

TRANSPORTATION Test WITH LEMONS FROM

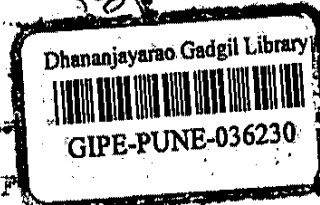
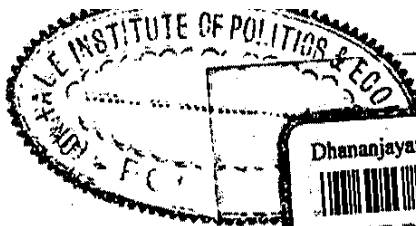
SOUTHERN CALIFORNIA TO NEW YORK. *August, 1948.*

By

E.M. Harvey

E.P. Atrops

H.W. Hruschka.



UNITED STATES DEPARTMENT OF
Agricultural Research Administration
Bureau of Plant Industry, Soils,
and Agricultural Engineering

H. T. & S. Office Report No. 195

TRANSPORTATION TEST WITH LEMONS FROM
SOUTHERN CALIFORNIA TO NEW YORK

August - 1948

By

E. M. Harvey, Senior Physiologist
E. P. Atrops, Asst. Chemist
H. W. Kruschka, Asst. Plant Physiologist

Division of Fruit and Vegetable Crops and Diseases

September 17, 1948
Pomona, California

126
10-50

TRANSPORTATION TEST WITH LEMONS FROM SOUTHERN CALIFORNIA
TO NEW YORK AUGUST 18 to 27, 1948

No significant transportation tests with lemons have been conducted since the summer of 1939, at which time the standard lemon load was 348 boxes and the stacks were only six boxes wide, allowing nearly one foot of space for air movement between the sides of the load and the walls of the car. At present the prevailing load is 464 boxes with the stacks eight boxes wide. The present load is not only more than thirty percent heavier than formerly but also has become a solid one. Shipping practices for lemons have been modified in other ways besides the size of the load. Previously most shipments moved under ventilation or if refrigerated, with initial icing only or initial icing plus one reicing in transit. If thus refrigerated the vents were oftentimes opened long enough before scheduled arrival to allow condensation to evaporate and make sure that the paper wraps would be dry. This was because buyers were accustomed to receive only tree ripe lemons (or weak fruit due to other causes) under refrigeration. That prejudice is now largely overcome and the trade no longer tends to discount refrigerated lemons or those that arrive with wrappers moistened by condensation.

Lemons are frequently held for many weeks in warehouses in the shipping area. The temperature maintained in these warehouses is within the range of 55 to 60°F. Among lemon shippers it is considered that the lower transit temperatures preferred for oranges (50° or lower) are likely to be harmful to lemons. Shippers feel that if temperatures lower than 55° are harmful to lemons during warehouse storage they should accordingly be avoided during shipment and that transit refrigeration methods used for oranges should not be used indiscriminately for lemons as they have been in many instances in the past. Because of these circumstances this test was designed to obtain information on how to obtain desired temperatures in transit for the heavier lemon load now being shipped and especially to consider transit refrigeration services under halfstage icing in the latest type cars equipped with fans to provide forced air circulation through the load.

Object

The object of the test can be stated thus: to compare different methods of refrigerating lemons during shipment in the warmest summer weather and determine the most economical and desirable icing service for such shipments.

Test Cars

Fifteen test cars of warehouse-cooled lemons were loaded August 18 from districts extending from San Bernardino County to Ventura County, thus including lemons of both foothill and coastal types. Because of the extensive loading area and the several locations of icing facilities it was not possible for the test personnel to secure firsthand icing records prior

to the make-up of the train at Colton, California; however, these icing records were furnished later by the Pacific Fruit Express Company. The icing services used are presented in table 1.

Two test boxes of lemons were placed in each car at the quarter-length, center-line, top-layer position. The test lemons were silvers and light greens, arranged in groups from the two principal districts.

All the cars were of the same series and had just come from the rebuilding shops. They were forty-foot cars having the same dimensions throughout and were equipped with fans, grates for halfstage icing, convertible bulkheads and wall flues. The rated capacity for full bunkers and half stages was, respectively, 11,500 and 6,500 pounds of chunk ice. The cars were rebuilt with wood sheathing and carried 4 inches of insulation in the side walls and 4-1/2 inches in the floor and ceiling. All loads were the prevailing size, 464 boxes, two layers high (on end), eight boxes wide and twenty-nine stacks long, with a total weight of about 40,000 pounds.

Temperature Records

Temperature records were obtained by means of electric resistance thermometers at twelve positions in one end of each car--at bunker, in the seventh stack from the end, and at the doorway. One thermometer was located at the middle south-doorway position and two were used for top and bottom air at center line near the doorway. These latter were intended to simulate "liquidometers" or other devices that would indicate inside air temperature at these two positions. Only a few American refrigerator cars are thus equipped, but it was desired to obtain these records and see how closely the air temperature corresponds to the temperature of the fruit. If there is a close correspondence it might enable operators to provide refrigeration on the basis of temperatures desired instead of by arbitrary rule, as at present.

Route and Running Time

The test was routed via Southern Pacific, Rock Island, Belt Railway Company of Chicago, and Erie Railroads to Jersey City. The total elapsed time from Colton, Calif. to Jersey City was 183 hours and 45 minutes. Of this, 107 hours and 8 minutes (58.2%) was running time and 76 hours and 37 minutes (41.8%) standing.

Weather Conditions

The weather conditions encountered were very satisfactory for the purpose of the test. Daytime temperatures across the desert reached a maximum of 114°F., which is not unusual, but the temperatures through the central and eastern states were also high, with a severe and wide-spread heat wave prevailing in those areas. The average temperature encountered by the test was 88°F., an average obtained from the temperature records taken at two-hour intervals during the nine days in transit. (See the outside temperature graph on the charts.)

Condition of Test Fruit and Commercial Loads at Destination

The test boxes were weighed in California and again in New York. Because of high outside temperature and high relative humidity of the air when the cars were being unloaded so much moisture condensed on the cool fruit in the test boxes that the weights were of no significance. Loss of weight in transit could not be determined because in about half of the instances the boxes weighed more in New York than in California.

Inspection of the fruit from the test boxes disclosed no differences in appearance or general condition attributable in any way to the type of refrigeration service used. The same is true of the commercial loads throughout.

Car M was diverted to Boston soon after its arrival in Jersey City and no data on the condition of this load are available.

Comparison of Air and Fruit Temperatures in Test Cars

The temperature records of the top and bottom air obtained in lieu of "liquidometer" records are presented in tables 3 to 17 and charts 1, to 15, inclusive. The air circulation in fan cars moving with the fans on is just the reverse to that found under natural refrigeration or with no fans. Under fan operation, the cold air is blown out through the top bulkhead opening over the load and moves down through the load to the space under the floor racks, back to the fans and into the bottom bunker openings. Hence, while running, the top air is colder than the bottom air. Upon stopping, this movement reverts to the natural circulation found in standard non-fan cars or just the reverse of that just described. Therefore, after the fans stop, the warmer air rises to the top and cooler air falls to the bottom of the load, resulting in an inversion of the temperature. Therefore the relation of the air temperature to that of the adjacent commodity will start to change as soon as the fans stop and will continue until an equilibrium has been established. This change for the top position may be from several degrees below to several degrees above the fruit temperature. However, if air temperatures are read immediately after stopping, before much change takes place, these readings will indicate fairly closely the conditions existing during fan operation. In standard non-fan cars in which only natural air circulation takes place, there is no inversion of the temperatures when the car stops and the time element in reading the temperatures is not so important.

In this test a great deal of variation was found in the extent of agreement of air and fruit temperatures, under conditions of different icing service and fan operation. With fans on, the closest correspondence prevailed after the train had been running continuously for a few hours and the temperatures were read immediately upon stopping. If the readings were delayed for as much as one half-hour the air temperatures could give a very incorrect picture of fruit temperatures. But by studying the air and fruit temperatures with the knowledge of the icing services used and the detail of train movement it was possible in most instances to understand the divergence or coincidence of the two sets of records. It is obvious that an exact correspondence between air and fruit temperatures

can not be expected. It also seems evident that it would be more difficult to judge the situation inside the car on the basis of air temperatures alone during periods of very hot or very cold weather.

Effect of Refrigeration Service on Temperature in Transit

The test cars were billed under several icing services used with both full-bunker and half-stage icing and with fans operating and not operating. These icing services included the most effective refrigeration service currently recommended as well as some not now being used or not ordinarily recommended. See tables 1 and 2.

The temperatures in transit are shown in tables 3 to 17, inclusive, and charts 1 to 15. An examination of these data leads to the conclusion that the more complete refrigeration services for oranges during the warmest weather (Full-bunker icing, priced and replenished, and reiced in transit) cooled the fruit to below 50° and are neither necessary nor desirable for lemons.

Half-stage icing with these services likewise proved more than adequate. (See records of cars C and N tables 5 and 16 and charts 3 and 14). With the exception of car Z, all cars that received two reicings in transit, whether full-bunker or half-stage iced, also showed more than adequate refrigeration. Car E (table 7 and chart 5), which was full-bunker iced with two reicings in transit had restricted air circulation ^{1/} through the bunkers carried the load throughout the trip at temperatures only slightly lower than those maintained in lemon warehouses. Cars J and K (tables 12 and 13 and charts 10 and 11) which received the same icing service as car E should be compared with car E. Car J had fans off and car K had fans on and unrestricted air circulation through the bunkers. Cars L and M (tables 14 and 15 and charts 12 and 13) received half-stage icing with two reicings; the former with fans off and the latter with fans on. All of these cars, J, K, L, and M, provided lower temperatures than necessary or desirable for lemons.

^{1/} This restricted air circulation through the ice in the bunkers was effected by blocking most of the bottom and top bulkhead openings and to retain the full circulation of air from the fans in the loading space, a portion of the floor rack next to the bulkhead was removed and a false bulkhead or flue was installed extending across the width of the car and up above the top of the load, thus bypassing the bunker with the greater portion of the air flow. This alteration was made by the engineering staff of the PRECO Corporation from suggestions by J. R. MacKill. It was the idea that a relatively small shunt current of air through the ice bunkers sufficient to take care of heat leakage and to maintain moderate load temperatures but without sacrificing air circulation through the load would be a modification which might be of benefit, not only to lemon shipments but for other perishable commodities which require only moderate refrigeration, such as tomatoes, bananas, avocados, etc.

Car I (table 11, chart 9) was loaded dry, precooled 8 hours, initially iced, and had one reicing in transit. At the end of the precooling period the records show an average load temperature of 53.4°F., having been lowered nearly 10.5 degrees in this time. However, the thermometers happened to be located in the half of the car nearest the precooling-air outlet. Undoubtedly, therefore, the inlet half of the car was cooler. The temperature of the air in the inlet ducts was 24 to 26°F. The refrigeration in this car also was considerably more than necessary.

Cars B and F (tables 4 and 8, charts 2 and 6) received icing services not currently recommended for lemons in mid-summer east coast shipments (see table 1). Even these cars, however, showed adequate refrigeration up to arrival in Jersey City, indicating that except in the most severe hot weather this service would no doubt be safe.

The test included early and late icings for both one and two reicings in transit. The indications were that a second reicing should be delayed until one or two days before arrival at Atlantic Coast destinations. Preiced and replenished shipments with only one reicing probably should have that reicing delayed for four or even five days. With warehouse-cooled lemons the aim should be the maintenance of temperature already attained, and not a rapid cooling as with warm loaded fruit, where an early reicing is normally required.

In general the results of this lemon shipping test indicate that mid-summer lemon shipments have been refrigerated more than necessary and that a substantial saving probably can be effected safely by using less expensive icing services.

ACKNOWLEDGEMENTS

This test was made possible by the companies and individuals listed below whose cooperation and assistance is gratefully acknowledged.

Sierra Madre-Lamona Citrus Association, Pasadena, Calif.
San Luis Lemon Association, San Luis, Calif.
Upland Lemon Association, Upland, Calif.
San Fernando Helix Lemon Association, San Fernando, Calif.
San Fernando Lemon Association, San Fernando, Calif.
Seaboard Lemon Association, Oxnard, Calif.
Culbertson Lemon Association, Saticoy, Calif.
Oxnard Citrus Association, Port Buena Vista, Calif.
Sonris Lemon Association, Oxnard, Calif.

Mr. Pete Holst, Mr. C. E. Howard, and Mr. Gordon Gould of the Pacific Fruit Express Company.

The Southern Pacific, Rock Island, R. F. D. of C., and the Erie Railroads, over which the test train travelled.

The Association of American Railroads furnished the business car accommodations at the request of the Western Lines and also furnished a member of the test party.

Besides the members of the test party the following assisted in overseeing the loading of test cars: J. P. MacRill, James Falzer, and Carl Waldapfel of the California Fruit Growers Exchange; G. L. R. G. G. Harlan, Barber, M. E. Getty, D. A. Lewey of the United States Department of Agriculture, and members of the staff of the Freco Corporation.

Mr. James A. Scanlon, Inspector for the California Fruit Growers Exchange and the staff of the U. S. Department of Agriculture Market Pathology Laboratory in New York who assisted in unloading the test cars and inspection of the test fruit.

Members of the test party were:

E. M. Harvey, U. S. Department of Agriculture
E. F. Atrops, " " " " " "
V. A. Reubelt, " " " " " "
W. I. Cottrell, Pacific Fruit Express Company
W. A. Nutty, Association of American Railroads

TABLE NO. 1

LOADING DATA

Commodity: warehouse-cooled lemons

	PFE 68151 A	PFE 68152 B	PFE 68150 C	PFE 68143 D	PFE 68142 E	PFE 68144 F	PFE 68149 G	PFE 68145 H
Shipper	San Fernando Pgts. Lemon Assn. San Fernando	San Fernando Lemon Assn. San Fernando	Oxnard Cit. Assn. Port Hueneme	Culbertson Lemon Assn. Saticoy	Somis Lemon Assn. Oxnard	Seaboard Lemon Assn. Oxnard	Oxnard Cit. Assn. Port Hueneme	Oxnard Cit. Assn. Port Hueneme
icing ^{1/} Service	Full Bunker Rule 239 (PI by C. Repl. RI Tucson).	Half Stage Rule 239 & 255 (PI by C. Repl. RI at Tucson)	Half Stage Rule 249 & 255. (Dry car II by C. Std. Ref.)	Full Bunker Rule 239 (PI by C. Repl. RI Dalhart)	Full Bunker Rule 239 (PI by C. Repl. RI El Paso & Horuell	Full Bunker Rule 239 (PI by C. Repl. DMR)	Half Stage Rule 249 & 255 (Dry car II by C. RI Dalhart & Karion.	Full Bunker Rule 249 (Dry car loaded II by C. RI El Paso & Larion
Fan position	Fans on	Fans on	Fans on	Fans on	Fans on, restricted circulation	Fans on	Fans on	Fans on
Loading period 8/16	7 a.m.- 12 m.	8:30 a.m.- 4:30 p.m.	7:30 a.m.- 12:30 p.m.	9:30 a.m.- 3:45 p.m.	1 p.m. - 3:30 p.m.	10:15 a.m.- 1:30 p.m.	7:30 a.m.- 11 a.m.	7:30 a.m. - 12:30 p.m.

^{1/} Key: PI by C - Priced by carrier
 II by C - Initially iced by carrier
 RI - Reiced in transit
 PC by C - Pfcooled by carrier
 Repl - Bunkers replenished at first regular icing station
 Std. Ref. - Standard refrigeration

TABLE 10. 1 (Cont'd)

	FFE 68145 I	FFE 68146 J	FFE 68147 K	FFE 68148 L	FFE 68149 M	FFE 68141 N	FFE 68146 O
Shipper	Upland Lemon Assn. Upland	San Dimas Lemon Assn. San Dimas	San Dimas Lemon Assn. San Dimas	Upland Lemon Assn. Upland	Upland Lemon Assn. Upland	Sierra-Ladre Lamanda Cit. Assn. Pasadena	Sierra-Ladre- Lamanda Citrus Assn. Pasadena
Icing Ser- vice	Full Bunker Rule 245 (Dry car PC by C & Mrs II by C. RI Dalhart)	Full Bunker Rule 239 (PI by C. Repl. RI El Paso & Fornell)	Full Bunker Rule 239 (PI by C. Repl. RI at El Paso & Fornell)	Half Stage Rule 239 & 255 (PI by C. Repl. RI at Tucson & Silvis)	Half Stage Rule 239 & 255 (PI by C. Repl. RI at Tucson & Silvis)	Half Stage Std. Ref. & Rule 255. (PI by C. Repl.)	Half Stage Rule 249 & 255 (Dry car loaded II by C. RI at El Paso & Silvis)
Fans	Fans on	Fans off	Fans on	Fans off	Fans on	Fans on	Fans on
Loading period 8/18	8:15 a.m.- 2:30 p.m.	9:05 a.m.- 2:00 p.m.	7:10 a.m.- 9:50 a.m.	1:00 p.m.- 4:35 p.m.	8:30 a.m.- 3:35 p.m.	11:30 a.m.- 3:30 p.m.	8:15 a.m.- 11:30 a.m.

TABLE 2

ICING RECORD

	Date	A	B	C	D	E	F	G	H	I
	Aug.	Full Bunker	Half Stage	Half Stage	Full Bunker	Full Bunker	Full Bunker	Half Stage	Full Bunker	Full Bunker
		Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
<u>Preiced</u>	Oxnard 8:30 a.m.				11,500	11,500	11,500			
	Los Angeles 10:45A	11,500	6500							
	Graham 10 a.m.									
<u>Replen- ished</u>	Oxnard 8-9 p.m.					1,500	2,400			
	" 8:30 a.m.				3,600					
	Los Angeles 4:30A	1,800	2400							
	Colton 8 a.m.									
	" 7:45 p.m.									
<u>Initial icing</u>	Oxnard 8-9 p.m.			6500				6500	11,500	Pre- cooled 8 Hrs
	Colton 8 p.m.									11,500 (5P)
<u>Reiced</u>	Los Angeles 8:20A			1200 (Repl)						
	Yuma 10 a.m.			2100						
	Tucson 10 p.m.	5,100	5,200	700						
	El Paso 1 p.m.			2000		4,400			7,300	
	Dalhart 7 p.m.			2300	8,300			4,900		6,100
	Kansas City 5:30P			3300						
	Silvis 5 p.m.			1200						
	Clearing 7 a.m.			1800						
	Marion 1:30A			600				6,500	10,000	
	Hornell 7:30P			1700		10,000				
<u>Total ice supplied to Jersey City</u>		18,400	14,100	23,600	23,400	27,400	13,990	17,900	28,800	17,600
<u>Ice remaining on arrival J. City</u>		none	none	4300	1,400	7,200	none	1,600	5,600	1,300
<u>Ice melted to Jersey City</u>		18,400	14,100	19,300	22,000	20,200	13,900	16,300	23,200	16,300
<u>Ice supplied at J. City 1-5P</u>	28	4,000	4,000	--	4,000	--	4,000	--	--	--

TABLE 2 - Cont'd

ICING RECORD

		Date Aug.	J Full Bunker	K Full Bunker	L Half Stage	M Half Stage	N Half Stage	O Half Stage
<u>Preiced</u>	Oxnard 8:30 a.m.	17						
	Los Angeles 10:45A	17						
	Graham 10 a.m.	17	11,500	11,500	6500	6500	6500	
<u>Replen- ished</u>	Oxnard 8-9 p.m.	18						
	" 8:30 a.m.	19						
	Los Angeles 4:30A	19						
	Colton 8 a.m.	19	6,200	5,800	5300	4800		
	" 7:45P	19					5900 (Repl)	
<u>Initial icing</u>	Oxnard 8-9 p.m.	18						
	Colton 8 p.m.	19						6500
<u>Reiced</u>	Los Angeles 8:20A	19						
	Yuma 10 a.m.	20					2100	
	Tucson 10 p.m.	20			3000	4500	2000	
	El Paso 1 p.m.	21	4,500	7,500			1700	6400
	Dalhart 7 p.m.	22					2700	
	Kansas City 5:30P	23					3000	
	Silvis 5 p.m.	24			6500	6500	1000	6500
	Clearing 7 a.m.	25					2000	
	Marion 1:30A	26					600	
	Hornell 7:30P	26	7,500	10,500			1800	
<u>Total ice supplied to Jersey City</u>			29,700	35,300	21,300	22,300	29,300	19,400
<u>Ice remaining arrival Jersey City</u>			7,200	7,000	700	200	8,500	50
<u>Ice melted to Jersey City</u>			22,500	28,300	20,600	22,100	20,800	19,350
<u>Ice supplied at J. City 1-5P</u>		28	--	--	4,000	4,000	--	--

TABLE 3 - Car A

Test 1948-1

TEMPERATURES IN TRANSIT

Lemons

Full Hunker. PI by Carrier, Repl. One R1 at Tucson. Fans on.

Place	Date Aug/	Time	Cut- side	CL BB	CL MB	CL TP	CL TQ	R3 MQ	R6 KQ	CL BQ	TA	LD SS	CL BD	CL TD	RA	Av. Top	Av. Bot
			Pre-icing Los Angeles 10:45 a.m., August 17.														
San Fernando	18	12 M	64°	567	625	625	620	587	602	562	680	616	610	620	420	622	580
			Repl. Los Angeles 4:30 a.m., August 19.														
Colton-Calif.	19	7:OOP.	83	435	528	537	538	495	526	471	538	506	480	548	439	541	462
Yuma, Ariz.	20	10:OOA	98	441	500	490	485	465	496	468	435	476	474	506	450	494	461
Tucson, "	20	9:30P	88	439	480	463	450	443	466	457	460	452	452	474	446	462	450
			Reiced Tucson 10:00 p.m., August 20.														
El Paso, Texas	21	1:OOP	100	427	455	435	412	413	430	432	414	422	440	434	422	427	433
" " "		7:OOP	91	409	450	437	414	417	432	432	516	434	445	432	416	428	430
Tucumcari, NM.	22	12 M	90	411	430	403	394	397	407	412	402	408	425	414	405	404	416
Dalhart, Texas		6:OOP	89	409	430	410	393	395	404	412	415	408	425	410	405	404	415
Herrington, Kas.	23	10:OOA	88	402	419	399	385	387	392	402	410	396	415	400	398	395	406
Kansas City, Kas.		5:30P	93	397	413	397	384	383	388	402	505	401	414	395	408	390	404
Eldon, Iowa	24	12 M	98	397	410	405	390	387	392	398	410	404	410	400	400	398	402
Silvis, Ill.		5:OOP	96	397	410	405	392	392	396	404	480	411	415	408	415	402	405
Hammond, Ind.	25	10:OOA	89	399	410	410	400	397	398	402	470	418	412	412	420	407	404
Marion, Ohio	26	2:OOA	73	409	410	420	410	405	407	407	455	426	420	420	425	417	412
Hornell, NY.		7:30P	83	427	423	431	434	431	428	426	506	450	449	440	455	435	434
Port Jervis	27	8:OOA	73	447	441	439	456	457	452	444	495	471	450	462	472	452	447
Jersey City, NJ.	27	3:OOP	103	457	450	470	470	467	462	457	576	486	460	476	485	472	458
" "	28	12 M	94	472	480	537	515	483	494	472	645	516	465	531	503	528	470
" "	29	10:OOA	93	445	487	556	525	480	491	467	628	504	470	538	468	539	461
" "	30	9:OOA	82	435	498	571	533	477	496	464	617	508	474	544	469	549	458
" "	31	9:OOA	75	442	510	580	550	482	507	468	620	513	476	556	480	562	462

TABLE 4 - CAP'E

1st 1948-1

TEMPERATURES IN TRANSIT

Lemons

Half Stage. PI by Carrier, Replenished, One Reicing at Tucson, Ariz. Fans on.

Date	Time	Out-side	CL BB	CL MB	CL TB	CL T ₁	R3	R6	CL	MD	CL	CL	Av. Top	Av. Lot			
Aug.										SS	TD	TD	BA				
Pre-iced Los Angeles 10:45 a.m., August 17.																	
San Fernando	18	4:50P	89°	580	637	649	650	645	624	580	--	644	660	652	470	650	607
Repl. Los Angeles 4:30 a.m., August 19.																	
Colton, Calif.	19	7:00P	83	469	538	580	590	565	574	462	--	566	509	591	430	587	480
Yuma, Ariz.	20	10:00A	98	475	525	534	512	533	538	506	--	524	532	528	505	525	504
Tucson, Ariz.		9:30P	88	490	517	514	500	520	516	510	--	514	535	512	518	509	512
Reiced at Tucson 10:00 p.m., August 20																	
El Paso, Texas	21	1:00P	100	482	497	477	440	480	474	475	--	466	500	460	425	459	486
" " "		7:00P	91	465	489	479	450	479	474	465	--	480	504	466	450	465	478
Tucumcari, N.	22	12 M	90	456	425	453	430	455	444	452	--	449	485	437	455	440	464
Dalhart, Texas		6:00P	89	455	471	449	426	451	444	446	--	449	480	437	455	437	460
Herington, Kas.	23	10:00A	88	455	463	449	435	450	442	446	--	450	474	442	460	442	458
Kansas City, Kas.		5:30P	93	460	462	455	450	460	450	450	--	466	484	457	480	454	466
Eldon, Iowa	24	12 M	98	460	481	504	495	485	480	480	--	509	505	496	505	498	488
Silvis, Ill.		5:00P	96	490	489	505	510	500	494	494	--	519	520	512	520	509	501
Panmond, Ind.	25	10:00A	69	516	517	539	544	529	524	514	--	554	538	542	545	542	523
Marion, Ohio	26	2:00A	73	545	547	574	580	565	554	554	--	589	575	578	575	577	558
Hornell, NY.		7:30P	83	560	582	599	612	600	592	580	--	616	612	609	612	607	591
Port Jervis, NY.	27	8:00A	73	608	607	619	626	623	612	608	--	634	630	628	625	624	615
Jersey City, NJ.		3:00P	103	620	619	631	638	633	622	610	--	644	640	642	635	637	623
" " "	28	12 M	94	640	645	673	674	650	644	624	--	679	655	668	650	678	640
" " "	29	10:00A	93	572	614	646	653	630	624	558	--	638	612	667	540	655	581
" " "	30	9:00A	82	553	605	643	650	616	625	621	--	627	603	656	553	650	592
Unloaded Aug. 30.																	

TABLE 5 - Car C

Test 1945-1

TEMPERATURES IN TRANSIT

Lemons

Half Stage. Dry Car Loaded, II by Carrier, Standard Refrigeration. Fans on.

Place	Date Aug.	Time	Out- side	CL BB	CL LB	CL TB	CL TQ	R3 RQ	R6 RQ	CL BQ	LD SS	CL BD	CL TD	HA	Av. Top	Av. Bot	
Hueneme, Calif.	18	1:00P	68°	625	638	623	641	647	630	628	684	649	649	646	647	637	634
<u>Initially iced Oxnard 8 p.m., Aug. 18. Repl Los Angeles 8:20 a.m., Aug. 19.</u>																	
Colton, Calif.	19	7:00A	83	505	559	567	542	543	558	540	549	580	551	572	505	560	532
Yuma, Ariz.	20	10:00A	98	505	541	505	491	512	520	530	496	554	547	508	508	511	527
<u>Reiced at Yuma 10 a.m., Aug. 20.</u>																	
Tucson, Ariz.		9:30P	88	485	521	505	449	474	479	503	472	509	514	466	479	473	501
<u>Reiced at Tucson 10 p.m., Aug. 20.</u>																	
El Paso, Texas	21	1:00P	100	455	493	468	409	435	437	468	432	484	483	428	444	435	469
<u>Reiced at El Paso 1 p.m., Aug. 21.</u>																	
" " "		7:00P	91	445	486	473	434	450	450	473	474	500	484	443	434	450	467
Tucumcari, N.M.	22	12 M	90	435	466	443	397	412	415	443	418	459	459	408	422	416	446
Dalhart, Texas		6:00P	89	430	456	438	399	410	413	438	437	458	449	408	420	415	439
<u>Reiced at Dalhart 7 p.m., Aug. 22.</u>																	
Herington, Kas.	23	10:00A	88	415	436	413	383	392	395	418	412	428	427	390	399	395	420
Kansas City, Kas.		5:30P	93	407	429	411	385	392	395	414	492	434	424	393	404	396	415
<u>Reiced at Kansas City 5:30 p.m., Aug. 23.</u>																	
Eldon, Iowa	24	12 M	98	401	419	411	379	385	389	403	407	424	415	388	394	393	406
Silvis, Ill.		5:00P	96	401	417	405	384	385	389	403	467	430	413	390	400	393	406
<u>Reiced at Silvis 5 p.m. Aug. 24.</u>																	
<u>Reiced at Clearing 7 a.m., Aug. 25.</u>																	
Hammond, Ind.	25	10:00A	89	395	409	398	384	385	385	398	434	448	414	392	404	391	402
Marion, Ohio	26	2:00A	73	393	405	393	375	376	381	393	412	434	404	388	394	385	397
<u>Reiced at Marion 1:30 a.m., Aug. 26.</u>																	
Hornell		7:50P	83	390	397	387	371	374	375	383	422	410	394	378	389	379	389
<u>Reiced at Hornell 7:30 p.m., Aug. 26.</u>																	
Port Jervis, NY.	27	9:00A	73	390	401	388	364	368	365	380	382	409	393	378	380	377	388
Jersey City, NJ.	27	3:00P	103	385	395	379	374	374	365	382	452	414	391	380	389	378	386
" " "	28	12 M	94	375	386	391	379	375	360	383	478	459	405	390	394	387	388
" " "	29	10:00A	93	374	389	410	427	378	368	391	514	467	421	410	407	416	395
" " "	30	9:00A	82	373	391	441	427	433	375	391	530	466	423	421	418	430	396
" " "	31	9:00A	74	390	406	475	477	396	400	402	600	488	431	490	434	481	408

TABLE 6 - Car D

Test. 1948-1

TEMPERATURES IN TRANSIT

Lemons

Full Bunker. PI by Carrier, Replenished, One Reicing at Dalhart. Fans on.

Place	Date		Out- side	CL	CL	CL	CL	R3	R6	CL		MD	CL	CL	Av. Top	Av. Bot	
	Aug.	Time		BB	MB	TB	TQ	MQ	MQ	BQ	TA	SS	BD	TD			BA
<u>Preiced at Oxnard 8:30 a.m., August 17.</u>																	
Saticoy	18	3:45P	75	553	564	577	588	562	575	564	655	594	587	605	407	590	568
<u>Replenished Oxnard 8:50 a.m., August 19.</u>																	
Colton, Calif.	19	7:00P	83	460	486	506	502	488	507	496	447	506	494	518	454	509	483
Yuma, Ariz.	20	10:00A	98	445	452	468	440	444	451	426	430	460	474	459	449	456	448
Tucson, Ariz.		9:30P	88	440	434	442	424	429	428	456	455	440	455	434	447	433	450
El Paso, Texas	21	1:00P	100	425	418	422	405	413	408	436	430	471	439	410	434	412	433
" "		7:00P	91	420	417	419	410	419	413	435	525	426	439	414	437	414	431
Tucumcari, N.M.	22	12 M	90	420	412	414	406	409	405	426	430	416	425	410	429	410	424
Dalhart, Texas	22	6:00P	89	420	412	414	410	411	405	425	447	418	424	414	434	413	423
<u>Reiced Dalhart 7 p.m., August 22</u>																	
Herington, Kas.	23	10:00A	88	402	397	398	380	381	381	401	403	396	399	384	404	387	401
Kansas City, Kas.		5:30P	93	396	396	394	382	384	379	399	470	396	397	384	405	387	397
Eldon, Iowa	24	12 M	98	392	390	392	382	379	378	393	401	392	395	386	399	387	393
Silvis, Ill.		5:00P	96	394	387	389	382	379	378	391	449	392	395	388	405	386	393
Hammond, Ind.	25	10:00A	89	390	387	390	388	384	383	393	404	398	404	394	411	391	396
Marion, Ohio	26	2:00A	73	396	387	392	390	384	388	391	425	400	399	394	405	392	395
Hornell, NY	26	7:30P	83	396	387	394	392	387	388	396	440	401	404	399	409	396	399
Port Jervis, NY.	27	8:00A	73	400	392	396	395	394	393	396	409	404	404	399	405	397	400
Jersey City, NJ.	27	3:00P	103	400	342	349	402	395	393	398	497	406	414	404	414	385	404
" "	28	12 M	94	402	407	447	450	395	403	404	585	420	419	440	435	446	408
" "	29	10:00A	93	392	419	462	502	402	414	412	572	438	431	449	437	478	412
" "	30	9:00A	82	391	431	498	494	403	425	416	559	445	443	468	440	487	417

TABLE 7 - Car E

Test 1942-1

TEMPERATURES IN TRANSIT

Lemons

Full Bunker. PI by C., Repl. Reiced El Paso & Hornell. Fans on, Restricted Circulation

Place	Date Aug.	Time	Out- side	CL BB	CL MB	CL TB	CL TQ	R3 KQ	R6 MQ	CL BQ	TA	MD SS	CL BD	CL TD	BA	Av. Top	Av. Bot
Preiced at Oxnard 8:30 a.m., August 17																	
Oxnard, Calif.	18	3:30P	70	644	631	629	644	635	633	647	608	642	648	607	610	627	646
Replenished Oxnard 8-9 p.m., Aug. 18																	
Colton, Calif.	19	7:00P	83	570	589	582	592	577	574	577	564	590	571	589	598	588	572
Yuma, Ariz.	20	10:00A	98	568	573	564	572	567	565	581	541	572	574	572	572	569	574
Tucson "		9:30P	88	564	558	548	560	559	554	572	570	566	572	567	580	558	569
El Paso, Texas	21	1:00P	100	558	543	534	543	540	535	507	542	547	560	553	569	543	542
" " "				Reiced at El Paso 1 p.m., August 21.													
" " "		7:00P	91	552	548	538	546	541	540	557	591	552	554	551	516	545	554
Tucumcari, NM.	22	12M	90	538	519	512	522	517	510	537	506	528	538	522	536	519	538
Dalhart, Texas		6:00P	89	533	517	508	520	513	510	533	516	526	538	522	536	517	535
Herington, Kas.	23	10:00A	88	523	505	496	505	600	498	517	501	508	518	507	513	503	519
Kansas City, Kas.		5:30P	93	518	503	496	505	500	500	517	506	510	516	505	516	502	517
Eldon, Iowa	24	12M	98	508	498	484	504	493	495	507	501	505	510	502	511	497	508
Silvis, Ill		5:00P	96	506	497	480	504	495	500	507	540	508	510	505	522	496	508
Hammond, Ind.	25	10:00A	89	508	498	497	506	495	502	512	521	516	513	509	521	504	511
Marion, Ohio	26	2:00A	73	508	501	502	514	501	510	513	522	517	513	512	540	509	511
Hornell, NY.		7:30P	83	513	503	504	515	505	515	517	544	517	513	517	536	512	514
Reiced Hornell 7:30P., August 26.																	
Port Jervis, NY.	27	8:00A	73	508	493	492	505	495	495	503	476	502	508	501	511	499	506
Jersey City, NJ.		3:00P	103	506	491	487	500	490	492	503	521	502	503	493	516	495	504
" " "	28	12M	94	488	498	497	505	487	498	492	542	505	491	502	462	501	490
" " "	29	10:00A	93	466	497	500	513	478	504	479	553	498	476	505	453	506	474
" " "	30	9:00A	82	452	493	502	536	470	510	469	550	496	470	512	458	517	464

TABLE 12 - Car J

Test 1948-1

TEMPERATURES IN TRANSIT

Lemons

Full Bunkers. Preiced by carrier, Replenished, Reiced El Paso and Hornell. Fans off

Place	Date		Out- side	CL	R6	CL	CL	MD	CL	R3	CL	CL	CL	Av.	Av.		
	Aug.	Time		BB	MQ	BQ	TD	SS	BD		BA	TA	MQ	TQ	TB	MB	Top
<u>Preiced at Graham 10 a.m., August 17.</u>																	
San Dimas, Calif.	18	2:00P	81°	582	625	613	628	629	594	450	734	607	621	604	627	618	596
<u>Repl. Colton 8:30a.m., August 19.</u>																	
Colton, Calif.	19	7:00P	83	442	563	475	586	535	488	418	603	574	594	567	554	582	468
Yuma, Ariz.	20	10:00A	98	410	531	441	566	505	459	406	558	464	577	536	523	560	437
Tucson, "		9:30P	88	393	515	430	572	491	450	407	586	469	558	523	509	551	424
El Paso, Texas	21	1:00P	100	385	504	425	546	484	447	408	562	455	554	514	501	538	419
<u>Reiced El Paso 1 p.m., August 21.</u>																	
" " "		7:00P	91	383	497	424	543	461	443	420	574	450	547	510	493	533	417
Tucumcari, NM	22	12M	90	380	477	415	535	470	438	410	533	442	537	493	480	522	411
Delhart, Texas		6:00P	89	374	482	417	533	471	440	404	548	434	536	495	480	521	410
Herington, Kas.	23	10:00A	88	373	470	413	525	463	437	407	520	430	527	484	472	512	408
Kansas City, Kas.		5:30P	93	370	404	416	518	459	435	412	565	424	516	485	467	506	407
Eldon, Iowa	24	12M	98	374	458	409	511	457	432	417	537	419	512	471	456	498	405
Silvis, Ill.		5:00P	96	369	457	409	503	462	432	424	561	419	513	473	452	496	403
Hammond, Ind.	25	10:00A	89	369	449	405	503	459	435	423	535	413	509	471	453	494	403
Marion, Ohio	26	2:00A	73	368	453	411	503	457	432	432	555	411	504	474	454	494	404
Hornell, NY.		7:30P	83	371	453	413	511	465	440	457	601	416	417	486	457	471	408
<u>Reiced at Hornell 7:30 p.m., August 26.</u>																	
Port Jervis, NY	27	8:00A	73	370	451	407	493	454	438	415	503	413	501	469	445	468	405
Jersey City, NJ		3:00P	103	361	440	401	493	445	448	420	532	408	494	465	442	484	403
" " "	28	12M	94	356	433	400	481	442	428	414	511	405	483	455	433	473	395
" " "	29	10:00A	93	360	429	446	479	443	424	418	522	402	477	451	428	469	410
" " "	30	9:00A	82	362	430	399	481	434	423	418	518	402	477	455	430	471	395
" " "	31	9:00A	75	362	430	398	473	439	425	416	518	398	478	451	420	466	395

TABLE 15 - Car M

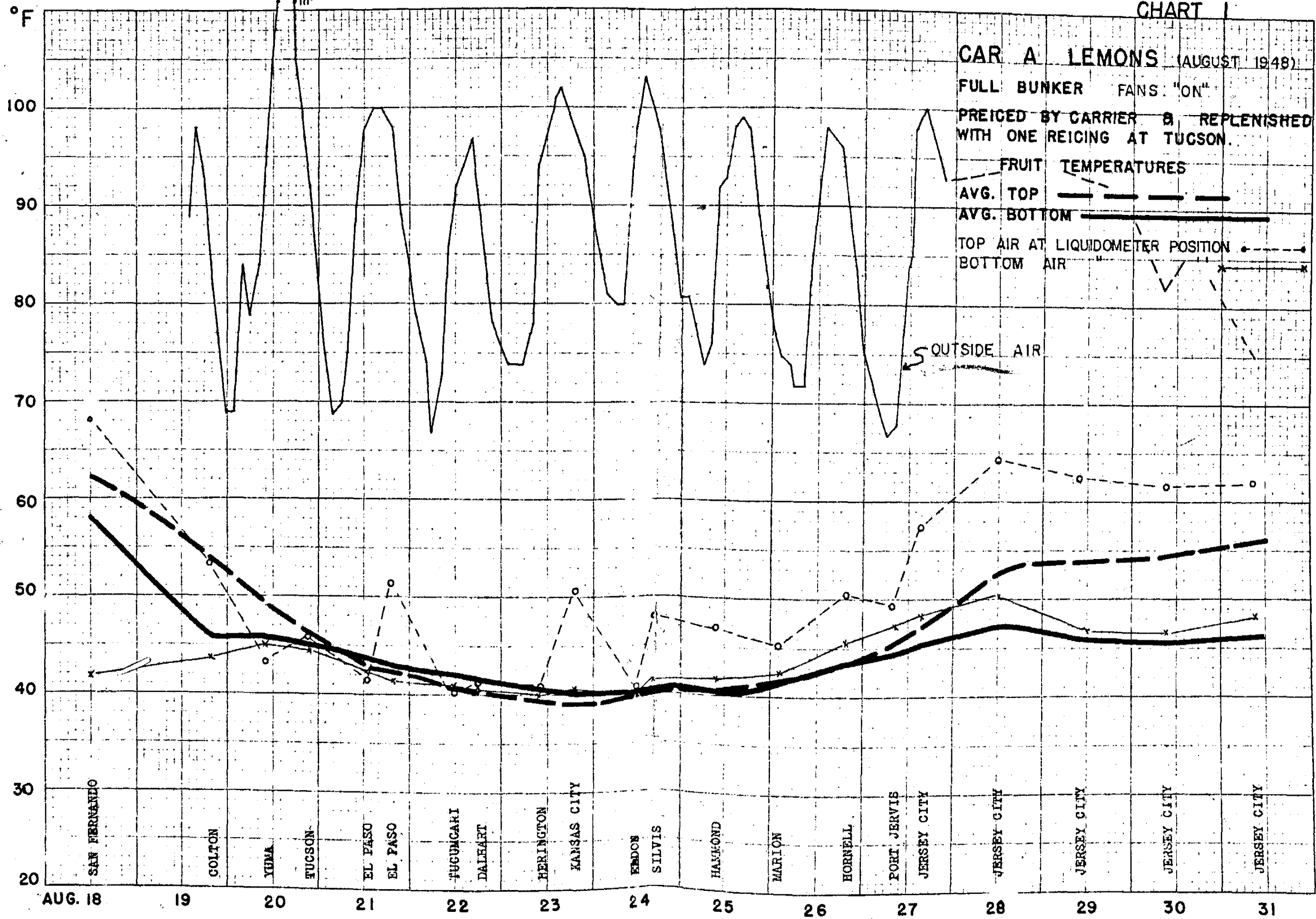
Test 1948-1

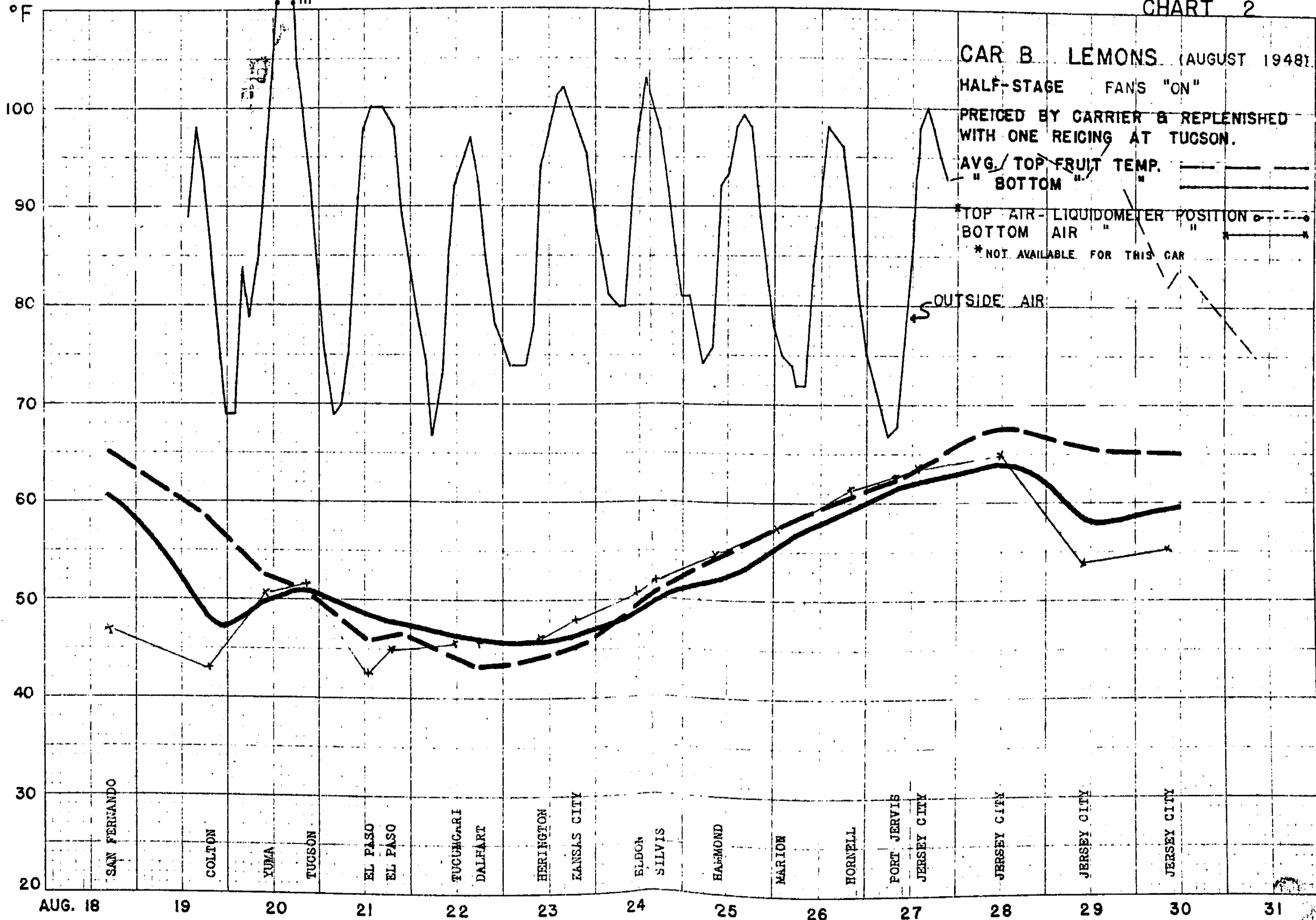
TEMPERATURES IN TRANSIT

Lemons

Half Stage. PI by Carrier, Repl., RI at Tucson and Silvis. Fans on.

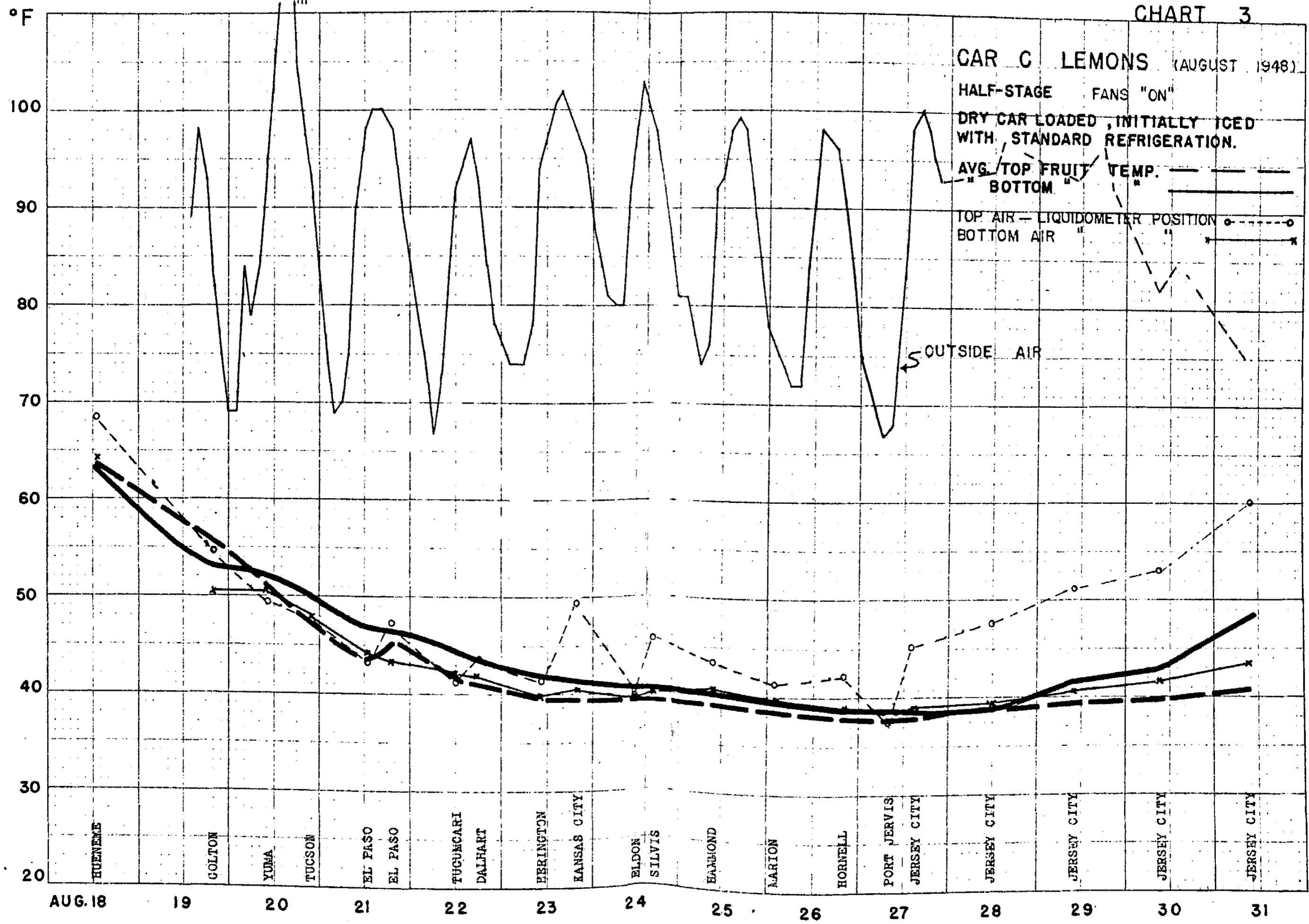
Place	Date Aug.	Time	Out- side	CL BB	R6 MQ	CL BQ	CL TD	LD SS	CL BD	BA	TA	R3 MQ	CL TQ	CL TB	CL MB	Av. Top	Av. Bot.
PI at Graham 10 a.m., August 17.																	
Upland, Calif.	18	3:40P	91°	562	585	630	604	614	600	513	812	635	663	624	620	630	597
Replenished Colton 8:30 a.m., August 19.																	
Colton, Calif.	19	7:00P	83	529	539	518	562	571	515	498	614	551	589	587	552	579	521
Yuma, Ariz.	20	10:00A	98	470	500	507	491	542	503	485	477	486	496	501	528	496	493
Tucson, "		9:30P	88	477	486	497	477	531	494	495	515	474	475	485	510	479	489
Reiced Tucson 10 p.m., August 20.																	
El Paso, Texas	21	1:00P	100	465	451	477	437	504	471	459	452	440	431	450	484	439	471
" " "		7:00P	91	456	457	473	446	510	474	444	528	451	444	463	474	451	468
Tucumcari, NM	22	12M	90	454	440	460	426	489	456	447	446	428	421	437	456	428	457
Dalhart, Texas		6:00P	89	444	434	457	427	484	450	449	462	430	424	440	452	430	450
Herington, Kas.	23	10:00A	88	447	432	447	431	477	452	451	466	430	429	444	438	435	449
Kansas City, "		5:30P	93	454	445	453	445	488	447	471	550	446	442	462	436	450	451
Eldon, Iowa	24	12M	98	473	467	458	493	509	477	499	532	478	486	503	455	494	469
Silvis, Ill.		5:00P	96	488	488	484	506	524	487	521	624	495	507	522	461	512	486
Reiced Silvis 5 p.m., August 24.																	
Hammond, Ind.	25	10:00A	89	464	459	464	468	505	470	457	477	451	452	467	454	462	466
Marion, Ohio	26	2:00A	73	455	444	453	451	490	457	451	468	435	432	450	444	444	455
Hornell, NY.		7:30P	83	449	434	446	444	479	446	451	478	433	429	444	427	439	447
Port Jervis, NY.	27	8:00A	73	450	436	448	450	477	448	447	452	435	434	456	432	445	449
Jersey City, NJ,		3:00P	103	453	442	448	513	582	453	465	527	443	442	464	433	473	451
" " "	28	12M	94	460	450	453	516	508	462	493	580	452	475	504	438	498	458
" " "	29	10:00A	93	444	451	450	510	511	464	451	546	446	474	499	441	494	453
" " "	30	9:00A	82	446	451	454	518	509	467	458	542	457	482	501	444	500	456
Diverted to Boston, 8/30																	





CAR C LEMONS (AUGUST 1948)

HALF-STAGE FANS "ON"
 DRY CAR LOADED, INITIALLY ICED
 WITH STANDARD REFRIGERATION.



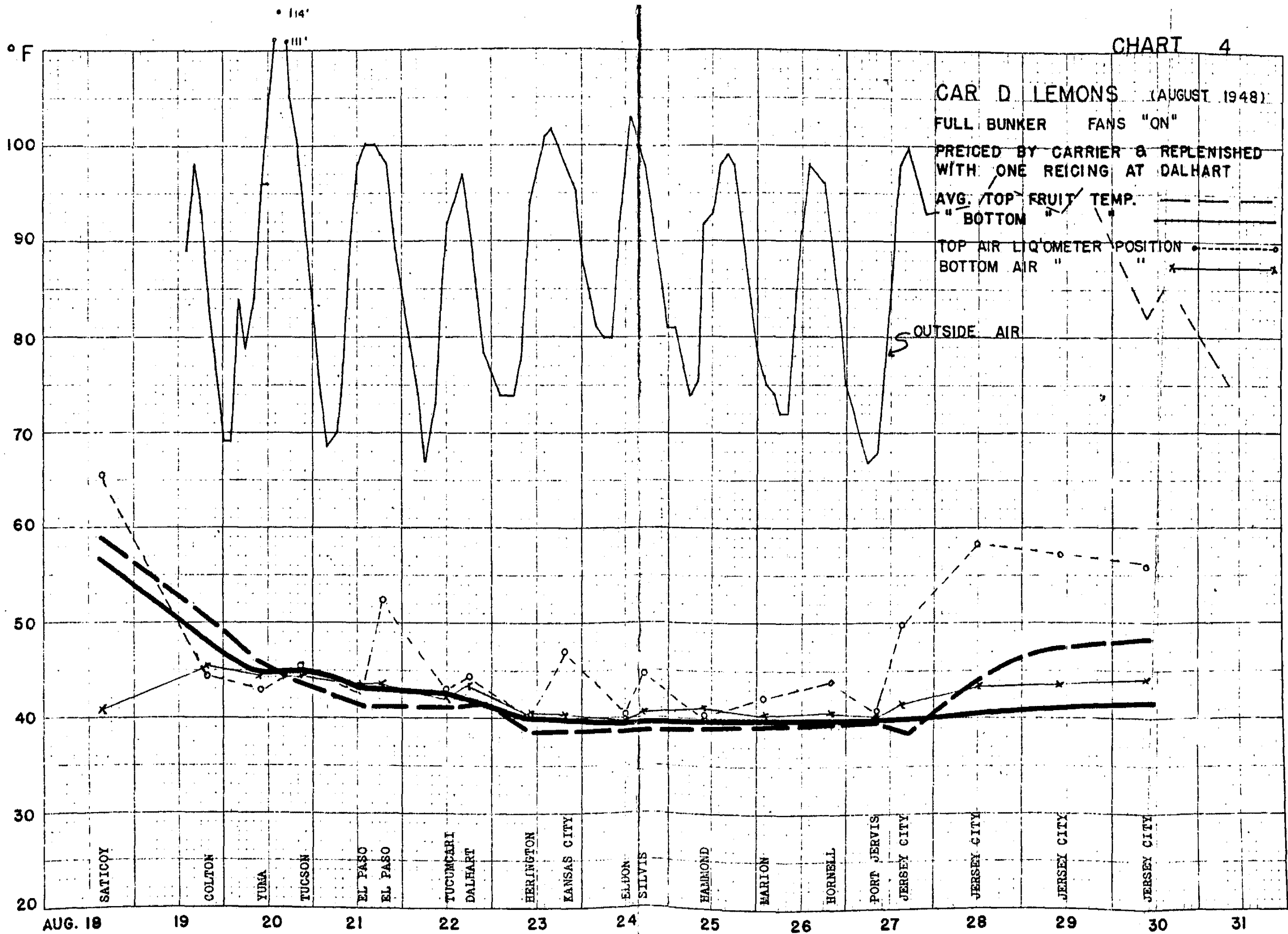


CHART 5

CAR E LEMONS (AUGUST 1948)

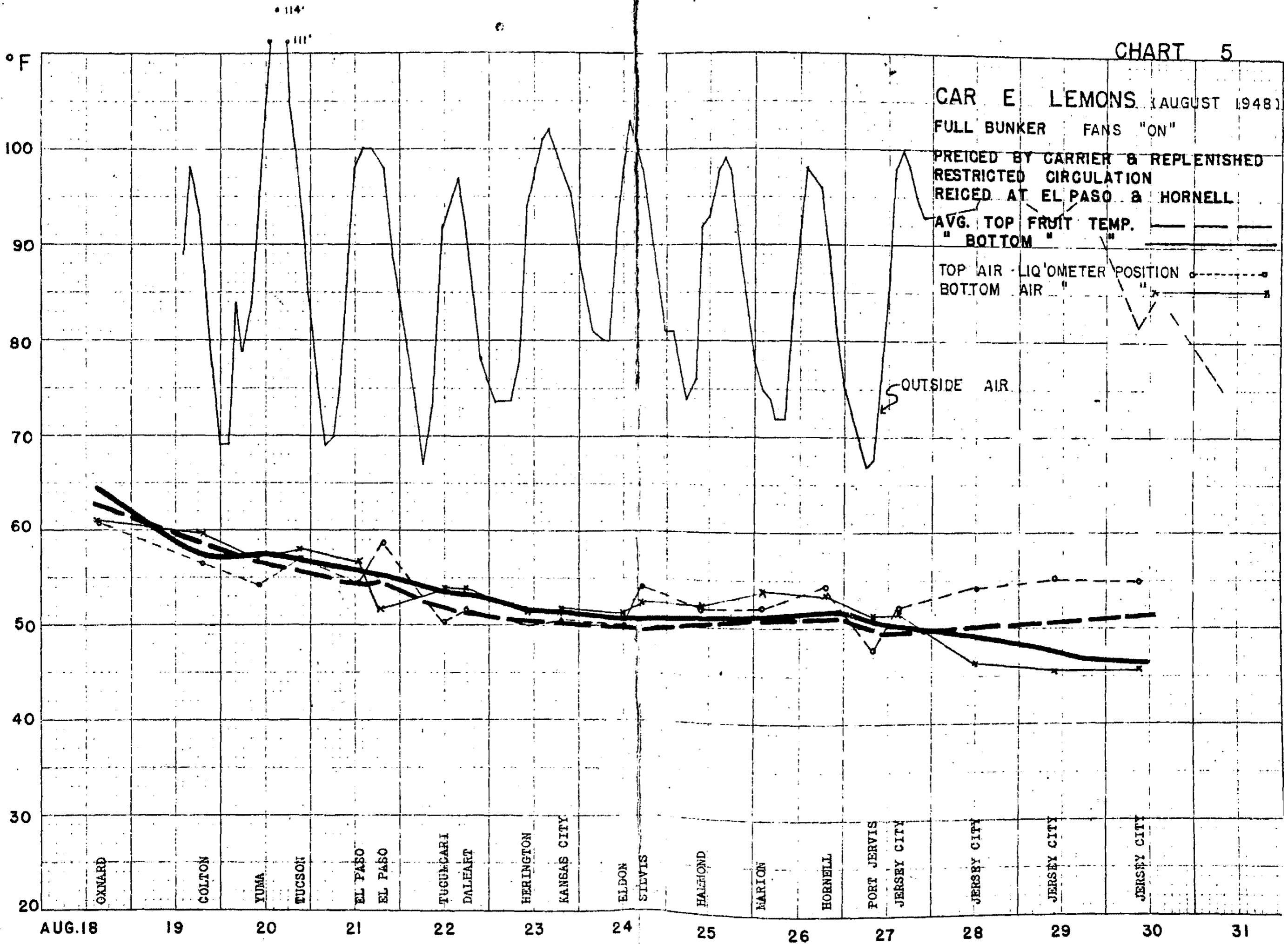
FULL BUNKER FANS "ON"

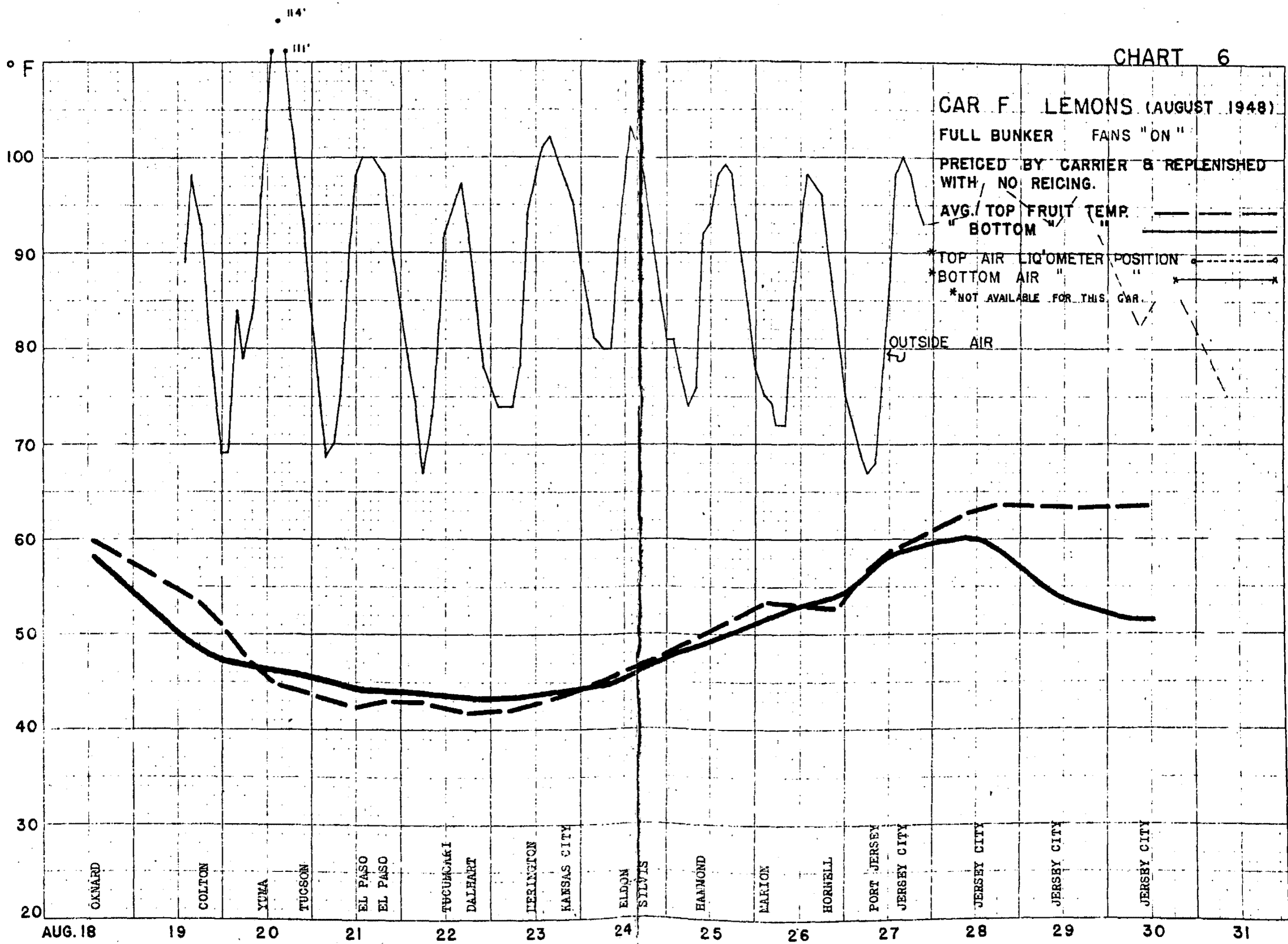
PREICED BY CARRIER & REPLENISHED
RESTRICTED CIRCULATION
REICED AT EL PASO & HORNELL

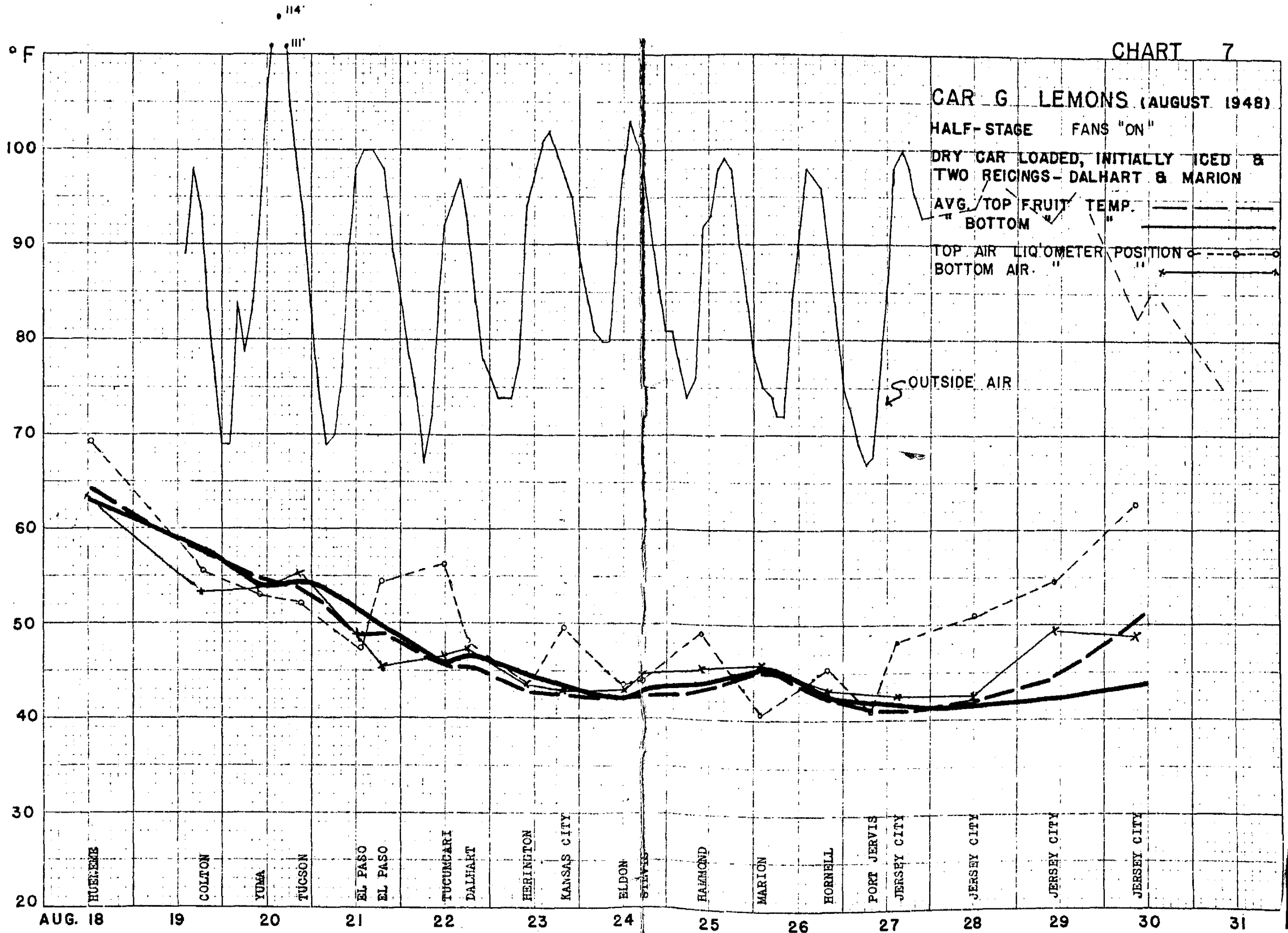
AVG. TOP FRUIT TEMP. ———
" BOTTOM " ———

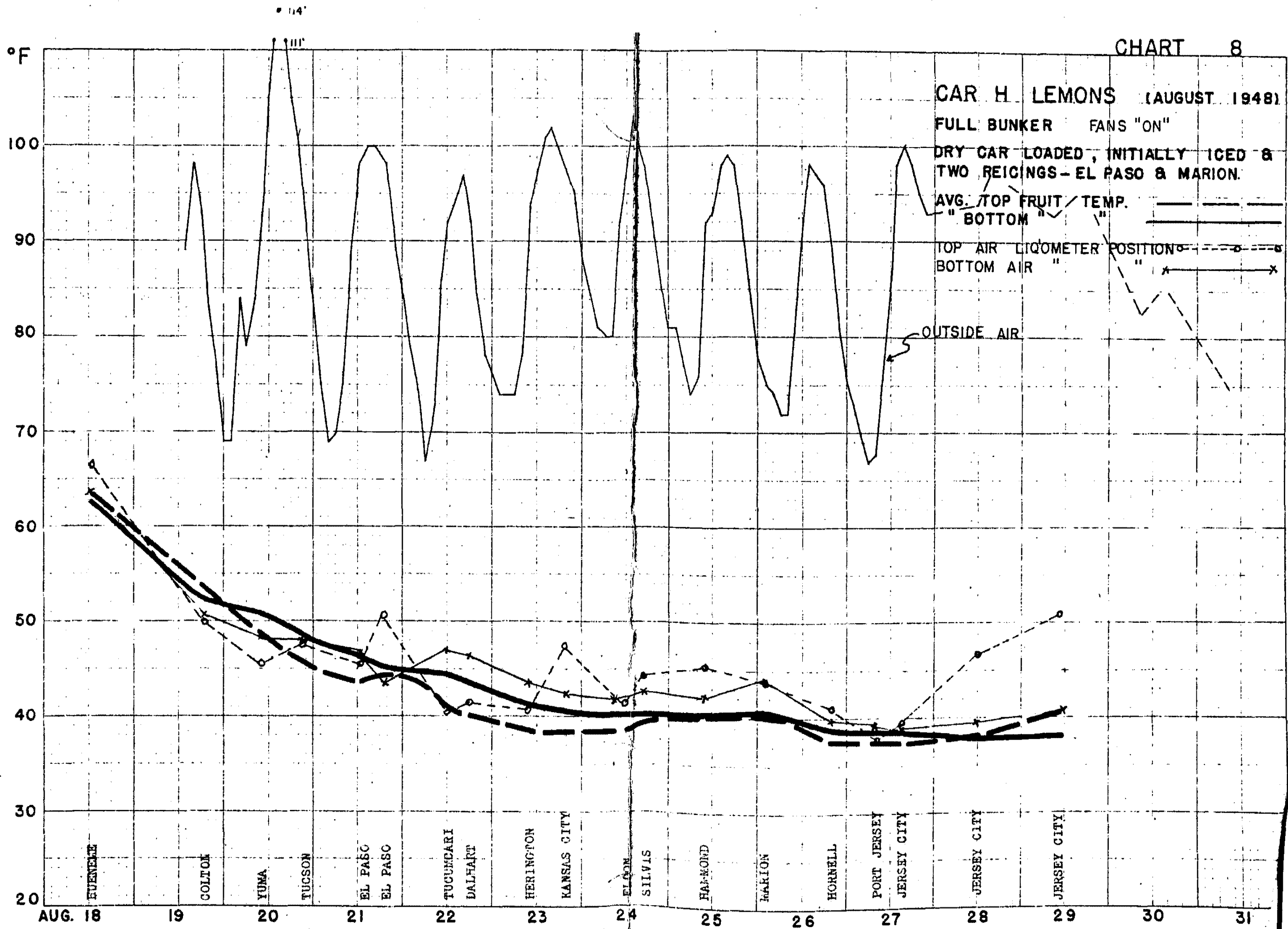
TOP AIR LIQ'OMETER POSITION ○ ———
BOTTOM AIR " " × ———

OUTSIDE AIR









CAR I LEMONS (AUGUST 1948)

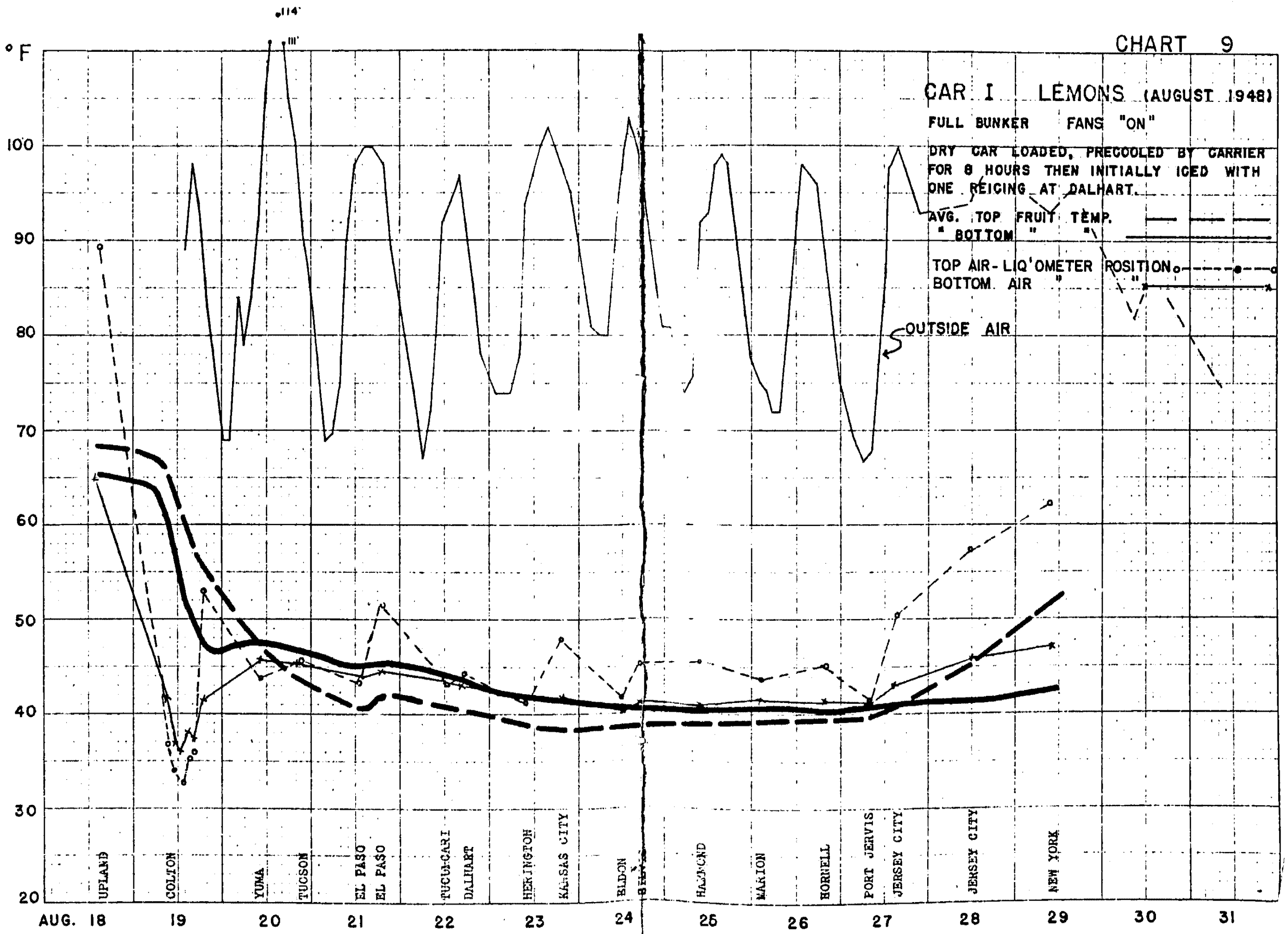
FULL BUNKER FANS "ON"

DRY CAR LOADED, PRECOOLED BY CARRIER FOR 8 HOURS THEN INITIALLY ICED WITH ONE REICING AT DALHART.

AVG. TOP FRUIT TEMP.
" BOTTOM "

TOP AIR-LIQ'OMETER POSITION
BOTTOM AIR "

OUTSIDE AIR



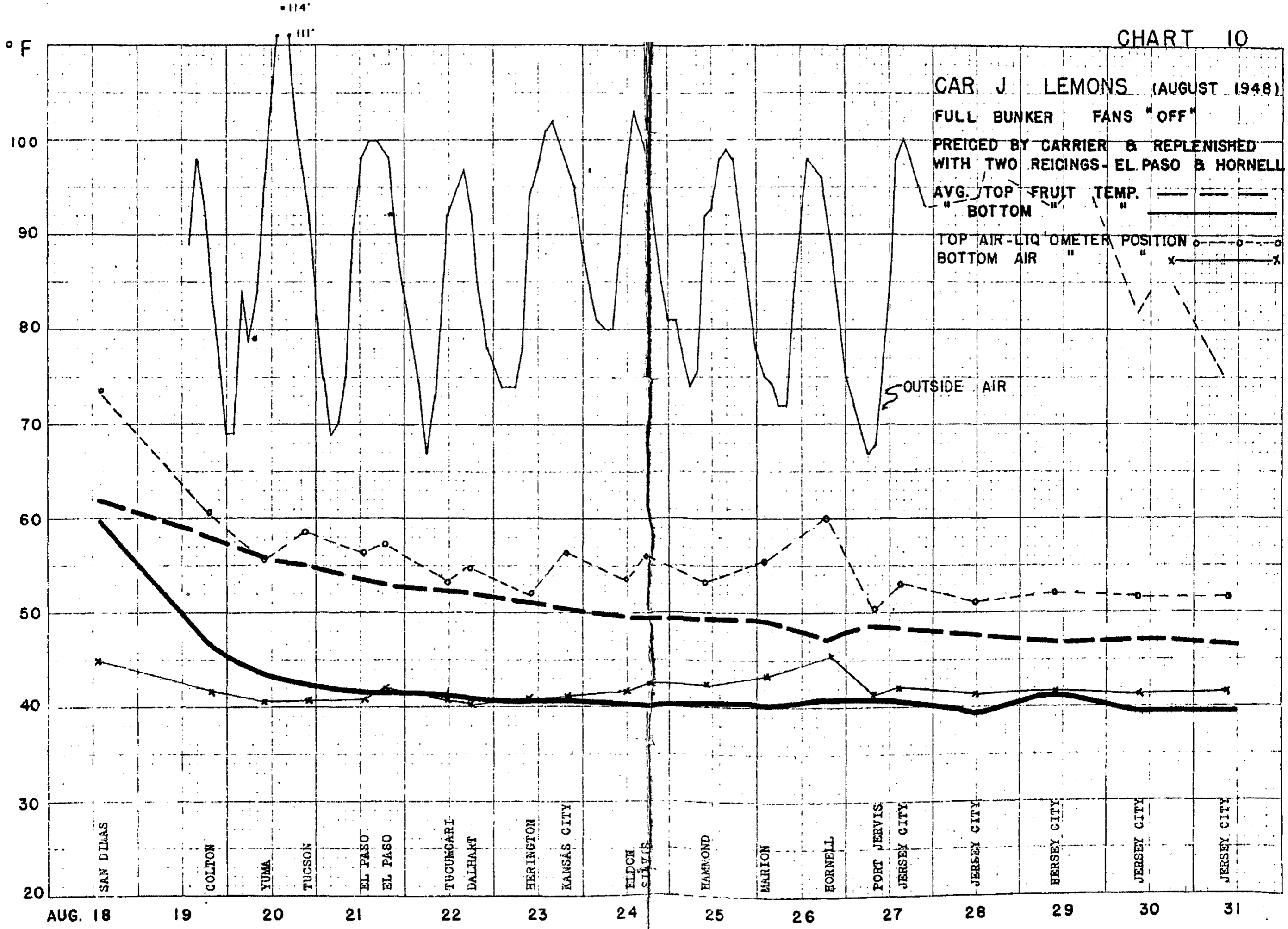


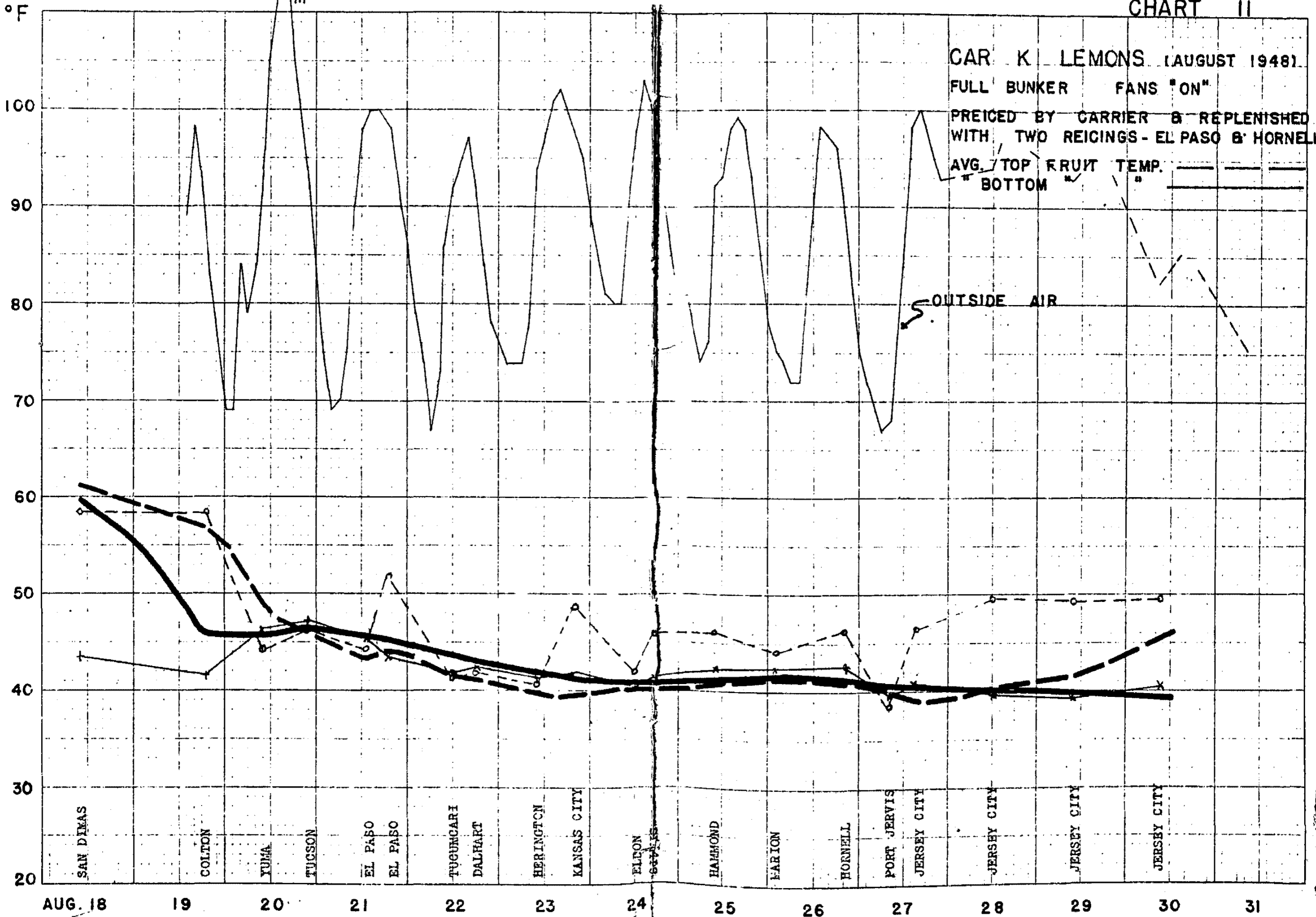
CHART II

CAR K LEMONS (AUGUST 1948)

FULL BUNKER FANS "ON"

PREICED BY CARRIER & REPLENISHED WITH TWO REICINGS - EL PASO & HORNELL

AVG. TOP FRUIT TEMP. _____
" BOTTOM " _____



CAR L LEMONS (AUGUST 1948)

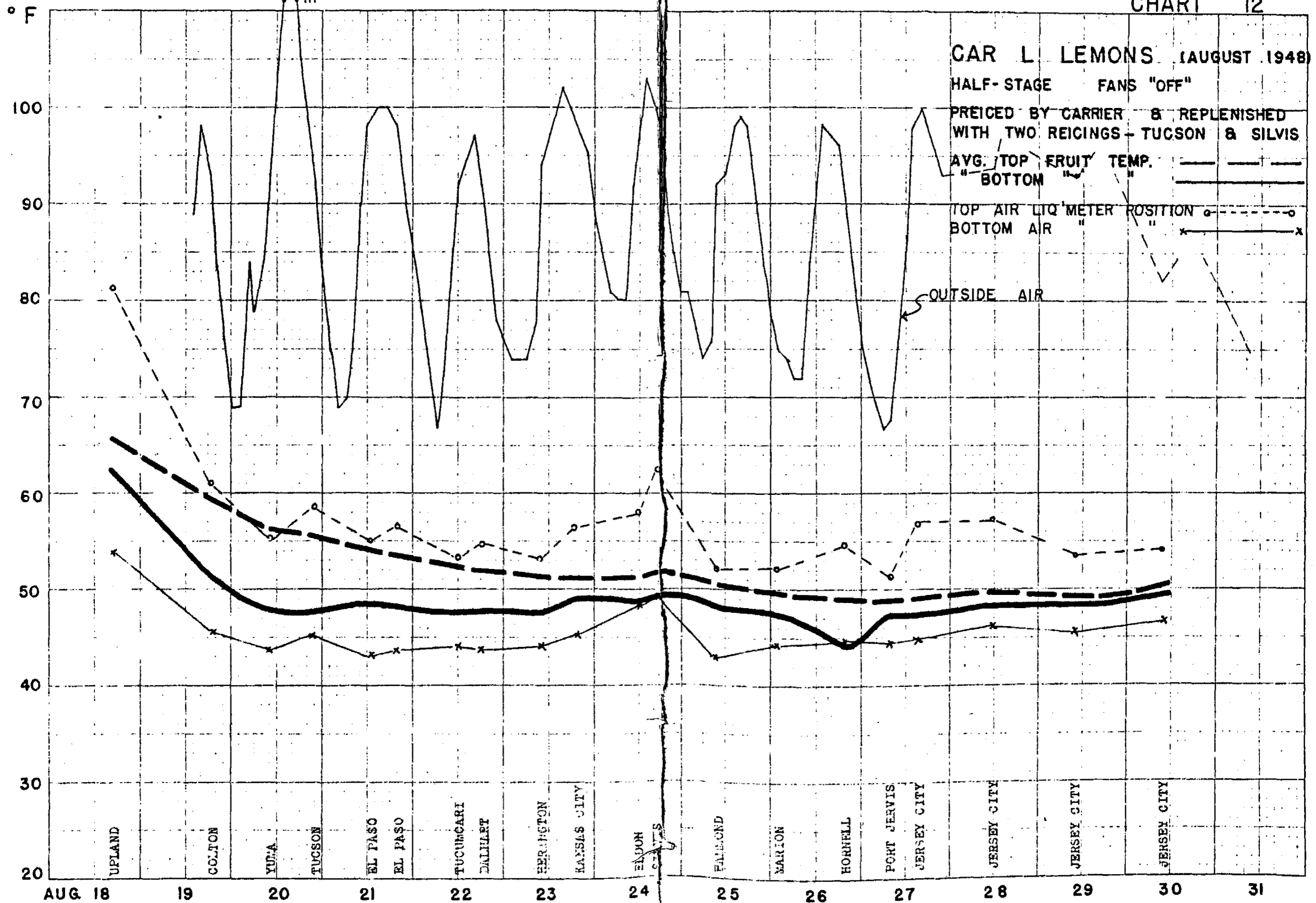
HALF-STAGE FANS "OFF"

PREICED BY CARRIER & REPLENISHED WITH TWO REICINGS - TUCSON & SILVIS

AVG. TOP FRUIT TEMP.
"BOTTOM"

TOP AIR LIQ METER POSITION
BOTTOM AIR

OUTSIDE AIR



CAR. M. LEMONS (AUGUST 1948)

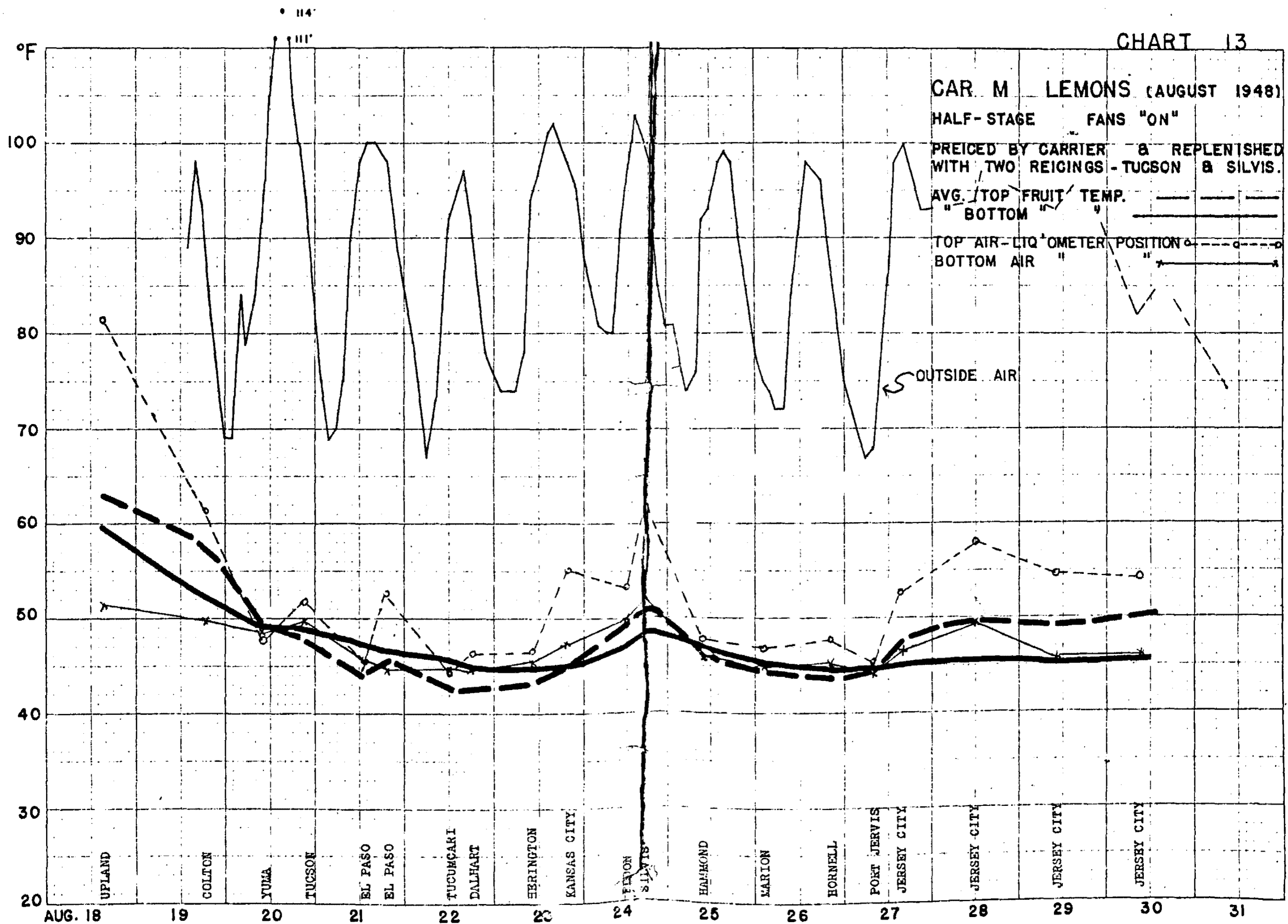
HALF-STAGE FANS "ON"

PREICED BY CARRIER & REPLENISHED WITH TWO REIGINGS - TUCSON & SILVIS.

AVG. TOP FRUIT TEMP. ———
" BOTTOM " ———

TOP AIR-LIQ'OMETER POSITION ○ ———○
BOTTOM AIR " " * ———*

OUTSIDE AIR



• 114

• 111

CAR N LEMONS (AUGUST 1948)

HALF-STAGE FANS "ON"

PREICED BY CARRIER & REPLENISHED THEN STANDARD REFRIGERATION

AVG. TOP FRUIT TEMP.
 "BOTTOM "

TOP AIR LIQ'OMETER POSITION
 BOTTOM AIR "

OUTSIDE AIR

