 F
Net Bal. 0.450 in.	Net Bal,	-0.284	Av. Wind	3.2 mi.
Equivalent for 30 days -0.90 in.	Equiv. for 30 days	-0.568	Rel.Humid. (Reno)	25.3%
Temp.of water in pan 37.0 -51.0F	Temp. of tundra in pan	(46.0°F at 2 1/2 in. (39.8°F at 4 in.		

Mean temp. of air	44.6 F
Average wind	2.8 Mi. per hour
Rel. Humidity	64.0%

The evaporation of water would have been somewhat greater if the water level could have been nearer the top of the pan. On the other hand, the evaporation from the tundra would have been less, if rains caught by the pan had not raised the water level higher than it normally exists in tundra.

Owing to the slight difference between the wind movement at the pans and in Inner Greenland, the evaporation measurements can be roughly applied elsewhere, except on the higher hills where the wind movement, as indicated by that at Radio Point, is probably three times as great.

VIII. Human Comfort

The following elements of an optimum day in Greenland are given to show how misleading ordinary shade temperatures are:

August 7. On banks of Lake Yost at Edge of Inland Ice.
Temp. in shade (if there were any) 49.0 F
Temp. in sun 66.0
Humidity 71.0% Clouds 50% mainly cirrus
Wind 4 mi. per hour.

Excerpts from diary: "makes one drowsy," Dr. Hobbs; "A good place to bask in the sun on the warm hillside on the heather with the lake plashing on the rocky shore." Church.

Either shade or wind would have quickly brought discomfort.

IX. Alkaline Waters

To test the distribution of alkaline waters discovered by Nordenskjold at Ilivilik and Itivnek, a sample of water was taken from a pond at the summit of the pass above Tasersuak. It contains in general the same elements as the other waters, except that the quantity of SO_3 is far less. This pond is fairly representative of all other ponds without outlet on the route to the Inland Ice.

The analysis, which follows, was made by Wayne B. Adams, Chemist of the Division of Food and Drugs Control of the University of Nevada, as a voluntary service to the Greenland Expedition. The analyses by Nordenskjold are also given for purposes of comparison.

	Ilivilik	Itivnek	Above Tasersuak
SO_3	44.31%	50.55%	23.6%
CL	9.07	8.80	5.0
CO_2	- --	0.85	- -
Fe_2O_3-Al_2O_3	- --	2.80	- -
MgO	3.48	2.98	5.8
CaO	3.21	- --	16.5
Na_2O	28.19	33.02	23.3
K_2O	4.99	1.00	2.6
Silica SiO_2			4.0
Iron and Aluminum Oxides			16.4[1]

1. "Iron and Aluminum content would probably be lower when the water was fresh and in its original state."

X. Ocean Temperatures

Owing to the paucity of data on ocean temperatures north of Newfoundland, the following selected readings are given in conclusion. In the fiords and Holstensborg Harbor, the readings were made directly from a small boat. In the open sea a tin bucket was used, two samples being taken each time for purposes of check.

Sept. 3-4	Maligiak, Ikertok, and Amerdlok Fiords	42.0 - 47.6 F.
5	Holstensborg Harbor	43.0
7	Davis Strait	51.5
	Open Sea	44.6
11	Nearing Labrador Coast (Continental Shelf?)	41.5
12	9:00 a.m. Leaving Coast	43.0
	3:30 p.m. In Iceberg Lane (Labrador Current?)	37.2
13	Within Sight of Land " "	38.7
14	8:00 a.m. Off Cape Harrison " "	38.7
	10:00 a.m. Entering Inlet east of Indian Harbor	43.3
15	Off Battle Harbor	45.5
16	Inside Belle Isle Strait	45.3
17	Harbor of Lance au Loup in Straits	43.0
18	In Gulf of St. Lawrence	54.9
	6 p.m. near Point Rich	55.6

In general the air matched the water temperature, but no detailed measurements were made. The close correspondence between the temperature of Holstensborg Harbor and Lance au Loup are notable, but perhaps even more so is the sudden rise in temperature within the Gulf of St. Lawrence, which indicates freedom from the possible effects of the Labrador Current.

J. E. CHURCH, JR.

Mt. Rose Observatory.

Reno, Nevada

October 17, 1926.

CLIMATIC RECORD OF INLAND GREENLAND

July 27 - August 17, 1926

Date		Station	Temperature Mean °F	Temperature Daily Range °F	Relative Humidity %	Cloudiness %	Wind Mi. Hourly	Precipitation	Remarks
July	27	Tasersuak	52.8	11.3	53.3	—	—		
"	28	Pass above Tasersuak	52.2	21.0	61.8	50?	—		
"	29	Foot of Aussivigsuit Tasiat	51.6	14.5	62.4	27.5	—	Light Rain T	
"	30	Head of Aussivigsuit Tasiat	49.1	21.7	63.6	2.3			
"	31	Lake Offley	47.1	22.0	62.3	37.0	4.0	Rain Streamers in East.	
Aug.	1	Near upper end Kardligsuit	48.2	19.0	64.9	43.3	3.7	Rain Streamers on SW Horizon	
"	2	Lake Emmons	48.7	27.4	59.6	52.6	3.3	Fog	
"	3	Mountain Valley	47.5	29.6	56.8	12.9	3.4		
"	4	Mountain Valley to Ice Cap	46.7	21.0	59.0	30.8	3.0	Haze over Ice Cap.	
"	5	Camp Cooley edge of Ice Cap	48.7	16.2	53.9	29.0	4.6		
"	6	Camp Cooley edge of Ice Cap	52.5	7.8	44.7	72.9	11.8		
"	7	Camp Cooley edge of Ice Cap	48.1	7.5	57.1	83.3	6.6		
"	8	Ice Cap toward Mountain Valley	47.3	7.5	74.3	96.6	0.3	Sprinkling T	
"	9	Mountain Valley-Lake Emmons	51.4	17.5	66.1	66.3	3.6	Light Rain T	
"	10	Lake Emmons-Lake Offley	47.6	12.7	67.5	50.4	3.2	Rain.03 in.	
"	11	Lake Offley-Lower end Aussivigsuit Tasiat	49.0	25.9	69.0	1.4	2.2		
"	12	Lower end Aussivigsuit Tasiat-Tasersuak	52.5	28.0	65.5	16.9	5.8		
"	13	Tasersuak	47.0	12.2	77.2	5.5	1.9		

Tasersuak

COMPARISON OF TEMPERATURE AND HUMIDITY AT HOLSTENSBORG, CAMP LITTLE AND INLAND GREENLAND

July 27 - August 17,1926

Date	Temperature °F Holstensborg Mean	Holstensborg Range	Camp Little Mean	Camp Little Range	Inland Greenland Mean	Inland Greenland Range	Station	Elevation Ft. above sea level	Relative Humidity % Holstensborg	Camp Little	Inland Greenland
July 27	45.7	6.3	49.5	9.5	52.8	11.3	Tasersuak		—	77.7	53.3
" 28	50.0	4.5	46.8	11.0	52.2	21.0	Pass above Tasersuak		—	86.0	61.8
" 29	51.1	2.0	46.1	19.0	51.6	14.5	Foot of Aussivigsuit Tasiat	426	—	85.9	62.4
" 30	49.5	3.4	47.6	28.0	49.1	21.7	Head " " "	426	—	80.0	63.6
" 31	51.1	2.2	45.2	17.0	47.1	22.0	Lake Offley		—	86.9	62.3
Aug. 1	53.8	2.7	49.7	19.0	48.2	19.0	Near Upper End Kardligsuit	820	—	84.5	64.9
" 2	53.6	2.2	50.9	31.0	48.7	27.4	Lake Emmons		—	62.4	59.6
" 3	53.1	1.6	50.4	14.0	47.5	29.6	Mountain Valley		—	61.3	56.8
" 4	52.2	1.4	49.8	32.0	46.7	21.0	Mountain Valley to Ice Cap		—	65.3	59.0
" 5	55.6	3.4	53.4	33.0	48.7	16.2	Camp Cooley:Edge of Ice Cap	1312	—	57.0	53.9
" 6	54.5	3.1	54.6	16.0	52.5	7.8	" " " " " "	1312	—	69.1	44.7
" 7	54.3	5.6	47.8	8.5	48.1	7.5	" " " " " "	1312	—	80.7	57.1
" 8	53.1	2.5	47.8	6,0	47.3	7.5	Ice Cap toward Mountain Valley		—	72.1	74.3
" 9	50.7	1.4	51.2	14.0	51.4	17.5	Mountain Valley-Lake Emmons		—	57.9	66.1
" 10	45.9	4.5	48.3	10.0	47.6	12.7	Lake Emmons-Lake Offley		—	71.8	67.5
" 11	44.1	5.0	46.0	21.0	49.0	25.9	Lake Offley-Lower End Aussivigsuit Tasiat		—	65.3	69.0
" 12	43.7	9.2	46.0	14.5	52.5	28.0	Lower End Aussivigsuit Tasiat-Tasersuak		—	68.4	65.5
" 13	47.5	7.2	43.9	14.5	47.0	12.2	Tasersuak		—	70.5	77.2
" 14	43.9	7.0	43.9	15.0	46.2	23.0	West End Tasersuak		—	67.6	77.5
" 15	44.8	10.4	47.3	17.5	46.8	17.0	" " "		—	65.1	78.9
" 16	43.9	5.9	52.4	26.0	51.7	21.0	" " "		—	52.4	63.6
" 17	44.4	5.9	50.3	14.5	50.2	27.0	Tasersuak-Itivnek		—	64.6	62.2
Mean	49.4*	9.6**	48.6	17.8	49.2	18.7			—	70.6	63.7
Max	57.6		69.0		64.0***						
Min	39.7		32.0		31.0						

*Corrected from 47.8 for lack of min,temp. readings only 8 a.m., 2 p.m., and 9 p.m.
** Corrected from 4.4 for lack of min. temp. factor of diff. between min. and 9 p.m. 5.2 F.
*** Lower max. due to elevation above sea level.

For American Meteorological Society

MEASUREMENTS OF EVAPORATION AND TEMPERATURES OF SOIL AND WATER IN SOUTHERN GREENLAND

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I. Evaporation

The general thriftiness of the vegetation in Greenland despite the precipitation of approximately 1 inch per month then prevailing, caused the writer to inaugurate a series of experiments in evaporation in connection both with the tundra and open water surfaces. The result shows that the evaporation during the two warmest months in an apparently dry summer exceeded but little, if any, the precipitation, thus leaving the winter accumulation of moisture in the humus and underlying blue clay for purposes of growth or reserve.

The experiment was conducted with Mt. Rose apparatus and methods used in studying the evaporation of snow, the pans being kept nested in the tundra to maintain the temperature of their contents at normal and weighed at such intervals as would represent differences in temperature, wind, and humidity. The main divisions were night and day with a few periods of twenty-four hours or longer. This would afford an opportunity to study the effects of night and day when they were growing slowly more diverse as the equinox approached and would show to a limited extent the relative potency of the factors of temperature, humidity, and wind. To simplify the comparison, the average hourly rate of evaporation is given as well as the average temperature, humidity, and wind.

The detailed table follows:

EVAPORATION - CAMP LITTLE, GREENLAND

August 18 - September 2,1926

Date	Length of Period (Hours)	WIND: End of Period Direction	WIND: Movement (Mi.per Hr)	HUMIDITY: Per Cent	RAIN (In)	TEMPERATURE °F: Air	Water in Pan	Tundra in Pan	Soil Under Pan
August									
18-19:7P.M- 6:20 A.M.	11	N	1.3	74.0		46.8			4 1/2 in=39 6 in = 37
19:7:50 P.M.	13.5	SW	6.7	70.1		51.3	48.0		
20:7:30 A.M.	12	E	1.1	85.2		42.2	44.2	2 1/2 in=46 4 in = 39.8	
21:7 P.M.	35.5[1]	SW-S	4.2	72.0	0.08	43.8			
22:7:15 P.M.	24.3	WofS	2.5	67.9		41.6	45.0		
23:9 A.M.	14	SW	0.6	77.0	T	40.1	43.0		
" 6:30 P.M.	9.5	N-NE	1.7	53.8		50.0	47.0		
24:9 A.M.	14.5	NE	3.0	63.3		37.6	32.0 Frozen 3mm.		
27:12 noon	75	E-mostly mostly W	2.8	68.1	0.33[3] after 9 A.M. of 25th.	41.9	45.4		
28:6 P.M.	30	WofS	1.9	54.8		44.8	51.0		
29:6:15 P.M.	24	SE	1.9	App.50.6[4]		app43.7[4]	49.0[5]		
30:7:30 A.M.	13	SE	1.2	64.2		37.6	32.0		
6:40 P.M.	11	NE	2.2	56.2		47.2	47.8		
31:7 A.M.	12	EofS to WofS	1.5	67.5		36.3	Pan frozen 3 mm		
7 P.M.	12	EtoNE	4.7	36.8		49.6	46		
September									
1:7:30 A.M.	12	E	2.9	56.0		38.3	33		
6:30 P.M.	11	EtoSofE	5.3	39.5		47.9	45[6]		
2:6:10 A.M.	12	NtoE Gusty	4.7	55.0		38.5	30		
Total	14.4 days		2.8mi.	61.8		43.3	41.9		

Wind on Radio Hill 6.9 mi.
" in Inner Greenland 3.9 mi.

EVAPORATION

Tundra Total	Tundra Aver. Hourly	Water Total	Water Average Hourly
-.001	.0001	+.0005	.00005
-.038	.0029	-.074	.0054
+.002	.0002	-.005	.0004
+.130	mostly rain	+.102	mostly rain
-.046	.0019	-.049	.0020
+.018	.0013	+.026	.0019
-.043[2]	.0045	-.031	.0033
-.017	.0012	-.024	.0017
+.500	Mostly Rain	+.404	Mostly Rain
-.082[2]	.0027	-.076	.0025
-.052	.0022	-.064	.0027
-.0185	.0014	-.029	.0022
-.0325	.0030	-.037	.0034
-.003	.0003	-.031	.0026
-.034	.0028		
-.007	.0006	-.019	.0016
-.035	.0032	-.072	.0065
-.007	.0006	-.042	.0035
-.416		-.553	

Summary

	Tundra	Water
Evaporation	-.416	-.553
Condensation (Dew)	+.132	+.103
Net Balance	-.284	-.450
Equiv. 30 days	-.568 app.	-.900 approx.

NOTES:
1. Rain storm two days. Snow on mountains
2. Exceeds evaporation from water surface since the rain. Is this due to high water level in pan? Has happened twice.
3. Total precip. for storm probably .50 in. or even more. Excess in water pan is .404 in. over the evap. for 75 hours,
4. Interpolated
5. No ice in pan, but ice in canvas bucket.
6. At surface 30 degrees; at 1 inch depth 31.

The evaporation of water would have been somewhat greater if the water level could have been nearer the top of the pan. On the otherhand, the evaporation from the tundra would have been less if rains caught by the pan had not raised the water level higher than itnnormally exists in tundra.

Owing to the slight difference between the wind movement at the pans and in Inner Greenland, the evaporation factor obtained can be roughly applied elsewhere, except on the higher hills where the wind movement, as indicated by that at Radio Point, is probably three times as great.

The comparison of evaporation losses from open water surfaces and from tundra is interesting because of the relatively small loss from the latter. Experiments by C. B. Ridgaway (Wyoming Exp. Station Bulletin No.52) indicates that the evaporation from soil with water level 6 in. below soil surface is 95 per cent of that from a free water surface, or if soil is kept loosened to the depth of 6 in., the evaporation would be diminished 45 per cent or reduced to 54 per cent of that from a free water surface. Yet in the present instance the soil protected by the thick mat of tundra has lost only 63.1 per cent including the amount transpired by the latter.

This shows vividly the xerophilous or "drought loving" character of the Arctic tundra, developed according to Schimper[1] and Kihlman[2] not from lack of precipitation but from impeded water supply caused from the permanent presence of ice in the ground.

Major Factors Affecting Evaporation

The factor of greatest potency appears to be the humidity, as shown in the evaporation of August 19 and September 1. For example:

	Humidity %	Wind (Mi.P.H.)	Temp. of Air	Temp. of Water	Evap. (In.Hrly)
Aug.19	70.1	6.7	51.3 F	48.0 F	.0054
Sep. 1	39.5	5.3	47.9	45.0	.0065

This is quite convincingly shown in the comparison of evaporation in Greenland and the Sierra Nevada later in this paper.

The factor second in potency is the wind, as is shown by comparing August 23 and 30 with August 19 above:

	Humidity %	Wind (Mi.P.Hr)	Temp.of Air	Temp.of Water	Evap. (in.Hourly)
Aug.19	70.1	6.7	51.3 F	48.0 F	.0054
(Aug.23	53.8	1.7	50.0	47.0	.0033
(" 30	56.2	2.2	47.2	47.8	.0034

1. Plant Geography
2. Pflanzenbiologische Studien aus Russisch-Lappland.

However, in the measurements taken by night, the evaporation is so small that variations seem to be smaller than the instrumental error. At least, all relationship between either humdity or wind and the evaporation is lost.

Comparison of Evaporation by Day and Night

The evaporation by day is thrice that at night, This is natural for all elements favoring evaporation are uaually in the ascendency during the day, as lowered humidity, increased wind, and higher temperature of air and water. At Camp Little the wind was mainly of the sea-breeze type, i.e. due to diurnal heating. The wind by day was double that at night, while the humidity was one-fourth, actually 24.3 per cent lower. Details are given in the following table:

	Humidity %	Wind (mi.p.hr)	Temp. of Air	Temp. of Water	Evap. (in.Hourly)
Day	51.3	4.1	49.2	47.0	.0047
Night	67.8	2.0	40.0	35.7	;0015
Mean of Day&Night	59.6	3.1	44.6	41.4	.0031
By Approx. twenty Four hour periods	57.8	2.8	43.4	48.3	.0024

Comparison of Evaporation in Greenland And at Eastern Base of Sierra Nevada

Quite in keeping with the low temperature of air and water and the relatively high humidity is the low rate of evaporation found to exist, this being only 1 inch as compared with more than 7 inches occurring the same month (August) at Lake Tahoe in the Sierra Nevada. All factors of evaporation are diverse except that of wind, the increase in the latter at Tahoe being only 0.4 mi. per hour. For purposes of comparison, the entire table is given:

Evaporation, Aug. 1926

	Greenland	Sierra Nevada
Humidity	61.8%	25.3% (Reno)
Temp.of Air	43.3 F	60.0 F
Movement of Wind	2.8 mi.Hourly	3.2 mi. Hourly
Evaporation(Tundra	0.568 in. app.	
(Water	0.90 " "	7.33 in. (Water)

Comparison of Precipitation-Evaporation Ratios In Greenland and Western United States

On the basis of measurements of precipitation and evaporation at Camp Little for the two weeks of Aug.20-Sep.2 and measurements for the entire growing season in the Western United States in 1887-88 (Carnegie Institution Publ.284,Tab.15), the ratio of precipitation to evaporation in the former exceeds that at the following representative stations in the latter by from 17 to 410 per cent.

Station	Precip. (in)	Evap. (in)	Ratio %
Greenland			
Camp Little	0.650	0.553	117.5
Western United States			
Chicago	10.18	15.5	65.7
Des Moines	12.43	15.5	80.2
Topeka	13.95	13.9	100.4
North Platte	8.39	17.7	47.4
Denver	4.43	27.3	16.2
Santa Fe	6.11	31.9	19.2
Helena	3.87	20.4	19.0
Boise	1.22	25.8	47.3
Salt Lake City	2.09	28.8	7.3
Winnemucca, Nevada	0.98	33.6	2.9
Portland, Oregon	2.97	12.8	23.2
San Francisco	0.18	8.0	2.3

II. TEMPERATURES OF SOIL AND WATER

1 - Water

A series of measurements inaugurated during the trip to the Inland Ice indicates that the soil rather than the Ice Cap is the cause of the low water temperatures which prevail, aided somewhat by supercooling at night.

The following measurements out of many will illustrate:

Water Flowing from Inland Ice

Water flowing over surface of Inland Ice	32.0 F
Water flowing over rocks one-fourth mile down stream from Ice	42.0 F
Water in Glacial Lake (Lake Yost) fed by above stream	50.0 F

Waters Unconnected with Inland Ice

Lake Off~~ley~~ - water under tundra on hillside	36.0 F
Lake Off~~ley~~ - Water in Lake	55.0 F
Semi-underground stream from Off~~ley~~ to Aussivigsuit Tasiat	46.0 F
Outlet of Aussivigsuit Tasiat	55.6 F
Tasersuak (25 mi. long) In blue Water	69.0 F
Camp Little - Bog	33.0 F
Camp Little - Water Fall Creek	42.0 F

field

2 - Soil

The reason for these persistently low temperatures was traced to the eternal frost that exists even at the end of the season at the depth of 16 to 23 inches beneath the surface. The following observations, among others, were made at Camp Little:

July 10	Remnant of Ice found at 6 in. depth Under tundra	
Aug. 19	5 1/2 in. In humus above clay soil	42.0 F
	7 in. In clay	36.2 F
	16 in. Clear Ice	

In northern Greenland, the frost line is said to exist only one foot beneath the surface, while at Godthaab, 200 miles south of Camp Little, the soil temperature in August even at the depth of 1 meter (or more than twice that of the frost line at Camp Little) is 12.1 F above freezing.

The following complete table is appended for those who seek fuller details:

WATER AND SOIL TEMPERATURES
SOUTHERN GREENLAND
-1926-

I.

(1) LAKES and STREAMS

Water Flowing From Inland Ice

On Inland Ice. Surface Water	Aug.7	32.0+	
One-Fourth Mile from Ice - flowi- ing owver rocks	"	42.0	
In Glacial Lake (Lake Yost) fed by above stream	"	50.0	

Waters Unconnected with Inland Ice But Affected by Frost Line

Lake Emmons (1 mi. long)		
Aug. 2 - 6 P.M.	56.0	light breeze from across lake
Aug. 3 - 7:15 A.M.	54.0	Min. air temp 31.0
Aug. 9 - 6:00 P.M.	56.0	
Lake Off~~ley~~ield Extension (near outlet Kardligsuit)		
Aug. 1 - 6:00 P.M.	53.0	
Aug. 2 - 6:00 A.M.	48.4	Min. Temp. 32.6
Lake Offley		
July 31 - 11:50 A.M.	59.0	
July 31 - 6:00 P.M.	57.0	Wind down lake
Aug. 1 - 6:00 A.M.	54.0	In shallow outlet 55 In tundra 1 ft. beneath surface 36.0
Aussivigsuit Tasiat (Head of Lake) (10 mi. long)		
July 30 - 3:00 P.M. Mountain stream flowing under tundra from Lake Off~~ley~~ield	45.3	Effect of low temp. of tundra (36.0) noticed at Offley
July 30 - In Bay at Head of Lake	59.0	Water partially landlocked.
Aussivigsuit Tasiat (Foot of Lake)		
July 30 - 10:15 A.M.	55.6	Breeze from east over Lake.
Little Aussivigsuit Tasiat (1 mi. long)		
In Current of Intake from Large Lake July 30:- 10:15 A.M.	55.6	Intake short. Temp same as in large lake

(1) Water and Soil Temparatures Southern Greenland Cont'd)

Little Aussivigsuit Tasiat (1 mi, long)		
Foot of Lake		
July 29 - 12 noon	60.0	In calm shallows
July 29 - 6:15 P.M.	58.0	Wind from center of Lake all afternoon. Does Lake serve as warming basin for colder waters of large Lake?
Aug. 11 - 3 P.M.	62.5	Only ripples on lake.
Aug. 11 - 6 P.M.	60.3	
Aug. 12 - 6 A.M.	55.2	Min. temp. 41.0
Tasersuak (20 mi. long) Head of Lake		
July 26 - 5 P.M.	49.0	Wind blowing up lake since noon
July 26 - 9:15 P.M.	45.5	Wind still fresh
July 27 - 6:30 A.M.	47.0	Wind quieted
July 27 - 9:10 A.M.	54.0	Calm or rippling
July 27 - 9:20 A.M.	49.0	In blue water. calm
Aug. 12 - 3 P.M.	55.0	Lake stirred by wind
Aug. 13 - 6 A.M.	50.2	Calm. Min air temp 43.0
Aug. 13 - 7:30 A.M.	48.4	In blue water. Breeze from west
Near West or Lower End		
Aug. 14 - 6 A.M.	49.0	Calm. Min air temp 39.2
Head of Southern Arm		
Aug. 14 - 10:10 A.M.	53.0	Very shallow for long distance from shore
At Gate		
Aug. 14 - 3 P.M.	49.0	In deep water

Note: Upper Maligiak Fiord, the lower extension of this system of lakes, showed temperature of 52.0 and 51.5 on Aug. 17 (See II). However, succeeding temperatures were lower.

WATER AND SOIL TEMPERATURES
SOUTHERN GREENLAND
-1926-

I.

(2) TUNDRA and UNDERLYING SOIL

(a) <u>In Wet Tundra or Bog</u>

July 31 - Lake Off~~ley~~ield - Within tundra on hillside	36.0
Aug. 19 - Camp Little - In Bog South of Creek	
1, Very small bog hole. Water exposed to air	~~33.0~~
" " " " Surface	33.0
" " " " 2 in. deep	33.0
" " " " 3 1/2-5in.deep	33.0
" " " " 7 in. deep	33.0
2. Water Hole 12x46 in.	
In shallow arm 1 in. deep	35.0
Sheltered and shaded 4 in. deep	33.0
Against Clay Bottom 12 in. deep	33.0
3. Check - In creek running over rocks	42.0
Aug. 27 - Head of Akugdlek (i.e. Middle Arm)	
Surface of Bog above Beach	35.0

(b) <u>In Soil</u>

Aug. 19 - Camp Little

1. West or Flat Exposure		
Base of shallow roots	2 in. deep	49.0
In damp humus	3 1/2 in "	43.9
"	4 in "	41.2
"	5 1/2 in "	39.0
Upper surface of clay soil	7 in. "	35.2
In clay soil	12 1/2 in"	35.0
"	14 in. "	32.4
2. North Exposure		
(1) In soil protected by tundra		
Just above Clay soil	5 1/2 in."	42.0
On Clay soil	7 in "	36.2
In clay (bulb of therm. not cloth covered)	9 1/2 in "	39.0
" "	11 1/2in "	36.0
" " (Bulb of therm. not cloth covered)	15 1/2 " "	39.0
" "	17 " "	35.2
" "	20 " "	32.2
" "	23 " "	32.1 or 32.0+*
(2) In Exposed Clay		
In clay	6 1/2 " "	41.6
" "	13 " "	37.8
" "	13 1/2 " "	38.4
3. Clay Bank (Steep West Exposure)		
In moist soil	21 " "	38.8
In chamber on solid(?) gravel or frost line	34 " "	34.0

* The rise of the frost line with increase in latitude is shown by the fact that in August at Godthaab, 200 mi. to the south, the frost line is deeper than 1 m., the soil temperature at this point being 12.1 F

(Continued)

(I-(2) Tundra and Underlying Soil Temperatures Continued)

(C) Digging For Frost Line

July 10 - Beneath tundra on brow of hill		4 in.	Thin Ice
Aug. 19 - Beneath tundra			
(1) Drilling in clay		13 1/2 in.	34.2 Degrees F
" "		18 1/2 "	32.8
" "		16 1/2 "	32.8
" "		18 1/2 "	32.5
" "		19 "	32.0**
(2) Open Hole			
In clay		16 in.*	Crystal clear ice Interlarded in clay and upper surface near melting point. Ice seemed to persist with depth at least 1 in. more and also farther as shown by drill.

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*(Note continued from previous page) above freezing, while in Northern Greenland the frost line is said to exist only one foot beneath the surface.

** "Moist; yet soil so firm that it bends drill when hammered down. So must be in a state of freezing. Frost line near here and insulated by tundra."

WATER AND SOIL TEMPERATURES

SOUTHERN GREENLAND

-1926-

II. FIORDS

1. Maligiak Fiord (N. Fork Ikertok)

Aug. 17	Off Belknap Island	52.0	
" 17	N. Head of Univ. Bay	51.5	
" 24	E. Head of Univ. Bay	42.0	
" 24	At Boat Landing Bay	45.0	
Sep. 2	N. Point Univ. Bay	45.6	Flood Tide Afternoon
	S. " " "	45.6	" " "
	Center of " "	45.6	" " "
	W. Point of Island (In Bay)	46.1	" " Shallow
	At tide gage	46.1	" " "
Sep. 3	At tide gage	45.0	Ebb Tide Morning, Temp air during night 28 F.
" 3	Inner edge of Bay	45.0	" " " Water calm.
" 3	Center of Bay	45.6	" " " " "
	S. Point of Bay	45.6	" " " " "
	Anchorage	46.0	" " " " "

2. Ikertok Fiord (Main Arm)

Sep. 3	Head	46.6	Ebb Tide Forenoon Water Calm
	One-third dist. to Sarfanguak	47.0	Tide Rising " " "
	Two-thirds " " "	47.8	" " " " "
	Off inlet to Sanfanguak	47.6	" " " " "

3. Amerdlok Fiord

Sep. 3	Leaving Sarfanguak	44.0	Tide near flood Afternoon
	1/5 dist. to Holstensborg	43.6	" " " "
	1/3 " " "	43.8	" " " " Wind fresh
	1/2 " " "	44.0	" " " " " "
	Nearing the sea	44.0	" " " " " "

4. Holstensborg Harbor

Sep. 5	Near Shore	43.0	Low Tide - calm - forenoon
A.M.	Middle Harbor	43.0	" " " "
	~~to Sea~~ Near Harbor Mouth	43.0	" " " "
P.M. >	Near Shore	43.4	Tide Higher, Fresh Wind from sea. Afternoon
" 5	Middle Harbor	43.2	" " Fresh Wind from sea. Afternoon
" 5	Near Harbor Mouth	43.0	" " Fresh Wind from sea. Afternoon

WATER AND SOIL TEMPERATURES

SOUTHERN GREENLAND

-1926-

III. OCEAN (Davis Strait - Gulf of St. Lawrence)

			Notes
Sep. 8	Davis Strait. 200 mi. S of Holstensborg	41.5	
" 9	275(?) mi. S of "	44.6	
" 9	Working SW toward Labrador. 340 mi. S "	44.2	
" 10	" " " " 500(?) " " "	43.5	
" 10	" " " " " "	42.8	Heavy wind and waves from NE to E
" 11	S. of Hudson Strait. 150 mi. S. of Cape Chidley	43.9	(Due to close approach to shore, where land and bay water is warmer)
" 11	3P.M. Occasional Icebergs (must be within 15 miles of shore)	44.2	
" 12	9A.M. Off Labrador Coast (But farther out)	43.0	
" 12	3:30P.M. Off " "	37.2	Icebergs to starboard all day, some floating ice; air very chilly. Sea becoming rough. Is this Labrador Current?
" 13	7:30A.M. " "	37.2	10 icebergs off starboard bow
" 13	5P.M. Within sight of land. Nearly off Easter Island outside Turnavik	38.7	Icebergs in either side. Jelly fish thick on banks. Almost calm.
" 14	8:20 A.M. Cape Harrison on straboard stern	38.7	
" 14	10:30A.M. Entering inlet E of Indian Harbor	43.3	
" 14	11:30A.M. Between Cutthroat Point and Indian Harbor	43.0	Inside of Islands
" 14	4:30P.M. In open sea off Sandwich Bay	42.8	In open sea. Berg fragments in distance. Temp. of air 42.8 F in sun 44.2 F.
" 15	8:30 A.M. Off Cape Bluff	45.0	
" 15	5:20 P.M. Off Battle Harbor (nearing Belle Isle)	45.5	A few icebergs still along shore and far out. One very large
" 16	8:15 A.M. Inside Belle Isle Strait	45.3	One piece of ice.
" 16	5 P.M. Slightly farther in Strait	44.6	Squall. Several measurements made while rounding iceberg but no variation in temperature of water detected with centegrade scale. Was water mixed by squal
" 17	9:30 In harbor of Lance au Loup (66 mi. South of Belle Isle)	43.0	Nearly calm. Fog. Same temp as Holstensborg.
" 17	5 P.M. " " " " " " "	42.8	Waves running in white caps.

Sep.18	9A.M.	In Gulf of St. Lawrence (20 mi. off Newfoundland)	54.9	Fog
" 18	6P.M.	In Gulf near Point Rich	55.6	

NOTES OF CLOUDS, BALLOONS, PREVAILING METEOROLOGICAL CONDITIONS. METHODS AND EQUIPMENT.

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July 1 to 4, latitude 55° to 62°. Almost continuously overcast low S, fS or fSK prevailing, accompanied by occasional light rain resembling a "Scotch mist".

July 5, latitude 63° to 65°. In the forenoon sky entirely covered with SKN; occasional light rain; temperature of air 3°, water, 2°, (C). In the afternoon a remarkable foehn cloud (low S) formed below the SKN or ASN, extending about 30 kilometres along the coast which apparently was about 30 kilometres east of the position of the Morrissey. This cloud was grey-white and very like the roll that forms in front of KN, but immensely larger. An hour or two after it formed this cloud became diffused and its upper edge, which at first had an altitude of about 25°, passed overhead. Near its southern end, the low ASN and SK above the foehn cloud were fibrous as if blown out from the ice-covered land. (See sketch, Page ,)

July 6, latitude 66° to 67°. In the morning, S and fS changing to fSK and fK prevailed, decreasing in amount from 10 to 6 before noon; during afternoon cloudiness increased and light rain or mist was nearly continuous after 5 P. M.

Landed at Holsteinsborg (latitude 67°, longitude 53°) about 5 P. M. where several hours were spent in an exchange of visits with the local officials and residents. At 10 P. M. we left Holsteinsborg for the head of Maligiak Fjord, the site of our summer camp, arriving at the head of navigation in the early afternoon of the 7th.

July 7. In Camp, University Bay, Maligiak Fjord, latitude 66°, 50'. Sky overcast, light rain in the morning, clearing in early afternoon; temperature of air 15°, water, 11°, nearly calm. The camp is near the shore, 8 metres above mean tide, in a cirque about 1500 metres in diameter, from the floor of which the cliffs surrounding it rise 400 to 500 metres. Exploration of the neighborhood indicates that the region is very rugged, much more so than is indicated by Nordenskjöld's photographs, and that a good site for a meteorological station will be very difficult to find. The average "height of land" appears to be between 300 and 600 metres, and the land surface consists of irregular hills and valleys without vegetation except grass and stunted shrubs in sheltered places. There are literally thousands of small lakes of every imaginable shape and dimensions. Altogether, the conditions for experimenting with limited-height sounding balloons are not at all favorable except during calms.

July 8. Cloudless and nearly calm until late afternoon when brisk sea-breeze set in up the fjord.

July 9. Nearly cloudless, calm and warm; maximum temperature 27° (80° F.), Temperature of water 12°.

July 10. Clear, except low S hiding the ridges opposite camp, 300 to 500 metres above the fjord; brisk sea-breeze in afternoon.

July 11. Overcast with low S touching all ridges in view (300 metres high), but lifting slowly during the day; Temperature lower, 13°, 12° and 8°, morning, noon and late afternoon, surface wind on shore (from west), light sea-breeze in afternoon. Thermo-hygrograph and barograph adjusted and set running, and a small anemometer erected on the storehouse.

July 12. Continued cool, temperature 4° in the morning, rising to 10° in the afternoon. Cloudy, the low S having been replaced by SK level 4 (approximately 1600 m.) Light sprinkles of rain during afternoon and evening.

July 13. Cloudy, slightly warmer, occasional sprinkles of rain.

July 14. Cloudy, four levels of clouds visible, occasional sprinkles of rain

(Notes — continued)

July 15. Overcast all day, low S touching ridges in rear of camp (300 metres), temperature fell after 10 A.M. and a fairly steady rain (the heaviest, so far) continued from near noon through the afternoon and night. Afternoon cold and damp.

Tide-gauge erected and set in operation near the landing.

July 16. A few rays of sunshine appeared through low SK near 9 A.M. but clouds increased later and were attended, by rain which continued through the day, slowly falling temperature which reached 6° before 8 P.M., and a moderate wind sometimes exceeding 10 metres and endangering the tents. m/s

July 17. Clearing; after the lowest ~~temperature~~ ~~reading~~ minimum since arrival (3.5°) the temperature rose and after 10 A.M. the weather became partly cloudy, calm and mild.

July 18. Partly cloudy and mild, nearer fair than any day within a week. Strong sea-breeze and high sea during the afternoon.

July 19. Partly cloudy, almost no wind and warmer, until late afternoon when the sea-breeze caused a sudden fall of about 6°.

July 20. Partly cloudy and warmer, cloudiness increasing to 9 by 7 P.M. The low SK or S increased in height from 980 metres (by dew-point) to about 1200 metres, changing apparently to a low AK moving from azimuth 120° with a velocity of 2 m/s.

The nephoscope, fitted with an improvised eye-piece to replace the original lost on the Morrissey, was used for the first time at 5 P.M.

July 21. Cloudy, mild and almost calm until afternoon

July 22. Clear in the morning, cloudiness increasing to 8 during late afternoon; temperature above normal.

Reuse for final resume

Conspicuous features of the weather of the past two weeks were the excessive amount of cloudiness, the very small apparent velocities of the lower and middle-level clouds, and the small precipitation. No day has been entirely cloudless and on all but one the mean cloudiness has exceeded 7. The prevailing form was a ragged AK having, at times. all the characteristics of SK, but often, at their edges resembling high CK with C fringes. To-day there occurred an excellent example of such a variable cloud-sheet: At first, during the forenoon, there was a typical AK moving very slowly first from NNW and afterward from NW, the relative velocity decreasing from 20 to 11 mm/m. Twice, well-defined CK and C were seen, but careful watching proved conclusively that these latter were develpping from the AK and moving from the same direction at the same velocity. Once the C-CK were definitely below the base of the AK. A pilot-balloon, liberated at 3:16 P.M. disappeared in this cloud at 1900 metres. A lower cloud — apparently a small K and fK — was found to be at a height of 1100 metres at 2 P.M.

The diurnal changes of temperature, wind and clouds are very unusual, compared with similar phenomena occurring along the Atlantic coast. The daily range of temperature is large, probably averaging more than 10° C. and sometimes during several successive days will exceed 15°. The maximum occurs approximately at noon and the minimum between 5 and 7 A.M. although, during storms (such as the three-day storm of last week) there is a tendency for the maximum to occur before noon and the minimum shortly after midnight. The diurnal phenomena of the sea-breeze, already referred to, (a sudden increase of wind up-fjord attended by a rapid fall of temperature and corresponding rise of humidity) begin usually about 6 P.M. but tend to occur earlier and irregularly on cloudy and partly cloudy days. To-day, these phenomena began before noon and there were five rises and falls of temperature with decreasing wind before 7 P. M.

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and increased alternately

July 23, Cloudiness decreased until 9A, then increased; entirely overcast after 6P; occasional ⊘° through evening.
Due to the cold wind prevailing, the afternoon and evening and evening were uncomfortable and dismal.

July 24, Cloudiness dense in early morning, thinning somewhat before noon, the S, which had hidden the ridges disappearing; between 11 A and 4 P., K developed, and were in all respects KN except for absence of thunder and lightning; ~~light~~ ⊘°, showers, between 1 P and 6:30 P.

July 25, Nearly clear in the morning, low fS developing into large K from which ⊘° (showers) fell between 12 M and 1 P; clearing afterward.

in the morning

July 26, Nearly clear; C visible for the first time since our arrival.
Dr. Church taking 3 hourly meteorological observations

The expedition to the Inland Ice left this morning. The personnel is Messrs. Hobbs, Church, Gould and Belknap, aided by four Greenlanders as packers; Mr. David Olsen, local manager of Sarfanguak conveyed the party to the head of the fjord. His entire party, including the Greenlanders, arrived yesterday evening, spending the night at our camp in order to make an early start.
The aerological program at our camp, the most important work of the expedition will be given first place. Three ascensions of pilot balloons are planned for every favorable day, supplemented by limited-height ballons-sondes using the Rossby valve, and by observations of clouds.

July 27, Partly cloudy all day, AK prevailing; C were seen occasionally.

July 28, Partly cloudy generally but almost clear in early afternoon.

B° 11A.

July, 29, The coolest morning so far, temperature 2° at 6 A. Air very clear; cloudiness increased, SK prevailing, and sky became entirely overcast by 8P; ⊘° 3:46 P. and 9:40 to 11 P.

July 30, Clear and cool in the morning, temperature 1° at 6 A., but rose rapidly to 16°, and until 4 P. the day was fine and comfortable. The usual daily "cold wave" (sea-breeze) was less disagreeable than usual perhaps because of continuous sunshine only slightly dimmed by C in the west during late afternoon. The last balloon was checked by observations of C.

July 31, Slightly warmer in the morning, but the usual sea-breeze developed and the afternoon was chilly and uncomfortable.
The tide-gauge, which had been unserviceable for several days was adjusted and re-set; the pens do not seem to function satisfactorily.

Aug. 1

~~July, 31,~~ Warmer in the morning, sky overcast with low AS (ASN) the first time this cloud has been observed), wind almost calm and sea quiet. After the morning pilot-balloon, the course of which indicated very light wind to considerable heights, the first ballon-sonde of the expedition was dispatched. The large balloon carrying the meteorograph, ~~xxx~~ inflated to a diameter of 1.1 metres, had a net lift of 535 grams and was equipped with a Rossby deflating valve the fuse of which was timed for five minutes. Possible sinking in case of falling into water was prevented by placing below the meteorograph three small pilot-balloons inflated with air to serve as floats. Another similar balloon lifting slightly more than its own weight was attached to the large balloon by a cord 10 metres long, to mark the place of descent. The weight of equipment and lift of balloons was as follows:

Meteorograph, basket and parachute,	265 grams
Rossby valve,	55
Fuse, 2.4 metres long,	40
Three 15 cm pilot-balloons for floats	95
One " " " marker,	30
Cord	20
Total	505
Lift, of two balloons,	610
Net Lift,	105 "

The net lift obviously was small considering the large surface exposed, and the balloons rose slowly, passing from the SW surface wind into a northerly current at a height of 350 metres, in which deflation occurred. The valve functioned perfectly and the apparatus landed in good condition about 400 metres south of camp.

Favorable conditions continuing, the experiment was repeated, employing the same apparatus, except that the length of fuse was increased to 3 metres to provide for an ascension lasting 7.5 minutes, and the floats were inflated with hydrogen to secure additional lift. The gas used during the second ascension evidentlyy was inferior to that generated for the first, for, although the same inflation was adopted and the weight of the float eliminated, the rate of ascent was very little better. (It was impossible to measure the lift accurately because of the wind, the velocity of which at times reached 6 m/s.)

This second ascension also was completely successful. Rising higher than those of the first ascension, and remaining in the northerly wind until they had passed south of camp, the balloons returned almost to their starting-point, falling about 50 metres north of the tide-gauge. The rate of descent was about 100 metres a minute. Although the meteorograph had been secured above the float, the weight of the deflated balloon inverted the apparatus and no record was obtained during the descent.

In addition to the two soundings with the meteorograph there were three ascensions of pilot-balloons during the day.

August 2, Nearly clear in the morning, C and CS increasing until noon and afterward slowly decreasing. The afternoon and evening were unusually warm, and the evening ascension of a balloon (the longest, so far) was made in comfort, a breeze dispelling most of the insects ordinarily very troublesome.

Efforts to clean the pens of the tide-gauge were futile and ended in losing both cleaning wires. XXXXXX a spare Marvin "register pen" was XXXXXX substituted XXXX for the glass siphon pen supplied with the instrument and the record resumed. Advantage was taken of the low humidity (24 per cent,) in the afternoon to adjust the thermo-hygrographs for range.

August 3, Partly cloudy and fairly comfortable, although the usual large range of temperature and cool sea-breeze occurred.

August 4, Clear and mild in the morning, nearly calm all day and sea smooth.

A third ascension of ballons-sondes was accomplished, the technique of which was the same as that of the second ascension except that two large balloons were used to secure the lift necessary to carry fuse long enough for a height of 1500 to 2000 metres. The balloons rose vertically, first moving from the west then, after six minutes rose into an easterly wind. Deflation occurred at the time it was expected, XXX the apparatus fell more rapidly than it rose (about 100 metres in a minute) and came to rest in the fjord about 1500 metres west of the starting-point.

The lift of the marker balloon was insufficient to keep the meteorograph and deflated balloon above the water, but although the instrument had been submerged at least 15 minutes before it was rescued, neither mechanism nor record was damaged, the smoked surface of the record-sheet having resisted sea-water admirably.

August 5, Warmer and very pleasant, except for insects which (because of the light wind) were very troublesome.

In view of the demands upon the time and energies of the staff, it has been decided to limit the number of ascensions of balloons to two daily except on unusual occasions, until the return of the expedition to the Inland-Ice.

The Marvin pen on the tide-gauge is very satisfactory and hereafter good records are expected.

August 6, Partly cloudy, AK in early morning succeeded by CS and AS after noon. The AK were typical, having the usual dark shading Later, the same cloud changed first (and slowly) into a ragged C and afterward into C-CS having trailing fibres or plumes. ⊕° was visible when the C form was definitely established. At 2 P. (see observations) C, CS and CK or AK apparently at different levels were observed, but the direction and velocity appeared to be the same. At 3 P. a distinct 22° arc was visible in the dense CK ordinarily classed in Level 2.

August 7, Warmer in the morning, but, due to cloudiness, the temperature changed little until the afternoon fall occurred. Wind gusty; one of several strong puffs, apparently blowing down the slopes from the east, damaged the large tent. ◎° 8 P., continuing through night.

August 8, ◎°, hardly more than a sprinkle, continued until 6 A; Temperature moderate; clouds AK or SK absolutely without motion either at 8 A. or through afternoon. Some S and fS were touching the ridges and no balloons were despatched.

August 9, Apparently clearing in the morning but sky became darkly overcast later and with the usual cool sea-breeze came a light Scotch mist between 4 and 8 P. Chilly and uncomfortable through late afternoon and evening. Pressure highest so far and shows no tendency to fall.

Clouds in afternoon too low for balloon-ascension.

August 10, ∞ apparently through most of night; the usual morning rise of temperature and following sea-breeze occurred, and the early afternoon was very uncomfortable.

The morning ascension was limited by low AK; in the afternoon the balloon rose through an opening in the AK, later disappearing behind this cloud but probably at a much greater height.

August 11, In the morning low, thin S, probably originally ≡, filled the valley about camp; the base was 20 to 100 metres above the water in the fjord. The sun shone through occasional rifts in this cloud which rose and evaporated before noon. After 11 A. the day was unusually fine and pleasant--the air clear and the wind above 2500 metres very strong.

Insects less troublesome, possibly because of cold and damp in the morning.

August 12, In the morning a few wisps of ≡ over the fjord, the sky clear, but AK increased toward afternoon. Temperature mild, becoming uncomfortable in late afternoon.

August 13, ≡ or S nearly on the surface of water in the fjord rose before 11A; temperature moderate and the sea-breeze began about noon.

The morning pilot-balloon indicating ideal conditions for recovering ballons-sondes, and the preceding ascension having failed to reach the upper limit of the easterly wind at the surface, it was decided to use three 35 cm. balloons controlled by 9.2 metres of fuse in an attempt to reach 2300 to 2700 metres. Two of these balloons had already been used in the ascension of the 4th and were employed as markers; the other, a new one, equipped with the deflating valve, supported the meteorograph and its raft of three small balloons moderately inflated. The basket was not used. The data of weight, lift, etc., are as follows:

Weight of three large balloons	495 grams.
" " float-balloons	75
" Parachute,	30
" Rossby valve	55
" meteorograph	185
" fuse (9.2 metres long)	200
Total weight	1040

Total Weight	1640	grams.
Total Lift	1585	"
Excess "	545	"
" Weight, after deflation of one balloon	665	"

The apparatus followed very nearly the course taken by the pilot-balloon launched two hours earlier, but deflation did not occur and after remaining distinctly visible without the telescope during a period of 80 minutes, balloons and meteorograph disappeared behind the cliffs north of camp. The deflating balloon did not burst but the marker balloons did with an interval of several minutes between explosions.

This is the first instance of failure of the Rossby valve and can not be accounted for; the fuse was only 50 per cent longer than that used successfully at a height between 1500 and 2000 metres on the 4th, the height expected entirely too low for failure due to lack of oxygen, or probable sticking of the valve because of cold.

<u>August 14,</u> In the morning, [redacted] rising into S and fS; fK prevailed until afternoon then C. The day was similar in most respects to the four preceding except that the afternoon sea-breeze was not so prominent, consequently the low temperature was less uncomfortable

<u>August 15,</u> Cloudy, cool although warmer than yesterday; (almost no wind or movement of clouds or balloons) AK prevailed but very prominent shower-clouds developed from the S lying over the fjords and ⊘ fell in the afternoon and evening. XXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX These K apparently rose into the AK at 11A, although the bases were hardly above the S level; the tops were surmounted by the cirrus overflow characteristic of KN spreading outward in thin fibres which apparently penetrated the AK without disturbing their appearance or the relative positions of the flocci until after the outspreading had gone on all sides far beyond the original K. Long streamers of ⊘ depended from this shower-cloud which was a true KN ~~except for~~ lacking the usual electrical phenomena. Two specimens of this cloud were observed, one in the NW between 10 A and 2P and another, the base of which was hidden by the ridge east of camp between 4P and 8:30 P. Light showers fell from the latter between 2 P. and 8 P. The AK gradually changed into or were replaced by dense, very high SK; the balloon launched at 6 P. indicated a height exceeding 3000metres. (See sketches)

<u>August 16,</u> Clear, except for a few SK, warmer, wind nearly calm.

This week three balloons will be launched daily at about 9:30 A. 1P and 6 P.

<u>August 17,</u> Clear, warmer and very little wind; insects (chiefly black flies) very disagreeable.

A messenger in the official motor-boat from Holstensborg arrived about 8 A. with a message refusing permission to hunt game out of season, and the use of radio on land.

The Ice-cap party returned at 3P, slightly ahead of their original schedule(due to shortage of food) reporting that a few days were spent near and on the Inland-Ice during which balloons were launched. Meteorological observations were made at frequent intervals during the journey and important data of ice, physiography and geology of the region secured.

August 18, The warmest since the second day after arriving in camp, clear, calm and the sea smooth. Insects most disagreeable.

August 19, Clear, warm in the morning, cool sea-breeze in afternoon.

August 20, Cloudy, AK, and some S over the ridges. The AK gradually became lower and merged into SK from (or through) which [illegible] (showers) fell during afternoon; temperature lower.

August 21, Cloudy, and perhaps the coolest day so far, wind fresh from the West, diminishing toward 8 P. Clouds were of the SKN type, light sprinkles having fallen at intervals of about two hours since yesterday evening. Occasionally a few flakes of snow fell with the rain. The ridges west of the fjord were white with snow and the lower ridge south of camp was white for several hours. Some C were visible through breaks in the SKN and there were excellent examples of C fibres trailing from SK extremely difficult to distinguish from true C. The low clouds had a definite movement from W for the first time since observations began at our camp. The height and velocity of the low clouds were easily determined otherwise and the usual ascensions of balloons were omitted.

Dr. Church has begun measurements of evaporation of water and of the tundra, employing small pans weighed on a spring-balance, also is determining the temperature of the soil at moderate depths.

August 22, Warmer, except in the morning, cloudiness increasing, sprinkles in the afternoon. Clouds in all levels were moving so slowly that changes of form were easily confused with other motions, and it was impossible to measure directions and velocities accurately. Excellent examples of C fringes on SK and it was extremely difficult because of similarity of direction and velocity, to distinguish between true and false C as during yesterday. Good comparisons of aerological and psychrometric methods of measuring heights and velocities of clouds were secured.

August 23, Mostly cloudy, occasional light sprinkles, clouds moving very slowly. Fine examples of K forming from S occurred in the afternoon and comparisons of aerological and psychrometric methods of determining heights obtained. ~~[illegible]~~ As on the 21st and 22d, it was difficult to separate the C fringes of the SK from true C above, both of which were moving from the same direction with the same velocity. At 11A a balloon entered the lower surface of the SKN(from which light sprinkles were falling) and evidently passed through the fringe of C, for it was visible two minutes after it first touched this cloud. Shortly afterward a partial halo (or fog-bow?) was seen above the sun unusual in that it was nearly straight instead of being an arc of a halo. At its upper edge it was 15° or 20° above the sun and about 30° long. The only colors (which were faint)were red and purple, on the lower edge. It was impossible to determine if this bow occurred in the false C fringe on the SK or the C-CS apparently above the SK.

The SKN from which rain or snow fell on the near-by ridges was white and indefinite and resembled the storm-clouds observed in the Sierras. As during yesterday, clouds in all levels moved so slowly that true directions and velocities were difficult to separate from changes of form going on within the clouds.

August 24, Clear and cool in the morning, temperature in the shelter 1°, but ice 5 mm thick formed in buckets in the open air. Sky gradually became overcast with CS, vCS, CS-AS, AS and AK, etc. until noon.

Tide unusually high.

August 25, beginning last night continued practically throughout the day, decreasing to a drizzle during afternoon; the amount was nearly equal to all that had fallen previously since our arrival. The higher ridges across the fjord show an increasing depth of snow. Temperature nearly stationary (4° to 7°). Sky overcast with low, dense SN and no balloons launched.

Manager Olsen of Sarfanguak came in the afternoon with a message (and book) from Dr. Porsild, director of the Arctic Experiment Station at Disko. He (Mr. Olsen) promised to move us to Holstensborg when the time for our departure comes.

Range of tide unusually large.

August 26, Cool, cloudy, low S on ridges; sky gradually cleared during the day.

August 27, Cool, sky overcast with AK which disappeared before noon and increased afterward. The higher ridges remain covered with snow.

The outstanding event of the day was the recovery of the meteorograph and balloons lost on the 13th through failure of the deflating valve -by Dr. Hobbs and Professor Belknap while ascending the snow-covered ridge across the fjord northwest of camp. The apparatus was on the eastern slope of the mountain about 10 kilometres NNW of camp and attracted attention by the contrast of the red silk parachute with the surrounding snow. The probability of finding ballons-sondes in this uninhabited region seldom visited is practically nil and this instance must be considered most remarkable.

The meteorograph was in good condition after two weeks of exposure to weather and the record during the ascension was excellent. Apparently a height between 5000 and 8000 metres was attained. The cause of failure to deflate could not be determined; the fuse had burned through and the rubber band used as a spring was broken or burned through, and the valve was in good condition.

August 28, Practically cloudless, traces of C and K all day; warmer, wind light and sea smooth.

Conditions were most favorable for ballons-sondes and accordingly, one was launched after the noon ascension of a pilot-balloon. The Rossby valve, set to deflate within 15 minutes, was attached to the marker balloon which was inflated to a diameter of 1.1 metres while the balloon carrying the meteorograph was inflated to 1.0 metre. Every precaution was taken to insure proper functioning but inflation did not occur, and the apparatus, rising into a strong NW wind, disappeared behing the cliffs east of camp having probably reached a height of about 8000 metres, while in sight.

It appeared probable that freezing of water condensed in the neck of the balloon (and unavoidable with the generating apparatus in use) prevented opening of the valve, for all experimental trials of the apparatus at room temperatures had been successful and there was no reason to expect failure of the fuse or other accessories.

Dr. Church suggested dispensing with the valve and exploding the balloon with the fuse, thereby saving the weight of the valve and simplifying the technique of this method. Evidently, the valve is rather too uncertain for use in this region.

August 29, Partly cloudy, calm and slightly warmer; a very pleasant day, except that, as usual during such conditions, black flies were particularly annoying.

August 30, C in the morning clearing in early afternoon, temperature moderate and except for cooling at sunset the day was pleasant and comfortable.

August 31, Clear in the morning, C with fine streamers and trailing fibres through afternoon; a very pleasant day.

There are many evidences of the passing of summer; all birds except a flock of ravens on the neighboring cliffs have disappeared leaves are turning red and brown and blueberries are drying.

September 1, Weather much the same as that of yesterday. A radiogram from the Putnam expedition, now en route from Ellesmere Land, states that the Morrissey will call for us at Holstensborg on the 5th, which will allow just time for for packing and stowing for the winter and the trip home. It has been decided that a barograph and thermo-hygrograph are to be left with Governor Bistrup for use at Holstensborg during the winter and one barograph, the anemoscope, nephoscopes, balloon-theodolites, and four anemometers returned to the Weather Bureau.

September 2, Mild and pleasant, fine C and CK nearly all day. The 94th (and final) ascension of a pilot-balloon occurred at noon and all apparatus and equipment of all kinds were dismantled and packed.

September 3, The coldest morning of the season —2° at 6 A., and plenty of ice in basins and on edges of streams. Weather clear and calm.

Mr. Olsen appeared at 10 A. just as the last packing was completed, our apparatus and baggage was placed aboard his motor sloop and the Expedition left for Holstensborg, stopping for luncheon at the Olsen's at Sarfanguak and arriving at Holstensborg about 8P.

A vacant lot just outside the town was assigned us for a camping-place while awaiting the Morrissey and after dinner with Governor Bistrup all our party retired early, much fatigued with a long arduous day.

September 4, Partly cloudy, C prevailing, and cool; ice in the pails and the ground was frozen in places.

September 5, Continued cool, and partly cloudy, fS and fSN in the morning with occasional showers.

September 6, Warmer, cloudy, fS on the near-by mountains clearing before noon leaving streaks of snow. During the afternoon cloudiness increased, the wind rose and rain began in the evening; the weather promises to be stormy and we were told that we might be delayed several days.

The Morrissey arrived in the early morning and because of the impending storm departure was postponed.

September 7,

The storm reached its maximum shortly after midnight, evidently one of the more violent of the season; rain fell intermittently until about 4 A. and the wind was high enough to endanger our tents. At daylight the weather began to clear and the wind rapidly became nearly calm. The temperature continued mild but the mountains were covered with snow down to a height of 500 metres. After 11 A. the sky became almost clear and the remainder of the day was fine and pleasant.

At noon, the sea having become smoother, we broke camp and moved all our equipment aboard the Morrissey whose departure had been fixed for about 3 P. As already stated, a barograph and thermo-hygrograph and an anemometer were left with Governor Bistrup for use during the coming year; Dr. Church supervised the enlargement of the local thermometer-shelter to accommodate the thermo-hygrograph, gave detailed instructions regarding the observations and care of instruments and prepared a supply of record-forms for use until the arrival of the next expedition in June 1927.

Dear Ferguson:
This is for you to incorporate in your introduction using also material from Kallquist.
Hobbs

Geofysiske Institutt
Bergen
November 13, 1929

Dr. W.H. Hobbs
University of Michigan
Ann Arbor, Michigan

My dear Dr. Hobbs:

Since receiving your letter of the sixteenth, which was delayed at the Bergen Museum, I have set to work on the introduction. Two days ago I received your letter acknowledging the receipt of the invoice.

Enclosed you will find the paper which calls attention to some of the things I believe an introduction to tabular data should contain. I should like to have you edit it as you see fit. However, since the work I carried out was a continuation of that begun by Kallquist, if it is agreeable with him, I see no reason why just one introduction cannot be used, our names to appear at its conclusion. I have thought you would also write a word of introduction so I have omitted the matter of time and personel.

The study I have undertaken concerns the high temperatures of the month of January, 1929. Already I have found some interesting situations and I hope to enlarge upon them. I heartily agree, that isobars drawn over the great plateau of Greenland are inaccurate, so I have kept away from that in the discussion.

Dr. Sverdrup has just returned from a business trip to Oslo where he was in conference with Professor Nansen. Since Dr. Sverdrup has lived in the Arctic several years his advice is invaluable. He is to be a member of the expedition and I asked him if the old saying 'there is always room for one more' held good in this case, but he hinted that space aboard was already at a premium. Letters for Dr. Sverdrup will reach him most quickly if addressed to him at the Geofysiske Institutt, rather than the Bergen Museum which is another building in another part of the city.

I have been dividing my time so that besides seeing the daily preparation of the weather map, I am able to spend some hours reading various meteorological publications. I shall have to wait until next summer to see the article in 'Science', since the magazine is not to be had in Bergen.

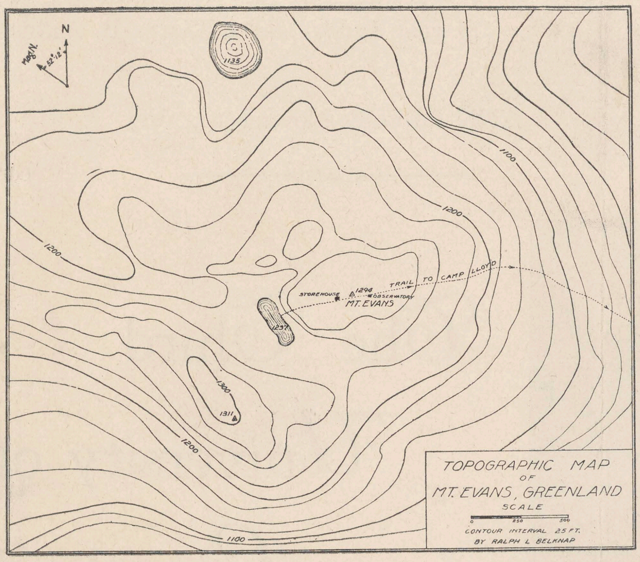
Yours very truly,

L. R. Schneider

Introduction

Mt. Evans, Greenland, in latitude approximately 66°-50'-30" north and longitude 50°-30' west, thirty miles from the west edge of the inland ice and eighty miles east of Holstensborg, owes a large measure of its favorableness as a place for meteorological study to the great 50 mile wide and 100 mile long extension of the inland ice in latitude 66°-0' north, which shuts the region from too direct contact with the weather of Davis Strait and the cyclonic disturbances usually off the south Greenland coast.

The immediate site has an elevation of 1294 feet and lies nearly two miles north of the nearby three and further southwest, ten mile wide water surface of Sondre Strömfjord. A great valley with an elevation of approximately 600 feet and whose nearest part is two miles east and farthest part is five miles west, extends as a semicircle around the east, north, and west sides of the mountain. A minor depression within 500 feet of the observatory continues from the north side around to the west to Lake Herz, but despite this the mountain top is well rounded. Because the topography is one of generally accordant mountain summits, visibility is unobstructed in all directions; one may look across the surrounding region from Pingo mountain forty miles west to the horizon of the inland ice perhaps sixty miles in the opposite direction.



MT. EVANS

The meteorological equipment used consisted of the following:

1. Mercurial barometer
2. Barograph
3. Thermo-hygrograph
4. Anemograph
5. Nephoscope
6. Rain gauge

7. Wind vane
8. Thermometers
9. Maximum thermometers
10. Minimum thermometers
11. Water thermometers
12. Sling psychrometers
13. Mt. Rose Snow Sampler
14. Evaporation pans
15. Praecisions Hygrometer
16. Equipment necessary for pilot balloon ascents

The thermometer shelter was approximately one hundred feet north of the observatory and both the shelter and the rain gauge were well exposed. The anemometer and wind vane were also well exposed mounted three feet above the roof of the observatory. By means of an extension on the vertical axis of the wind vane the wind direction could be conveniently read indoors. The pilot balloons were standard size, in pure gum and colors red and blue, and were filled with hydrogen generated with calcium hydride and water.

The primary object of the expedition was the study of the air circulation on the margin of the ice-cap. Its investigation was carried out mainly by means of pilot balloons which were released daily, usually at 9:30 A.M. and 3:30 P.M. Additional ascents were made when conditions were unusual.

Of importance, but secondary, was the daily record of the weather. Pressure, temperature, and humidity were observed daily at 8 A.M. and 8 P.M. although a continuous record of these conditions were recorded by instruments. Direction and kind of clouds and surface wind direction were also taken at these times, but additional cloud observations were made every second hour and that of wind direction every hour. Other perhaps less important records were those kept of ground temperature, the temperature of Lake Herz and those of the daily evaporation. Several kite ascents were made but the work had to be abandoned because the field was unsatisfactory and the time consumed too great. Unfortunately, the records obtained were of no significance.

Regarding observations and their method of proceedure, three things need to be mentioned. (1). True readings of snowfall were sometimes impossible to obtain when extremely light snow was kept practically suspended in the air by the wind. Upon some other occasions rapid evaporation reduced the total amount of snowfall. (2). During times of low temperatures depressions in the wet bulb reading were obtained by applying snow to it and then by exposing the snow covered muslin to the air. (3). Data concerning cloud velocity and direction was most accurately obtained by means of pilot balloons. Nephoscope readings were few owing to the prevailing sheet clouds. Frequently, too, clouds were evaporating or remained apparently stationary.

Of outstanding significance are the daily records of pressure temperature, humidity, wind direction and velocity, and precipitation, gathered in Holstensborg by a special observer employed by the expedition. Of especial interest, but not included in this volume are, the daily weather notes, several photographs of clouds, and a graphic record of the portion of the sky covered by cloud at the regular times of cloud observation.

SPECIMEN FORMS OF TABLES POSSIBLY ADAPTED TO THE PUBLICATION OF DATA OF BALLOONS AND CLOUDS.

The tables attached hereto are specimens of the economical form used for large or long tables in the ANNALS of Harvard College Observatory (Blue Hill Observations) which may be desirable for the larger tables of data obtained by the University of Michigan Expeditions to Greenland, 1926—1930.

In Table XI (Page 242), by printing the date in heavy type it is possible to include the month, date and time in the same column, thereby saving space without loss of clearness. This form is adapted to the data from pilot-balloons as well as detailed observations of clouds.

Table XII, (Page 259), is suggested for the hourly observations of prevailing kind and amount of cloud. In both tables (XI and XII) the data are continuous and the pages full, each containing data of about 1½ months; a year's observations will require 8 pages instead of the 12 necessary if each month's data is given a whole page.

The Introduction to the Cloud Observations on page 240 is to be condensed for use in describing the observations in Greenland.

The space occupied by text and tables, 15 X 22 cm., (6 X 8¾ inches) could perhaps, with advantage, be increased to 17 X 24 cm. (7 X 9½ inches) without increasing the size of the page and leave ample margins. The latter dimensions are those of the ANNALES of the Aeronautical Observatory at Lindenberg.

(Please preserve these specimens)

S. P. Fergusson.

Balloon Entered or lost due to:-

Sheet #1

Kind	High	Date	(start) Time	Amt (Start)	Remarks
AS	2070	April 18, '29	9:36A	7	
AS	3330	" " "	4:25P	1	
AS	3510	April 19, '29	10:03A	9	
AS	1710	" 19 '29	4:14P	5	
AS	2610	" 20 "	3.19P	8	
CS	4950	" 21 "	2.02 P	3	
AK	2430	" 22 "	9:38A	1	
AK	3870	" 22 "	4:16P	2	Balloon was cut off by AK
C	4410	" 24 "	11:24A	3	
C	5310	" 25 "	9:41A	7	
C	6210	" 25 "	4:24P	2	
AS	3150	" 28 "	9:23A	9	
AS	2070	" 28 "	4.06P	6	
SK	990	" 30 "	11.15A	8	
FSK	7470	May 2 1929	4.46 P	X	Balloon cut off by FSK
CS	5130	" 4 "	4:27P	10	
SK	801	" 5 "	4.08P	9	
C	3150	" 7 "	9.27A	2	Hz. due to Falling snow from C
AS	612	" 7 "	3.48	Blank	" " " " " from AS
AS	1710	" 8 "	3:24P	9	
AS	1530	" 9 "	9:10A	7	Ent falling snow from AS snowcloud
SK	2070	" 10 "	4:21P	6	cut off by SK
AK	3510	" 11 "	6:59P	2	cut off by AK
CS	4590	" 12 "	5:05P	8	Entered CS snowcloud
CS	3510	" 15 "	4:24P	5	
AS	2610	" 17 "	9:12A	7	Cut off by K
K	9630	" 21 "	2:55P	X	
SK	2430	" 26 "	2:39P	5	
AS	4410	" 27 "	10:36A	1	
MK	1710	June 6 "	4:12P	4	
SN	990	" 8 "	3:05P	10	
SK	1350	" 9 "	3:27P	9	
S	1170	" 10 "	10:43A	10	
AS	1890	" 10 "	4:14P	9	
SK	2070	" 11 "	8:31A	1	
SK	4410	" 11 "	4:05P	5	Cut off by SK
SN	1530	" 12 "	9:23A	6	
AS	1170	" 12 "	4.06 P	2	
LAS	2070	" 12 "	4:56P	7	

Sheet #2

Kind	Heighth	Date	Time	Am't	Remarks
LAS	1890	June 12, 1929	10:09A	4	
AS	2070	" 13 "	9:21A	3	
SK	1350	" 14 "	9:35A	4	
SK	1170	" 14 "	4:04P	6	
AK	2970	" 15 "	9:19A	1	
K	2070	" 16 "	9:15A	3	Cut off by K
K	2790	" 16 "	4:20P	1	Cut off by K
CK	5670	" 18 "	9:22A	4	CK formed after B. A. was started (4/10)
CS	4770	" 18 "	5:06P	7	
SN	1170	" 19 "	9:23A	10	
S	801	" 19 "	4:24P	4	
SN	0	" 20 "	9:29A	10	Cloud "anchored" to Mt. Evans
AS	1530	" 20 "	4:03P	10	
C	5310	" 21 "	4:14P	1	
AS	4410	" 22 "	9:19A	10	
FSK	2610	" 23 "	8:41A	1	Cut of by FSK
C	8010	" 27 "	9:29A	3	CS broke up from 10 to 3C at end / 7CS of run
CS	7290	" 28 "	9:50A	3	5/10 end of run
CS	8910	" 28 "	4:53P	3	
AS	4230	" 29 "	9:26A	1	
AS	2430	" 29 "	4:46P	4	Entered base of C streamers
C	7650	" 30 "	9:37A	X	
AK	5310	" 30 "	4:44P	4	
AS	8190	July 3 "	9:36A	1	Cut off by AS
AK	3870	" 3 "	4:31P	3	Entered Snow Streamers from AK
AS	3510	" 6 "	9:15A	8	Entered Base AS (Tails)
SK	2070	" 7 "	4:06P	10	
SK	1530	" 8 "	4:08P	8	
SK	2250	" 9 "	9:09A	6	
SK	3150	" 9 "	4:07P	5	Cut off by SK
AS	2070	" 10 "	9:43A	6	
AS	4230	" 11 "	9:15A	2	
SN	1710	" 12 "	3:59P	6	
SK	1710	" 13 "	9:01A	3	
AS	2430	" 16 "	9:05A	9	
AS	1710	" 17 "	9:49A	9	
AS	2250	" 19 "	9:22A	6	

Sheet # 3

Kind	Height	Date	Start Time	Am't	Remarks
SK	1840	July 21, 1927	2:33 P	7	Balloon Obscured by SK ????
K	1890	" 22 "	1:25 P	6	" " " K ???
K	8370	" 23 "	2:00 P.	3	obscured in this case must mean cut off
SK	414	" 27 "	1:58 P	6	
K	990	Aug 2, 1927	2:00 P	7	
AK	2430	" 18 "	2:23 P	5	
SK	927	" 21 "	4:02 P	3	
SK	2430	Sept 4 1927	2:12 P	8	Obscured by SK
AK	1530	" 5 "	2:50 P	8	
AK	3330	" 6 "	1:33 P	2	Obscured by AK
AK	2610	" 6 "	1:59 P	2	
SK	3690	" 11 "	2:20 P	2	Obscured by SK
SK	2250	" 15 "	2:00 P	3	
K	7830	" 16 "	2:13 P	3	Obscured by K (Cut off)
AS	5490	" 25 "	2:18 P	4	Obscured by AS.
AK	2610	" 27 "	2:58 P	7	
AK	6390	" 28 "	4:46 P	4	Obscured by AK
AS	2430	Oct 1, 1927	1:57 P	5	
S	2250	" 3 "	5:32 P	8	Obscured by S
S	4950	" 5 "	3:03 P	4	Obscured by S
SK	2970	Nov 1, 1927	2:18 P	6	
AS	4230	" 2 "	10:08 A	5	
SK	2070	" 3 "	10:14 A	10	
SK	1890	" 3 "	1:30 P	2	
SK	2070	" 4 "	1:41 P	5	Obscured by SK
SK	2430	" 9 "	10:02 A	7	
SK	2250	" 9 "	1:22 P	5	
SK	3570	" 10 "	2:39 P	9	
AK	5490	" 13 "	10:02 A	1	
SK	1350	" 25 "	1:39 P	8	
SK	2970	" 27 "	1:46 P	4	
AS	5130	" 28 "	1:46 P	7	
SK	1350	Dec 2, 1927	2:03 P	8	
SK	1890	" 2 "	2:32 P	6	
S	801	" 4 "	12:56 P	10	
S	1530	" 5 "	2:18 P	10	
S	990	" 6 "	1:50 P	9	
SK	1710	" 10 "	1:05 P	7	
SK	2250	" 10 "	2:22 P	5	Entered SK Foehn

Sheet #4

Kind	Height	Date	Time	Amt	Remark
AS	5310	Dec 17, 1927	1:29 P	5	
SK	2790	" 21 "	10:45 A	6	
SK	2250	" 21 "	2:02 P	6	
SK	2250	" 24 "	11:54 A	8	
S	612	" 24 "	1:43 P	4	
AS	3330	Jan 2, 1928	1:58 P	8	
S	612	" 2 "	10:00 A	10	
AS	3690	" 3 "	1:50 P	6	
SK	2970	" 5 "	2:14 P	6	
S	2250	" 6 "	2:07 P	6	
SK	3150	" 7 "	1:59 P	8	
AS	3870	" 8 "	1:51 P	8	
AK	3510	" 9 "	1:41 P	2	
S	990	" 15 "	1:53 P	4	
SK	3510	" 16 "	12:57 P	4	
S	1710	" 23 "	1:20 P	10	
S	612	" 25 "	1:31 P	8	
AK	3330	" 25 "	2:28 P	4	
SK	3510	" 27 "	1:44 P	7	Obscured by SK ??
S	801	" 28 "	1:24 P	6	
AS	4590	" 31 "	2:09 P	1	
AS	2970	Feb. 2, 1928	11:26 A	7	
AS	3870	" 2 "	3:43 P	8	
AS	5310	" 4 "	11:12 A	5	
S	990	" 4 "	2:05 P	9	
S	1170	" 10 "	3:16 P	10	
AK	5850	" 13 "	2:49 P	6	Obscured by AK
SK	2430	" 14 "	1:52 P	7	
SK	1710	" 15 "	9:57 P	6	
S	990	" 16 "	11:05 A	9	
S	1350	" 20 "	11:03 A	6	
S	1350	" 20 "	2:11 P	7	
AK	2610	" 25 "	11:15 A	2	
SK	1170	" 25 "	3:46 P	8	
SK	2070	" 26 "	10:16 P	8	
SK	2070	" 26 "	12:16 P	9	
SK	2250	" 27 "	10:15 A	9	
AS	4590	" 28 "	10:40 A	8	
AS	4050	" 28 "	2:29 P	9	

Sheet #5

Kind	Heighth	Date	Time	Am't	Remarks
SK	3150	March 2, 1928	2:21P	6	
AS	4410	" 3 "	10:24A	7	
AS	3870	" 4 "	10:24A	8	
AS	4050	" 4 "	3:12P	5	
AS	2970	" 5 "	2:52P	8	
AS	4050	" 6 "	10:27A	5	
AS	3870	" 6 "	2:19P	10	
SK	2610	" 7 "	2:06P	7	
AK	3150	" 9 "	10:19A	5	
SK	2610	" 9 "	1:49P	8	
AS	3330	" 10 "	10:16A	10	
AS	2430	" 13 "	10:13A	7	
S	1890	" 13 "	2:10P	8	
S	612	" 14 "	10:53	10	
S	1710	" 14 "	5:15P	7	Obscured by Stratas ??
S	612	" 15 "	10:11A	9	
S	612	" 16 "	10:53A	9	
SK	1350	" 16 "	2:27P	7	
AS	3330	" 18 "	10:08A	9	
AS	2970	" 23 "	11:11A	3	
AS	1530	" 26 "	10:10A	3	
AS	2610	" 27 "	10:24A	8	
C	5310	" 28 "	11:25A	2	
K	6030	" 28 "	2:47P	3	Obscured by K ??
AS	4770	" 29 "	10:41A	7	
AS	2790	" 29 "	2:25P	7	
AK	1890	" 30 "	10:22A	6	
AK	2070	" 30 "	2:15P	2	
SK	990	" 31 "	2:05P	3	
AS	3330	April 10, 1928	2:28P	4	
S	414	" 12 "	2:06P	10	
K	990	" 26 "	2:30P	4	Obscured by K ??
K	414	" 26 "	3:07P	7	
K	2250	" 29 "	2:32P	3	Obscured by K ??
AK	2070	May 5, 1928	2:13P	9	
SK	1350	" 9 "	2:03P	8	
S	3870	" 11 "	2:19P	6	Obscured by S ??
SK	612	" 12 "	2:08P	9	
S	1350	" 13 "	1:52P	8	

Sheet #6

Kind	Heighth	Date	Time	Am't	Remarks
SK	1170	May 16, 1928	2:02P	8	
AK	2070	" 17 "	2:03P	1	
SK	1530	" 18 "	1:58P	9	
S	801	" 19 "	2:04P	10	
AK	7830	" 20 "	7:13P	4	Obscured by AK ??
SK	1710	" 21 "	2:30P	10	
SK	1890	" 22 "	2:00P	6	
AK	3150	" 23 "	2:12P	3	Obscured by AK ??
SK	1170	" 24 "	2:24P	9	
SK	801	" 28 "	1:52P	7	
SK	2070	June 1 1928	2:12P	9	
SK	5490	" 1 "	5:01P	6	Obscured by SK ??
SK	1530	" 2 "	10:01A	2	
SK	1890	" 3 "	2:20P	10	
K	6030	" 4 "	2:30P	3	
AK	4950	" 10 "	3:20P	5	Obscured by AK
AK	2970	" 11 "	2:12P	5	
SK	6570	" 19 "	2:28P	4	Obscured by ~~S~~ SK
K	2790	" 20 "	2:01P	1	Obscured by K
AS	1170	" 21 "	1:55P	6	
SK	2610	" 22 "	2:08P	9	
AS	2610	" 23 "	2:24P	3	
SK	5850	" 24 "	2:28P	7	Obscured by SK
SK	2070	" 25 "	2:07P	7	Obscured by SK
SK	9990	" 27 "	2:56P	4	Obscured by SK
SK	801	July 1 1928	2:09P	8	0
SK	2250	" 2 "	2:11P	3	Obscured by SK
AK	2610	Jy 3 "	2:11P	2	Obscured by AK
S	990	" 4 "	2:03P	3	
SK	3150	" 5 "	2:20P	6	Obscured by SK
AS	1710	" 8 "	2:14P	10	
S	414	" 9 "	2:08	10	
SK	1890	" 10 "	2:00P	5	
AK	801	" 11 "	2:06P	—	
SK	2250	" 12 "	2:24P	9	
AK	2790	" 13 "	2:29P	3	
SK	2970	" 14 "	2:35P	4	
SK	6390	" 15 "	2:49P	4	cut off by SK
AK	1170	" 18 "	2:17P	1	Obscured by AK

N.T.G. notes given

Sheet #7

Kind	Heighth	Date	Time	Am't	Remarks
S	1350	July 19, 1928	2:31P	7	
AK	2610	" 20 "	2:26P	9	Cut off by AK
AK	4230	" 21 "	2:24P	8	
SK	2250	" 23 "	2:23P	6	cut off by SK
AK	6030	" 31 "	10:37	6	
AK	2430	Aug 1 1928	2:11P	5	
CS	7470	" 2 "	10:47P	3	
AK	2430	" 3 "	N.T.G	2	
K	6930	" 5 "	2:31P	1	Obscured by K cloud
AK	1170	" 8 "	2:06P	9	
SK	2430	" 10 "	2:13P	6	Obscured by SK
SK	414	" 14 "	2:13P	3	
S	414	" 15 "	2:02P	7	
AS	1350	" 23 "	10:22A	5	
SK	1350	" 30 "	2:08P	5	
AS	2790	Sept 6 1928	2:26P	10	
SK	1530	" 7 "	2:11P	4	
SK	6390	" 10 "	2:41P	4	Cut off by SK
SK	2430	" 13 "	1:63P	5	
AS	2070	" 25 "	2:06P	3	
SK	1350	" 29 "	1:10P	5	
AS	1530	" 30 "	2:00P	2	
SK	1350	Oct 4 1928	1:26P	8	Cut off by SK
AS	9630	" 20 "	2:20P	1	Cut off by AS
AK	4050	" 22 "	2:19P	8	
S	612	" 26 "	1:28P	10	
AS	2070	Nov. 5, 1928	1:19	7	
S	2430	" 26 "	12:50P	X	
CS	1710	" 27 "	12:34	X	Obscured by CS
AS	1350	" 28 "	12:34	7	Obscured by AS
S	1890	Dec 5, 1928	1:22P	7	
AS	1350	" 7 "	12:09	6	
AS	2430	" 8 "	1:16P	4	
AK	2970	" 9 "	12:31P	1	Obscured by AK
CS	5670	" 13 "	12:55P	5	
CS	4590	" 16 "	12:49P	2	
AK	2610	" 17 "	12:19	3	
AS	2610	" 18 "	12:00m	3	
AS	990	" 20 "	12:19m	9	

Sheet #8

Kind	Am't	Heigth	Date	Time	Remarks
A.S.	2	1350	Dec 22, 1928	12:37P	Entered thru AS
AS	3	1530	" 23 "	12:12P	
AS	4	2610	" 22 "	9:04P	Or candle extinguished
CS	10	2790	" 26 "	12:57P	
CS	8	3330	Jan 2, 1929	12:44P	
AS	2	1350	" 6 "	12:37P	
AS	9	1350	" 8 "	12:43P	
AS	8	2070	" 10 "	12:39P	
CS	8	6930	" 11 "	1:02P	
AS	8	2250	" 12 "	12:52P	
AS	9	2250	" 13 "	12:37P	
AS	4	1170	" 14 "	11:52A	
2AS	4	612	" 15 "	12:28P	
AS	2	1530	" 17 "	12:23P	
AK	2	2070	" 18 "	12:11P	
CS	10	6750	" 25 "	12:27P	
AK	2	4050	" 26 "	N.T.G.	
AS	7	1350	Feb. 2, 1929	11:57A	
AS	2	3870	" 3 "	12:13P	
CS	8	5310	" 6 "	12:12P	
S	5	990	" 14 "	3:05P	
AS	1	1890	" 15 "	12:00N.	
AS	3	2430	" 16 "	12:08P	
AS	7	1710	" 17 "	12:14P	
AS	6.	2250	" 18 "	12:24P	
AS	9	2430	" 20 "	11:58A	
AS	6	2070	" 22 "	12:28P	Entered A S snow streamers
AS	8	3870	" 23 "	12:46P	
AS	9	1890	" 24 "	1:10P	
AS	X	2070	" 25 "	12:56P	
AS	9	1710	" 26 "	12:40P	
AK	X	2250	" 27 "	4:32P	
Haze	—	4230	March 2 1929	11:47A	
AS	9	3510	" 4 "	1:54P	
AS	9	2250	" 5 "	1:22P	
AS	9	3870	" 7 "	12:41P	
AS	9	3150	" 8 "	12:27P	
SK	6	1710	" 9 "	12:24	
AS	9	3510	" 10 "	2:39	

Sheet # 9

Kind	Am't	Heighth	Date	Time	Remarks
AS	10	2610	March 13, 1929	1.44 P	
AS	4	4050	" 14 "	12:34 P	
S	10	1350	" 17 "	1:32 P	
CS	9	4410	" 18 "	12:46 P	
AS	9	3150	" 20 "	1:02 P	
SN	10	801	" 21 "	12:54 P	
S	3	3510	" 22 "	6:31 P	Cut off by Stratus
AS	2	3870	" 24 "	2:31 P	Thin
CS^{+} or AS^{x}	3^{+} 2^{x}	3330	" 30 "	3:18 P	Cloud entered indefinite
AS	10	2430	" 31 "	1:15 P	AS very thin
AS	9	2970	April 1 "	12:41 P	
AS	2	3570	" 3 "	3:14 P	
CS	N. G.	3870	Ap. 5 "	2:33 P	Entered falling snow from CS
SN	8	612	" 9 "	1.33 P	Obscured by haze & SN
SN	10	801	" 10 "	4:04 P	
SN	5	1530	" 12 "	2:48 P	
S	10	612	" 14 "	9:04 P	
SK	5	990	" 14 "	3:10 P	

Patterson's hydrogen generator, using calcium hydride. A modified form was used by the expeditions to Grønland, in 1926-1927-1928-1929.

and caustic soda, and is at present obtained from calcium hydride and water. This is a very simple and convenient method of obtaining hydrogen, as the generator can be carried about and the gas generated where and when required. Two forms of the generator are shown in figs. I and II, which are self explanatory. In both cases the outer can is about 10 inches in diameter and 30 inches high, and is filled with water to the top of the inner can; a perforated bottom *A*, which can be removed, is necessary to prevent the hydride from falling to the bottom of the outer can and allowing the gas to escape at the sides. The calcium hydride is broken up into small pieces and placed in a rubber tube *F* (the inner tube of an automobile tire)—and the free end closed by a clamp. The lumps of hydride are worked down by hand, and in fig. 1 they drop onto the shelf *B*

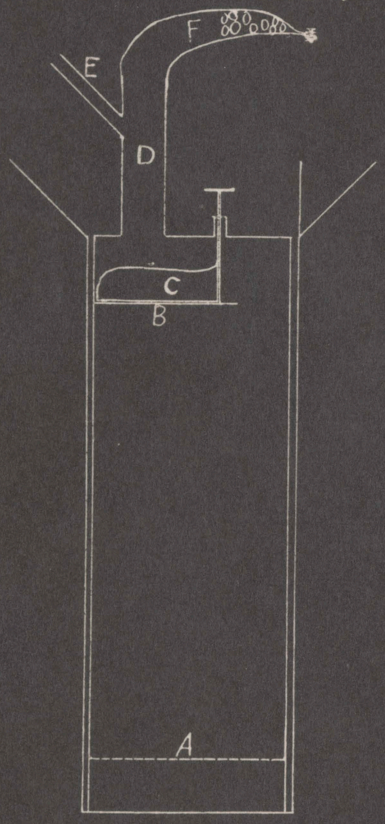


Fig. I

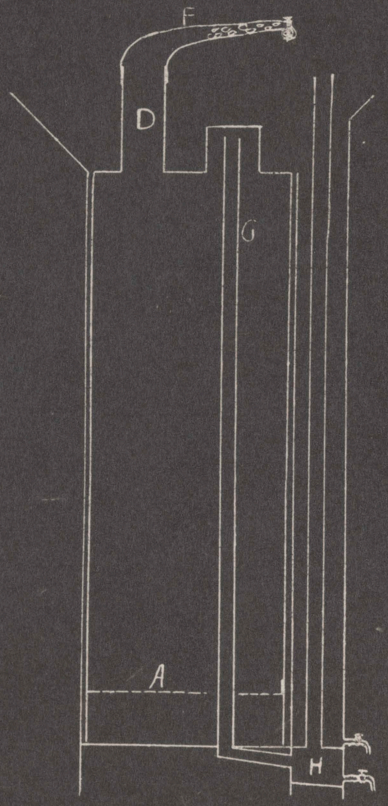


Fig. II

from which they are scraped off into the water by the scraper *C*. In fig. I the gas outlet to the balloon is through *E*. The escaping gas is very hot and saturated with moisture, much of which condenses in the connecting tube and the neck of the balloon. To cool the gas and take out most of the moisture the generator was modified, as shown in fig. II. In this form the outlet is through the tube *G*, and the condensed moisture is collected in *H*, and can be drained off by a drip cock. The outlet tube from *H* has a water-jacket around it and there is an enlargement on the tube leading to the balloon in which cotton waste or sea-weed is placed to prevent fine dust and the condensed water vapour from getting into the balloon. When all is ready for filling, a small piece of hydride is dropped into the water and the gas generated is allowed to raise the inner can about 6 inches, in which position it is clamped. The hydride is then worked slowly into the generator and usually it requires from 6 to 10 minutes to fill the balloon.

The chemical reaction in the production of hydrogen from calcium hydride is

$$Ca\,H_2 + H_2\,0 = Ca\,0 + 2\,H_2$$

Taking 1 as the atomic weight of hydrogen and 40 as that of calcium, 10·5 grammes of hydride produce one gramme of hydrogen, and one gramme of hydrogen gives a lift of 13·4 grammes to the balloon. At first it was assumed that one gramme of hydride gave a gramme lift to the balloon, and thus the desired lighting power of the balloon was obtained by taking an amount of hydride equal to the weight of the balloon, the instrument and the free lift. If the hydrogen produced were pure, the above calculation shows that the balloon would have a greater lifting power than the weight of calcium hydride used, but the experience was that it very often had less, and that the hydride was very far from being uniform in composition.

This led to a test of the purity of the gas by determining its density with a microbalance similar to that used by Ashton (Proc. Roy. Soc. series A, vol. 89, p. 439) except that there was no necessity to use a small quantity of gas. With this balance it takes only a few minutes to get a reading that is accurate to less

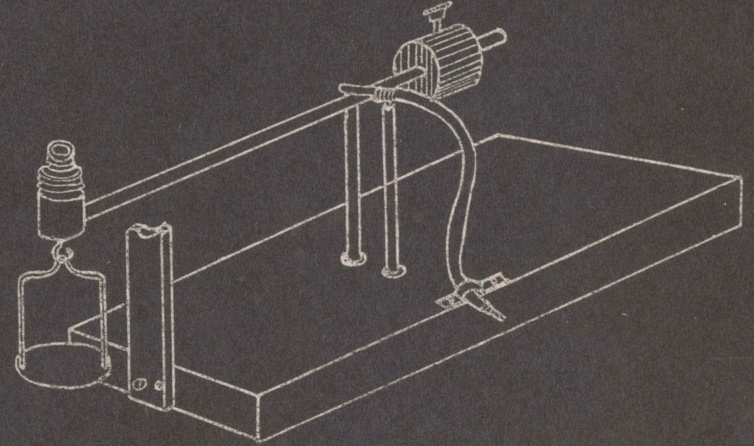
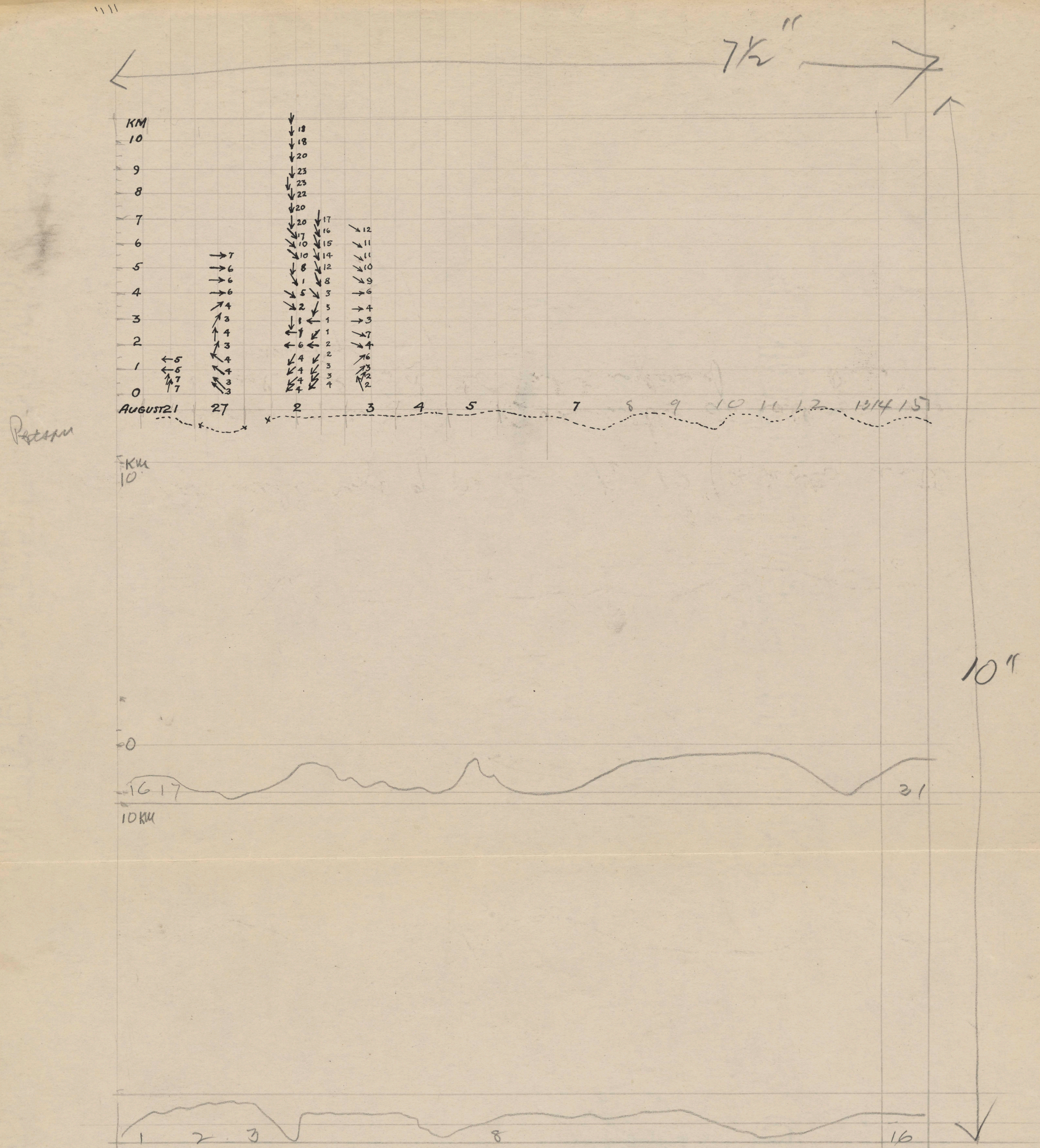
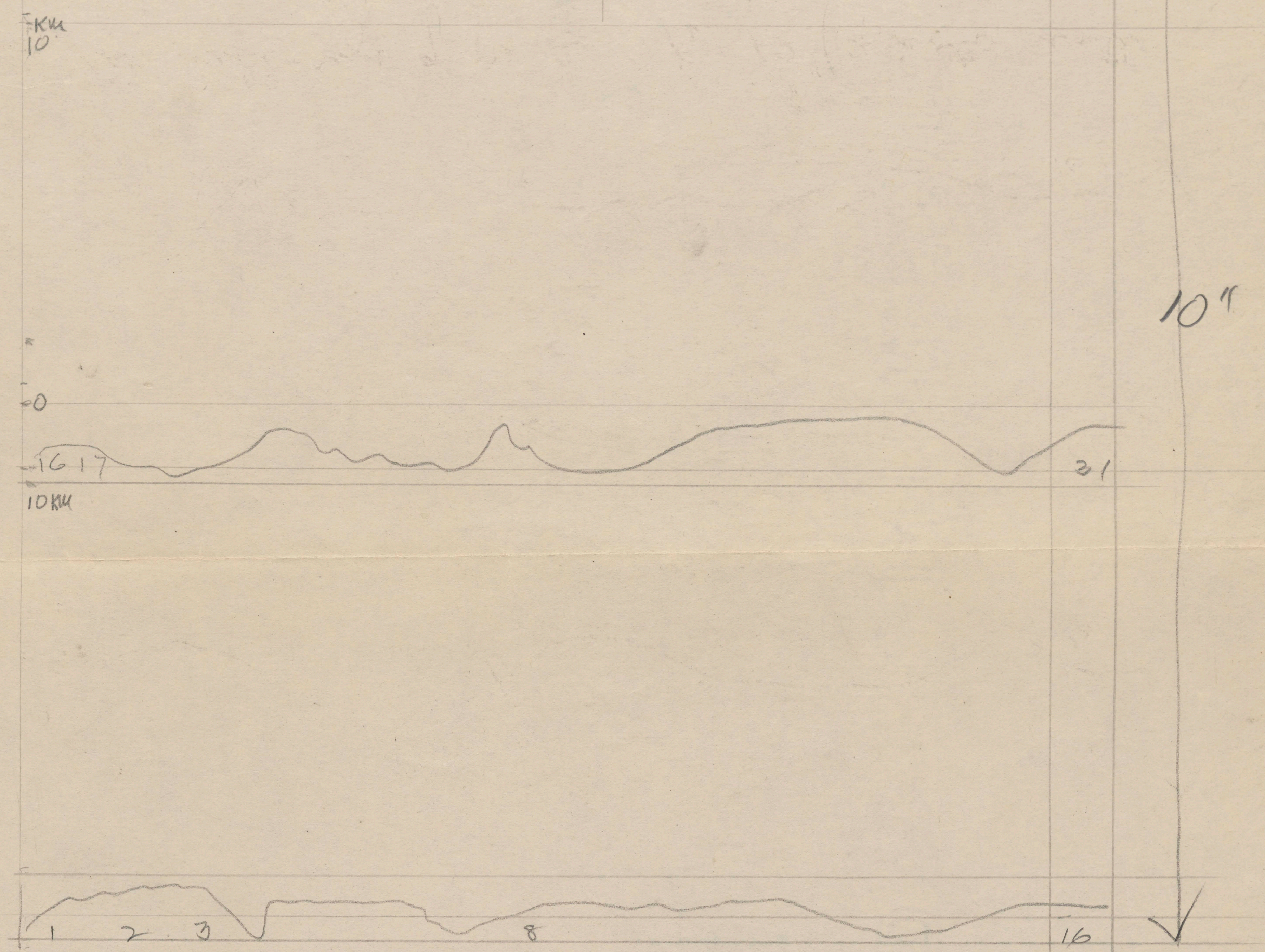


Fig. III.

than one per cent. If d_a and d_h are the densities of air and hydrogen at standard temperature and pressure, the following values for $\frac{d_a}{d_h}$ were obtained with the microbalance for the hydrogen obtained from different samples of calcium hydride: 12·7, 11·3, 10·8, 10·5, 8·4, 11·1, 10·4, 9·6, 9·7, 10·0, the mean being 10·4. This is less than the value obtained on the assumption that a gramme of the calcium hydride gives a gramme lift to the balloon. Hydrogen obtained from commercial zinc and sulphuric acid gave 11·3 for $\frac{d_a}{d_h}$. The ratio for atmospheric air and pure hydrogen is 14·4. On the average, then, the volume of hydrogen produced from calcium hydride required to give the necessary free lift to the balloon is 1·4 times that which would be required if the hydrogen were pure. In the poorest sample, 1·8 times as much was required, and in the best, 1·1. This, combined with the quality of the rubber, has made it impossible to reach any great heights in the balloon ascensions even when using much larger balloons than the usual size. When it was discovered that a gramme lift per gramme of calcium hydride could not be depended upon a balance, fig. III, was constructed in order to give the correct lifting power to the balloon.



[Plate full-size of page 7½X10" (quarto) with 3 sections or about 1½ months of balloon-plots and simultaneous data at surface ..... Pressure -.-.-- Temp -..-..-..- Humidity?]



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-··-··-··- Humidity?]