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APGC-TDR-63-19 Vol 1



Firefly III, Sounding Rocket Launching Report

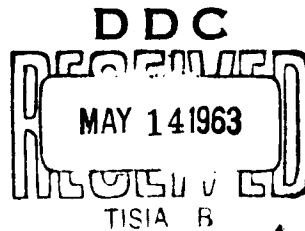
Launch Facility, Vehicles, and Data Reduction
(33 Vehicles Launched 15 October-15 December 1962)

by William K. Vickery

APGC Technical Documentary Report No. APGC-TDR-63-19 Vol 1

APRIL 1963

APGC Project No. 4984W1



DEPUTY FOR AEROSPACE SYSTEMS TEST

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FOREWORD

This report, consisting of Volumes 1 and 2, describes the sounding rockets, ballistic computations, range support, and the launch and flight data obtained by the Air Proving Ground Center under APGC Project 4984W1, Firefly III. Thirty-three sounding rockets were launched in support of a basic research program directed by the Air Force Cambridge Research Laboratories. This project was conducted under the authority of AFCRL/AFOAR Form 613 for Project 4984, Atmospheric Chemical Physics (Firefly III).

Catalog cards may be found in the back of this document.

ABSTRACT

Thirty-three sounding rockets (15 Nike-Cajun, 4 Nike-Apache, 9 Honest John-Nike-Nike, and 5 Aerobee 150) were launched from the Aerospace Launching Facility, Eglin Gulf Test Range, Florida. These launchings were conducted in support of Project Firefly III, directed by the Geophysics Research Directorate, Air Force Cambridge Research Laboratories, Office of Aerospace Research.

The overall report, consisting of Volumes 1 and 2, describes the sounding rockets, ballistic computations, range support, and the launch and flight data obtained. Specifically, Volume 2 presents only the theoretical and empirical vehicle trajectory data tabulated at the Air Proving Ground Center.

Thirty-one rockets provided trajectories which were sufficient to meet the scientific requirements. Two Nike-Cajun flights were unsatisfactory.

The maximum altitude predictions averaged approximately 3 percent high for the Aerobee 150's, 6 percent high for the Honest John-Nike-Nike's, and 7 percent high for the Nike-Cajun's. The maximum altitude predictions were also satisfactory for the Nike-Apache rockets.

PUBLICATION REVIEW

This technical documentary report has been reviewed and is approved.



A. T. CULBERTSON
Brigadier General, USAF
Vice Commander

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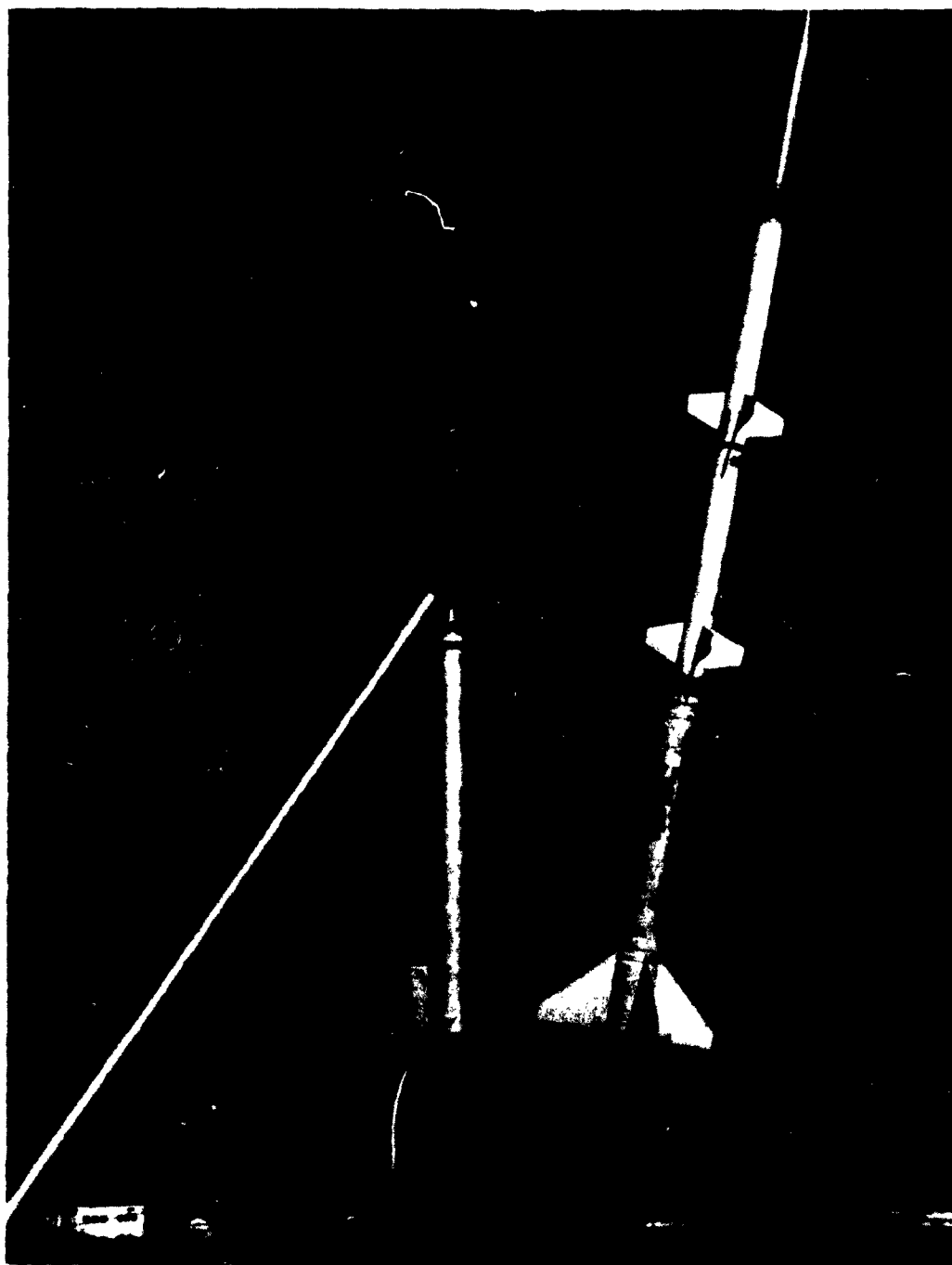
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SECTION 1 - INTRODUCTION

The Deputy for Aerospace Systems Test, APGC (Air Proving Ground Center), launched 33 sounding rockets from the Aerospace Launching Facility at Site A-11, EGTR (Eglin Gulf Test Range), on Santa Rosa Island, Florida, between 15 October 1962 and 15 December 1962. There were 5 Aerobee 150, 9 Honest John-Nike-Nike, 4 Nike-Apache, and 15 Nike-Cajun rockets launched in support of an AFCRL (Air Force Cambridge Research Laboratories) basic research program designed to provide controlled releases of various chemicals into the upper atmosphere. The support required of APGC was provided in accordance with the requirements and schedule set forth by AFCRL.

APGC support in this program consisted of providing rocket assembly, launch facilities, launch and support operations, optical and radar tracking instrumentation and telemetry receiving stations, ballistic services for vehicle trajectory and impact predictions, and trajectory data reduction and analysis. Other support services were provided which included fin survey data reduction, spin tab and fiberglass nose cone fabrication, and the assembly of certain payload subsystems.

This portion of the report, Vol 1, describes the support and presents the vehicle and flight data obtained. The flights are identified by the AFCRL assigned name. The information presented with regard to vehicle and flight data is generally grouped by rocket system, with these groups divided by payload configuration and subdivided by firing order. Volume 2 of this report contains the theoretical and empirical vehicle trajectory data tabulated at APGC.

SECTION 2 - SOUNDING ROCKETS, FIN SURVEY AND DATA REDUCTION, AND TRACKING AIDS

SOUNDING ROCKETS

Four sounding rocket systems were utilized during the series of launchings, the Aerobee 150, the Honest John Nike-Nike, the Nike-Apache, and the Nike-Cajun. These systems are briefly discussed in

the following paragraphs. The Atlantic Research Corporation was the primary AFCRL payload contractor, and furnished hardware for all but two of the payloads. The Geophysics Corporation of America furnished two payloads for NASA. Vehicle serial numbers, payload weights, fuel analysis, fin survey data, and other rocket physical data are recorded, where applicable, in Table 1.

AEROBEE 150. The Aerobee 150 is a liquid-propellant sounding rocket. It consists of a 2.5 KS 18,000 solid propellant JATO booster and the AJ 11-21 liquid propellant sustainer. See Fig. 1 for a sketch of the vehicle and payloads utilized, and Table 1 for additional vehicle data.

The sustainer carried a 10-in. range-safety extension which contained an AN/DPN-41 tracking beacon and an AN/DRW-11 command receiver. Three of the payloads, Karen, Laura, and Martha, were equipped with telemetry transmitters.

The fins were set to provide a roll rate of 2 rps at sustainer burnout. No attempt was made to verify the roll rate.

HONEST JOHN-NIKE-NIKE. The Honest John-Nike-Nike is a three-stage solid-propellant sounding rocket. The first stage is an Honest John M-6 rocket motor and the second and third stages are Nike M-5 rocket motors. See Fig. 2 for a sketch of the vehicle and payloads utilized, and Table 1 for additional vehicle data.

Standard Honest John fins were used on the first stage. Variable incidence fins¹ with Inconel steel leading edge caps were used for the second and third stages. The fins were surveyed and set to provide a roll rate at burnout of each stage as follows:

Stage	Roll Rate (rps)
1	0.7
2	1.0
3	7.0

The exception was Patsy which had the same roll rates for the first and second stages, but a third-stage burnout roll rate of 0.65 rps. The roll rates of these vehicles could not be determined from the tracking film.

Second- and third-stage ignition was accomplished by ground igniting pyrotechnic delay igniters through a first-motion switch. Nominal ignition delays were launch plus 10 seconds for the second stage, and launch plus 25 seconds for the third stage.

¹Fins are manufactured by the Space Vehicle Division, Atlantic Research Corporation.

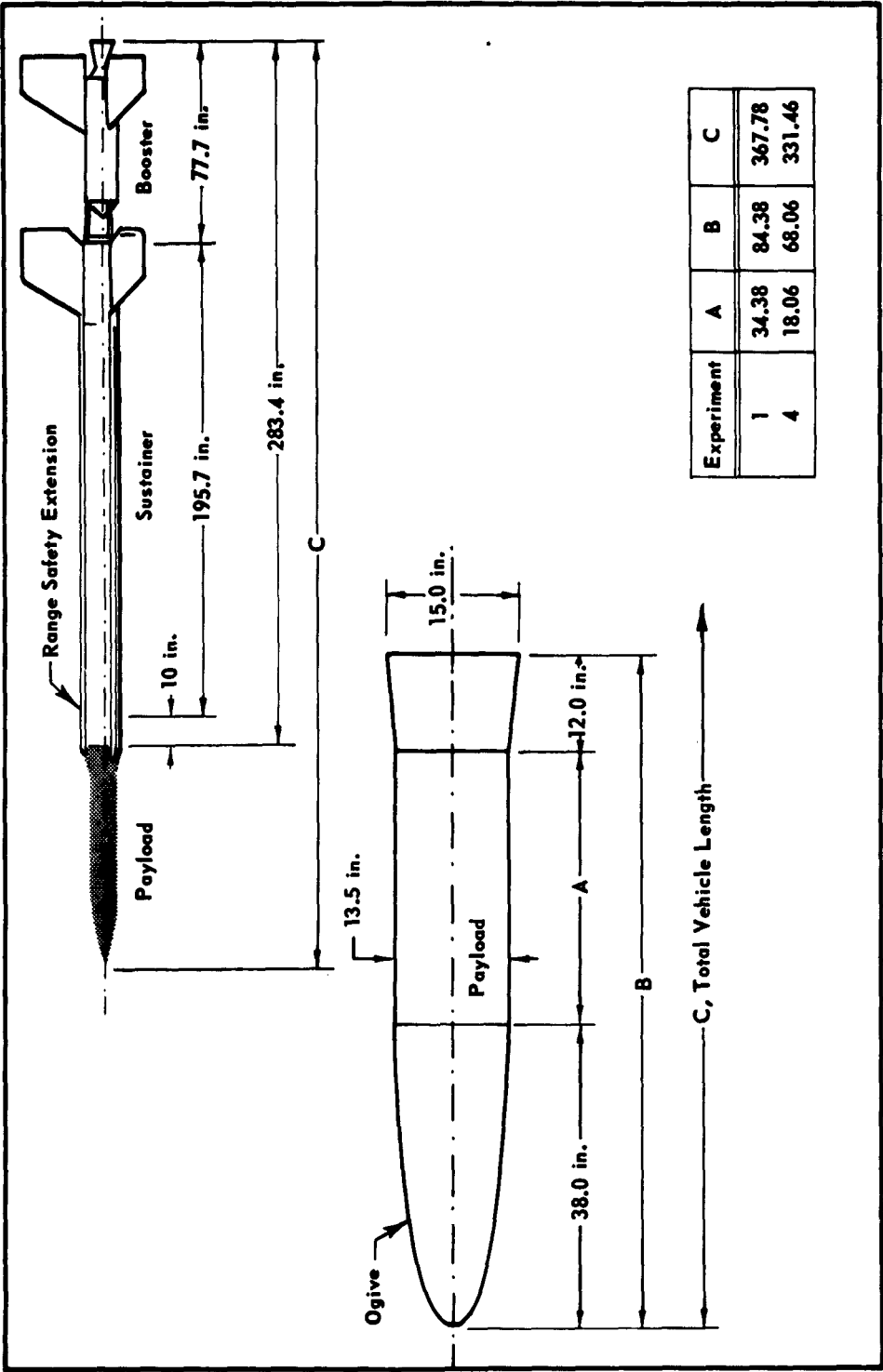


Fig. 1: Aerobee 150 Vehicle and Payload Configurations.

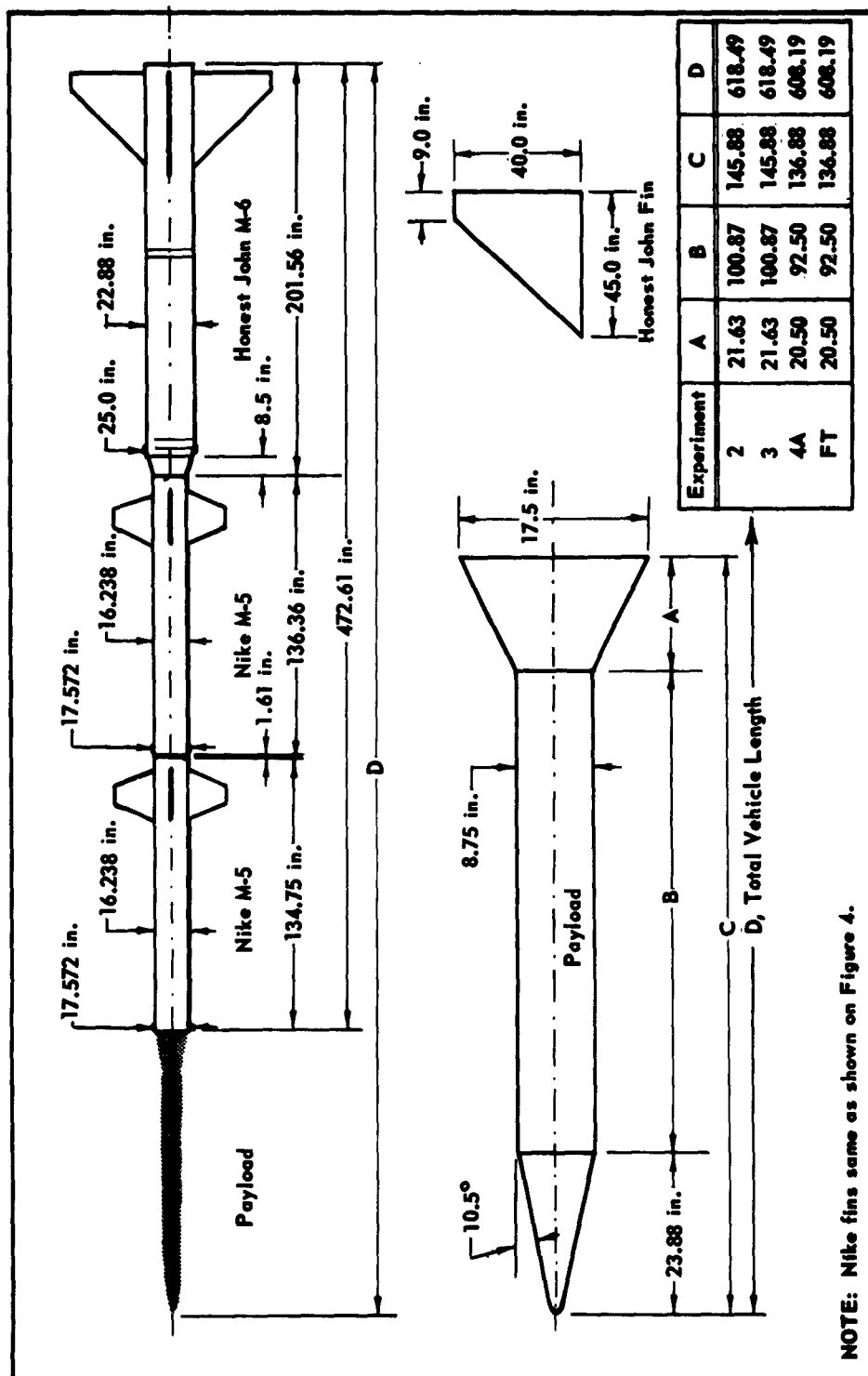


Fig. 2: Honest John-Nike-Nike Vehicle and Payload Configuration.

The first stage was separated by drag after burnout. The second stage was held to the third stage with a retractable pin until launch plus 20 seconds to prevent premature separation. After pin retraction the second stage was also separated by drag.

An AN/DPN-41 radar tracking beacon was flown on Ethel. All vehicles, except Hazel, carried tracking flares. The Ethel, Mabel, Dinah, Eva, Netty, and Olga payloads were equipped with telemetry transmitters.

NIKE-APACHE. The Nike-Apache is a two-stage solid-propellant vehicle. The first stage is a Nike M-5 rocket motor and the second stage an Apache TE-307 rocket motor.

Variable incidence fins were used on the first stage and Apache fins² were used on the second stage. The fins for these vehicles were surveyed and the first-stage fins canted to provide a roll rate of 1 1/2 rps at first-stage burnout. The blank tabs on the second-stage fins were milled flat. The residual burnout roll rates for the second stages are given in Table 3. Actual roll rates are not available.

Second-stage ignition was accomplished by ground igniting pyrotechnic delay igniters through a first-motion switch. The nominal delay time was launch plus 20 seconds. Actual times were not recorded, but were about 20 to 21 seconds on the four vehicles, as reported by observers. Flares or other tracking aids were not used.

The Nike-Apache and payload configurations are shown in Fig.3, and additional vehicle data are recorded in Table 1.

NIKE-CAJUN. The Nike-Cajun sounding rocket is a two-stage solid-propellant vehicle. The first stage is a Nike M-5 rocket motor, and the second stage is a Cajun TE-82 Mod 1 rocket motor.

Variable incidence fins were used on the first stage and fixed fins³ on the second stage. All fins were surveyed, and the first-stage fins were canted to provide a roll rate of 1 1/2 rps at first-stage burnout. Some second-stage fins were flown without wedges, some with small wedges to provide approximately 1 rps at second-stage burnout, and some with larger wedges to provide a 6-rps burnout roll rate. Predicted roll rates are shown in Table 1. Actual roll rates could not be determined.

² Fins are manufactured by the Space Vehicle Division, Atlantic Research Corporation.

³ Fins are manufactured by the Aerolab Development Company.

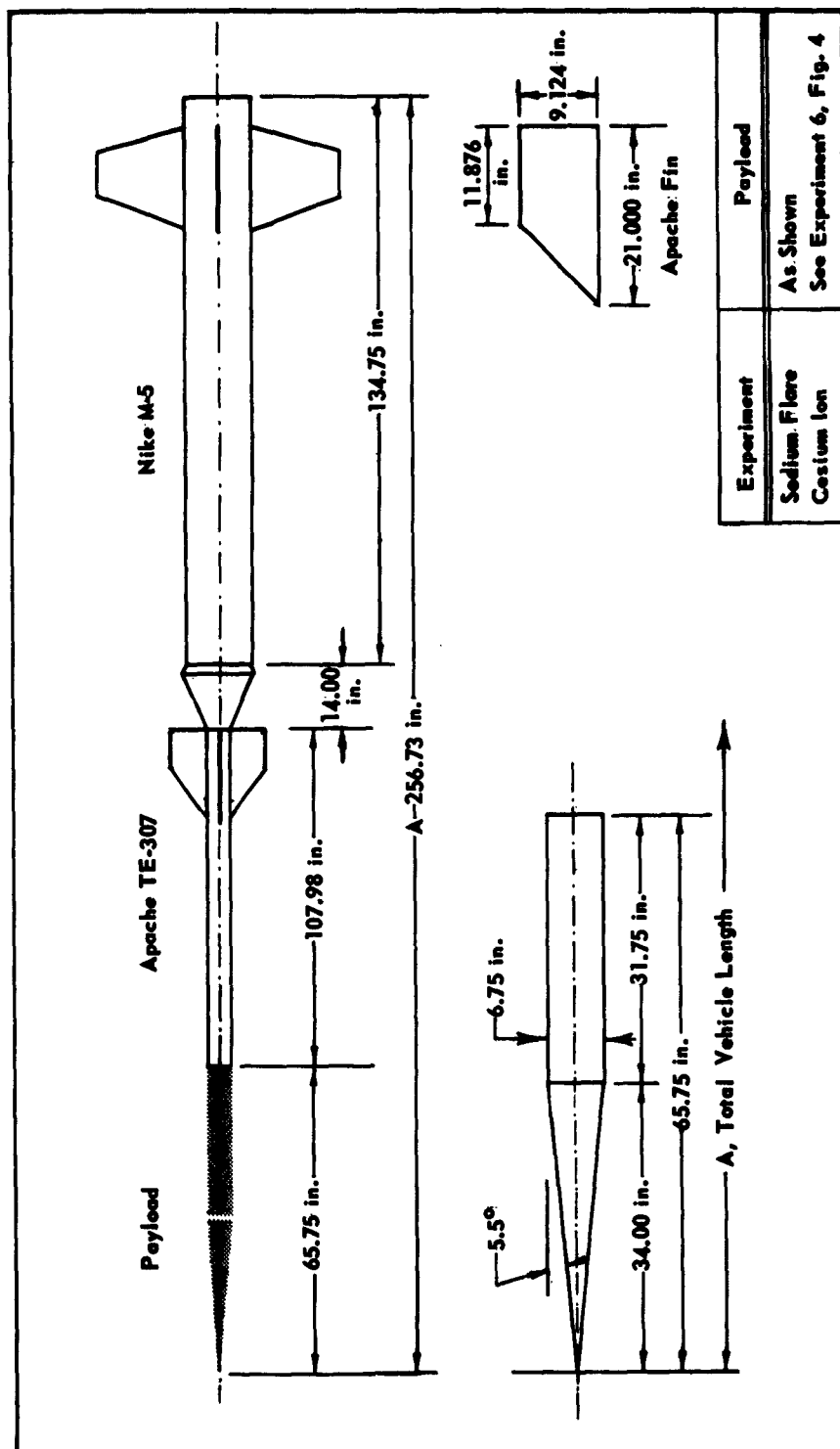


Fig. 3: Nike-Apache Vehicle and Payload Configuration.

See Fig. 4 for a sketch of the vehicle and payload configurations flown, and refer to Table 1 for additional vehicle data. The spin tabs used for the 6-rps spin rate are shown in Fig. 5.

Second-stage ignition was accomplished by ground igniting pyrotechnic delay igniters through a first-motion switch. Two nominal delay times were used, 16 and 17 seconds. Ballistic predictions used a 17.88-second second-stage ignition time, a value which was derived from an examination of the ignition history of Cajuns previously launched at AFGC. The average ignition delay for 11 recorded Cajun ignition times on this series was 18.73 seconds.

Tracking flares were flown on 12 of the 15 Nike-Cajuns. No tracking aids were used on Queenie, Paula, and Enid.

FIN SURVEY AND DATA REDUCTION

The fins were surveyed for the Honest John, Apache, and Cajun vehicles by assembling the fins to the motors, leveling, and surveying. A three-chord survey was performed on the Apache and Cajun fins, and a five-chord survey was performed on the Honest John fins. The Nike fins were mounted in a jig and a five-chord survey was accomplished.

The data from the surveys were reduced on an LGF-30 computer using a program written by AFGC from theory provided by AFCRL. The program output provided the tab length for the Cajun spin tabs for a 6-rps roll rate, and the corresponding Nike fin cant angles for a 1 1/2-rps roll rate at Nike burnout. The Nike cant angles incorporated the effect of the 6-rps Cajun fin and tab. The program also provided the residual burnout roll rates for the Cajuns and Apaches without tabs, and the proper Nike cant angles for a 1 1/2-rps roll rate at first-stage burnout. The effect of the Cajun or Apache fin, and tab, if used, was neglected for low second-stage roll rates.

The Honest John fins were installed with the preset 30 minutes of cant. The roll rate was corrected by tabs to 0.7 rps at first-stage burnout. The computer output provided the proper tab length for the Honest John fins and the Nike cant angles for the second and third stages. The effects of the second- and third-stage fin cants were incorporated into the computation of the first-stage tab length and the effects of the third-stage fin cant included into the calculation of the second-stage fin-cant angle.

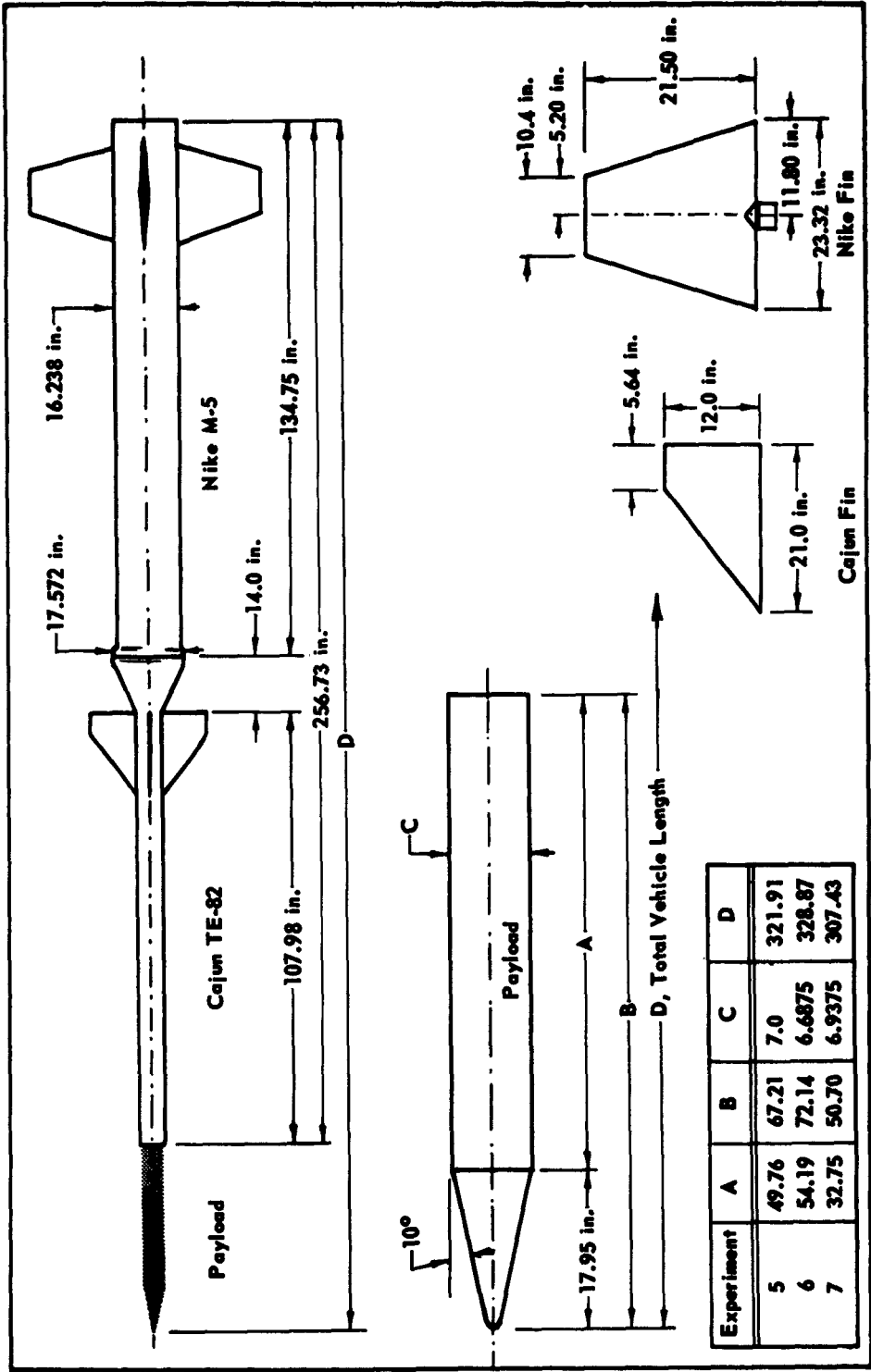


Fig. 4: Nike-Cajun Vehicle and Payload Configurations.

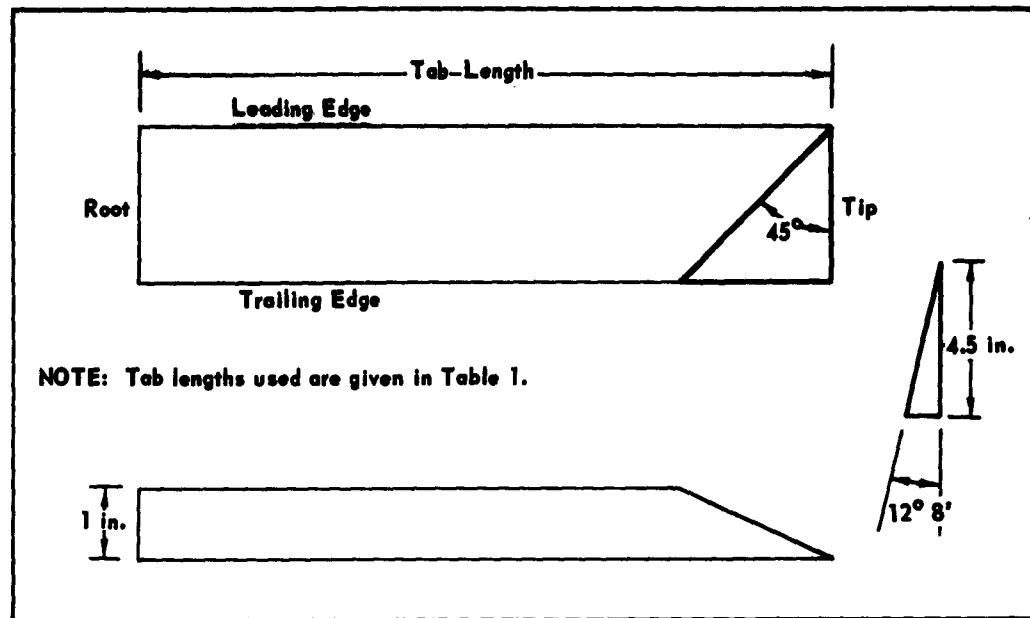


Fig. 5: Cajun Tabs.

The Aerobee 150 fins were surveyed and canted in accordance with the Aerojet-General Field Test Procedure, AF TP-1121-019.

TRACKING AIDS

Flares were flown on 12 of the 15 Nike-Cajun vehicles and on 8 of the 9 Honest John-Nike-Nike vehicles. The flares were mounted on the fin shroud, between fins, and 180 degrees apart. A typical installation is shown in Fig. 6. The flares were U. S. Flare Division, Atlantic Research Corporation, Type 175C. The identification of the specific flares used is given in Table 1. The flares provided 30 seconds of light source as a tracking aid.

A flashing light was flown on Honest John-Nike-Nike Hazel. The light flashed at 1-second intervals until third-stage ignition, but was inadequate as a tracking aid.

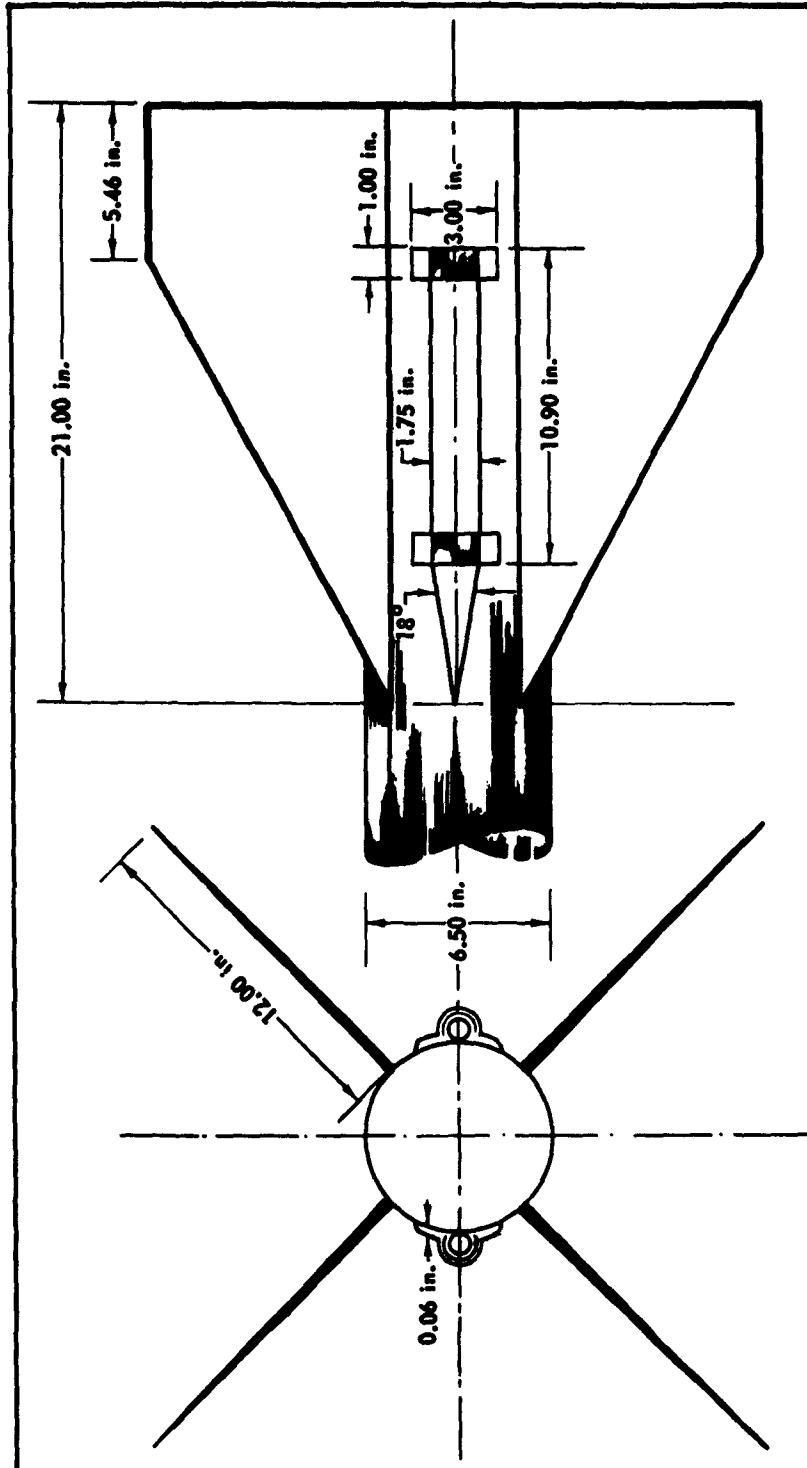


Fig. 6: Typical Flare Installation.

SECTION 3 - BALLISTIC COMPUTATIONS

DISPERSION STUDIES

Dispersion studies have been published for the vehicles launched during this project. The studies are listed in the References section of this report.

TRAJECTORY PREDICTIONS

Vehicle trajectory calculations were based upon the input data shown on Tables 2 through 5. Table 2 applies to the Aerobee 150; Table 3 applies to the Honest John-Nike-Nike; Table 4 applies to the Nike-Apache; and Table 5 applies to the Nike-Cajun. The trajectory calculations were performed on an IBM 7090 computer using a six-degree-of-freedom ballistic program.

Theoretical trajectories based on the input data, the actual launcher settings, and the winds nearest the time of launch have been computed and are provided along with the tabulated flight data in Volume 2. These theoretical data are also plotted with the actual data in Figs. 30 through 133.

The drag of the tracking flares was not considered for either the Honest John-Nike-Nike or the Nike-Cajun vehicles, but an additional 3 lb for flare weight was added as payload for the Nike-Cajun. The drag of the 6-rps Cajun spin tabs was considered in the predictions, and 2 lb for tab weight were added as Cajun payload. The drag and weight of the small tabs was neglected.

Maximum altitude and range versus launch angle for various payload weights are shown for the Aerobee 150 (Fig. 7), Honest John-Nike-Nike (Fig. 8), Nike-Apache (Fig. 9), and the Nike-Cajun (Figs. 10, 11, and 12).

The predictions for Honest John-Nike-Nike Ethel were based upon the best information available prior to the flight. Ethel was flown as a vehicle flight test, and the flight performance was used as a basis for the prediction of the subsequent flights in the series.

The Nike-Apache predictions were based on a 10-degree half-angle nose cone. The physical configuration of the sodium flare payloads was not determined until shortly prior to the scheduled launch, and the lack

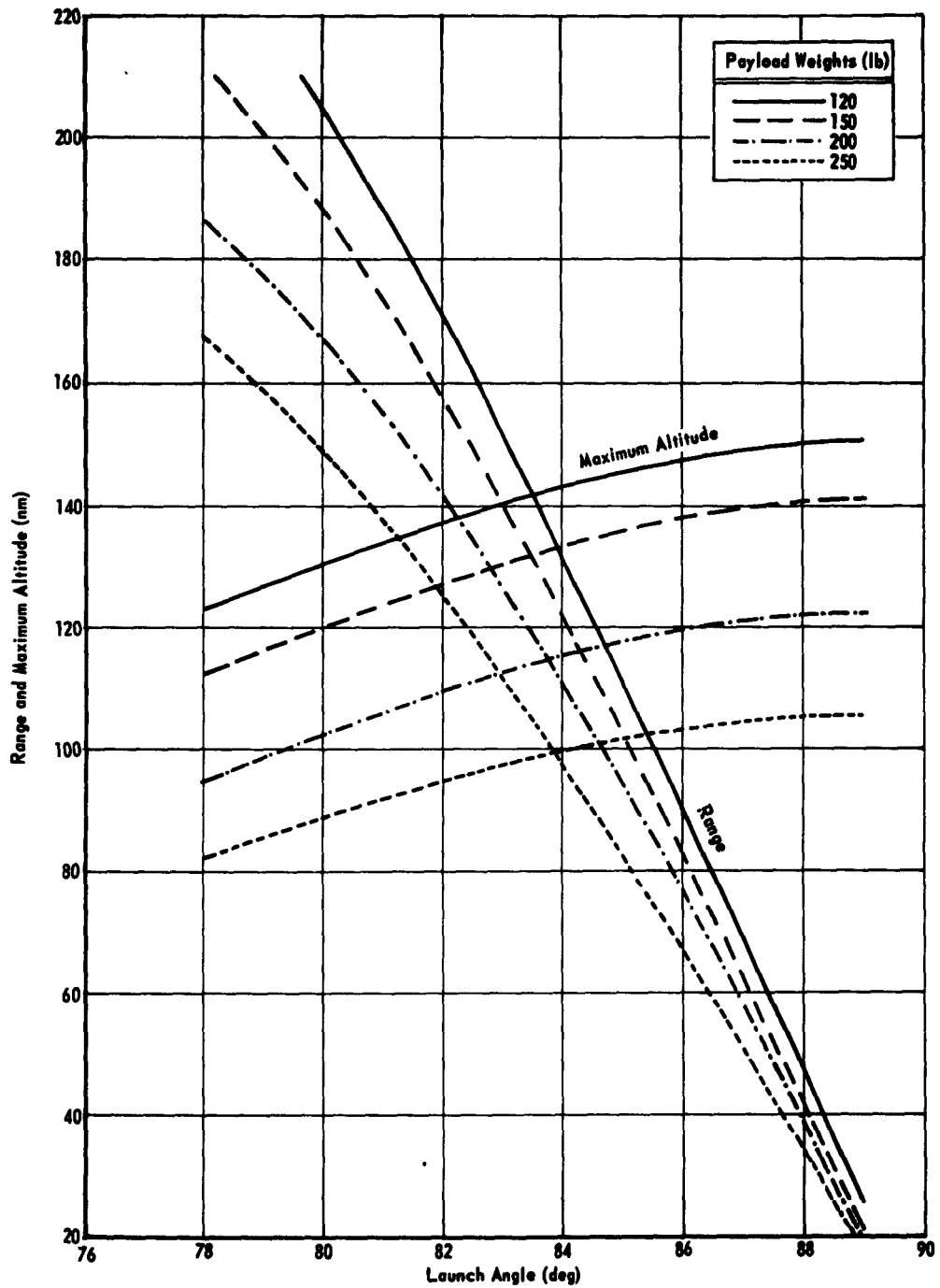


Fig. 7: Aerobee 150 Range and Maximum Altitude vs. Launch Angle for Various Payload Weights.

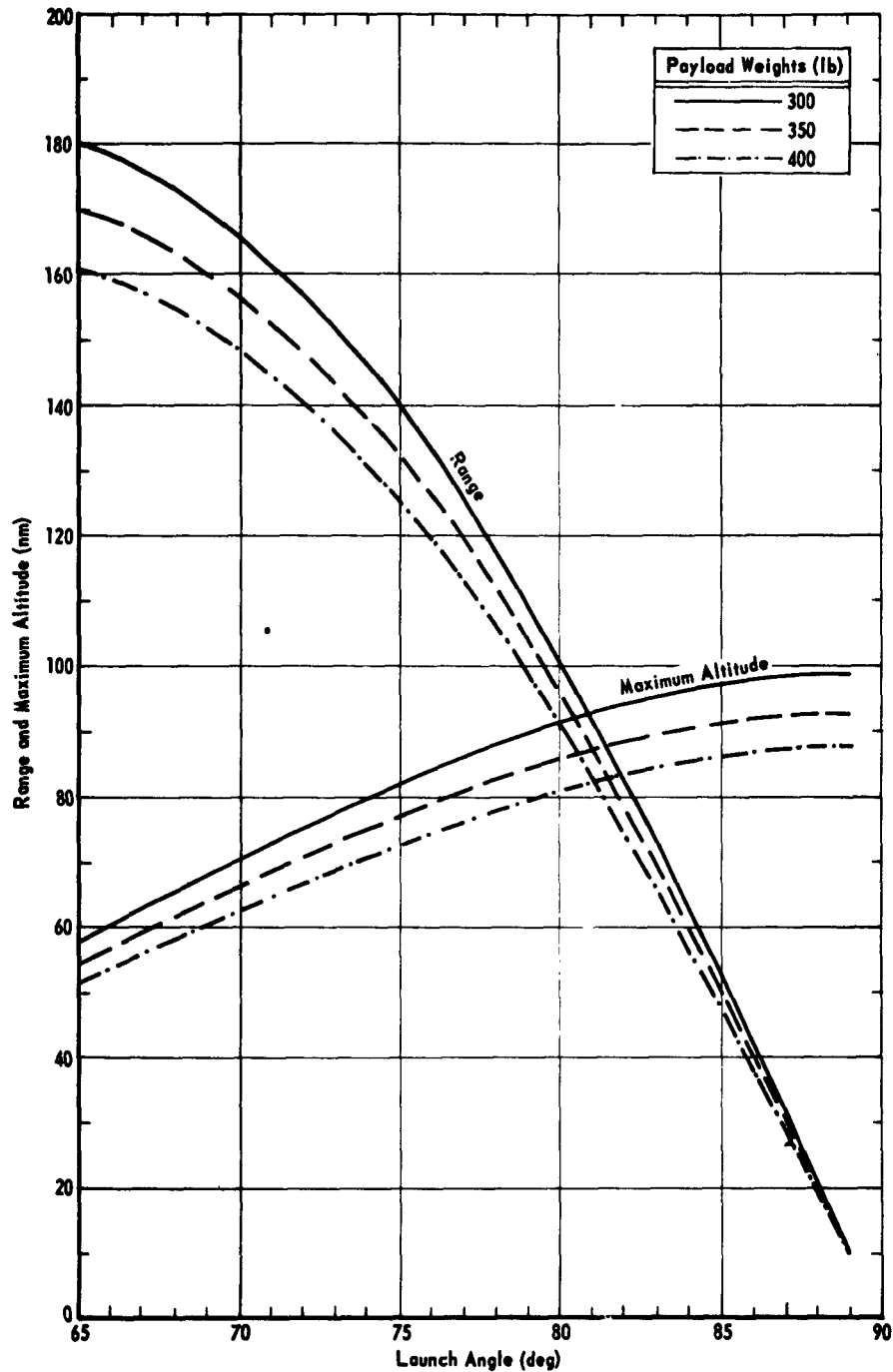


Fig. 8: Honest John-Nike-Nike Range and Maximum Altitude vs. Launch Angle for Various Payload Weights.

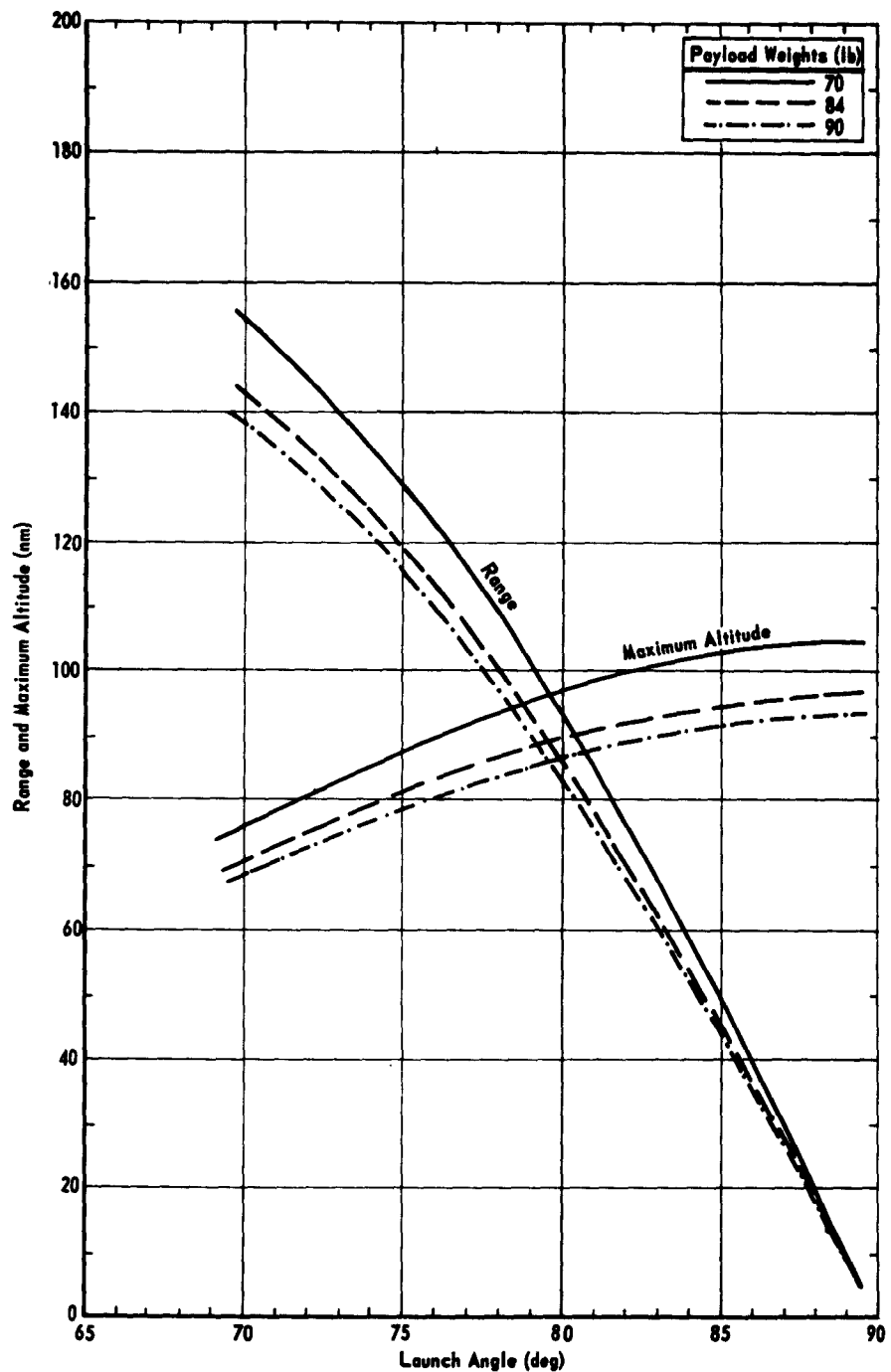


Fig. 9: Nike-Apache Range and Maximum Altitude vs. Launch Angle for Various Payload Weights.

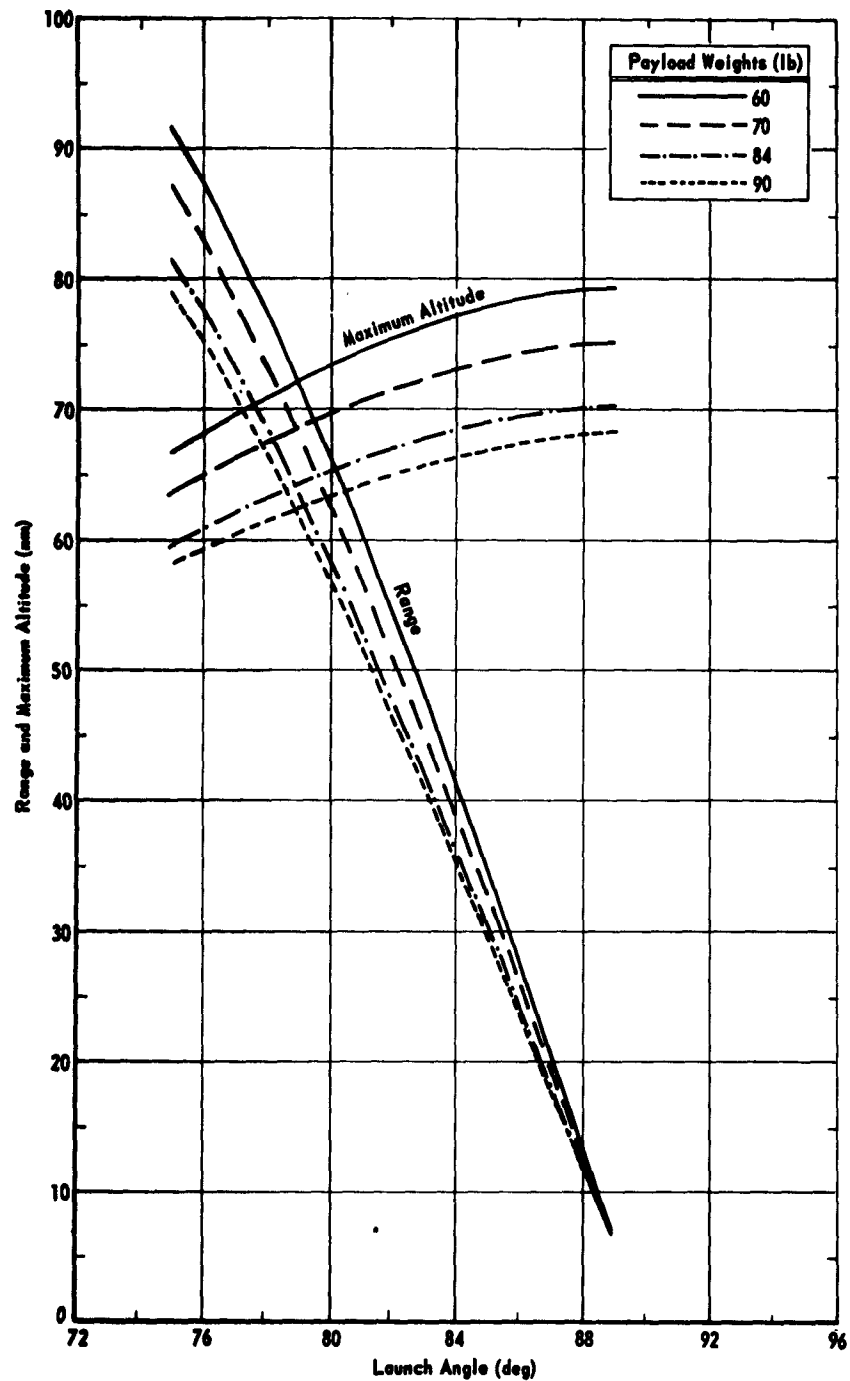


Fig. 10: Nike-Cajun Range and Maximum Altitude vs. Launch Angle for Various Payload Weights. (Small or no Tabs.)

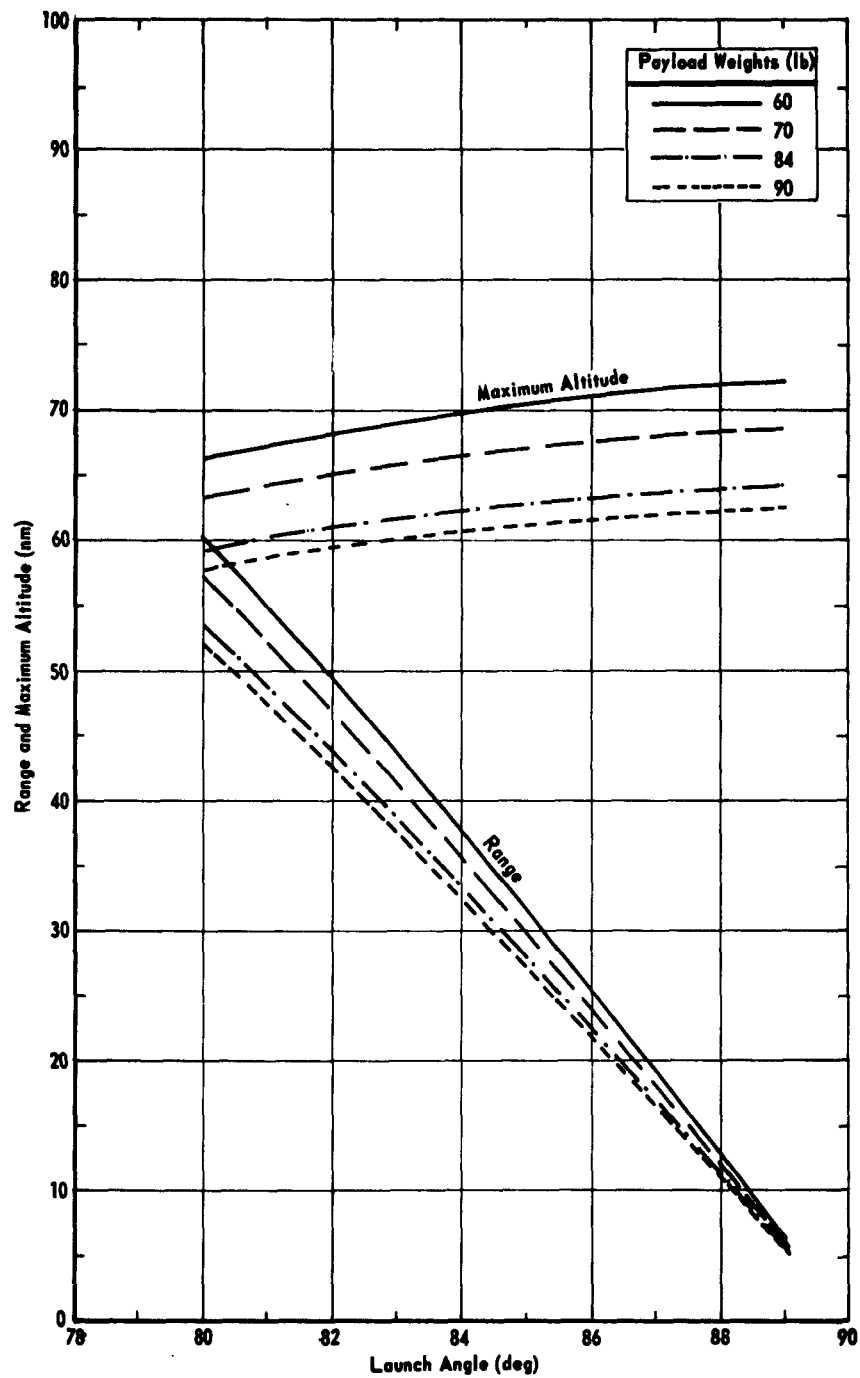


Fig. 11: Nike-Cajun Range and Maximum Altitude vs. Launch Angle for Various Payload Weights (6-rps Tabs.)

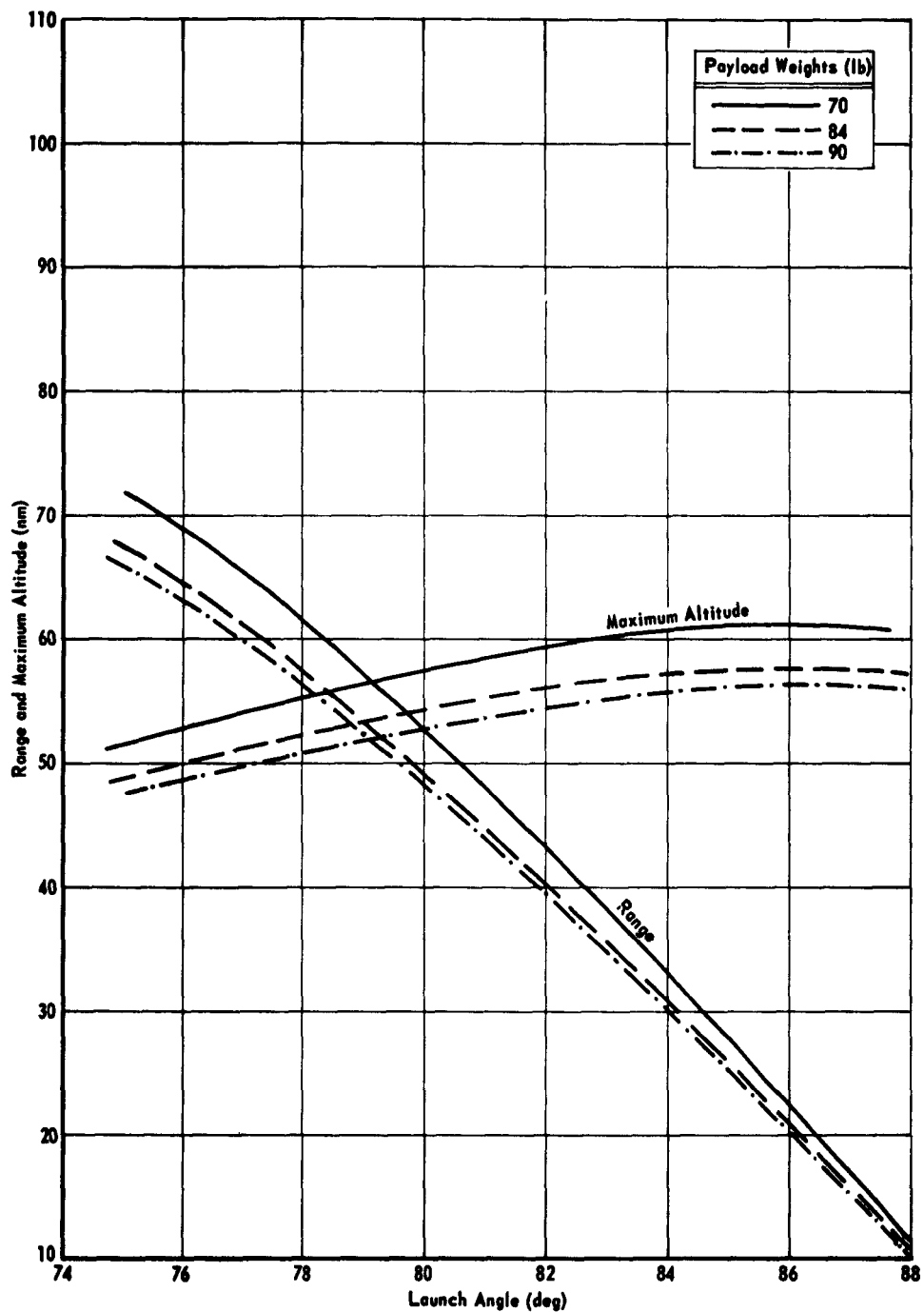


Fig. 12: Nike-Cajun Range and Maximum Altitude vs. Launch Angle for Various Payload Weights. (6-rps Tabs, $K_D + 10\%$.)

of time prevented recomputing the ballistics for the 5 1/2-degree half-angle nose cone. The dispersion was arbitrarily increased to account for the variance.

The APMC maximum altitude predictions for the Nike-Cajun flights on Firefly II were examined and found to be high. The input data were revised for Firefly III and the predictions were again high. Fig. 10 was used for the prediction of the vehicles with small or no tabs, and Fig. 11 was used for those vehicles with the 6-rps tabs. However, the predictions would have closely approached the actual altitudes achieved if Fig. 11 had been used in the place of Fig. 10 and if a new prediction chart, shown as Fig. 12, had been used for Fig. 11. Fig. 12 is Fig. 11 modified by adding 10 percent to the drag coefficient.

IMPACT PREDICTIONS

The impact predictions for these vehicles were made on a Royal McBee Corporation LGF-30 computer. The prediction program utilized the raw pilot balloon and radiosonde data (provided in azimuth and elevation angles) and an approximation of the IBM 7090 ballistic trajectory program to compute the impact points. The pilot balloon data were obtained by the single-theodolite measurement technique. The predicted impact points are shown in Table 1. These values were checked by computing postlaunch wind-weighted theoretical trajectories on the IBM 7090 computer. The impact points were extracted from the theoretical trajectories and are listed in Table 1. Actual impact points, where available, are also listed.

In a few cases the prelaunch high-altitude winds used for impact predictions were forecast winds. These were provided by the range weather forecaster and were based on the latest available radiosonde and other meteorological data available to the forecaster at that time.

In other cases, the high-altitude winds could not be measured because of high wind velocities, although the direction was generally known. Estimates of velocity, when available from the forecaster, were used. Otherwise, the data from the nearest radiosonde release were used. This applied to either the prelaunch or postlaunch calculations.

SAFE IMPACT PREDICTION CHARTS

The charts shown as Figs. 13 through 16 define the maximum allowable impact area for the vehicles flown, and are for conditions under

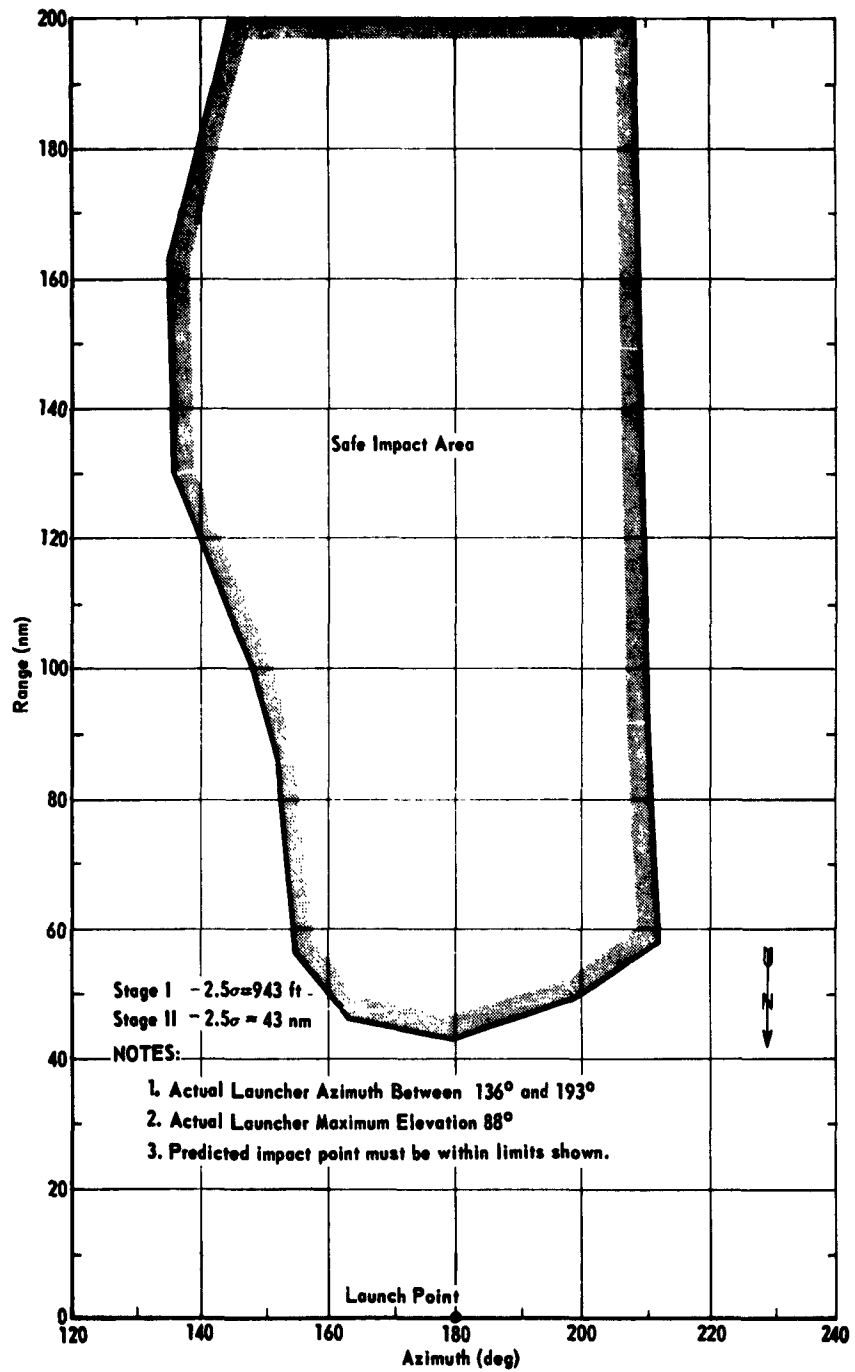


Fig. 13: Aerobee 150 - Predicted Safe Impact Area.

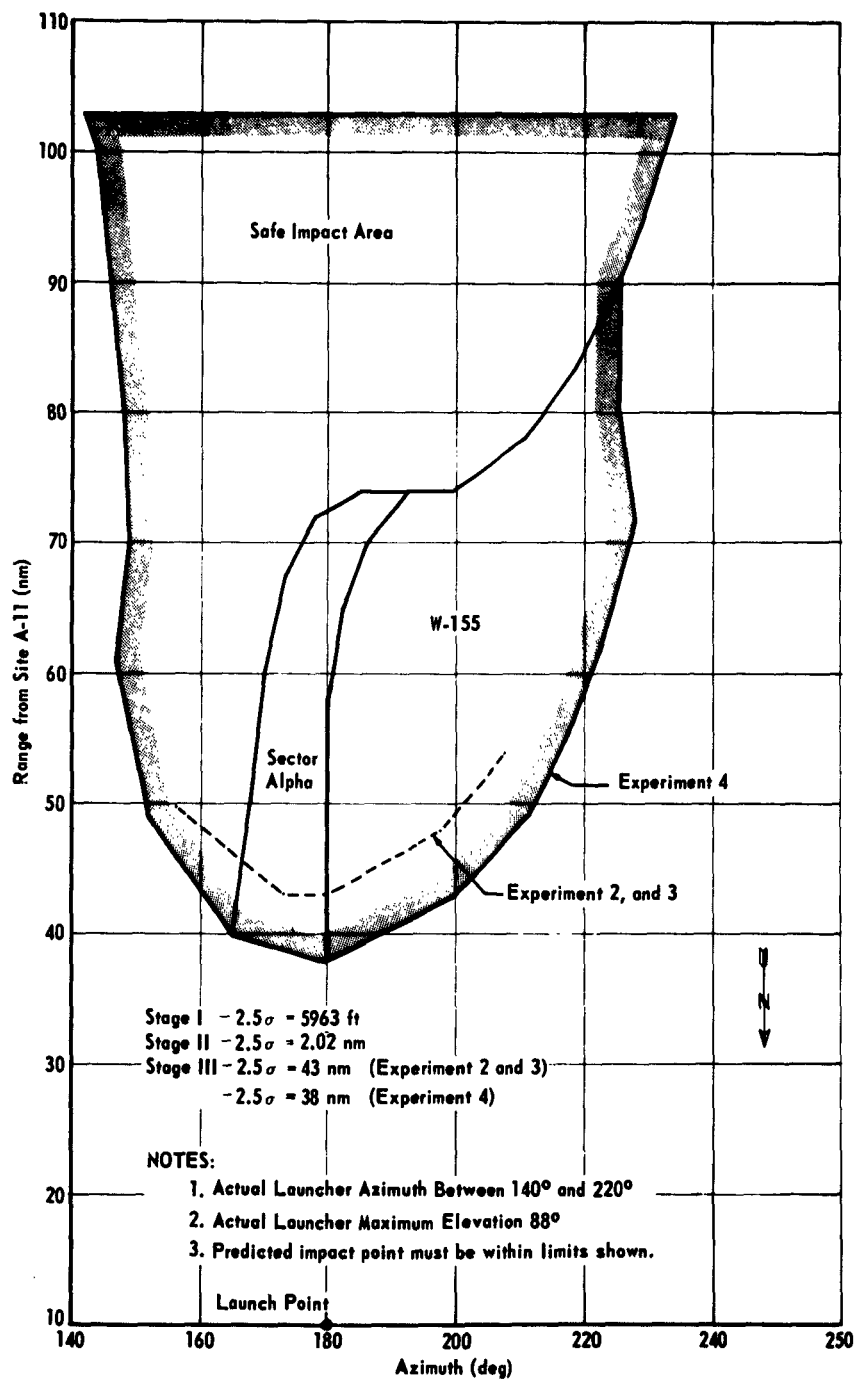


Fig. 14: Honest John-Nike-Nike. Stage III, 300-lb Payload - Predicted Safe Impact Area.

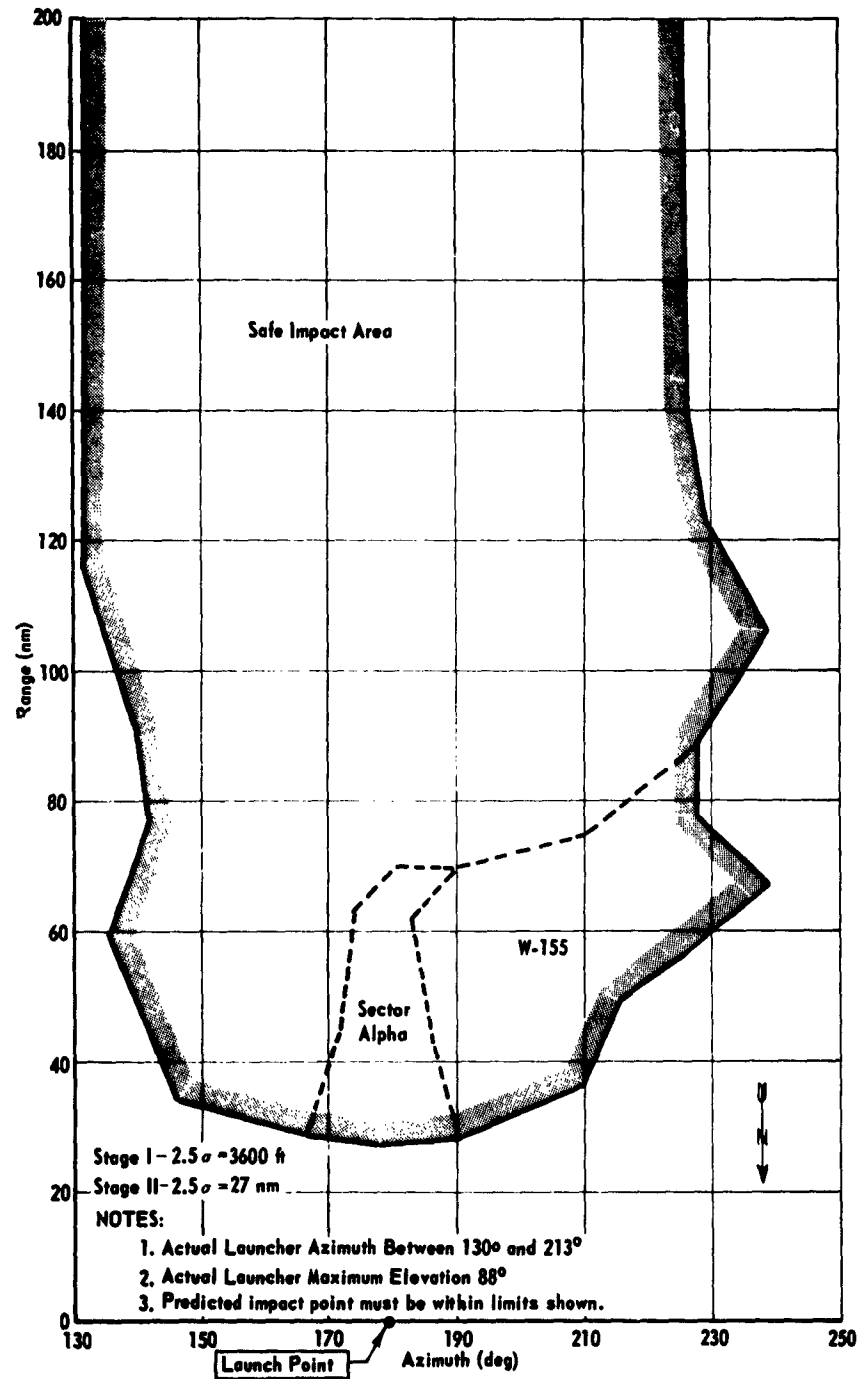


Fig. 15: Nike-Apache - Predicted Safe Impact Area.

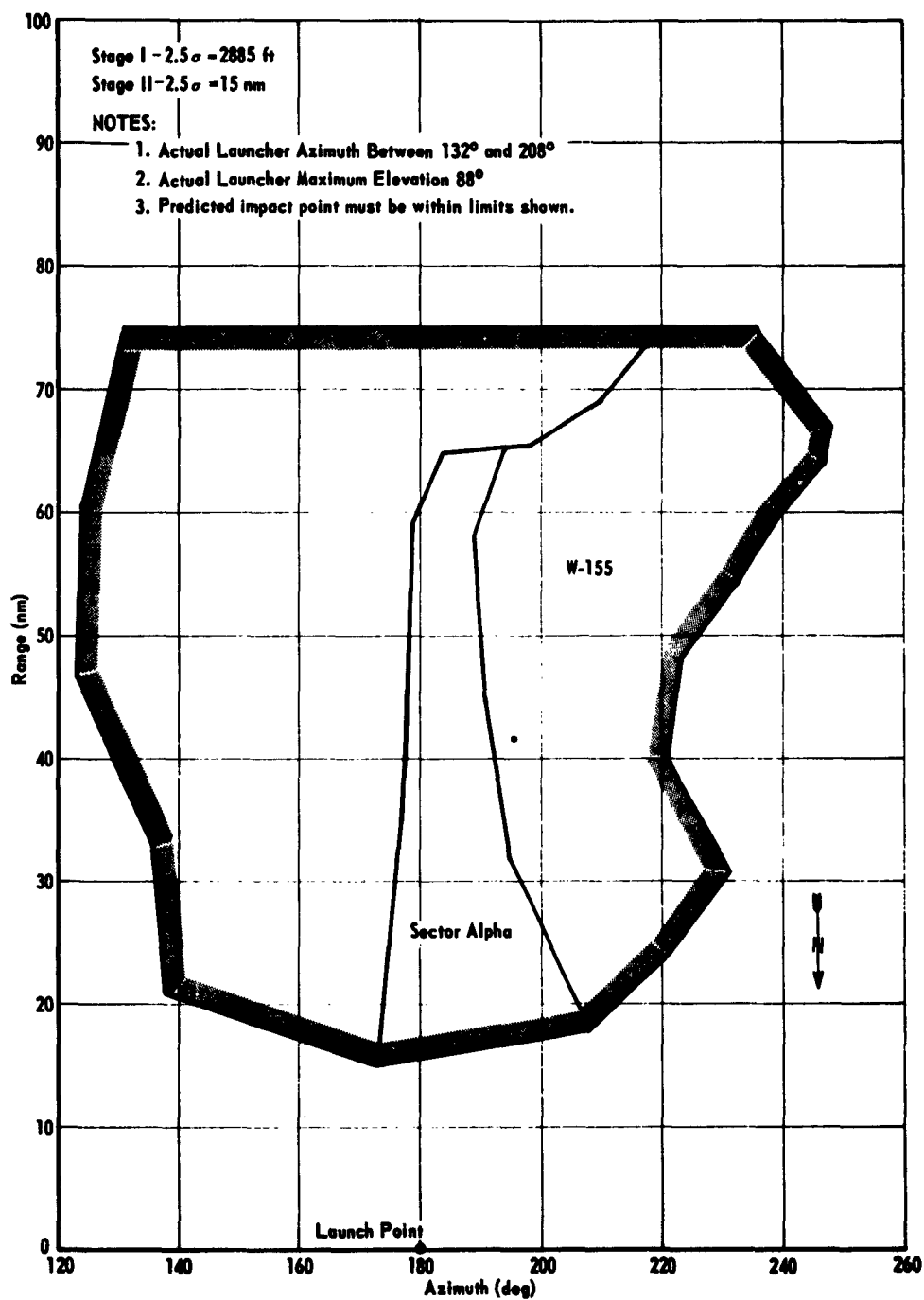


Fig. 16: Nike-Cajun with 6-rps Tabs - Predicted Safe Impact Area.

which the total water range is available. Warning Area 155, and a part thereof, Sector Alpha, is normally closed to probe operations during daylight hours. The entire area is open from sundown until sunrise, and Sector Alpha may be reserved during daylight hours with sufficient advance scheduling information. The charts are based upon the protection of land masses by 2 1/2 sigma. The numerical value for the 2 1/2 sigma is indicated on each chart. Of course, with changes in dispersion, the boundaries change accordingly.

Range safety permitted launching, provided that the impact point was within the chart boundaries (the maximum effective elevation permitted is governed by the dispersion), the booster impact azimuths were within the maximum launcher setting azimuths and downrange 2 1/2 sigma or more, and the launcher settings were within the limits described. Other governing considerations, not discussed here, concern boat and air traffic in the range.

SECTION 4 - LAUNCH FACILITIES

The launch site was the Aerospace Launching Facility on Santa Rosa Island, Florida. Three boom-type general-purpose launchers were used for launching the solid-propellant vehicles. The Aerobee 150 vehicles were tower launched. The locations of the launchers were as follows:

Pad	North Latitude	West Longitude	Elevation Above MSL (ft)
1	30° 23' 41.398"	86° 42' 43.222"	14,047
2	30° 23' 41.385"	86° 42' 39.970"	14,050
3	30° 23' 41.469"	86° 42' 36.962"	14,050
Tower	30° 23' 41.154"	86° 42' 59.544"	13,082

The Honest John-Nike-Nike vehicles were launched from the general-purpose launcher located on Pad 1. This launcher was modified and outfitted with zero-launch fittings. The rocket was suspended at three points, i. e., front and rear lug positions on the Honest John motor and at the forward end of the second stage. The hangar attached to the second stage was of the retractable type.

The Nike-Cajun and Nike-Apache vehicles were launched from the

general-purpose launchers located on Pads 2 and 3. These launchers were equipped with rails designed to simultaneously release both first-stage launch tees after 200 in. of travel. The launcher pads used are indicated on Table 1.

The Aerobee vehicles were launched from the Aerobee tower which provides 156 ft 10 in. of travel.

The Aerospace Launching Facility is shown in Fig. 17.

SECTION 5 - EGTR TECHNICAL FACILITIES

Contraves phototheodolites located on Santa Rosa Island, an AN/FPS-16 radar at Site A-20, an AN/MPS-19 radar at Site A-3, a telemetry station at Site A-6, and an AN/FRW-2 command transmitter at Site A-3 were provided, as necessary, in support of the project. The radars are normally supported with an optical acquisition aid. In addition to the optical aid, the AN/FPS-16 radar can be equipped with an acquisition aid which uses the telemetry signal to direct the radar antenna. This system, known as the AGAVE, was scheduled for most of the telemetry transmitter equipped vehicles. See Fig. 18 for a map of the EGTR technical facilities.

The instrumentation scheduled for the various vehicles is discussed in the following paragraphs.

AEROBEE 150

One AN/MPS-19 radar was scheduled for beacon track on all flights, and one AN/FPS-16 radar was scheduled for skin track on all flights except Fanny. AN/MPS-19 data were recorded on all flights; however, the data were not reduced on Karen and Laura, in favor of the AN/FPS-16 data. AN/FPS-16 data were obtained on all flights for which the radars were scheduled. All the AN/FPS-16 data were reduced. One AN/FRW-2 was scheduled for range safety purposes. Contraves phototheodolites were not provided for these flights.

HONEST JOHN-NIKE-NIKE

One AN/FPS-16 was scheduled for skin track on all flights, and one

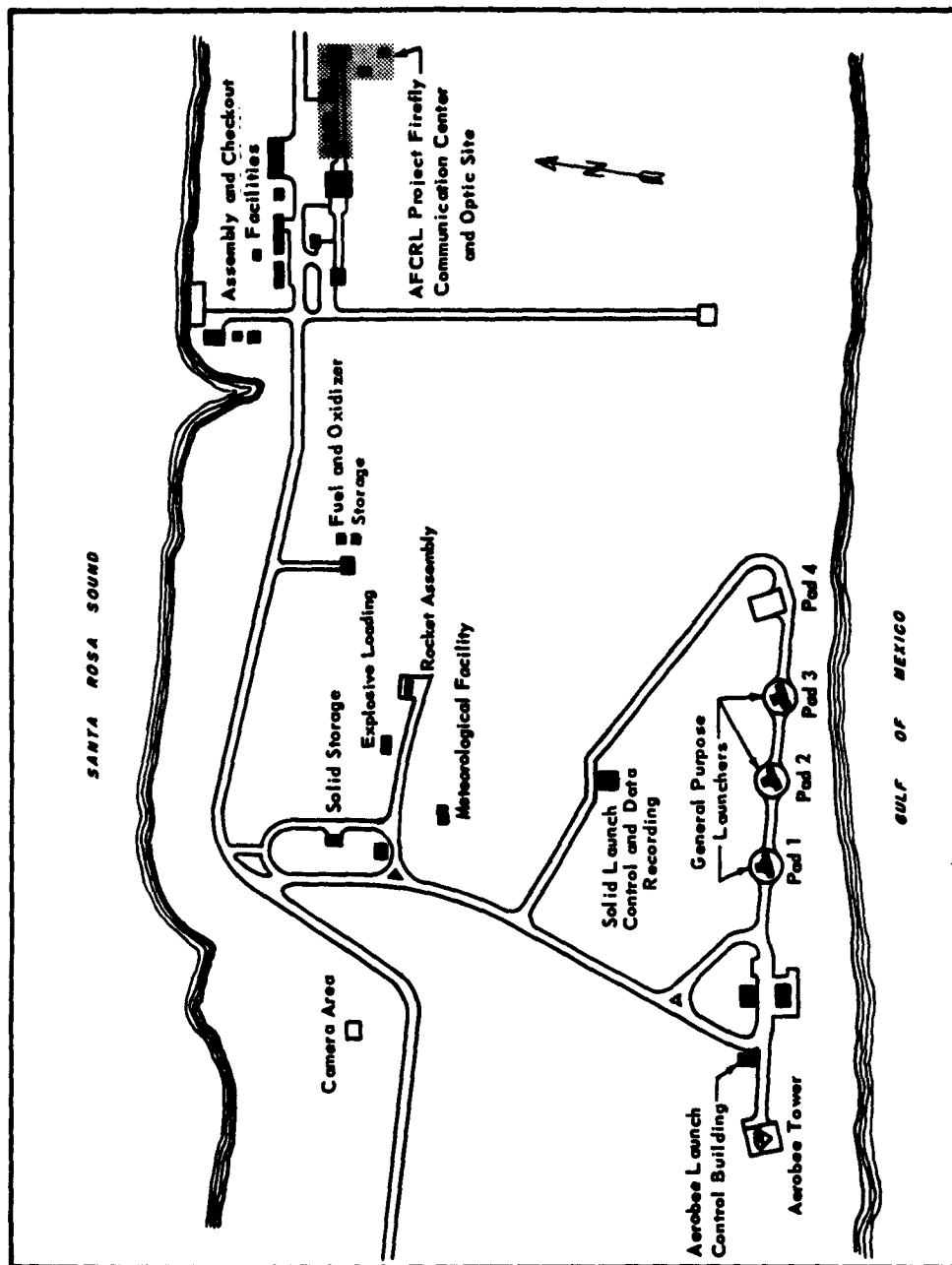


Fig. 17: Aerospace Launching Facility.

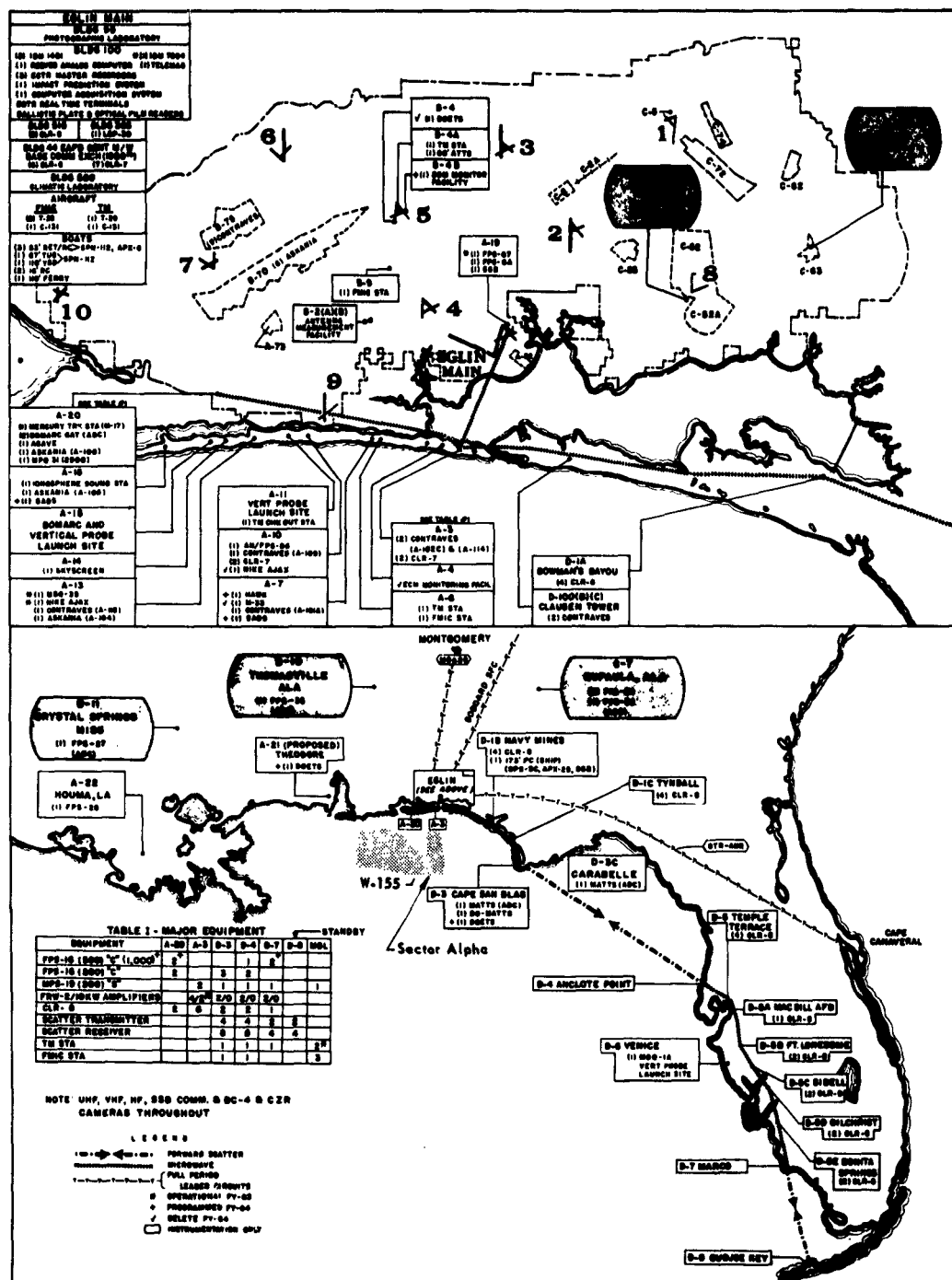


Fig. 18: EGTR, Technical Facilities - January 1963.

APGC-TDR-63-19

AN/MPS-19 was provided for beacon track on Ethel. The AN/FPS-16 data on Ethel were not reduced, in favor of the AN/MPS-19 data. AN/FPS-16 data were obtained on all flights except Hazel and Mabel. Contraves phototheodolites were scheduled on all flights except Mabel, Dinah and Eva. Hazel's flashing lights were inadequate as a tracking aid. Mabel carried flares and a telemetry transmitter, but the AGAVE was not scheduled for that flight.

NIKE-APACHE

Tracking aids were not flown on the Nike-Apache vehicles, and phototheodolites were not scheduled. An AN/FPS-16 radar was provided to skin track for three of the flights, but was unable to acquire the vehicles.

NIKE-CAJUN

Phototheodolites were scheduled on all flights. Data were obtained on all but Queenie, Paula, Carol, Beverly, and Enid. Flares were not flown on Queenie, Paula, and Enid, and the flares were not ignited on Carol. AN/FPS-16 radar skin track was scheduled on 9 flights, and data were obtained on 5 flights.

SECTION 6 - RANGE WEATHER SUPPORT

The 4th Weather Group provided weather forecasts, single-theodolite pilot balloon and radiosonde wind measurements, and weather observations at the time of launch. The wind measurements were taken by pilot balloon up to 10,000 ft, and by radiosonde to 60,000 ft. The wind data are shown in Table 6. The weather observations are listed in Table 1.

SECTION 7 - DATA REDUCTION

PHOTOTHEODOLITE DATA

The Davis least-squares method for an N-station solution ($2 \leq N \leq 6$) was used to compute phototheodolite space-position data on an IBM 7090 computer. This method is a true least-squares method which minimizes the deviation in azimuth and elevation readings and yields the best possible solution from the available data. The Bodwell 2-station solution is used for obtaining the trial point used in the N-station Davis solution. Standard deviations in space positions are derived from errors in azimuth and elevation readings from each station. The film was read at the rate of 10 data points per second and smoothed by a least-squares fit of a third-degree moving-arc polynomial using 21 points. Velocity and acceleration are obtained by evaluating the first and second derivatives of the polynomial.

RADAR DATA

Radar data were computed as the product of the slant range and direction cosines of the line of sight from the radar to the vehicle. The data were smoothed in the same manner as the phototheodolite data, except that 21 points were used through burnout, 99 points were used through the trajectory to approximately 90,000 ft on the descent, and 47 points were used from 90,000 ft to impact.

TABULAR DATA

The tabulated phototheodolite, radar, and theoretical data, grouped by vehicle, experiment, and launch order, are presented in Volume 2.

The data are reduced with reference to the applicable launcher and to the predicted impact azimuth of each particular flight. The predicted impact azimuths are given in Table 1, and are shown on the plots of range versus displacement. Negative signs in the displacement column indicate that the flight azimuth at that time is to the left of the predicted impact azimuth (as seen from the launch point). The values of the acceleration shown are absolute values. The acceleration is negative when the velocity is decreasing. The data that occur at discontinuities or near end points must be used with reservation, because of the possible effect of the smoothing routine. Ignition and burnout times may be displaced as much as 0.5 second, and velocities at end points tend to be distorted.

PLOTTED DATA

Chemical release position data, as provided by AFCRL, are plotted in part in Figs. 20 through 29. The release position as a function of altitude and time are plotted against the wind-weighted theoretical trajectory data. Some AFGC empirical data are shown for comparison. These chemical release position data are also listed in Table 1 under Event Times and Event Altitudes.

The data collected by AFGC have been plotted, in part, and are shown in Figs. 30 through 133. The following data were plotted for each flight:

Altitude vs. Time
Range vs. Displacement
Velocity vs. Time

In some cases, there are two sets of plots for a flight; a set which covers through burnout of the last stage, and a set which covers the entire trajectory. The radar data obtained on Enid were not plotted, because of the small amount of data obtained.

The plots are grouped by vehicle, experiment, and launch order. The order of vehicle arrangement is Aerobee 150, Honest John-Nike-Nike, and Nike-Cajun. No data were obtained for the Nike-Apache vehicles.

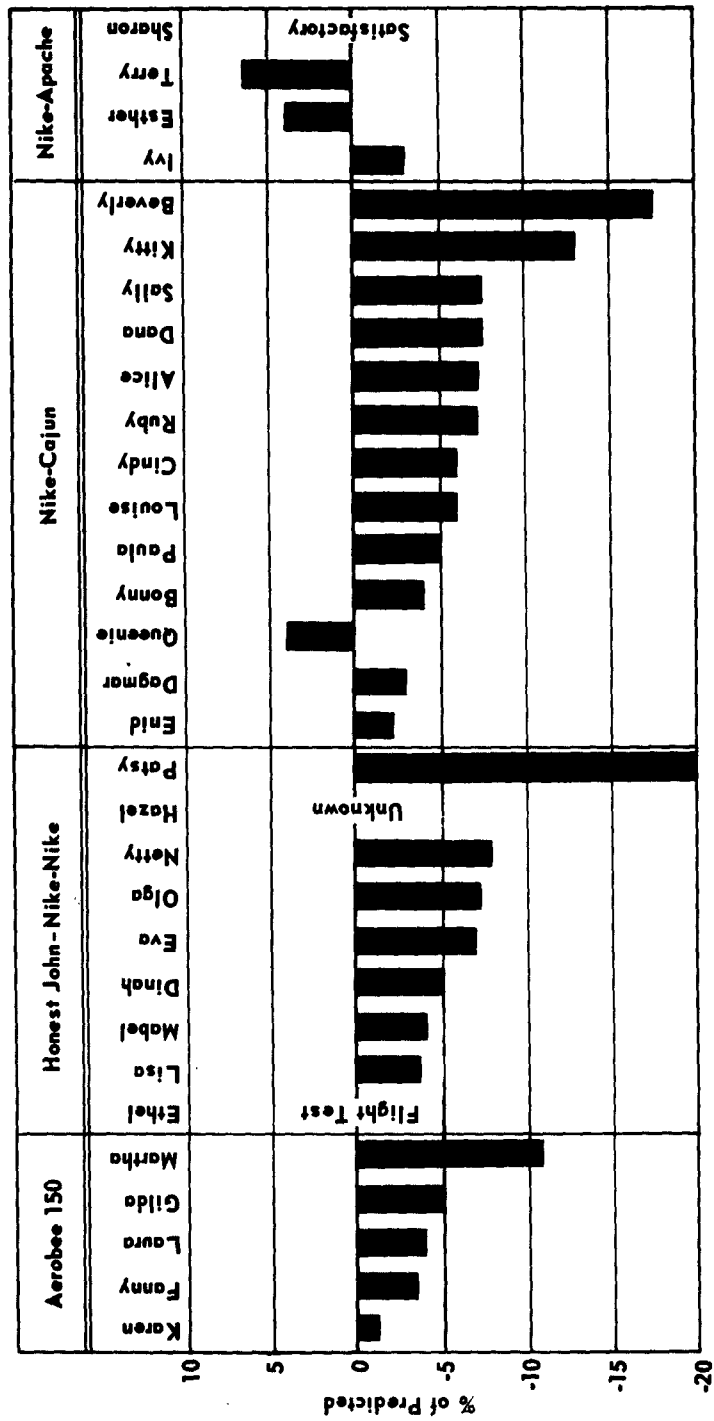


Fig. 19: Sounding Rocket Actual Maximum Altitude Deviation from Predicted Altitude.

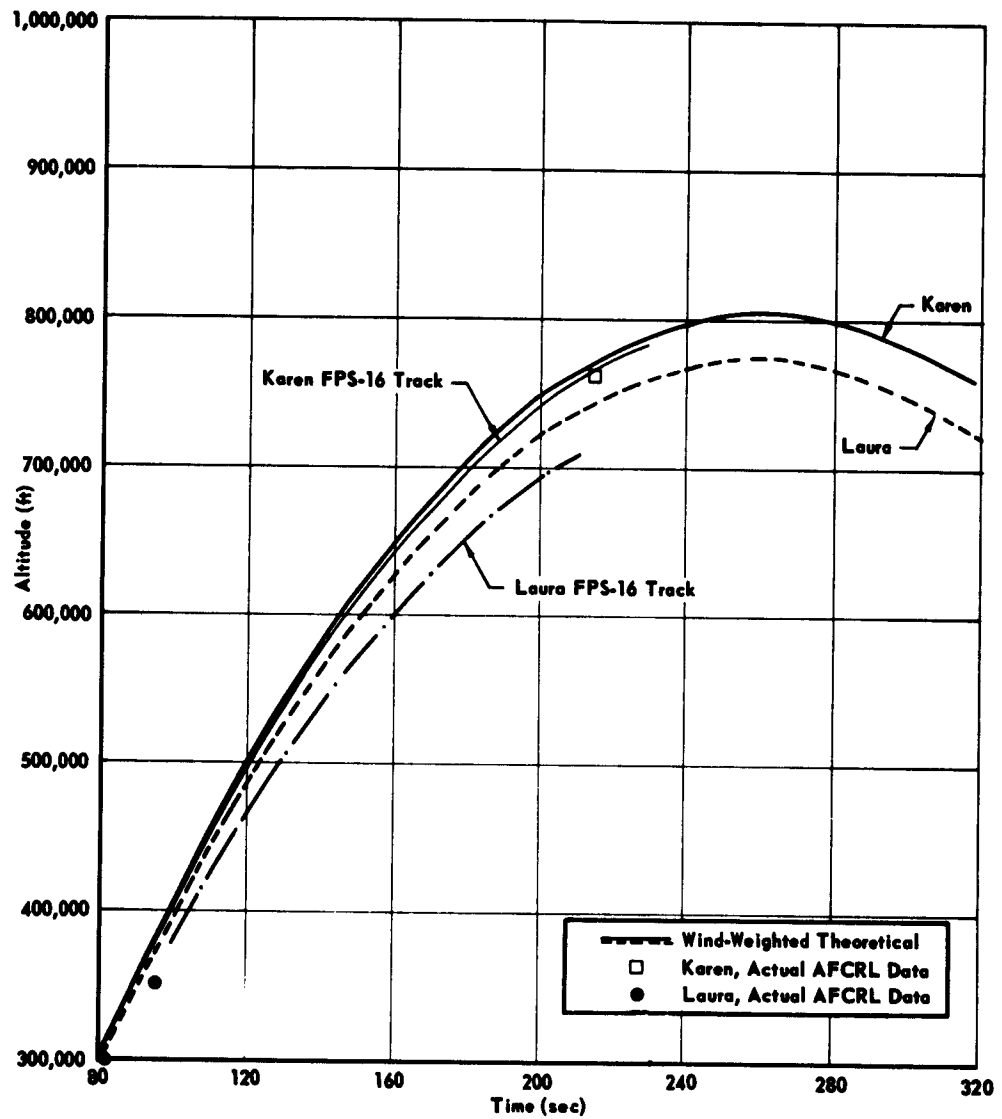


Fig. 20: AFCRL Chemical Release Positions vs. Wind-Weighted Theoretical Trajectories. Aerobee 150. (Karen and Laura).

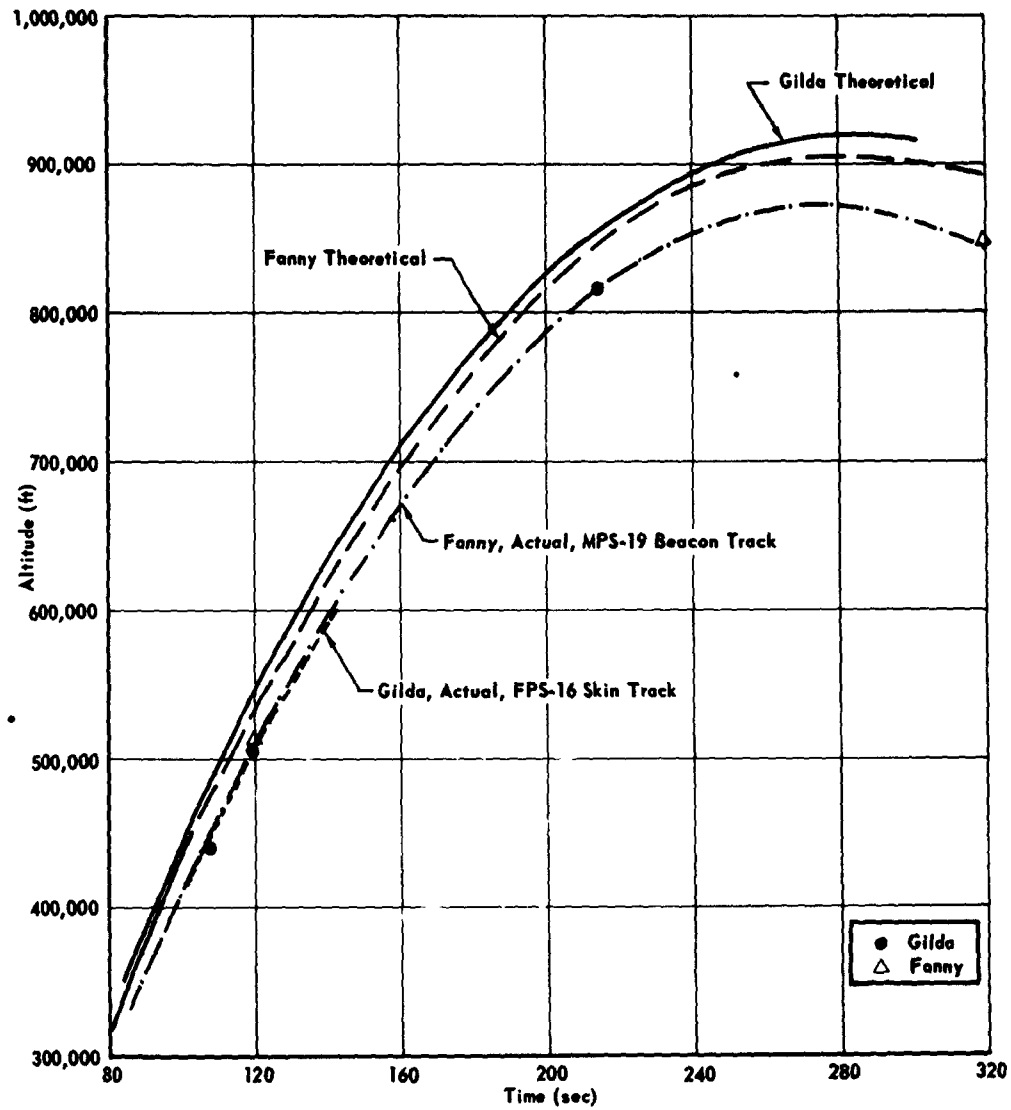


Fig. 21: AFCRL Chemical Release Positions vs. Wind-Weighted Theoretical Trajectories. Aerobee 150 (Fanny and Gilda).

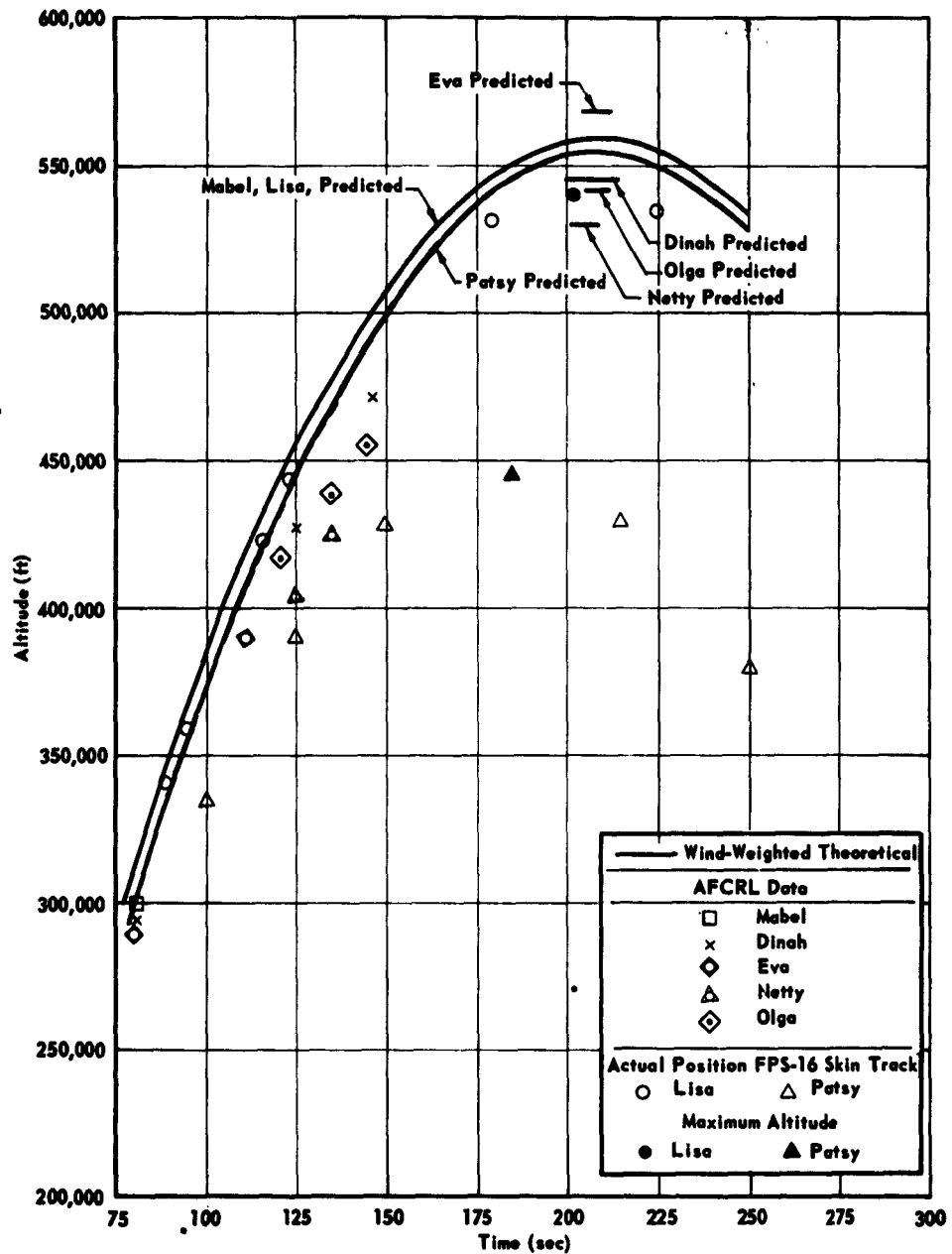


Fig. 22: AFCRL Chemical Release Positions vs. Wind-Weighted Theoretical Trajectories. Honest John-Nike-Nike (Mabel, Dinah, Eva, Netty, Olga, Lisa, and Patsy).

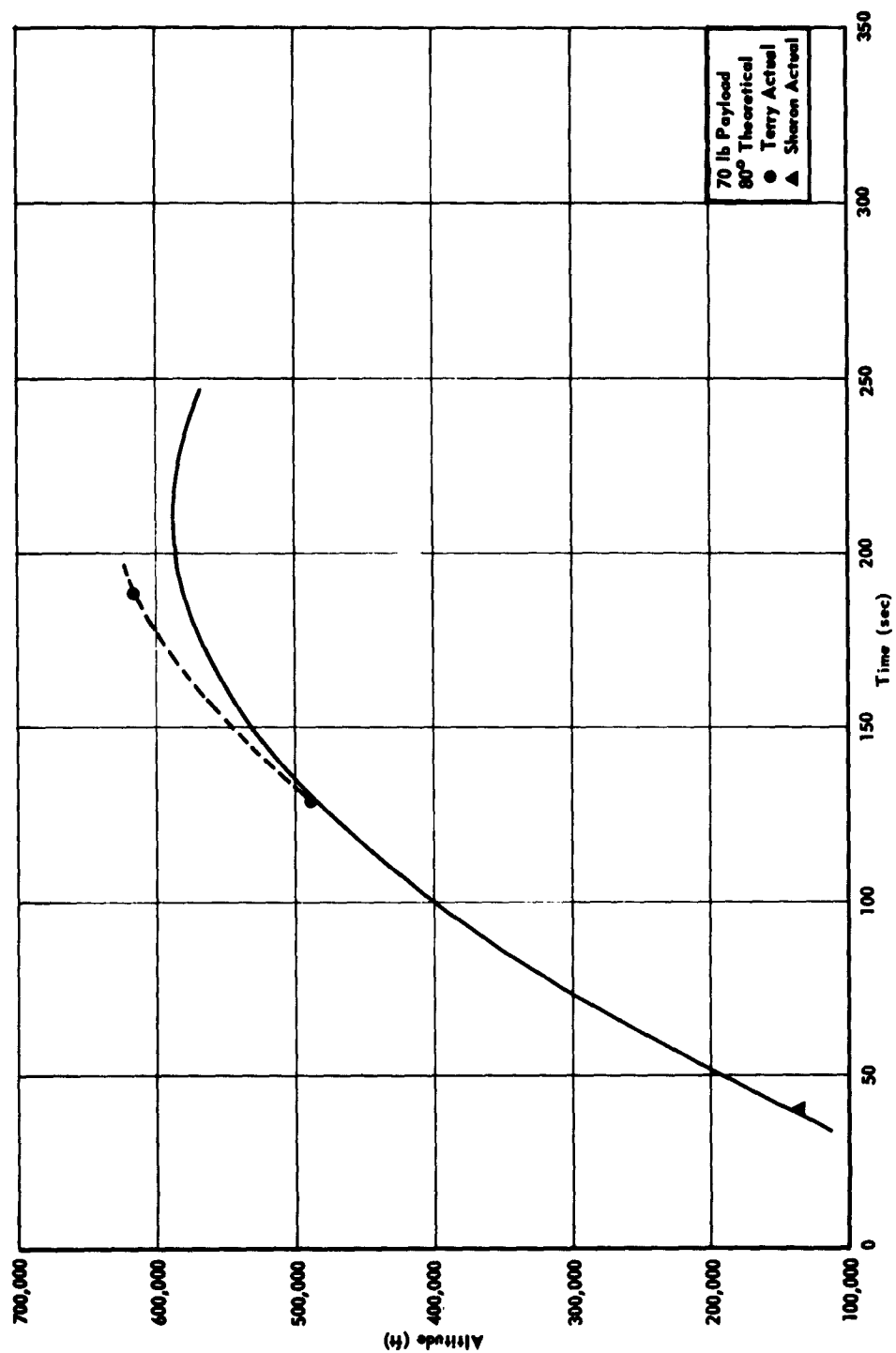


Fig. 23: AFCRL Chemical Release Positions vs. Wind-Weighted Theoretical Trajectories. Nike-Apache. (Terry and Sharon).

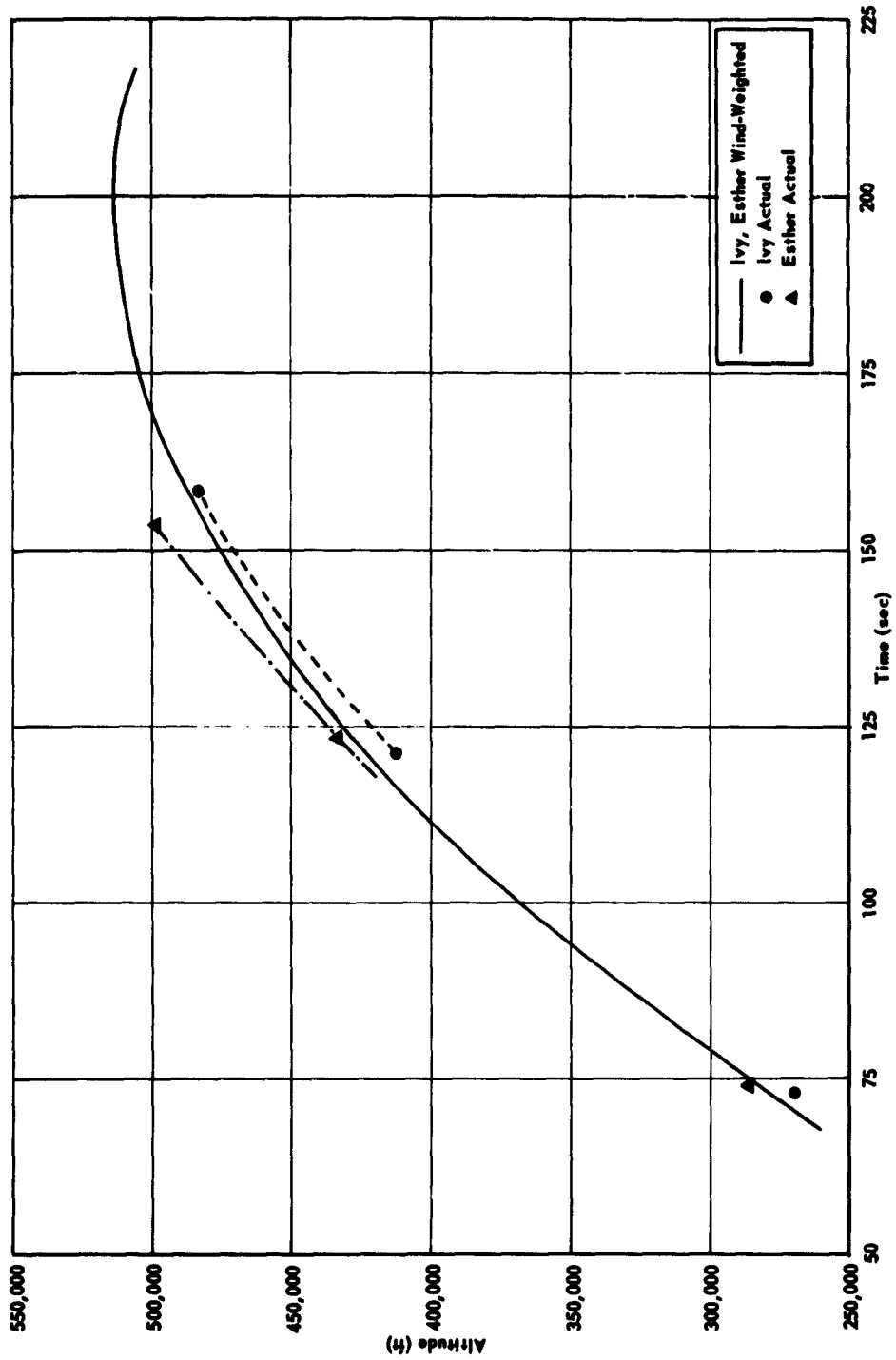


Fig. 24: AFCRL Chemical Release Positions vs. Wind-Weighted Theoretical Trajectories. Nike-Apache (Ivy and Esther).

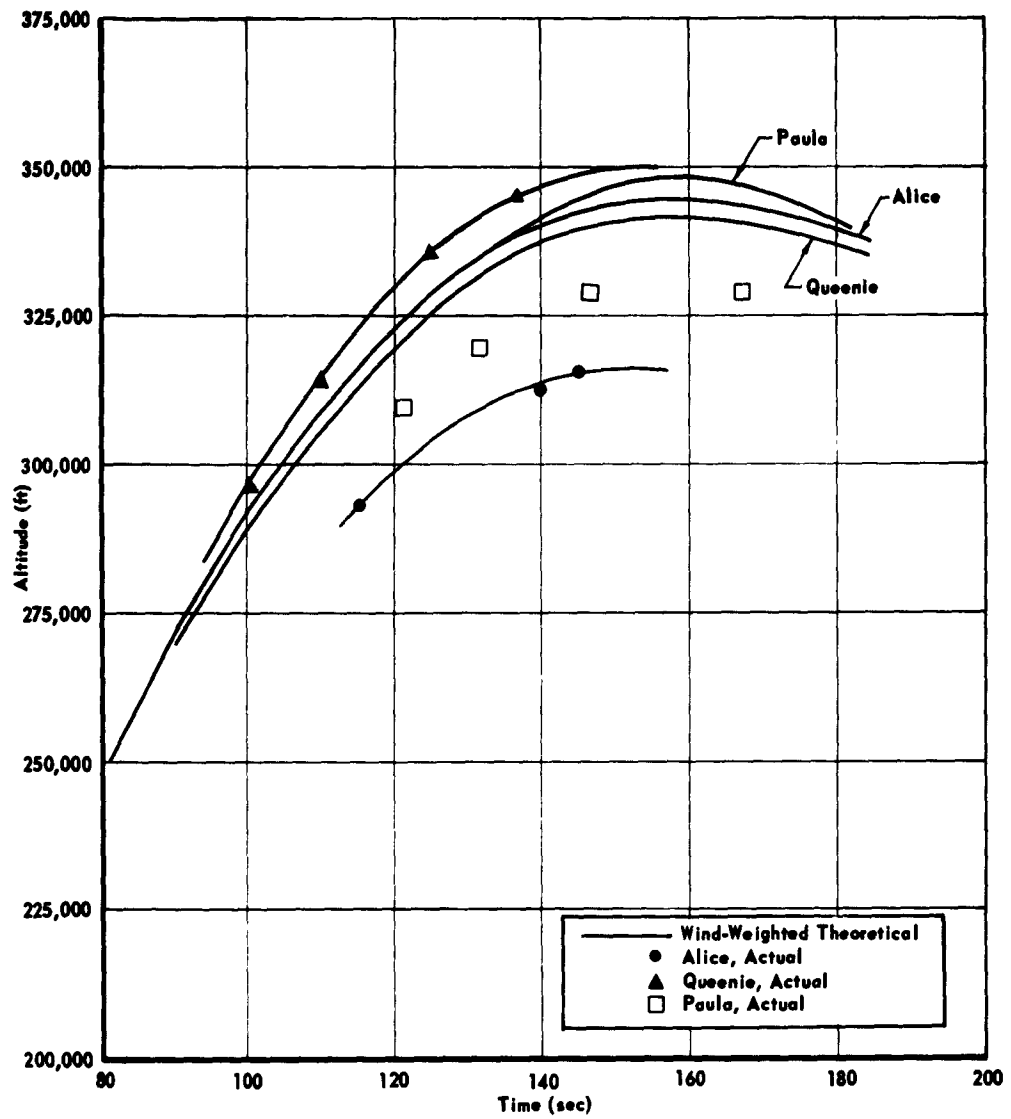


Fig. 25: AFCRL Chemical Release Positions vs. Wind-Weighted Theoretical Trajectories. Nike-Cajun (Alice, Queenie, and Paula).

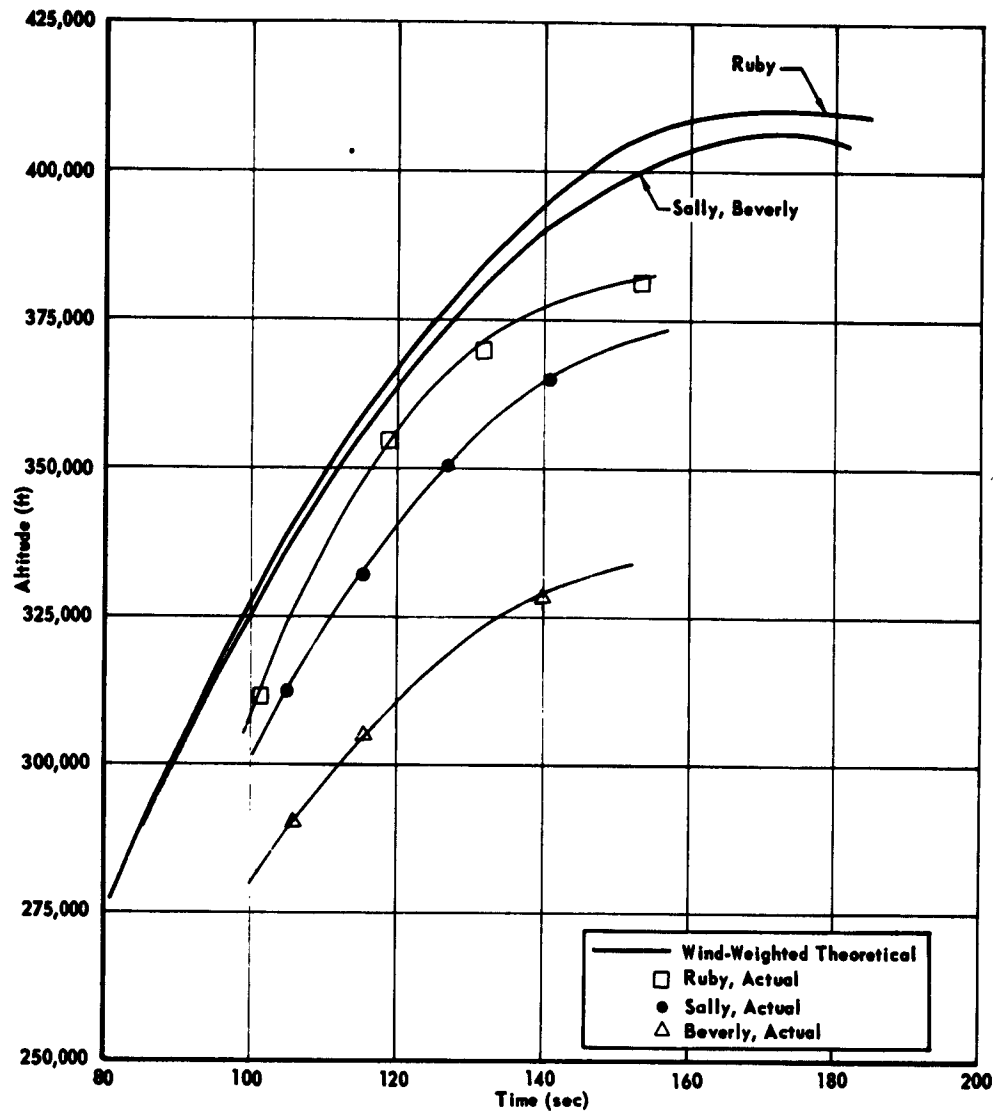


Fig. 26: AFCRL Chemical Release Positions vs. Wind-Weighted Theoretical Trajectories. Nike-Cajun. (Ruby, Sally, and Beverly).

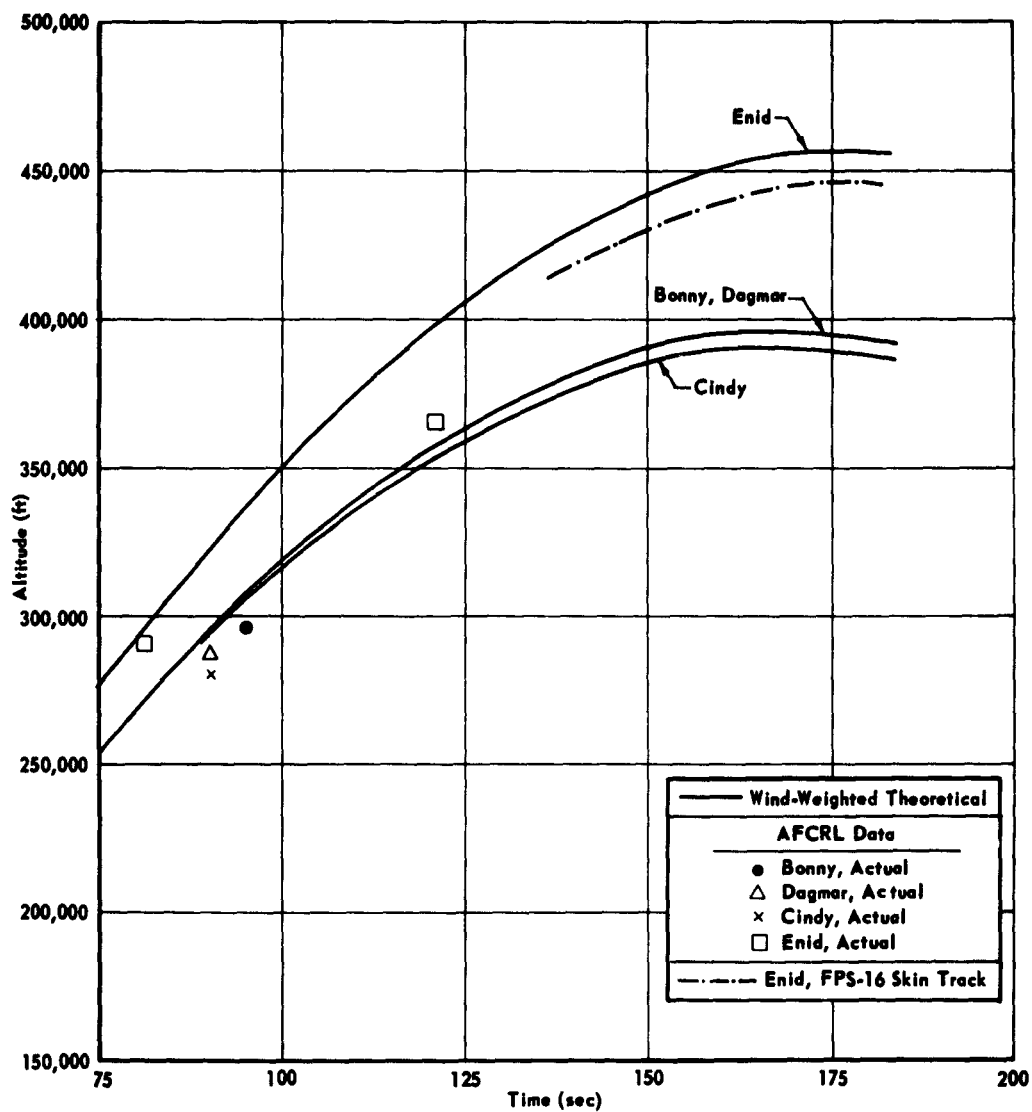


Fig. 27: AFCRL Chemical Release Positions vs. Wind-Weighted Theoretical Trajectories. Nike-Cajun. (Bonny, Dagmar, Cindy and Enid).

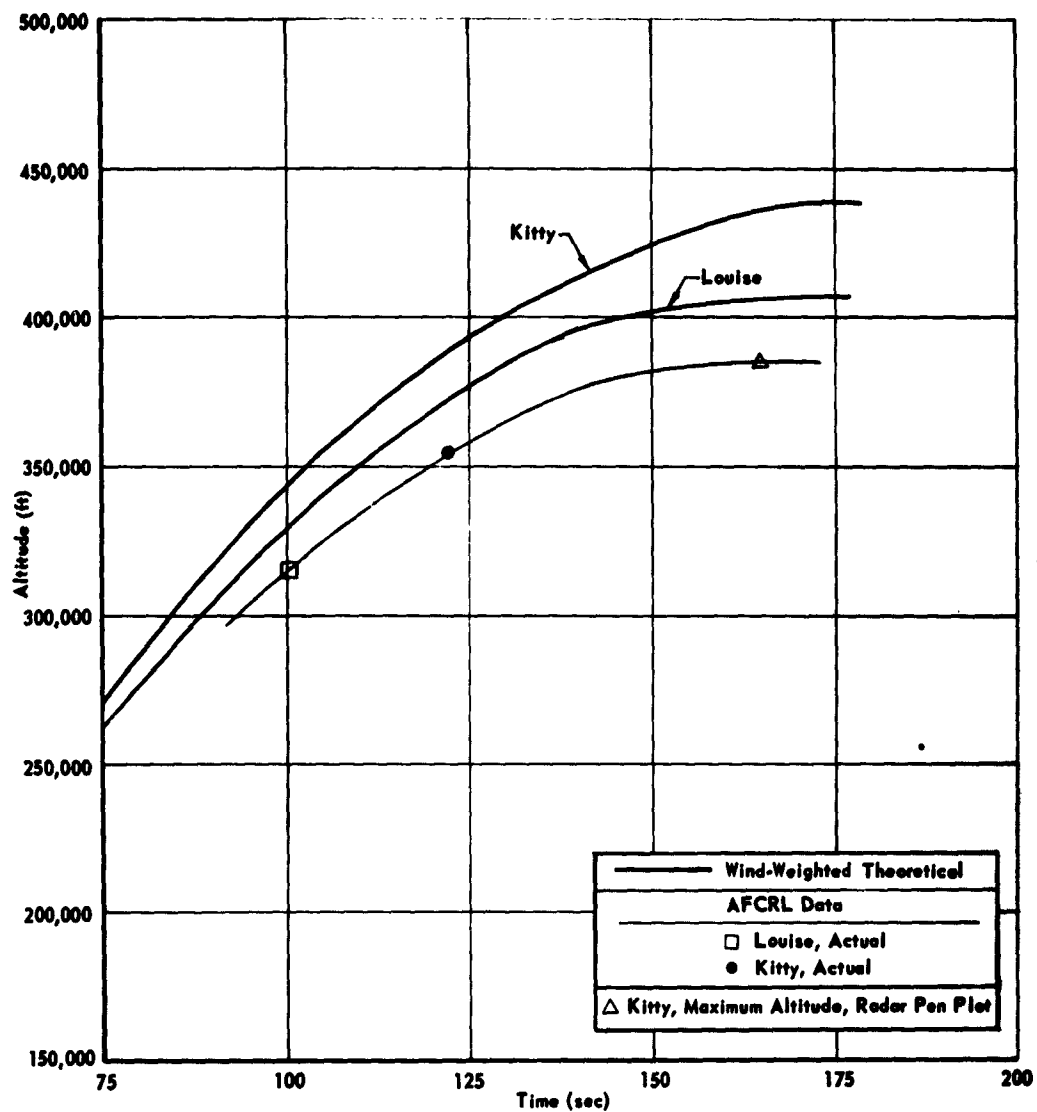


Fig. 28: AFCRL Chemical Release Positions vs. Wind-Weighted Theoretical Trajectories. Nike-Cajun. (Louise and Kitty).

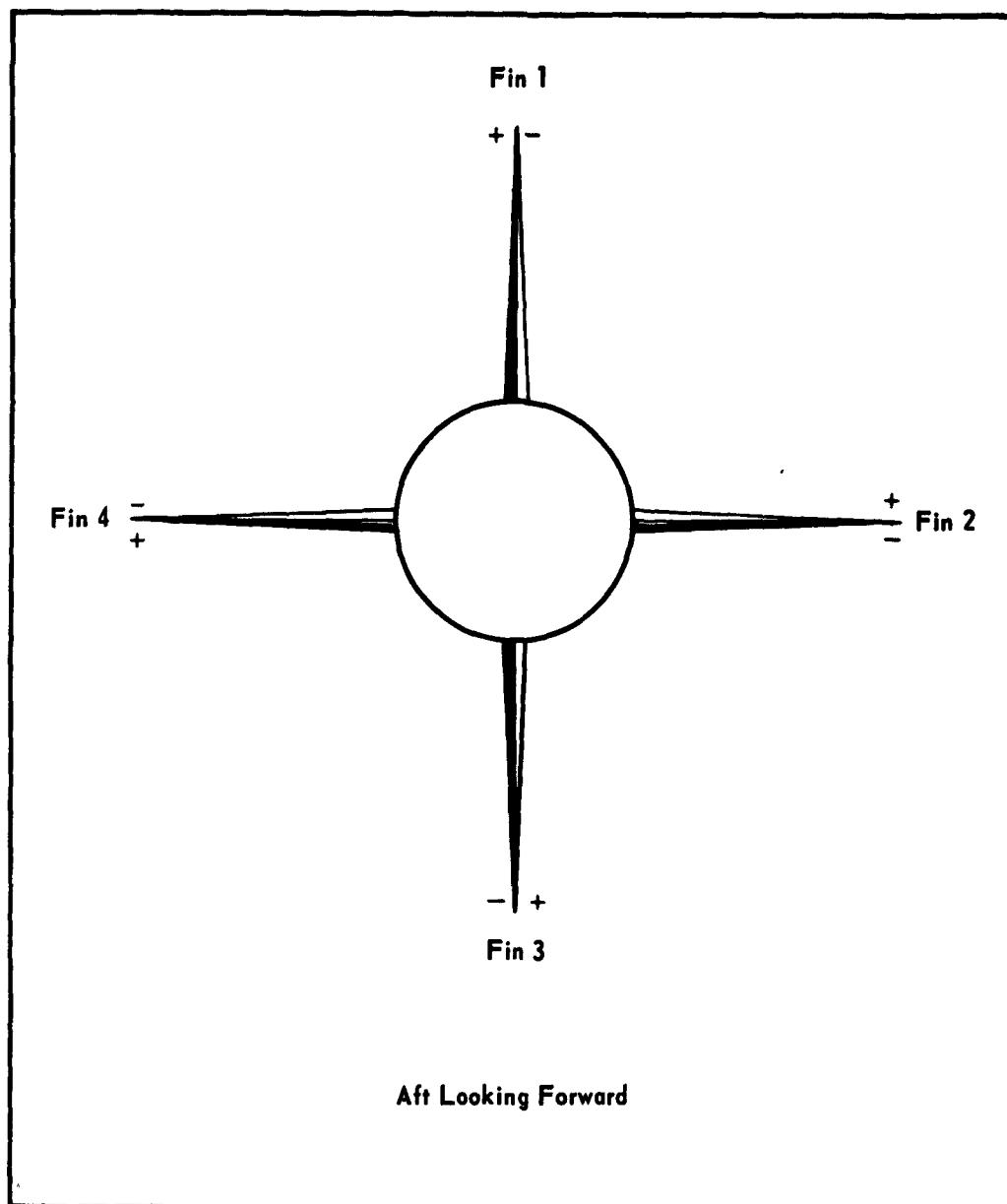


Fig. 29: Sign Convention for Spin Tab Installation.

SECTION 8 - DISCUSSION

DATA SUMMARY

Vehicle physical data, launch conditions, and highlights of the vehicle trajectories have been assembled in Table 1. The following remarks are for clarification of some of the data given.

Launch times given are taken from a lift-off switch. These values were compared with phototheodolite frame-of-first-fire times and differed in the third decimal place. Lift-off times were not recorded for four flights, and the data for these flights were reduced to the nearest minutes shown. Launch times are CST (Central Standard Time) and are equal to Greenwich Mean Time minus 6 hours.

Two values are shown for payload weight, a predicted weight used for the ballistic impact predictions and the actual weight.

The flight data shown have two values, a theoretical and an actual. The theoretical represents the performance from the wind-weighted theoretical trajectories. The actual values are measured and the data source is indicated.

The event times and altitudes were chemical release position data provided by AFCRL.

The impact azimuths derived from AFCRL chemical release data may deviate from the actual impact azimuth by ± 5 degrees.

The direction of vehicle roll was clockwise (as viewed from the aft), except those shown with negative roll rates. The fin tabs were applied in accordance with the sign convention shown in Fig. 29.

VEHICLE TRACKING

Two vehicles were launched during the day, Ethel and Martha. All others were launched at twilight (about one-half hour before local sunrise or after sunset), or at night.

Optical tracking was a requirement, and tracking flares were provided as indicated in other sections of this report. In several cases, flare burnout times were so close to final-stage burnout times that the reduced trajectory data end at or prior to burnout. The flares were

consistant in reaching a burning time of approximately 30 seconds. (See Table 1 for the predicted burning times.)

Radar skin tracking was set forth as a requirement after the launch series began, and became APGC's first large scale effort to provide AN/FPS-16 skin track of high-acceleration multi-stage sounding rockets. All factors considered, this first effort was deemed to have been very satisfactory. If the flare burning times had extended to the predicted values, the radars would have provided even more data.

Some factors influencing radar tracking, in addition to flare burning time, were:

1. The third stage of the Honest John-Nike-Nike had a tendency at ignition to break lock on automatic track.
2. The AGAVE was used on four Honest John-Nike-Nike flights, and definitely enhanced the AN/FPS-16 radar acquisition capability.
3. The return signal on the third stage of the Honest John-Nike-Nike faded into the noise on five flights at approximately 475,000 ft altitude. The same thing happened on the Aerobee vehicles at an altitude of 700,000 ft. This is a result of the effect of the attitude of the vehicle and slant range on the radar cross-section. On three of the Honest John-Nike-Nike flights and one Aerobee flight acquisition aids tracked throughout the trajectory and the targets were reacquired on the descent.

AN/FPS-16 radar skin track data were acquired on 7 of the 9 Honest John-Nike-Nike flights and on 2 flights tracked throughout the trajectory. On the four Aerobee flights which were skin tracked the data acquired prior to loss of signal were better than the AN/MPS-19 beacon track. AN/FPS-16 radar skin tracking for the Nike-Cajuns was hampered by the flare burning time, a faster vehicle, and a smaller target. Yet, the radars acquired shortly after lift-off (on vehicles with flares) on 3 of 6 flights, and acquired some data on 5 of 9 (3 without flares) flights.

VEHICLE PERFORMANCE

Thirty-three vehicles were launched. Thirty-one vehicles achieved altitudes which satisfied the scientific requirements. There were two Nike-Cajun failures, one because a malfunction occurred during second-stage burning and one because an error resulted in no second-stage

ignition. One each Aerobee 150, Honest John-Nike-Nike, and Nike-Cajun provided flights which were much lower than would have normally been expected. There are insufficient data to explicitly define the causes of the low flights.

VEHICLE PERFORMANCE PREDICTIONS

Fig. 19 is a presentation of the percentage the maximum altitude is known, or is estimated from known portions of the trajectory, to have deviated from the APMC predicted maximum altitude. The following percentages are derived from the best data available, either tracking data, AFCL chemical release position data, or as further defined. The Aerobee predictions, discounting Martha, were about 3 percent high. The Honest John-Nike-Nike predictions were based upon the performance of Ethel, which may have been slightly above optimum. The predictions for these vehicles, discounting Ethel, Hazel, and Patsy, averaged about 6 percent high. The Nike-Cajun predictions averaged about 7 percent high. The Nike Apache predictions were also satisfactory. No numerical value is assigned, because two payload configurations differed slightly from that upon which the predictions were based.

TABLE 1. VEHICLE AND FLIGHT DATA FOR (1) AEROBEE 150, (2) HONEST JOHN-NIKE-NIKE, (3) NIKE-APACHE, AND (4) NIKE-CAJUN.

AEROBEE 150 - AFCEB Name	Karen	Laura	Martha	Fanny	Gilda
Vehicle No.	AC 3.449	AC 3.450	AC 3.451	AC 3.452	AC 3.453
Experiment No.	1	1	1	4	4
Launch Date	15 Dec 62	7 Dec 62	15 Dec 62	10 Nov 62	13 Nov 62
Launch Time (CST)	1926:00, 570	1908:00, 415	1130:00, 284	1905:00, 110	1730:00, 090
Vehicle Model No.	AJ 11-21	AJ 11-21	AJ 11-21	AJ 11-21	AJ 11-21
Vehicle Serial No.	AF 91	AF 88	AF 95	AF 90	AF 89
Booster Model No.	AJ 60-80	AJ 60-80	AJ 60-80	AJ 60-80	AJ 60-80
Booster Serial No.	A-87	A-80	A-92	A-65	A-82
Sustainer Fin Serial No.	A-62	A-50	A-84	A-53	A-62
Booster Fin Serial No.	A 139, 140, 141	A 148, 149, 150	A 151, 152, 153	A 142, 143, 144	A 172, 173, 174
Booster Design	R 1959	R 1959	R 1959	R 2031	R 2031
Predicted/Actual Payload Weight (lb)	153/153.5	150/150.5	150/154	120/117.5	120/119
Launch Altitude (deg T)	146	136	145	136	177
Launch Elevation (deg)	86.2	83.9	85.1	83.1	81.1
Predicted/Actual Elevation (deg)	86	82.9	85.1	84.8	86.4
Theoretical/Actual Burnout Time (sec)	51.4/51.13	51.4/52.63	51.4/51.83	51.4/51.74	51.4/52.74
Theoretical/Actual Burnout Altitude (ft)	130,882/135,275.3	128,649/128,877.3	132,049/127,780.3	137,061/139,630.4	137,684/138,162.4
Theoretical/Actual Burnout Velocity (ft/sec)	6620/6418.3	6760/6387.2	6660/6115.3	6984/6814.4	6984/6688.4
Theoretical/Actual Altitude (ft)	2/N/A	2/N/A	2/N/A	2/N/A	2/N/A
Theoretical/Actual Zenith (deg)	263.2/N/A	258.7/N/A	266.4/253.4	279/275.5	280.5/N/A
Theoretical/Actual Zenith (nm)	132.3/118/N/A	127.4/130/N/A	135.7/138/121.4	149.7/142.5/143.5	151.4/148/N/A
Actual Event Times (sec)	90, 102, 215, 315	82, 94, 215	27.4	108, 120, 184, 319	108, 120, 213, 340
Theoretical/Actual Impact Time (sec)	107.6/121.5, 234, 225	89.7/N/A	504/516.3	139, 157, 2, 229, 5, 268	137, 155, 253, 236
Predict Impact Point (Az, deg/range, nm)	498/N/A			529/N/A	532/ 532.3
Booster	153/2300	152/1400	147/3000	150/3300	177/3700
Sustainer	175/83	129/142	178/83	174/115	182/82
Theoretical Sustainer Impact Point (Az, deg/range, nm)	176/112	191/142	179/80	182/91	187/70
Actual Sustainer Impact Point (Az, deg/range, nm)	187.10/N/A	184.10/N/A	174/74.4	168/100.6	186.5/107.3
Sustainer Fin Settings (nm)					
Fin 1	15, 25	15, 05	14, 75	15, 0	15, 10
Fin 2	16, 60	16, 00	11, 50	16, 5	15, 00
Fin 3	15, 65	15, 30	14, 25	14, 1	15, 60
Booster Fin Settings (deg)					
Fin 1	2, 5	2, 5	2, 5	2, 5	2, 5
Fin 2	2, 5	2, 5	2, 5	2, 5	2, 5
Fin 3	2, 5	2, 5	2, 50	2, 5	2, 5
Vehicle Gross Left-off Weight (lb)	1502.0	1498.3	1486.8	1465.3	1466.3
Burnout CG (in, from tip)	144, 58	140, 77	138, 9	138, 34	138, 1
Propellant Analysis (%)					
Oxidizer (nitric acid)	88, 77	90, 11	87, 91	89, 52	87, 90
Hydrofluoric Acid	0, 71	0, 74	0, 68	0, 68	0, 72
Nitrogen Dioxide	9, 44	8, 36	8, 38	8, 43	9, 85
Water	1, 04	0, 77	1, 21	1, 35	1, 49
Metal Nitrates	0, 04	0, 02	0, 02	0, 02	0, 04
Specific Gravity (at 60° F)	1, 560	1, 557	1, 560	1, 552	1, 563
Date Sampled	--	20 Nov 62	12 Dec 62	31 Oct 62	15 Nov 62
Running Fuel (%)					
Water	0, 25	0, 25	1, 0	0, 4	0, 4
Solids	2, 30	2, 30	1, 56	1, 36	1, 36
Specific Gravity (at 80° F)	1, 062	1, 062	1, 06	1, 058	1, 058
Date Sampled	--	14 Nov 62	12 Dec 62	31 Oct 62	31 Oct 62
Starting Slug (%)					
Water	1, 5	1, 0	1, 20	1, 0	1, 0
Solids	--	2, 9	2, 10	2, 56	2, 56
Specific Gravity (at 80° F)	1, 096	1, 097	1, 096	1, 096	1, 096
Date Sampled	--	20 Nov 62	12 Dec 62	31 Oct 62	31 Oct 62
Launch Weather					
Temp., Dry Bulb (°C)	18	14	18	13	16
Relative Humidity (%)	76	85	49	79	66
Cloud Cover (%) & Altitude	140 Scd, HI Scd	25 Scd	Clear	Clear	Clear
Wind Direction (deg T)	150	190	140	290	325
Surface Velocity (ft)	15	23	7	8	13
Visibility (nm)	7	7	10	7	10
Data Obtained					
Photobedline	Not Scheduled	Not Scheduled	Not Scheduled	Not Scheduled	Not Scheduled
Radar AN/MP-19, Beacon Track (sec)	Not reduced	Not reduced	3, 0-516, 0	3, 1-329, 5	3, 1-81, 9
Radar AN/FP-16, Skin Track (sec)	13, 1-221, 5	8, 8-206, 5	7, 0-720, 0	Not Scheduled	62, 5-147, 5/508, 5-532, 8

TABLE 1. (Continued)

HONEST JOHN-NIKE-NIKE - AFCL Name	Ethel	Mabel	Dinah	Eva	Netty	Olga
Vehicle No.	AC 20, 463	AC 20, 454	AC 20, 455	AC 20, 461	AC 20, 456	AC 20, 458
Experiment No.	Flight Test	2	2	3	3	3
Launch Date	23 Oct 62	27 Nov 62	3 Dec 62	6 Dec 62	12 Dec 62	14 Dec 62
Launch Time (CST)	1309:59, 622	1759:59, 895	2245:00, 147	0421: --	1745:59, 928	1752:00, 165
Launch Pad	1	1	1	1	1	1
Honest John SN	1514	2048	1210	2131	1639	2049
Nike Second Stage SN	29017	28963	28970	28977	28989	44036
Nike Third Stage SN	28120	28971	28972	28966	7752	20990
Honest John Igniter Lot & SN	RAD-1-30-50	RAD-1-13-NA	RAD-1-28-43	RAD-1-13-NA	RAD-1-28-47	RAD-1-13-NA
Nike Second Stage Igniter SN	17	14	16	18	19	15
Nike Third Stage Igniter SN	21	25	23	24	26	22
Honest John Fin SN	1514	6	4	6	3	8
Nike Second Stage Fin Survey No.	1	7	5	6	4	9
Nike Third Stage Fin Survey No.	10	16	14	15	13	18
Flare SN	12 & 15	4 & 5	1 & 12	11 & 19	9 & 14	5 & 8
Predicted Flare Burning Time (sec)	80	130	65	65	65	65
Payload Design	R 2030	R 1938	R 1938	R 1938	R 2117	R 2117
Predicted/Actual Payload Weight (lb)	343/325	300/299	300/301	300/334	325/327	425/328
Launcher Azimuth (deg T)	159	171	167	143	175	156
Launcher Elevation (deg)	77.6	78.0	80.8	77	76.8	78.4
Predicted Effective Elevation (deg)	80	81	80	82.5	80	80
Predicted/Actual Honest John Burnout Altitude (ft)	4513/4345 ²	4118/NA	4117/NA	4115/NA	4089/4544 ²	4103/4494 ²
Predicted/Actual Honest John Burnout Velocity (fps)	1889/1808 ²	1811/NA	1810/NA	1812/NA	1805/1760 ²	1787/1767 ²
Predicted/Actual Honest John Burnout Time (sec)	4, 8/4, 7 ²	4, 8/NA	4, 8/NA	4, 8/NA	4, 8/4, 9 ²	4, 8/5, 0 ²
Predicted/Actual Honest John Roll Rate (rps)	0, 7/NA	0, 7/NA	0, 7/NA	0, 7/NA	0, 7/NA	0, 7/NA
Predicted/Actual Nike Second Stage Ignition Time (sec)	10/8, 6 ²	10/ 10 ⁹	10/NA	10/NA	10/9, 8 ²	10/9, 1 ²
Predicted/Actual Nike Second Stage Burnout Altitude (ft)	19083/18783 ²	18272/NA	18, 219/19, 883 ³	18, 327/19, 410 ³	18, 150/19, 850 ²	18, 192/19, 029 ²
Predicted/Actual Nike Second Stage Burnout Velocity (fps)	2987/2964 ²	2935/NA	2934/2955 ³	2931/2909 ³	2915/2837 ²	2916/2875 ²
Predicted/Actual Nike Second Stage Burnout Time (sec)	12, 87/12, 4 ²	12, 87/NA	12, 87/13, 0 ³	12, 87/13, 0 ³	12, 87/13, 7 ²	12, 87/12, 9 ²
Predicted Nike Second Stage Roll Rate (rps)	1/NA	1/NA	1/NA	1/NA	1/NA	1/NA
Predicted/Actual Nike Third Stage Ignition Time (sec)	25/23, 700 ¹	25/223 ⁹	25/23, 4 ³	25/23, 6 ³	25/26, 6 ²	25/23, 8 ²
Predicted/Actual Nike Third Stage Burnout Altitude (ft)	57,977/59, 599 ²	59, 309/NA	58, 958/62, 915 ³	59, 797/64, 922	58, 667/64, 030	58, 929/NA
Predicted/Actual Nike Third Stage Burnout Velocity (fps)	5585/5844 ²	5910/NA	5908/5823 ³	5906/5690 ³	5815/5644 ²	5821/NA
Predicted/Actual Nike Third Stage Burnout Time (sec)	27, 87/27, 3 ²	27, 87/NA	27, 87/28, 8 ³	27, 87/29, 8 ³	27, 87/31, 0 ²	27, 87/NA
Predicted Nike Third Stage Roll Rate (rps)	7/NA	7/NA	7/NA	7/NA	7/NA	7/NA
Predicted/Actual Nike Third Stage Zenith (nm)	72, 7/86, 5 ⁴	92, 1/NA	90/NA	93, 6/NA	87, 5/NA	89, 4/NA
Predicted/Actual Nike Third Stage Time to Zenith (sec)	186/208 ⁴	209/NA	206/NA	210/NA	203/NA	205/NA
Actual Event Times (sec)	121	80, 119, 147	80	79, 2	80	80
Actual Event Altitudes (Km)	137	92, 3	90, 127, 145	88, 6	101, 2	--
Predicted/Actual Impact Time (sec)	359/ 396 ⁴	401/NA	397/392 ³	404/NA	391/378 ³	395/383 ³
Predicted Impact Point (Az, deg/range, ft)						
First Stage	159/15, 400	163/13, 500	168/15, 000	139/16, 400	156/14, 400	158/16, 400
Second Stage	158/28, 000	155/29, 000	171/29, 000	139/29, 000	158/26, 400	154/32, 600
Third Stage	170/88	165/91	170/100	170/76	190/97	170/97
Theoretical Impact Point (Az, deg/range, ft)						
Third Stage	164/97	168/96	183/107	168/85	196/102	177/94
Actual Impact Point (Az, deg/range, ft)						
Third Stage	164, 5/ 80 ⁴	157 ¹⁰ /NA	177/90 ³	155 ³⁻⁸ /NA	193/91, 5 ³	165, 5/76 ³
First Stage Fin Tab Length (in.)						
Fin 1	+9, 366	+7, 375	+7, 445	+12, 274	-6, 48	+17, 73
Fin 2	+5, 561	+9, 600	-23, 441	-28, 595	-14, 965	-19, 758
Fin 3	+8, 570	+5, 425	+11, 810	+10, 930	+6, 56	+13, 23
Fin 4	+16, 225	-10, 000	-10, 000	-30, 000	-15, 00	0
Second Stage Fin Cant (milliradians)						
Fin 1	-5, 76	-2, 68	-4, 40	-5, 48	-6, 70	-5, 87
Fin 2	-4, 61	-2, 78	-2, 49	-8, 26	-7, 76	-5, 91
Fin 3	-4, 05	-2, 02	-2, 15	-5, 40	-3, 11	-5, 72
Fin 4	-5, 20	-1, 92	-4, 05	-2, 61	-2, 61	-5, 68
Third Stage Fin Cant (milliradians)						
Fin 1	+13, 0	+13, 66	+14, 57	+11, 99	+13, 43	+14, 23
Fin 2	+13, 1	+13, 83	+14, 96	+14, 77	+13, 72	+12, 58
Fin 3	+13, 1	+14, 25	+15, 25	+15, 00	+13, 89	+12, 56
Fin 4	+13, 1	+14, 08	+14, 85	+12, 21	+13, 59	+14, 22
Launch Weather						
Temp., Dry Bulb (°C)	12	12	11	5	14	8
Relative Humidity (%)	36	42	98	59	89	87
Cloud Cover (% & Alt)	Clear	Hi Sctd	Hi Thin Sctd	Clear	Middle Ovc	25 Sctd
Wind Direction (deg T)	360	020	Calm	300	340	280
Surface Velocity (kt)	10	9	Calm	14	17	12
Visibility (nm)	8	7	7	7	6 in Haze	7
Data Obtained						
Phototheodolite (sec)	1, 0 - 28, 8	Not Scheduled	Not Scheduled	Not Scheduled	2, 0 - 33, 0	1, 0 - 27, 1
Radar AN/MPS-19 Beacon Track (sec)	4, 0 - 384, 0	NA	NA	NA	NA	NA
Radar AN/FPS-16 Skin Track (sec)	Not reduced	None	11, 0 - 148, 5; 301 - 347	9, 6 - 123, 0	39 - 145, 5; 319 - 377, 5	11, 8 - 33, 4; 95, 5 - 150; 300 - 382, 5

	Ethel	Mabel	Dinah	Eva	Netty	Olga	Hazel	Lila	Patsy
	AC 20, 463 Flight Test 23 Oct 62 1309:59, 622 1 1514 29017 28120 RAD-1-30-50 17 21 1514 1 10 12 & 15 80 R 2030 343/325 159 77.6 80 ude (ft) 4513/4345 ² ity (fps) 1889/1808 ² 0 (sec) 4, 8/4, 7 ² u) 0, 7/NA Time (sec) 10/8, 6 ² Altitude (ft) 19083/18783 ² Velocity (fps) 2987/2964 ² Time (sec) 12, 87/12, 4 ² 1/NA Time (sec) 25/23, 700 ¹ Altitude (ft) 57,977/59, 599 ² Velocity (fps) 5585/5844 ² Time (sec) 27, 87/27, 3 ² 7/NA 72, 7/86, 5 ⁴ Zenith (sec) 186/208 ⁴ 121 137 359/ 396 ⁴ 159/15, 400 158/28, 000 170/88 164/97 164, 5/ 80 ⁴ +9, 366 +5, 561 +8, 570 +16, 225 -5, 76 -4, 61 -4, 05 -5, 20 +13, 0 +13, 1 +13, 1 +13, 1 12 36 Clear 360 10 8 1, 0 - 28, 8 4, 0-384, 0 Not reduced	AC 20, 454 2 27 Nov 62 1759:59, 895 1 2048 28963 28971 RAD-1-13-NA 14 25 6 7 16 4 & 5 130 R 1938 300/299 171 78, 0 81 4118/NA 1811/NA 4, 8/NA 0, 7/NA 10/ 10 ⁹ 18272/NA 2935/NA 12, 87/NA 1/NA 25/223 ⁹ 59, 309/NA 5910/NA 27, 87/NA 7/NA 92, 1/NA 209/NA 80, 119, 147 92, 3 401/NA 163/13, 500 155/29, 000 165/91 168/96 157 10/NA +7, 375 +9, 600 +5, 425 -10, 000 -2, 68 -2, 78 -2, 02 -1, 92 +13, 66 +13, 83 +14, 25 +14, 08 12 42 Hi Scld 020 9 7 Not Scheduled NA None	AC 20, 455 2 3 Dec 62 2245:00, 147 1 1210 28970 28972 RAD-1-28-43 16 23 4 5 14 1 & 12 65 R 1938 300/301 167 80, 8 80 4117/NA 1810/NA 4, 8/NA 0, 7/NA 10/NA 18, 219/19, 883 ³ 2934/2955 ³ 12, 87/13, 0 ³ 1/NA 25/23, 4 ³ 59, 958/62, 915 ³ 5908/5823 ³ 27, 87/28, 8 ³ 7/NA 90/NA 206/NA 80 90, 127, 145 397/392 ³ 168/15, 000 171/29, 000 170/100 183/107 177/490 ³ +7, 445 -23, 441 +11, 810 -18, 000 -4, 40 -2, 49 -2, 15 -4, 05 +14, 57 +14, 96 +15, 25 +14, 85 11 98 Hi Thin Scld Calm Calm 7 Not Scheduled NA 11, 0-148, 5, 301-347	AC 20, 461 2 6 Dec 62 0421: -- 1 2131 28977 28966 RAD-1-13-NA 18 24 5 6 15 11 & 19 65 R 1938 300/334 143 77 82, 5 4115/NA 1810/NA 4, 8/NA 0, 7/NA 10/NA 18, 327/19, 410 ³ 2931/2909 ³ 12, 87/13, 0 ³ 1/NA 25/23, 6 ³ 59, 797/64, 922 5906/5690 ³ 27, 87/29, 8 ³ 7/NA 93, 6/NA 210/NA 79, 2 88, 6 404/NA 139/16, 400 139/29, 000 170/76 168/85 155 3-8/NA +12, 274 -28, 595 +10, 930 -30, 000 -5, 48 -8, 26 -5, 40 -2, 61 +11, 99 +14, 77 +15, 00 +12, 21 5 59 Clear 300 14 7 Not Scheduled NA 9, 6-123, 0	AC 20, 456 3 12 Dec 62 1745:59, 928 1 1639 28989 7752 RAD-1-28-47 19 26 3 4 13 9 & 14 65 R 2117 325/327 175 76, 8 80 4089/4544 ² 1805/1760 ² 4, 8/4, 9 ² 0, 7/NA 10/9, 8 ² 18, 150/19, 850 ² 2915/2837 ² 12, 87/13, 7 ² 1/NA 25/26, 6 ² 58, 667/64, 030 5815/5644 ² 27, 87/31, 0 ² 7/NA 87, 5/NA 203/NA 96 101, 2 391/378 ³ 156/14, 400 158/26, 400 190/97 196/102 193/91, 5 ³ -6, 48 -14, 965 +6, 56 -15, 00 -6, 70 -7, 76 -3, 11 -2, 61 +13, 43 +13, 72 +13, 89 +13, 59 14 87 Middle Ovc 340 17 6 in Haze 2, 0-33, 0 39-145, 5, 319-377, 5	AC 20, 458 3 14 Dec 62 1752:00, 165 1 2049 44036 20990 RAD-1-13-NA 15 22 8 9 18 5 & 8 65 R 2117 425/328 156 78, 4 80 4103/4494 ² 1787/1767 ² 4, 8/5, 0 ² 0, 7/NA 10/9, 1 ² 18, 192/19, 029 ² 2916/2875 ² 12, 87/12, 9 ² 1/NA 25/23, 8 ² 58, 929/NA 5821/NA 27, 87/NA 7/NA 89, 4/NA 205/NA 80 -- 395/383 ³ 158/16, 400 154/32, 600 170/97 177/94 165, 5/76 ³ +17, 73 -19, 758 +13, 23 0 -5, 87 -5, 91 -5, 72 -5, 68 +14, 23 +12, 58 +12, 56 +14, 22 8 87 25 Scld 280 12 7 1, 0-27, 1 11, 8-33, 4 95, 5-180, 300-382, 9	AC 20, 461 4A 31 Oct 62 1732:00, 160 1 1593 850 7969 RAD-1-21-61 12 28 1 2A 11 None None R 2030 335, 5/317 169 73, 3 80 4018/NA 1804/NA 4, 8/NA 0, 7/NA 10/NA 17, 837/NA 2913/NA 12, 87/NA 1/NA 25/NA 57, 534/NA 5791/NA 27, 87/NA 7/NA 83, 4/NA 199/NA None None 382/NA 169/18, 900 167/32, 400 172/110 175/119 NA +8, 217 -16, 104 +12, 411 -10, 00 -4, 81 -5, 36 -6, 49 -5, 94 +13, 97 +13, 88 +14, 15 +14, 24 15, 5 25 Clear 360 12 8 None NA None	AC 20, 462 4A 1 Nov 62 2227:59, 135 1 1287 44039 28969 RAD-1-27-47 11 27 2 3 12 1 & 6 130 R 2030 325/319 162 82, 2 82, 2 4146/4271 ² 1803/1793 ² 4, 8/4, 4 ² 0, 7/NA 10/5, 2 ² 18, 394/14, 315 ² 2913/3160 ² 12, 87/8, 9 ² 1/NA 25/23, 1 ² 59, 708/61, 346 2-8 5814/5663 2-8 27, 87/26, 8 2-8 7/NA 93/89, 5 ³ 208/203 ³ None None 401/421 ³ 156/9000 154/22, 000 170/65 164, 5/73 166/49 ³ +9, 10 -14, 11 +8, 44 -15, 00 -2, 06 -2, 60 -1, 93 -1, 39 +15, 05 +13, 99 +13, 64 +14, 71 11 96 Clear 015 10 10 2, 0-26, 8 NA 13, 0-30, 0, 51, 5-421	AC 20, 460 4A 4 Dec 62 1951:00, 115 1 2134 44049 28987 RAD-1-13-NA 13 20 7 8 17 7 & 10 65 R 2030 325/327 160 79, 5 82, 2 4110/4496 ² 1804/1804 ² 4, 8/4, 9 ² 0, 7/NA 10/9, 858 1822/19, 808 ² 2915/2938 ² 12, 87/13, 3 ² 1/NA 25/22, 8 ² 58, 983/58, 598 ² 5817/5845 ² 27, 87/27, 0 ² 0, 65/NA 88, 9/3 92/73, 3 205/203 ³ None None 394/372 ³ 170/14, 200 170/28, 900 170/97 185/96 178/66 ³ +17, 68 -24, 88 +9, 69 -30, 00 +8, 35 +8, 42 +9, 52 +9, 46 +2, 99 +2, 49 +2, 89 +3, 39 15 98 Clear 270 7 7 2, 5-27, 3 NA 11, 0-372

TABLE 1. (Continued)

NIKE-APACHE - AFCL Name		Terry	Sharon	Ivy	Ester
Vehicle No.	AC S. 465	AC S. 466	AC S. 468	AC S. 466	AC S. 467
Experiment No.	Sodium Flare	Sodium Flare	Sodium Flare	Cesium Ion	Cesium Ion
Launch Date	1 Dec 62	1 Dec 62	3 Dec 62	3 Dec 62	3 Dec 62
Launch Time (CST)	1720:00.120	1720:00.120	1720:00.022	1801: --	2145: --
Launch Pad	2	2	2	3	3
Nike SN	34766	34766	29025	34849	20150
Apache SN	BP 15-613-4	BP 15-613-3	BP 15-613-3	BP 15-622-6	BP 15-621-5
Nike Igniter Lot & SN	RAD-2-146-74	RAD-2-146-74	RAD-2-140-87	RAD-3-37-9	RAD-3-37-26
Apache Igniter Lot & S	TED-E-13-14	TED-E-13-14	TED-E-13-17	TED-404-1-2	TED 401-2-8
Nike Fin Survey No.	9	9	19	17	18
Apache Fin Survey No.	1	1	4	2	3
Payload Design	GCA	GCA	GCA	R 2224	R 2224
Payload Weight (lb)	70/69.75	70/69.75	70/69.75	90/88.25	90/88.25
Launch Azimuth (deg T)	171	171	151	162	165
Launcher Elevation (deg)	79.4	79.4	81.6	79.6	80
Predicted Effective Elevation (deg)	81.5	81.5	81.2	79.5	79.5
Predicted/Actual Nike Burnout Altitude (ft)	4285/NA	4285/NA	4272/NA	4194/NA	4194/NA
Predicted/Actual Nike Burnout Velocity (fps)	3300/NA	3300/NA	3299/NA	3248/NA	3248/NA
Predicted/Actual Nike Burnout Time (sec)	2.87/NA	2.87/NA	2.87/NA	2.87/NA	2.87/NA
Predicted/Actual Nike Burnout Roll Rate (rps)	1.5/NA	1.5/NA	1.5/NA	1.5/NA	1.5/NA
Predicted/Actual Apache Ignition Time (sec)	20.042/1.5	20.042/1.5	20/NA	20.0/NA	20.0/NA
Predicted/Actual Apache Burnout Altitude (ft)	60.074/NA	60.074/NA	59.682/NA	5873/NA	58.468/NA
Predicted/Actual Apache Burnout Velocity (fps)	6282/NA	6282/NA	6273/NA	5875/NA	5874/NA
Predicted/Actual Apache Burnout Time (sec)	25.4/NA	25.4/NA	25.4/NA	25.4/NA	25.4/NA
Predicted/Actual Apache Burnout Roll Rate (rps)	-0.145/NA	-0.145/NA	+0.11/NA	+0.018/NA	+0.003/NA
Predicted/Actual Apache Zenith (arc)	99.6/NA	99.6/NA	97.4/NA	84.3/NA	84.5/NA
Predicted/Actual Event Times (sec)	214/NA	214/NA	212/NA	197.1/NA	197.3/NA
Predicted/Actual Event Times (KSec)	40/40	40/40	--	93/121-158	--
Predicted/Actual Impact Time (sec)	--/42.3	--/42.3	128-188/103-188	--/126-149	--
Predicted/Actual Impact Time (sec)	417/NA	417/NA	413/NA	384/NA	385/NA
Predicted Impact Point (Az, deg/range, nm)					
Nike					
Apache					
Theoretical Apache Impact Point (Az, deg/range, nm)	162/11.6	162/11.6	158/11.4	168/11.7	171/11.9
Actual Apache Impact Point (Az, deg/range, nm)	171/81	171/81	170/83	170/83	170/83
Nike Fin Cant (multiradians)	168.4/77	168.4/77	174.5/89.3	177/94	180/92.5
Fin 1	--/NA	--/NA	--/NA	--/NA	--/NA
Fin 2	+5.27	+5.27	+5.67	+4.19	+4.72
Fin 3	+5.10	+5.10	+5.63	+5.31	+6.19
Fin 4	+6.34	+6.34	+3.69	+5.71	+6.03
Launch Weather	+6.57	+6.57	+3.73	+4.60	+4.57
Temps. Dry Bulb (°C)	12	12	16	16	11
Relative Humidity (%)	61	61	58	58	61
Cloud Cover ("w Altitude)	Hi Thin Br'n	Hi Thin Br'n	Hi Thin Sc'd	Hi Thin Sc'd	Hi Thin Sc'd
Wind Direction (deg T)	30	30	195	180	--
Surface Velocity (kt)	10	10	3	3	Calm
Visibility (nm)	7	7	10	10	7
Data Obtained	Not Scheduled	Not Scheduled	Not Scheduled	Not Scheduled	Not Scheduled
Photocollite	Not Scheduled	Not Scheduled	None	None	None
Radar AN/FPS-16 Skin Track					

TABLE 1. (Continued)

NIKE-CAJUN - AFCRL Name	Alice	Brenda	Queenie	Paula	Ruby	Carol	Sally
Vehicle No.	AC 6, 434	AC 6, 435	AC 6, 438	AC 6, 437	AC 6, 439	AC 6, 436	AC 6, 44
Experiment No.	5	5	5	5	5	5	5
Launch Date	16 Oct 62	17 Oct 62	19 Oct 62	25 Oct 62	1 Nov 62	2 Nov 62	5 Nov 62
Launch Time (CST)	515:00, 090	1900:00, 132	0517:00, 124	0521:00, 035	0525:00, 035	0525: --	0529:00,
Launch Pad	2	2	2	3	2	2	2
Nike SN	28947	34745	28128	28114	29023	34764	28982
Cajun SN	PV-16-120-9	PV-16-8-18	PV-16-163-2	PV-16-8-13	PV-16-120-7	PV-16-163-8	PV-16-
Nike Igniter Lot & SN	RAD-2-146-56	RAD-2-146	RAD-2-146-35	RAD-2-146-17	RAD-2-146-117	NA/94	RAD-2-
Cajun Igniter Lot & SN	NA/-295	TED-5-2-3-430	NA/-2	TED-3-2-9	TED-9-1-11	TED-001-1-2	TED-6-
Nike Fin Survey No.	10B	3	13	12	14	16	15
Cajun Fin SN	C-1019	C-1013	C-1009	C-1004	C-1036	C-1037	C-1038
Flare SN	2 & 3	2 & 5	None	None	17 & 14	11 & 18	6 & 20
Predicted Flare Burning Time (sec)	130	80	NA	NA	80	80	65
Payload Design	R 1689	R 1689	R 1689	R 1689	R 1689	R 1689	R 1689
Payload Weight (lb)	90/92, 5	90/92, 25	85/88	85/90	90/90	90/90	90/89
Launcher Azimuth (deg T)	191	164	205	194	186	196	144
Launcher Elevation (deg)	84, 8	86, 8	85, 5	84, 2	83, 2	84, 2	82, 2
Predicted Effective Elevation (deg)	85, 4	82, 9	86, 7	86, 6	86, 7	85, 5	85
Predicted/Actual Nike Burnout Altitude (ft)	4275/5839 ⁷	4253/6036 ²	4273/NA	4289/NA	4276/5809 ²	4278/NA	4260/57
Predicted/Actual Nike Burnout Velocity (fps)	3279/3088 ⁷	3287/3135 ²	3266/NA	3279/NA	3268/3114 ²	3269/NA	3269/10
Predicted/Actual Nike Burnout Time (sec)	2, 87/3, 5 ⁷	2, 87/3, 6 ²	2, 87/NA	2, 87/NA	2, 87/3, 5 ²	2, 87/NA	2, 87/3,
Predicted/Actual Nike Burnout Roll Rate (rps)	1, 5/NA	1, 5/NA	1, 5/NA	1, 5/NA	1, 5/NA	1, 5/NA	-1, 5/NA
Predicted/Actual Cajun Burnout Time (sec)	17/20, 110	16/16, 102	16/NA	16/ 18	17/22, 365	16/None	17/18, 8
Predicted/Actual Cajun Burnout Altitude (ft)	48, 574/49, 109 ²	48, 261/41, 776 ²	47, 124/NA	47, 199/NA	50, 518/57, 199 ³	50, 469/NA	50, 277/
Predicted/Actual Cajun Burnout Velocity (fps)	5016/4734 ²	5009/2462 ²	4886/NA	4949/NA	5184/4967 ³	5178/NA	5182/50
Predicted/Actual Cajun Burnout Time (sec)	20, 6/23, 6 ²	19, 6/19, 2 ⁸	19, 6/NA	19, 6/NA	20, 6/26, 2 ³	19, 6/NA	20, 6/22
Predicted/Actual Cajun Burnout Roll Rate (rps)	6/NA	6/NA	6/NA	6/NA	1/NA	1/NA	4-1/NA
Predicted/Actual Cajun Zenith (nm)	61/NA	60, 3/NA	56, 4/NA	57, 3/NA	67, 7/NA	67, 5/NA	67, 0/NA
Predicted/Actual Time to Zenith (sec)	165/NA	163/NA	158, 3/NA	160/NA	174/NA	172/NA	172/NA
Actual Event Times (sec)	N, R., 115, 140, 145	None	100, 8, 110, 6, 125, 136, 8	121, 3, 131, 5, 146, 5, 166, 8	101, 8, 118, 7, 132, 153, 4	None	105, 111
Actual Event Altitudes (Km)	N, R., 93, 101, 2, 101, 5	None	90, 7, 95, 7, 101, 9, 106	95, 98, 100, 4, 100, 4 100, 4	96, 109, 113, 117, 2	None	96, 7, 10 112, 0
Predicted/Actual Impact Time (sec)	326/NA	323/NA	315/NA	318/NA	346/NA	344/NA	343/NA
Predicted Impact Point (As, deg/range, nm)							
Nike	162/4400	160/8850	158/4800	135/5000	152/7160	138/3800	143/10,
Cajun	172/25	164/37, 5	174/17, 5	190/18	166, 19, 5	190/27	170/29
Cajun Theoretical Impact Point (As, deg/range, nm)	178/26, 2	162/38	189/15, 2	197/19	167/18	198/25	176, 5/
Cajun Actual Impact Point (As, deg/range, nm)	NA/86/NA	NA/NA	NA/250 ¹⁰ /NA	NA/214 ¹⁰ /NA	207/ 29 ³	NA/NA	NA/87 ¹⁰
Nike Fin Cant (milliradians)							
Fin 1	1, 92	1, 04	3, 73	1, 99	3, 45	5, 14	-4, 49
Fin 2	1, 65	1, 44	2, 60	2, 46	5, 20	4, 12	-5, 19 5
Fin 3	2, 74	0, 92	0, 89	1, 19	4, 76	3, 40	-4, 38
Fin 4	3, 01	0, 52	2, 03	0, 72	3, 01	4, 40 ²	-3, 79 2
Cajun Fin Tab Length (in.)							
Fin 1	4, 88	4, 96	5, 69	5, 27	2 (Two Tabs)	2 (Two Tabs)	2 (Two
Fin 2	4, 73	4, 76	4, 76	4, 71	tabs	tabs	tabs
Fin 3	6, 05	6, 48	4, 53	5, 15	180°	180°	180°
Fin 4	5, 00	6, 27	5, 64	6, 91	Apart	Apart	Apart
Launch Weather							
Temp., Dry Bulb (°C)	7	9, 5	18	6, 8	5, 5	8	6, 7
Relative Humidity (%)	87	66	84	69	60	79	67
Cloud Cover (% & Altitude)	Clear	Clear	Clear	Clear	Clear	Hi Thin Scd	Clear
Wind Direction (deg T)	038	310	030	010	010	015	300
Surface Velocity (kt)	8	4	6	12	8	11	6
Visibility (nm)	7	7	15	10	10	7	7
Data Obtained							
Phototheodolite (sec)	3, 5-29, 6	2, 1-81, 4	None	None	1, 6-26, 0	None	0, 3-27,
Radar AN/FPS-16 (sec)	Not Scheduled	Not Scheduled	Not Scheduled	None	10, 6-107, 4 296, 1-335, 3	None	None

NA - Not applicable or not available,
1 - Contraves Phototheodolite film data.

2 - Contraves Phototheodolite tabulated data.
3 - AN/FPS-16 skin track tabulated data.

4 - AN/MPS-19 beacon track tabulated data,
5 - AN/FPS-16 skin track pen plot.

6 - AN/MPS-
7 - First data

Col	Sally	Beverly	Bonny	Dagmar	Cindy	Enid	Louise	Kitty	Dana
6, 436	AC 6. 440	AC 6. 445	AC 6. 441	AC 6. 443	AC 6. 442	AC 6. 444	AC 6. 448	AC 6. 446	AC 6. 447
Nov 62	5 Nov 62	6 Nov 62	15 Oct 62	16 Oct 62	7 Oct 62	25 Oct 62	22 Oct 62	23 Oct 62	10 Dec 62
5: --	0529:00, 005	0200:00, 135	0514:00, 795	1840:00, 055	0516:00, 097	0030:00, 065	0519:00, 133	0519:00, 100	1929:59, 065
2	2	2	2	2	2	2	2	2	2
764	28982	28140	34740	29015	28974	28985	34746	28983	929
-16-161-8	PV-16-120-8	PV-18-120-15	PV-16-120-12	PV-16-10-15	PV-16-120-10	PV-16-124-12	PV-16-124-13	PV-16-8-14	PV-16-120-16
894	RAD-2-146-71	RAD-2-146-123	RAD-2-146-116	RAD-2-146-52	RAD-2-146-369	RAD-2-146-70	RAD-2-146-54	RAD-2-146-18	RAD-1-41-317
D-001-1-2	TED-6-1-5	TED-9-1-8	TED-6-1-3-241	TED-5-1-3-257	TED-6-1-4-236	TED-001-1-3-415	TED-5-2-4-258	--	TED-9-1-10
1037	15	11	10A	8	4	5	6	7	None
8 18	C-1038	C-1001	C-1020	C-1018	C-1006	C-1007	C-1016	C-1017	C-1021
65	6 & 70	2 & 4	13 & 16	9 & 16	3 & 10	None	1 & 7	4 & 8	3 & 15
1689	R 1689	R 1689	R 2250	R 2250	R 2250	2/3 R 2250	R 1874	R 1874	--
900	90/89	90/89	90/90	90/92	90/92, 5	67/65, 5	70/73	75/71	60/59, 5
5	114	197	184	165	175	167	167	169	162
2	82, 2	82, 6	82, 0	82, 4	78, 6	82, 6	76, 5	77, 4	84, 8
5	85	84, 6	82, 2	81, 8	81, 7	86	81	80	82, 8
78/NA	4260/5751 ²	--/NA	4239/5730	4244/NA	4225/5740 ²	4342/NA	4761/5758 ²	4271/5710 ²	4362/6155 ²
59/NA	3269/5084 ²	--/NA	3270/3122 ²	3270/NA	3271/3116 ²	3329/NA	3315/3168 ²	3316/3135 ²	3348/3113 ²
47/NA	2, 87/3, 5 ²	--/NA	2, 88/3, 4 ²	2, 88/NA	2, 88/3, 5 ²	2, 88/NA	2, 87/3, 5 ²	2, 87/3, 5 ²	2, 87/3, 6 ²
5/NA	-1, 5/NA	-1, 5/NA	1, 5/NA	1, 5/NA	1, 5/NA	1, 5/NA	1, 5/NA	1, 5/NA	1, 5/NA
/None	17/18, 86 ²	17/22, 46, 5	17/17, 605 ¹	16/15, 911 ¹	17/17, 436 ¹	16/NA	16/16, 8	16/16, 935 ¹	17/21, 47 ¹
369/NA	50, 277/50045 ²	50, 270/57, 395 ³	49, 821/48, 523 ⁸	49, 917/45, 522 ²	49, 655/47, 003 ²	51, 016/NA	49, 844/46, 795 ²	50, 020/46, 591 ²	51, 084/55, 322 ³
78/NA	5182/5019 ²	5179/4694 ³	5176/5300 ⁸	5177/5105 ²	5176/5075 ²	5551/NA	5432/5372 ²	5439/5330 ²	5676/5385 ³
6/NA	20, 6/22, 4 ²	20, 6/27, 5 ³	20, 6/21, 1 ⁸	19, 6/19, 3 ²	20, 6/20, 6 ²	19, 6/NA	19, 6/20, 2 ²	19, 6/20, 4 ²	20, 6/25, 4 ³
/NA	~1/NA	~1/NA	~0, 04/NA	~0, 146/NA	~0, 799/NA	~0, 99/NA	~0, 59/NA	~0, 23/NA	~0, 61/NA
5/NA	67, 0/NA	66, 6/NA	65, 5/NA	65, 2/NA	64, 2/NA	68, 2/NA	68, 2/NA	69, 2/63 ⁵	77, 2/71, 3 ³
7/NA	172/NA	172/NA	170/NA	170/NA	169/NA	183/ 180 ⁵	175/NA	176/NA	185/181, 5 ³
one	105, 115, 6, 127, 141, 2	--	95--	88, 8--	--	81--	100, 4	122	109
one	96, 7, 102, 5, 107, 6, 112, 0	89, 1, 93, 7, N, R., 101, 7	91, 2	88, 8, 106	84, 2	88, 6, 112	96, 7	108	108, 1
14/NA	143/NA	143/NA	140/--	140/--	138/--	368/548 ³	351/NA	353/708	368/469
18/1800	143/10, 200	143/7900	166/8600	167/8300	172/9300	169/4200	142/9700	157/11, 000	136/11, 300
10/27	170/29	178/31	168/44	169/47	170/47	170/27	170/57	169/61	213/49
18/25	176, 5/32	186/33	169, 5/47	168/46	171/53	191/28, 4	173/64	172/59	209/39
A/NA	187 10/--	182 10/--	182, 5 10/NA	181 10/NA	180, 5 10/NA	202/28, 5 ³	187 10/NA	187 10/NA	208/36, 5 ³
14	-4, 49	-4, 97	+5, 54	+1, 19	+4, 81	+6, 2	4, 06	3, 20	4, 0
12	-5, 19 ⁵	-4, 46	+6, 56	+3, 63	+4, 81	+7, 8	3, 78	4, 76	4, 0
40	-4, 38	-4, 17	+5, 90	+2, 40	+3, 69	+6, 1	4, 59	4, 58	4, 0
40 2	-3, 79 ²	-4, 68	+4, 89	+3, 96	+3, 68	+4, 5	4, 86	3, 02	4, 0
(Two Tabs)	2 (Two Tabs)	2 (Two Tabs)	None	None	None	None	None	None	None
tab	tab	tab	None	None	None	None	None	None	None
80*	180*	180*	None	None	None	None	None	None	None
apart	Apart	Apart	None	None	None	None	None	None	None
9	6, 7	6, 6	20, 5	9	6	10, 5	18	-1	8
11 Thin Scd	67	88	89	87	87	86	80	80	21
15	Clear	HI Scd	Clear	Clear	Clear	Clear	Clear	Clear	Clear
1	300	045	072	053	360	010	350	350	280
1	6	10	13	4	12	10	12	10	20
None	7	7	7	7	7	7	7	8	7
None	0, 3-27, 2	None	1, 2-21, 1	4, 1-21, 2	1, 4-26-2	None	0, 4-26, 0	0, 6-23, 3	2, 7-25, 4
None	None	12, 5-32, 7	Not Scheduled	Not Scheduled	Not Scheduled	136, 5-184, 0 232, 0-251, 5 522, 5-547, 5	None	289, 7-705, 7	16, 6-468, 5

1a. 6 - AN/M-S-19 beacon track pen plot, 8 - Last data point from tabulated data, 10 - Derived from AFCLRL chemical position data,
7 - First data point from tabulated data, 9 - Visual observation.

TABLE 2. AEROBEE 150 PHYSICAL AND AERODYNAMIC DATA, STAGE I, STAGE IA, AND STAGE II.

ROCKET PHYSICAL AND AERODYNAMIC DATA												DATE: 31 October 1962	
PROPELLANT MASS (m_p) SLUGS		PROPELLANT C.G. FROM TAL (m_p) FT		RADIUS OF GYRATION OF PROP AXIAL (r_p) FT		TRANSVERSE (r_p) FT		NOZZLE EXIT AREA (A_n) IN ²		STAGE NO.			
1,6148		3,250		.40		.721		71,136		I			
TOTAL IMPULSE (I_t) LB-SEC		DIAMETER IN FT		BURNING (t_b) SEC		FLIGHT TIME (t_f) SEC		LENGTH OF STAGE INCHES		MOTOR IDENTIFICATION			
9300		1.25		.5		0 - 2.5		350, 34		2, 5 KS - 18000			
PAYLOAD		TOTAL MASS (m_t) SLUGS		C.G. FROM TAL (m_t) FT		AREA (A_n) INCHES - FT ²		MOMENTS OF INERTIA TRANVERSE (I_{xy}) SLUGS-FT ²					
150		65,0454		12.05		17.00		2750					
TIME SEC	THRUST SLUGS	SPIN RAD/SEC		MACH NO		CP FT FROM TAL		I_{xy}		I_{xy}		I_{xy}	
0	18,400	0		0		7.03		10.64		.189			
.5	18,600	0		.3		6.78		10.99		.189			
				.5		6.61		10.64		.189			
				.7		6.82		9.82		.191			
				.9		6.11		10.21		.239			
				1.1		4.28		11.98		.317			

TABLE 3. HONEST JOHN-NIKE-NIKE PHYSICAL AND AERODYNAMIC DATA, STAGE I, STAGE IA, AND STAGE II.

ROCKET PHYSICAL AND AERODYNAMIC DATA													DATE: 28 November 1962	
PROPELLANT MASS (m_p) SLUGS		PROPELLANT C.G. FROM TAIL (r_{p1}) FT		RADIUS OF GYRATION OF PROP AXIAL (r_A) FT		TRANSVERSE (r_N) FT		NOZZLE EXIT AREA (A_e) IN ²		STAGE I				
63.716		9.258		.687		4.19		363.74						
TOTAL IMPULSE (I_T) LB-SEC		DIAMETER (in) FT		BURNING (T_B) SEC		FLIGHT TIME (T_F) SEC		LENGTH OF STAGE INCHES		MOTOR IDENTIFICATION				
383,837		1.907		0 - 4.8		0 - 4.8		618.55		HONEST JOHN				
PAYLOAD		TOTAL MASS (m_t) SLUGS		C.G. FROM TAIL (r_N) FT		AXIAL (A_0) SLUGS - FT ²		MOMENTS OF INERTIA TRANSVERSE (I_N) SLUGS-FT ²						
400		222.70		18.36		110.2		33.034						
375		221.92		18.34		109.8		32.934						
350		221.14		18.31		109.4		32.834						
300		219.59		18.26		108.63		32.605						
TIME SEC	THRUST (LBS)	SPIN (RAD/SEC)	LIQUID			MACH NO	CP FT FROM TAIL	E_N	E_D	E_L	E_M	(Q_{L+M})		
			A	B	G				POWER ON	POWER OFF				
0	79,966	0				0			.197					
4.8	79,966	4.40				.5	15.88	13.43	.197					
						.7	15.57	13.95	.216					
						.9	15.40	15.07						
						1.1	15.13	17.54	.450					
						1.3	15.00	15.45						
						1.5	15.21	13.73	.538					
						2.0	15.47	10.70	.423					
						2.5	16.47	8.80	.355					
						3.0	17.27	7.61						
								(HONEST JOHN FREEFALL DRAG)						
								$K_D d^2/M$						
						0		.01132						
						.5		.01132						
						1.0		.02404						
						1.5		.03606						
						2.0		.02620						
						2.5		.02281						
						3.0		.02106						
						3.5		.01990						
						4.0		.01891						

TABLE 3. (Continued)

ROCKET PHYSICAL AND AERODYNAMIC DATA														DATE: 28 November 1962	
PROPELLANT NAME (M _p) SLUGS		PROPELLANT C.G. FROM TAIL (Q _p) FT	RADIUS OF GYRATION OF PROP AXIAL (I _A) FT		TRANSVERSE (Q ₀) FT		NOZZLE EXIT AREA (A _e) IN ²		STAGE II		MOTOR IDENTIFICATION				
TOTAL IMPULSE (I ₀) LB-SEC		DIAMETER (D) FT	BURNING (T _B) SEC		FLIGHT TIME (T _F) SEC		LENGTH OF STAGE INCHES		NIKE						
TOTAL MASS (M ₀) SLUGS		C.G. FROM TAIL (Q ₀) FT		MOMENTS OF INERTIA		TRANVERSE (I ₀) SLUGS-FT ²									
PAYLOAD		TOTAL MASS (M ₀) SLUGS		C.G. FROM TAIL (Q ₀) FT		AXIAL (I ₀) SLUGS - FT ²									
TIME SEC	THRUST (LBS)	SPIN (RAD/SEC)	LIQUID			MACH NO	CF FT FROM TAIL	Q _N	F ₀		K _L	K _H	(Q ₀ -I ₀)		
			A	B	G				POWER ON	POWER OFF					
10.00	45.710	3.45				9	9.79	14.45	162	294					
12.88	45.710	6.28				1.1	9.43		428	570					
						1.3	9.96	14.54							
						1.5	10.35	12.18	301	426					
						2.0	10.65	8.98	244	305					
						2.5	11.29	7.39	234	282					
						3.0	11.88	6.40	177	213					
						4.0	12.98	5.14	165	180					
						5.0	13.95	4.38	151	166					
							NIKE FREEFALL DRAG K _d d ² /M								
						0			0413						
						.5			0413						
						.9			0465						
						1.1			0581						
						1.5			0500						
						2.0			0454						
						3.0			0430						
						4.0			0424						
400			93.40			14.11			35.0			5761			
375			92.62			14.06			34.8			5833			
350			91.84			14.00			34.6			5907			
300			90.29			13.89			34.2			6053			

TABLE 3. (Continued)

ROCKET PHYSICAL AND AERODYNAMIC DATA													DATE: 28 November 1962	
PROPELLANT MASS (m _p) SLUGS		PROPELLANT C.G. FROM TAIL (h _p) FT		RADIUS OF GYRATION OF PROP AXIAL (r _A) FT		TRANSVERSE (h _G) FT		NOZZLE EXIT AREA (A _N) IN ²		STAGE III				
22.94		6.58		.47		2.48		210		MOTOR IDENTIFICATION NIKE				
TOTAL IMPULSE (I _p) LB-SEC		DIAMETER (D) FT		BURNING (t _b) SEC		FLIGHT TIME (t _f) SEC		LENGTH OF STAGE INCHES						
13,645		1.375		25.00-27.88		12.88 - IMPACT		280.63						
PATHLOAD		TOTAL MASS (m ₀) SLUGS		C.G. FROM TAIL (h _G) FT		AXIAL (h _G) SLUGS - FT ²		MOMENTS OF INERTIA TRANSVERSE (I _{yy}) SLUGS-FT ²						
400		52.84		9.83		22.6		1779						
375		52.06		9.50		22.4		1709						
350		51.28		9.17		21.8		1679						
300		49.73		8.51		21.0		1609						
TIME SEC	THRUST (LBS)	SPM (RAD/SEC)	LIQUID			MACH NO	CP FT FROM TAIL	I _{yy}	E _D		K _L	I _{yy}	(Q _{yy} =5-5)	
			A	B	G				POWER ON	POWER OFF				
12.88 0		19.54												
25.00 45,710		15.08												
27.88 45,710		43.97				.7				.126				
						1.0				.212				
						1.1			.149	.216				
						1.5	3.11	7.46	.122	.181				
						2.0	3.97	5.43	.092	.134				
						2.5	4.86	4.49	.079	.106				
						3.0	5.40	3.96	.071	.104				
						4.0	6.30	3.28	.059	.098				
						5.0	7.08	2.89	.051	.067				
						6.0	7.65	2.65	.048	.057				
						7.0	8.18	2.50	.045	.053				

TABLE 4. NIKE-APACHE PHYSICAL AND AERODYNAMIC DATA, STAGE I AND STAGE II.

ROCKET PHYSICAL AND AERODYNAMIC DATA													
DATE: 1 November 1962													
PROPELLANT MASS (m_p) SLUGS		PROPELLANT C.G. FROM TAIL (l_p) FT		RADIUS OF GYRATION OF PROP AXIAL (r_p) FT		TRANSVERSE (l_{tr}) FT		NOZZLE EXIT AREA (A_e) IN ²		STAGE I			
22,938		6.33		.47		2.48		210		MOTOR IDENTIFICATION			
TOTAL IMPULSE (I_t) LB-SEC		DIAMETER (D) FT		BURNING (t_b) SEC		FLIGHT TIME (t_f) SEC		LENGTH OF STAGE INCHES		NIKE			
131,645		1.375		0 - 2.88		0 - 2.88		323.94					
PAYLOAD		TOTAL MASS (m_0) SLUGS		C.G. FROM TAIL (l_0) FT		AXIAL (A_0) SLUGS - FT ²		MOMENTS OF INERTIA TRANSVERSE (I_0) SLUGS-FT ²					
90		50,506		8.76		18.3		1799					
84		50,320		8.67		18.3		1750					
70		49,884		8.51		18.2		1626					
60		49,574		8.40		18.1		1620					
TIME SEC	THRUST (LBS)	SPM (RAD/SEC)	LIQUID			MACH NO	CF FT FROM TAIL	t_{th}	I_0 POWER ON	I_0 POWER OFF	KD^2/M - I_0	t_{th}	$(Q_{ac}-s^2)$
0	45,710	0	A	B	G	0	5.33	7.62	.1175		.042		
.19	45,710	0				.50	5.20	7.62	.1125		.042		
2.88	45,710	9.422				.75	5.03	8.42	.1075				
						1.00	4.82	9.25	.1675		.062		
						1.50	6.16	7.56	.1460		.052		
						2.00	6.65	5.79	.1313		.045		
						2.50	6.95	4.96	.1200				
						3.00	7.20	4.44	.1100		.040		
						4.00	7.46	3.78	.0945		.037		

TABLE 4. (Continued)

ROCKET PHYSICAL AND AERODYNAMIC DATA														DATE: 16 November 1962	
PROPELLANT NAME (m_p) SLUGS		PROPELLANT C.G. FROM TAIL (l_p) FT		RADIUS OF GYRATION OF PROP AXIAL (r_p) FT		TRANSVERSE (l_{g1}) FT		NOZZLE EXIT AREA (A_e) IN ²		STAGE II		MOTOR IDENTIFICATION			
4, 14		4.46		.17		2.29		35, 81		STAGE II		MOTOR IDENTIFICATION			
TOTAL IMPULSE (I_T) LB-SEC		DIAMETER (DI) FT		BURNING (t_b) SEC		FLIGHT TIME (t_f) SEC		LENGTH OF STAGE INCHES		APACHE					
32, 115		.542		20.00 - 25.40		2.88 - IMPACT		174.21							
PAYLOAD		TOTAL MASS (m_0) SLUGS		C.G. FROM TAIL (l_{g2}) FT		AXIAL (I_{xx}) SLUGS - FT ²		TRANSVERSE (I_{yy}) SLUGS - FT ²							
90		9, 557		6.07		.26		220							
84		9, 371		5.85		.26		218							
70		8, 935		5.73		.25		210							
60		8, 625		5.60		.25		205							
TIME SEC	THRUST (LBS)	SPIN (RAD/SEC)	LIQUID			MACH NO	CP FT FROM TAIL	I_{xx}	I_{yy}		POWER ON	POWER OFF	I_{zz}	($I_{xx} + I_{yy}$)	
2.88	0	9.422	A	B	C										
20.0	6160	0				1.5	1.93	12.90	.347	.425					
20.1	6160					2.0	2.09	10.41	.306	.370					
20.2	6213					2.5	2.30	8.84	.274	.335					
20.4	6053					3.0	2.53	7.76	.248	.296					
20.8	5788					3.5	2.75	7.26	.226	.271					
21.2	5629					4.0	2.94	6.64	.209	.245					
21.6	5576					5.0	3.33	5.53	.184	.213					
22.0	5576					6.0	3.68	4.79	.174	.193					
22.4	5629					6.5	3.87	4.42	.174	.193					
22.8	5841														
23.2	5947														
23.6	6266														
24.0	6584														
24.4	7009														
24.8	7487														
25.0	7646														
25.2	3186														
25.4	796	0 Without wedges													

[illegible]

[illegible]

TABLE 6. WIND DATA.

Recher	Direction (deg true)																													
	Altitude (ft)																													
	Speed (kt)																													
Date	350	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000	4000	5000	6000	7000	8000	9000	10,000	15,000	20,000	25,000	30,000	35,000	40,000	45,000	50,000	55,000	60,000	
Mar 2	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 3	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 4	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 5	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 6	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 7	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 8	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 9	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 10	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 11	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 12	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 13	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 14	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 15	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 16	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 17	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 18	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 19	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 20	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 21	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 22	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 23	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 24	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 25	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 26	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 27	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 28	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 29	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 30	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 31	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 32	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 33	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 34	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 35	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 36	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 37	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 38	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 39	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 40	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 41	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 42	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 43	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 44	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 45	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 46	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 47	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 48	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	230	230	290	300	310	310	310	310	310	310	310	310	310
Mar 49	802	779	194	185	191	191	183	192	192	208	214	200	188	189	190	200	210	2												

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9 - Prelaunch winds
7 - Postlaunch winds

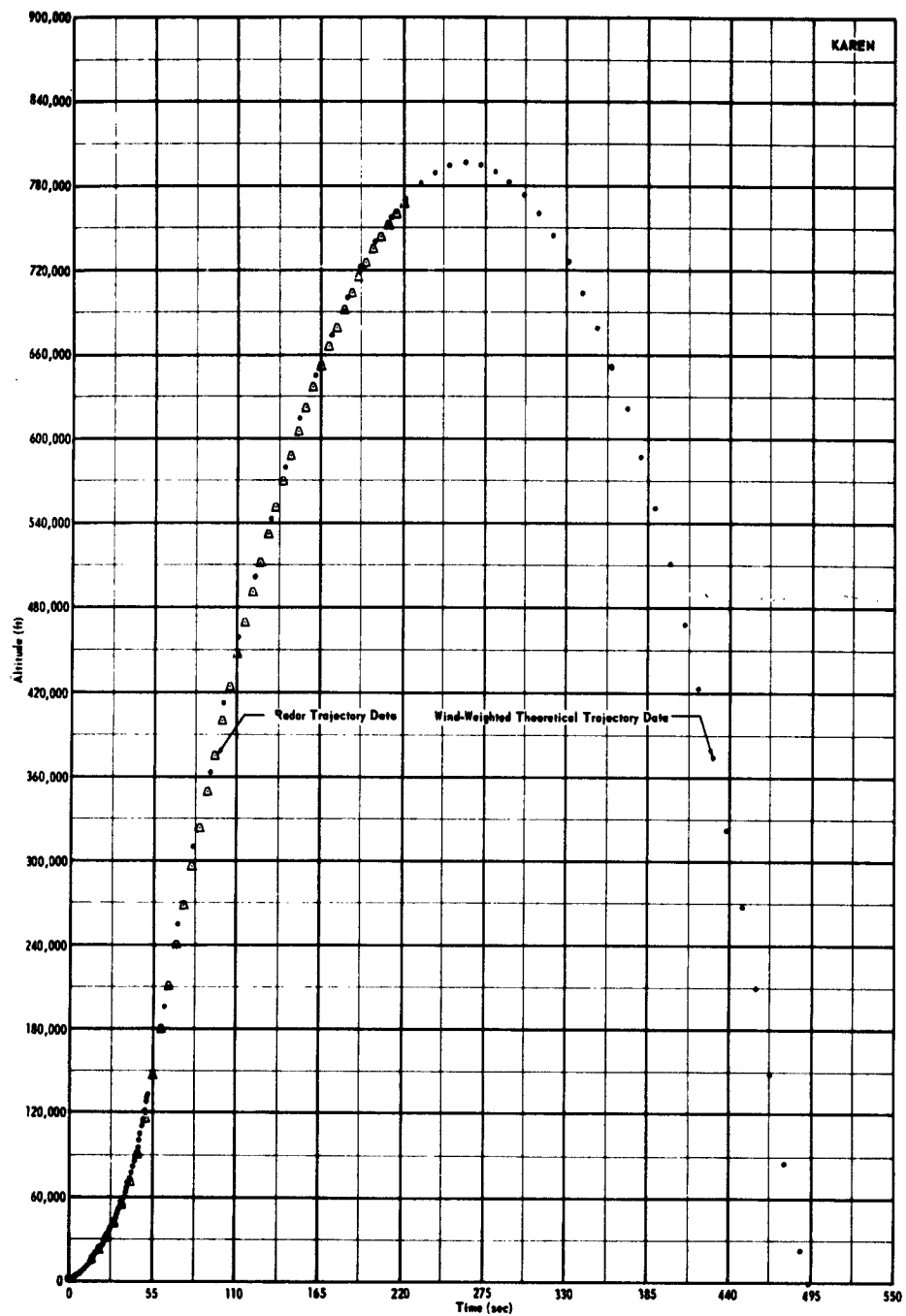


Fig. 30: Aerobee 150 (Karen) Altitude vs. Time (Entire Trajectory).

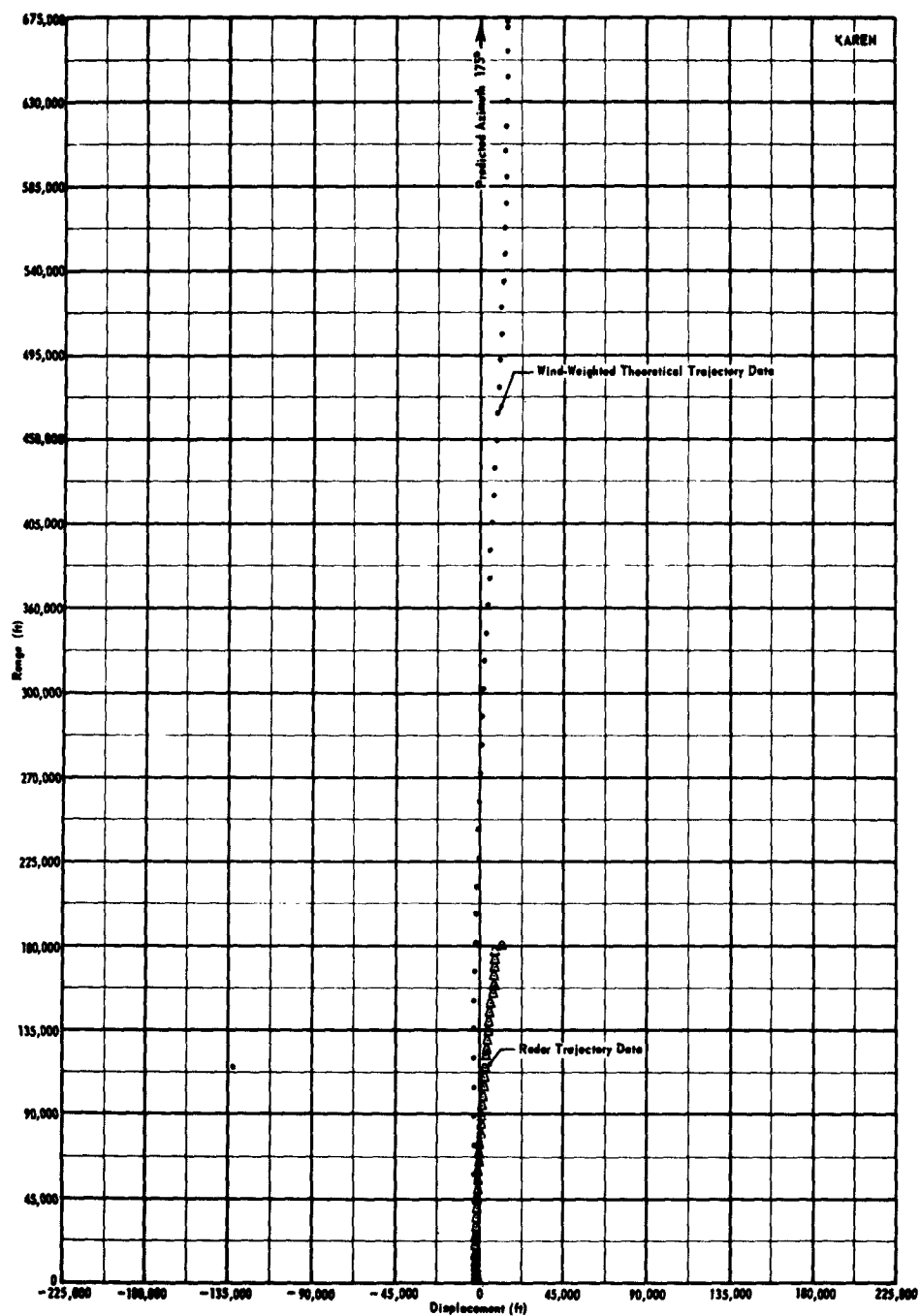


Fig. 31: Aerobee 150 (Karen) Range vs. Displacement (Entire Trajectory).

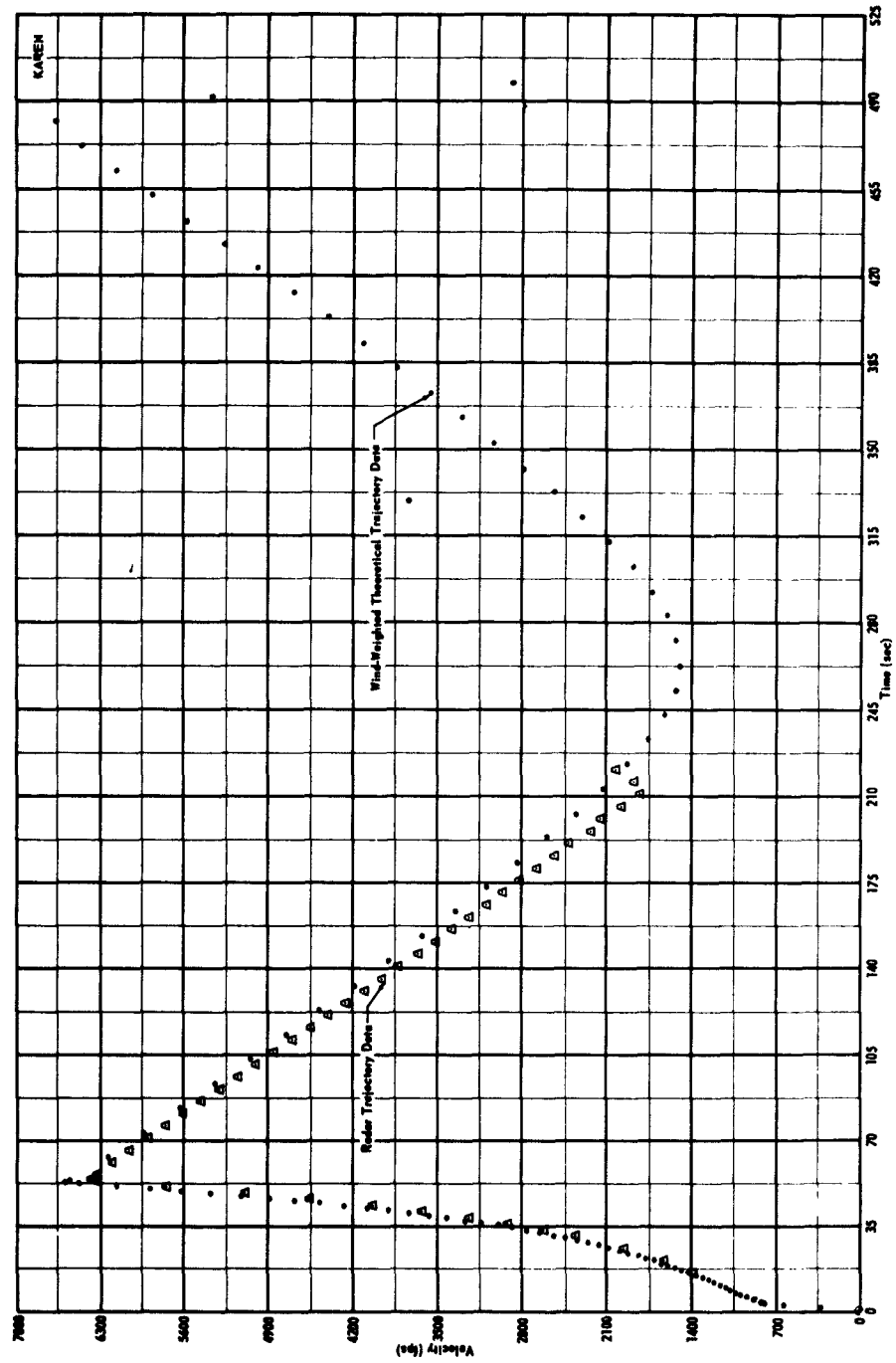


Fig. 32: Aerobee 150 (Karen) Velocity vs. Time (Entire Trajectory).

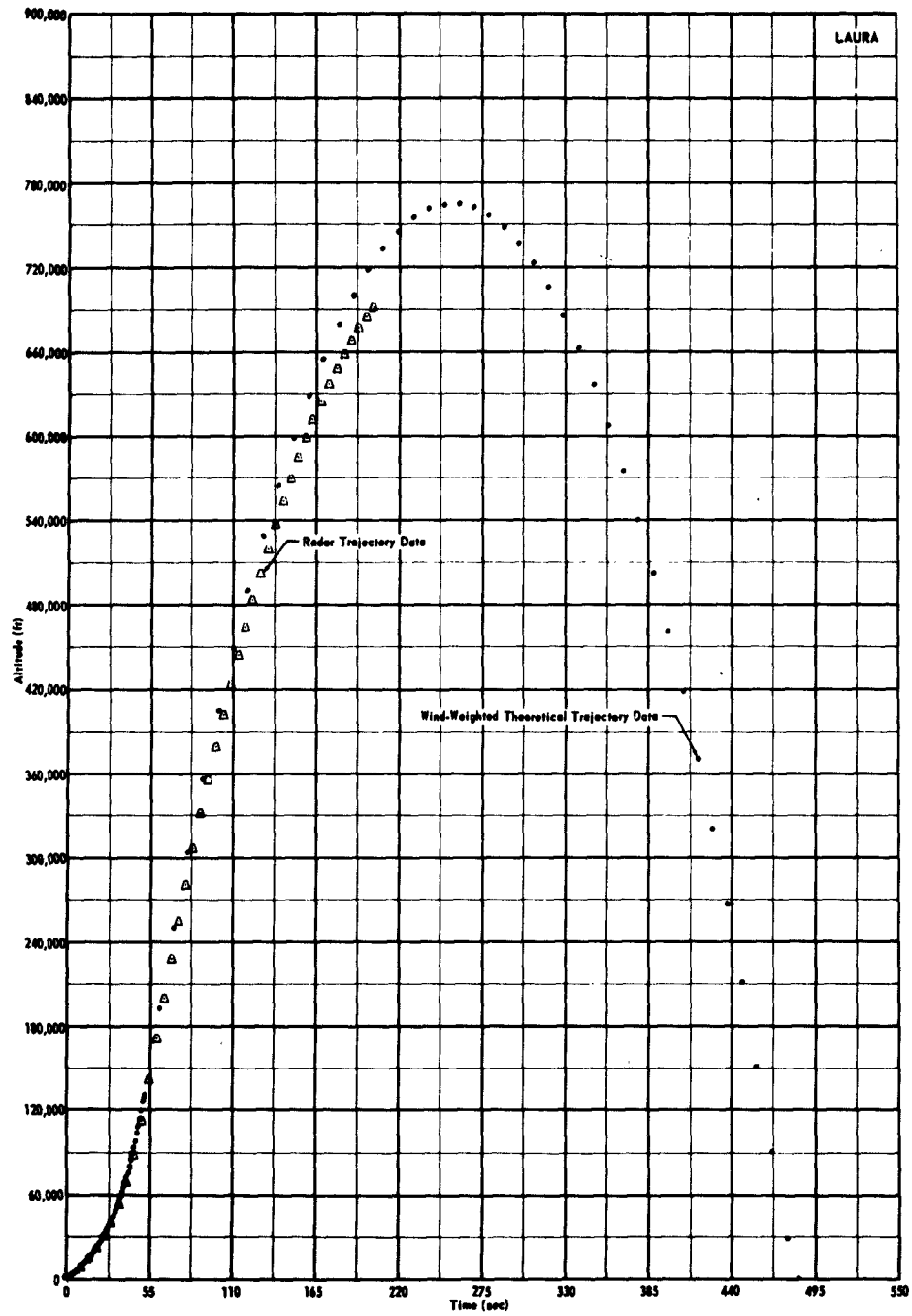


Fig. 33: Aerobee 150 (Laura) Altitude vs. Time (Entire Trajectory).

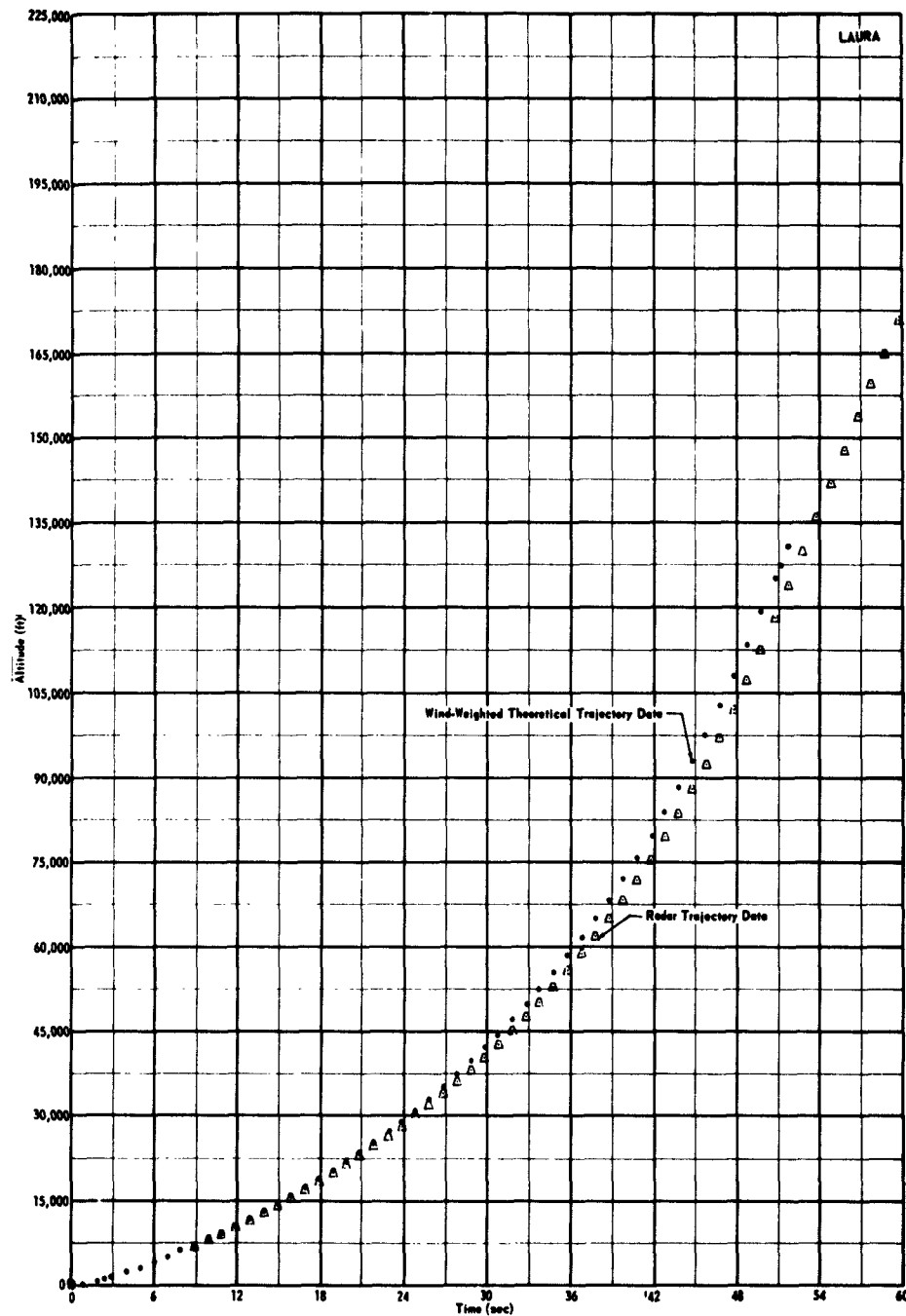


Fig. 34: Aerobee 150 (Laura) Altitude vs. Time (Trajectory Through Burnout).

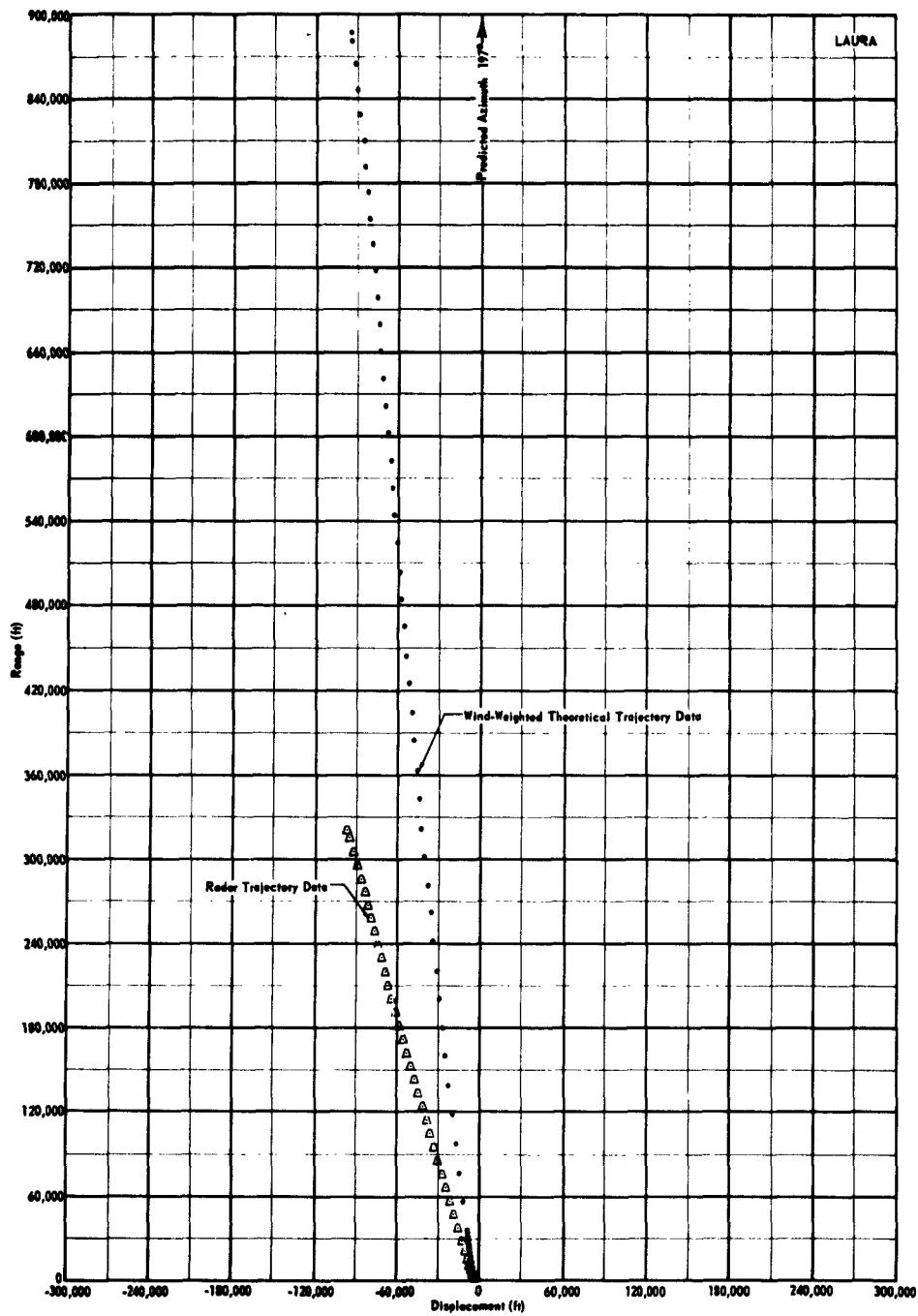


Fig. 35: Aerobee 150 (Laura) Range vs. Displacement (Entire Trajectory).

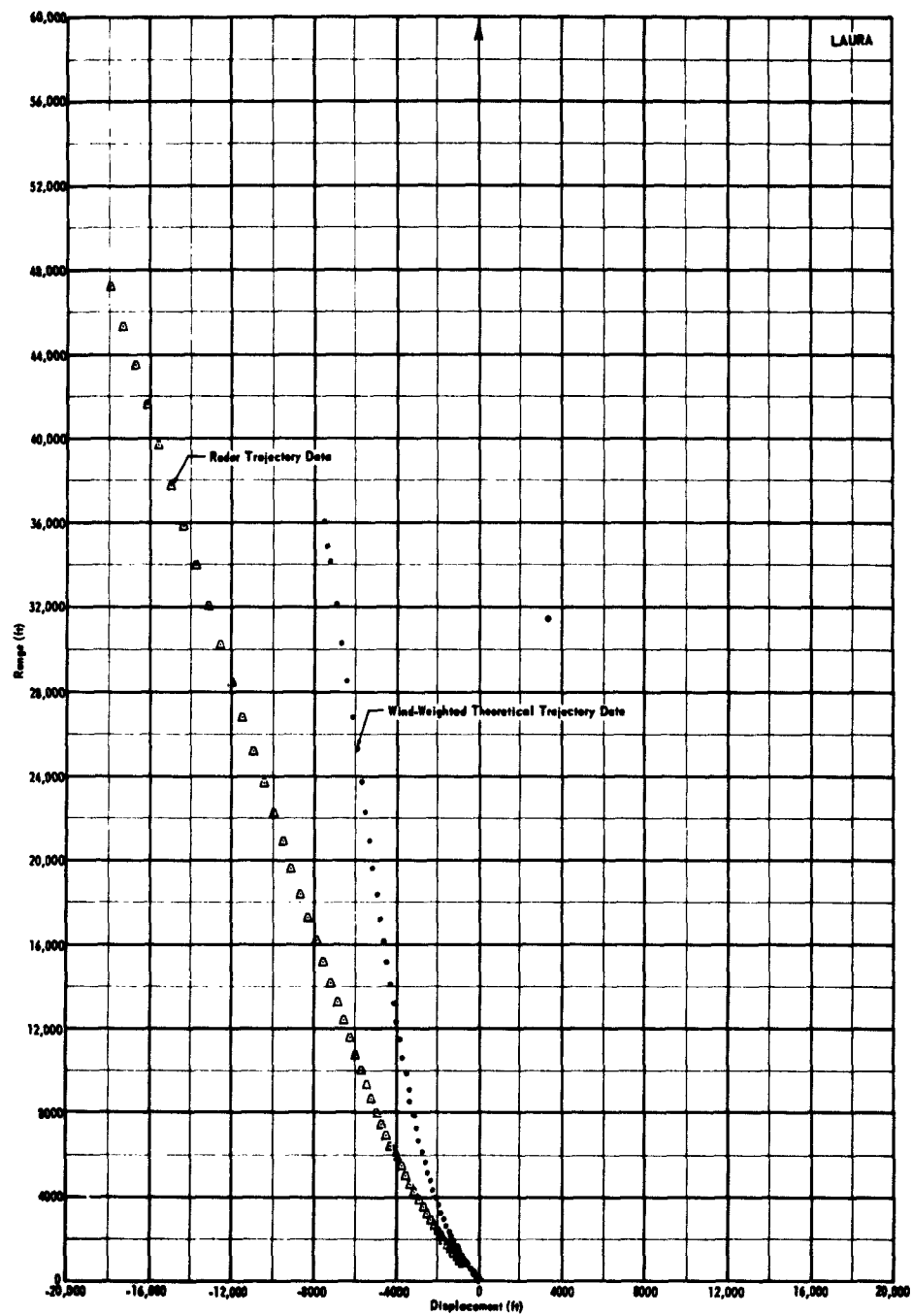


Fig. 36: Aerobee 150 (Laura) Range vs. Displacement (Trajectory Through Burnout).

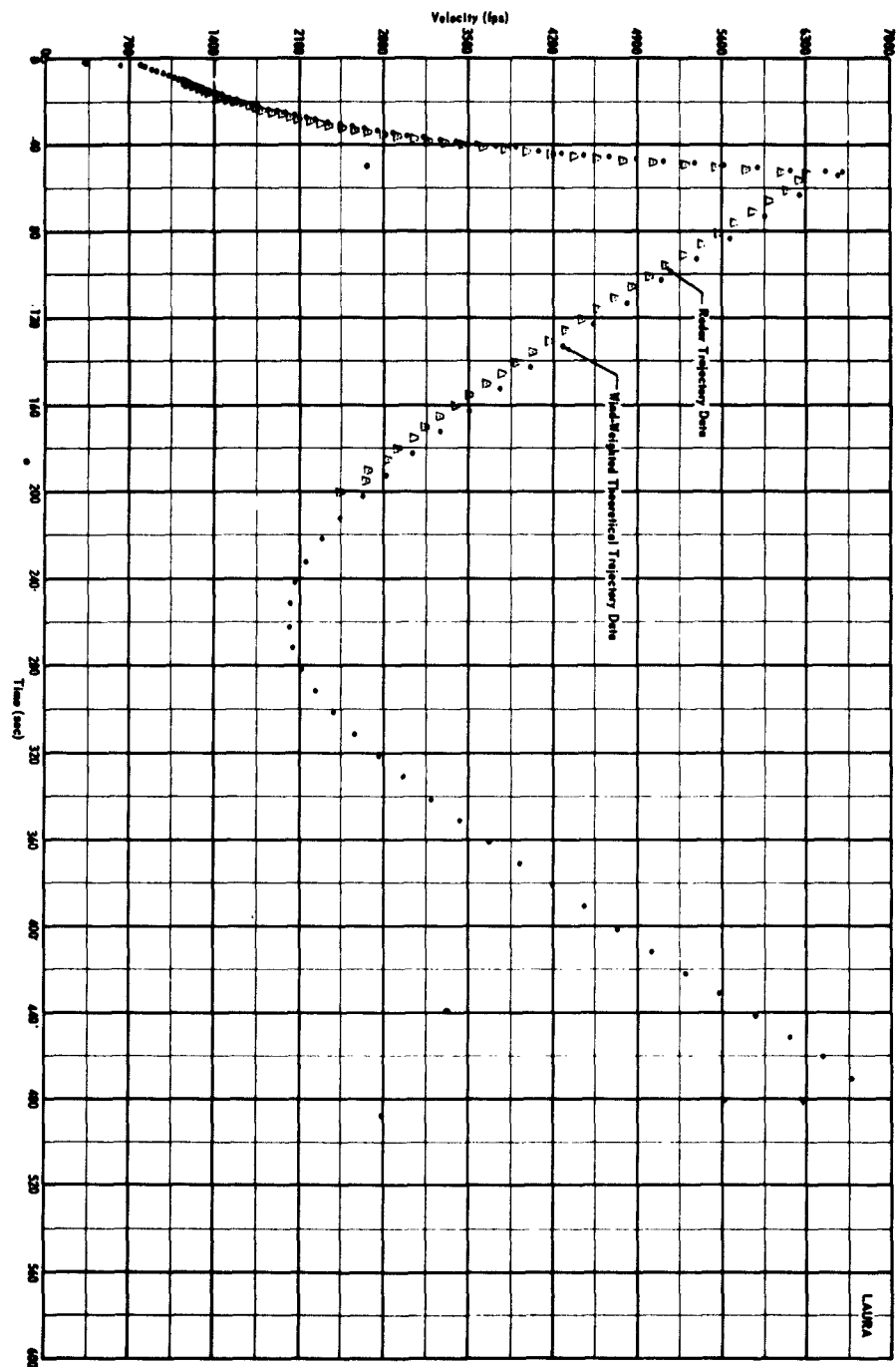


Fig. 37: Aerobee 150 (Laura) Velocity vs. Time (Entire Trajectory).

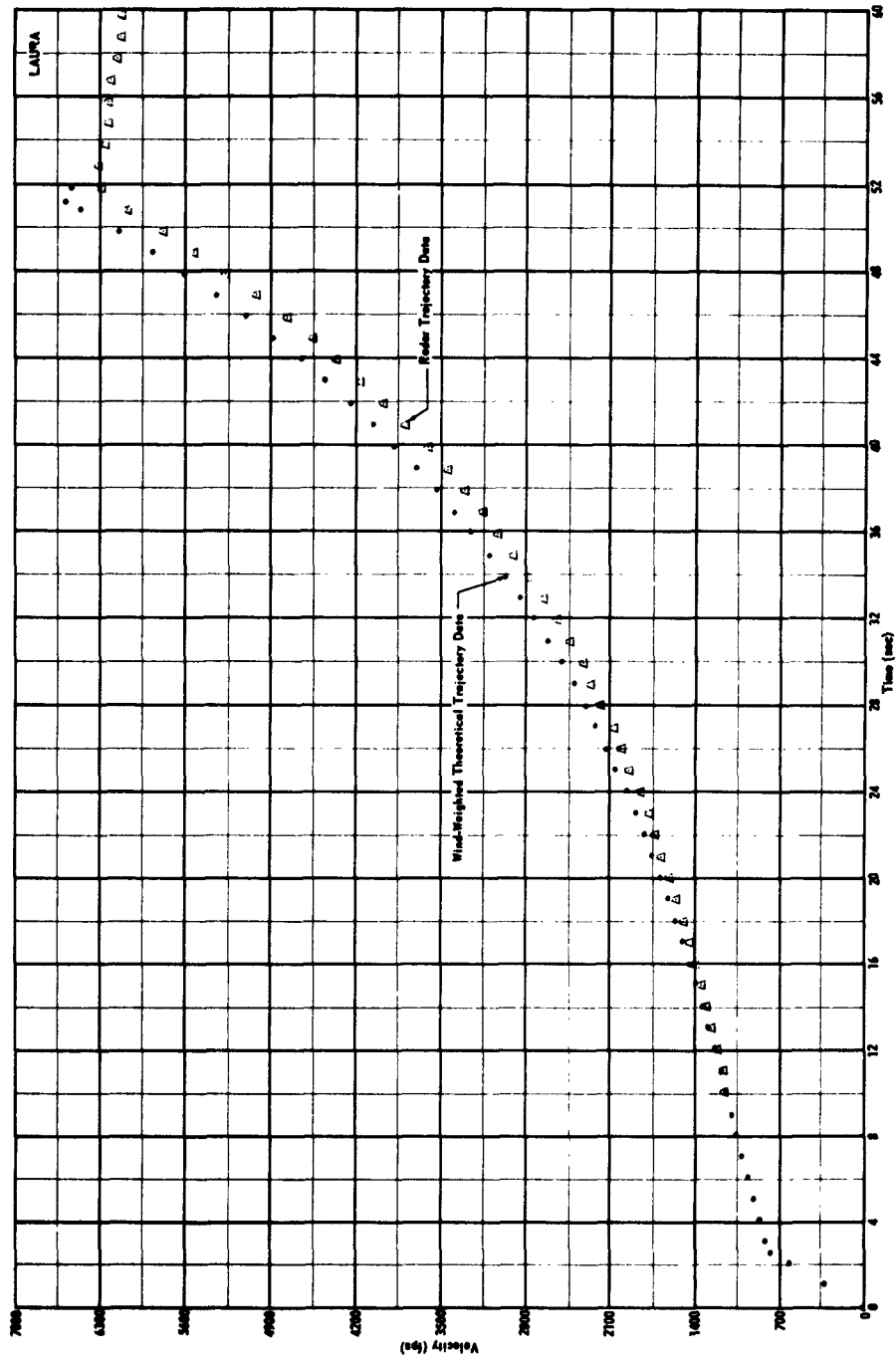


Fig. 38: Aerobee 150 (Laura) Velocity vs. Time (Trajectory Through Burnout).

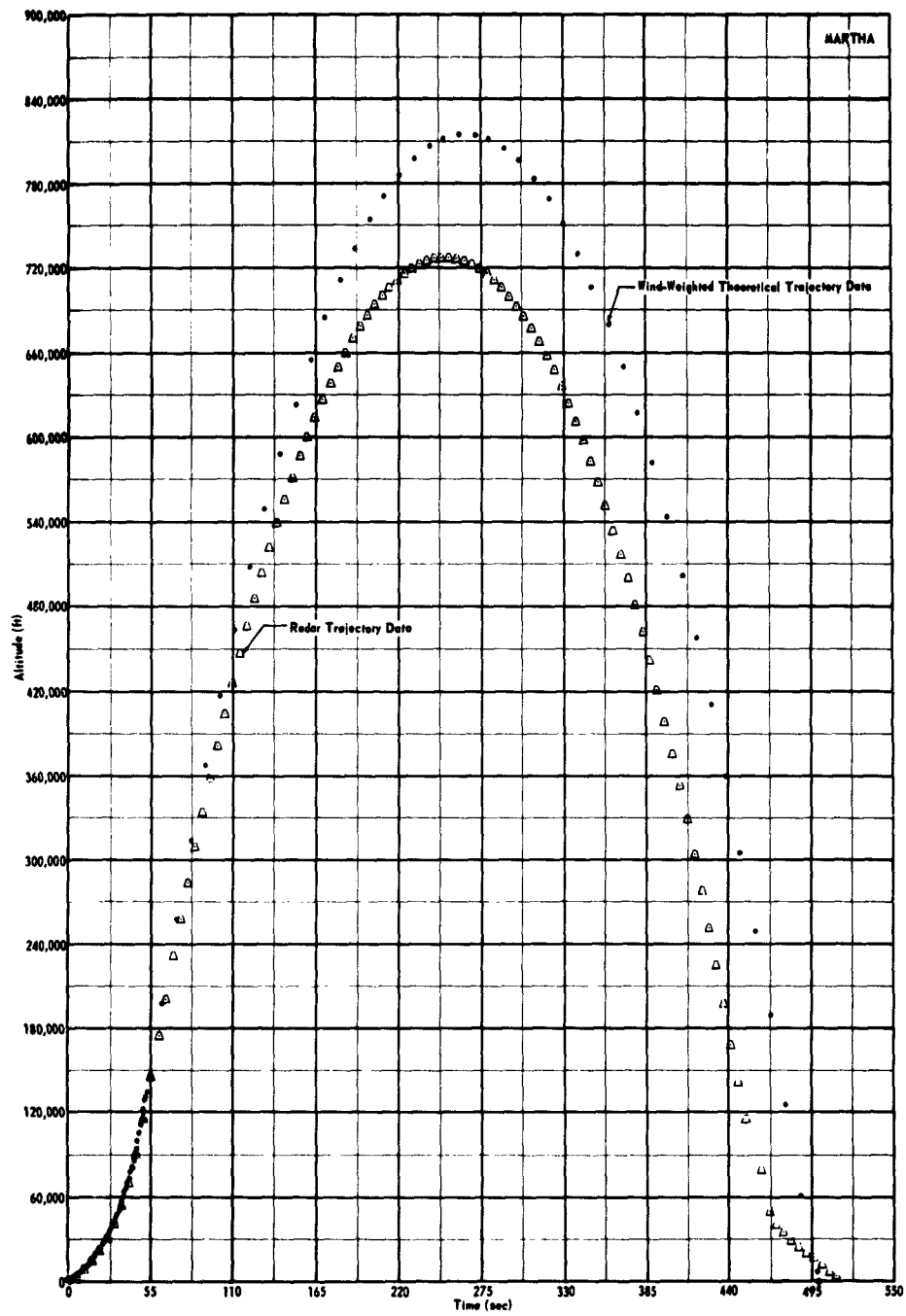


Fig. 39: Aerobee 150 (Martha) Altitude vs. Time (Entire Trajectory).

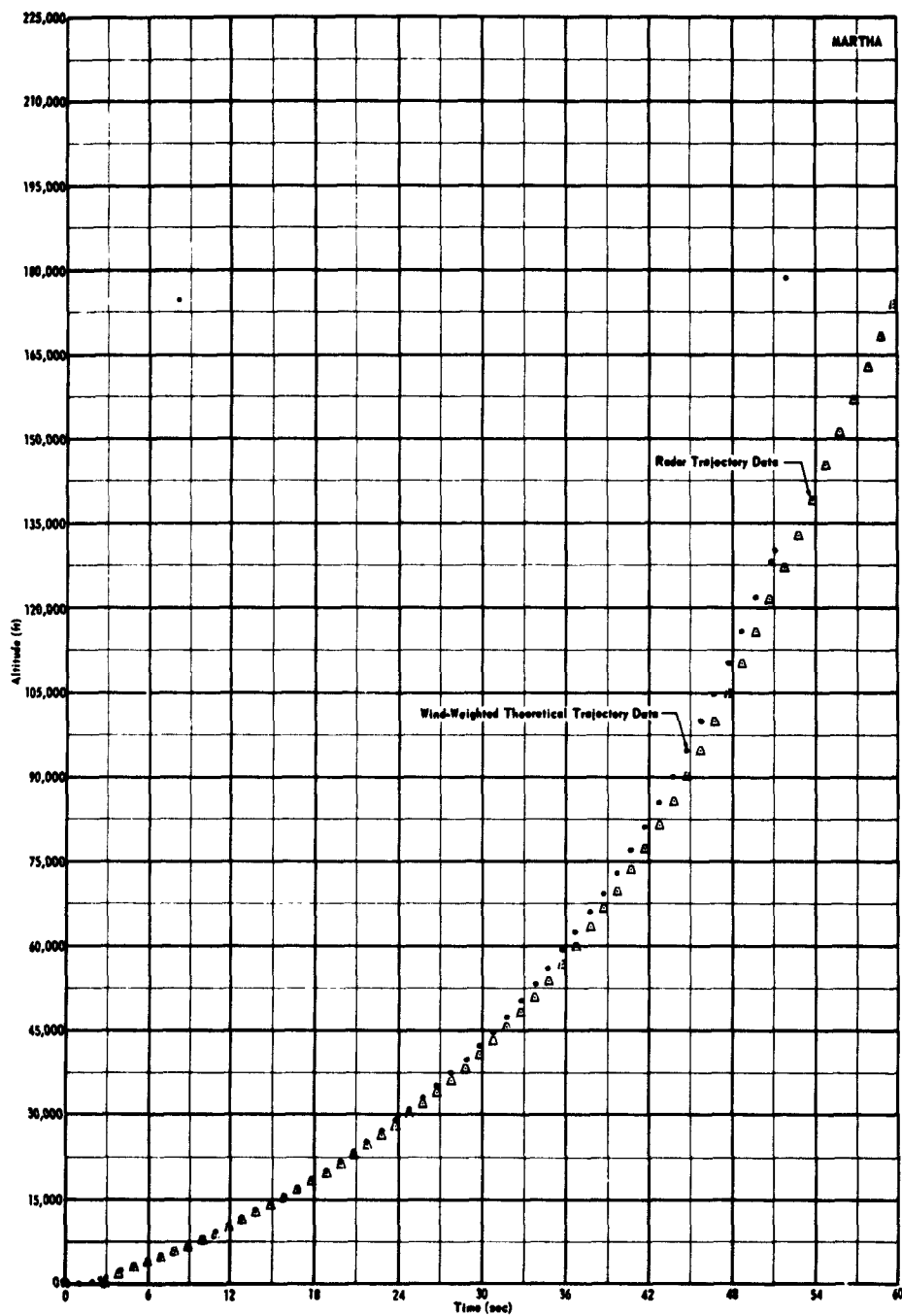


Fig. 40: Aerobee 150 (Martha) Altitude vs. Time (Trajectory Through Burnout).

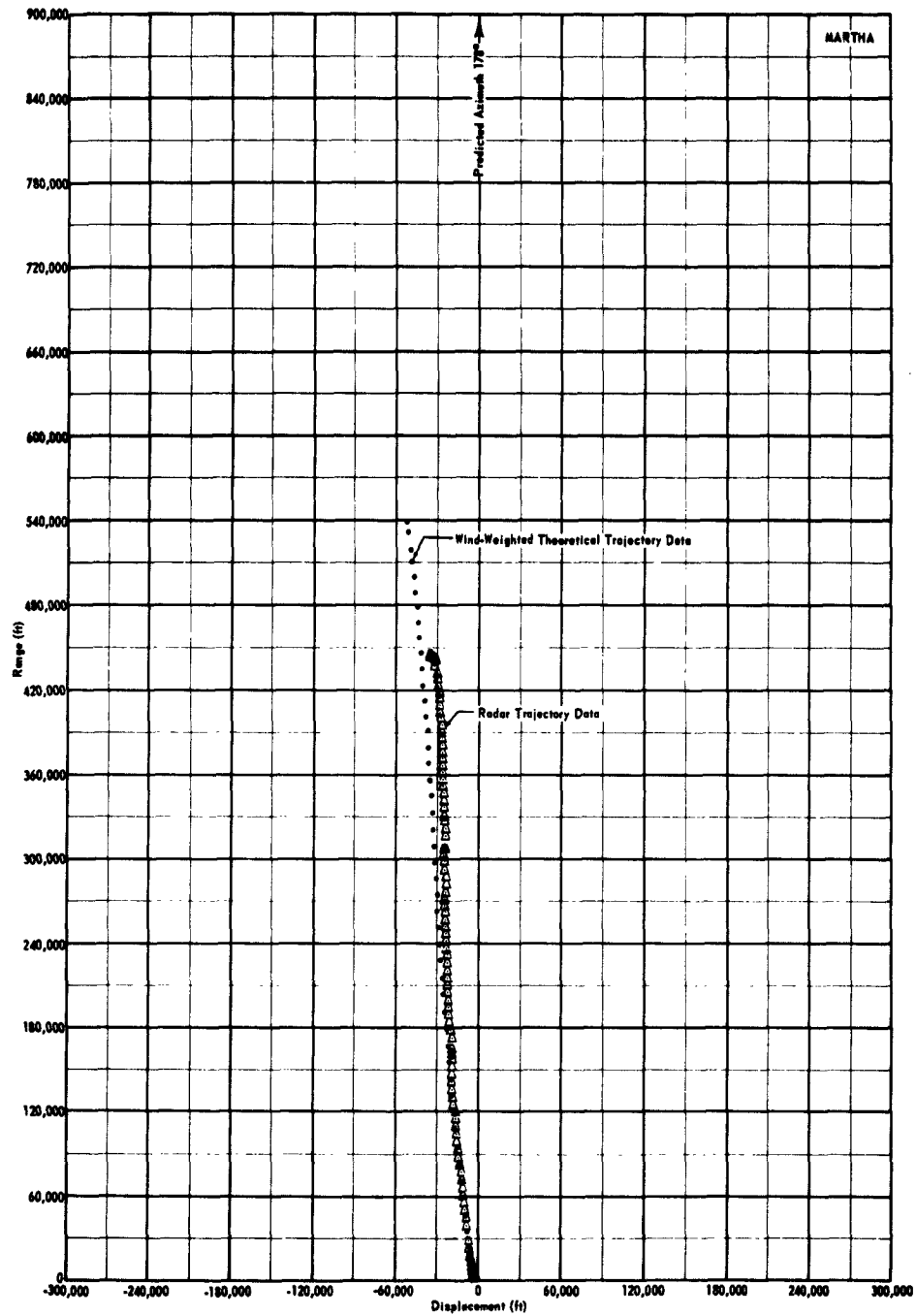


Fig. 41: Aerobee 150 (Martha) Range vs. Displacement (Entire Trajectory).

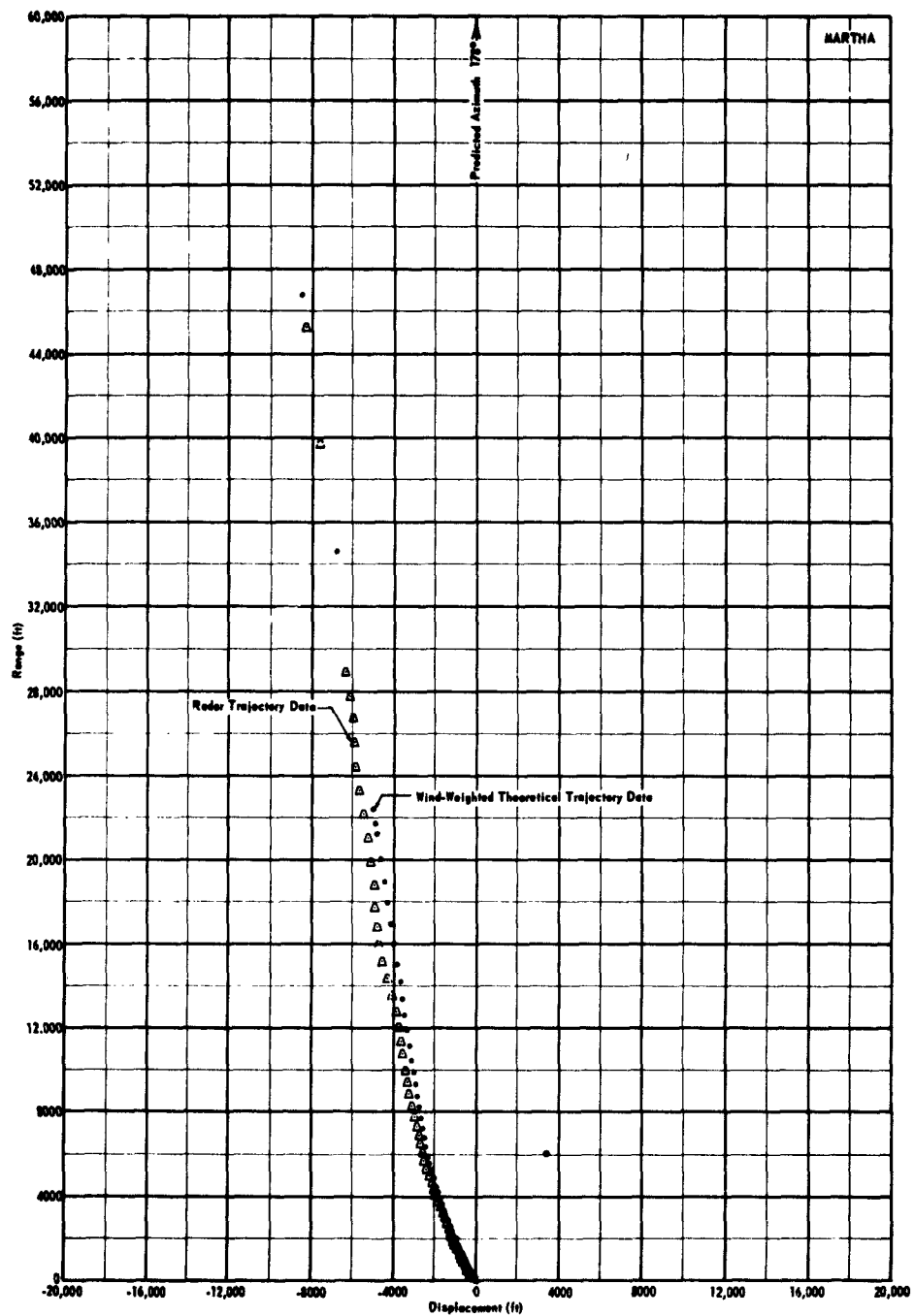


Fig. 42: Aerobee 150 (Martha) Range vs. Displacement (Trajectory Through Burnout).

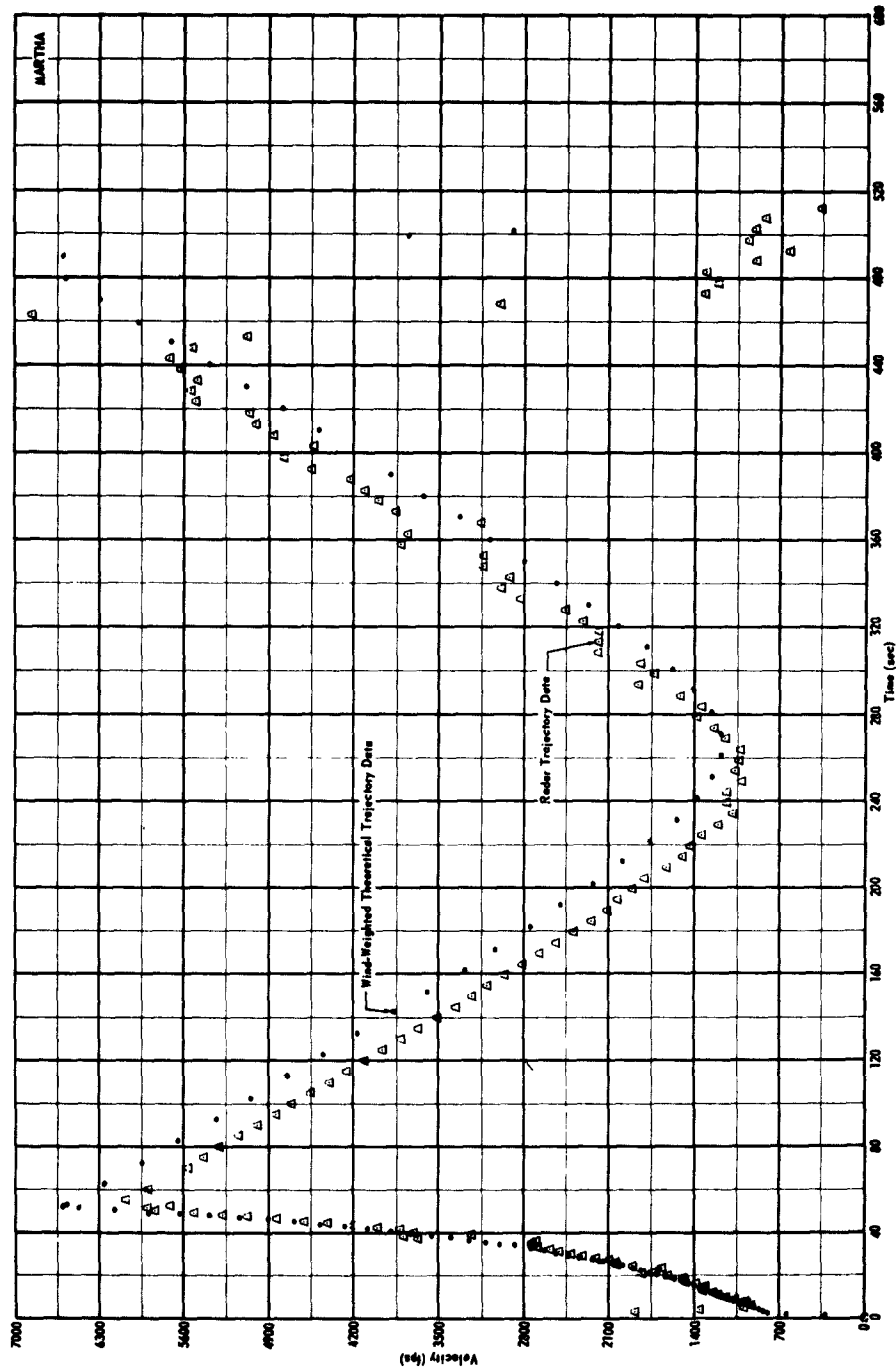


Fig. 43: Aerobee 150 (Martha) Velocity vs. Time (Entire Trajectory).

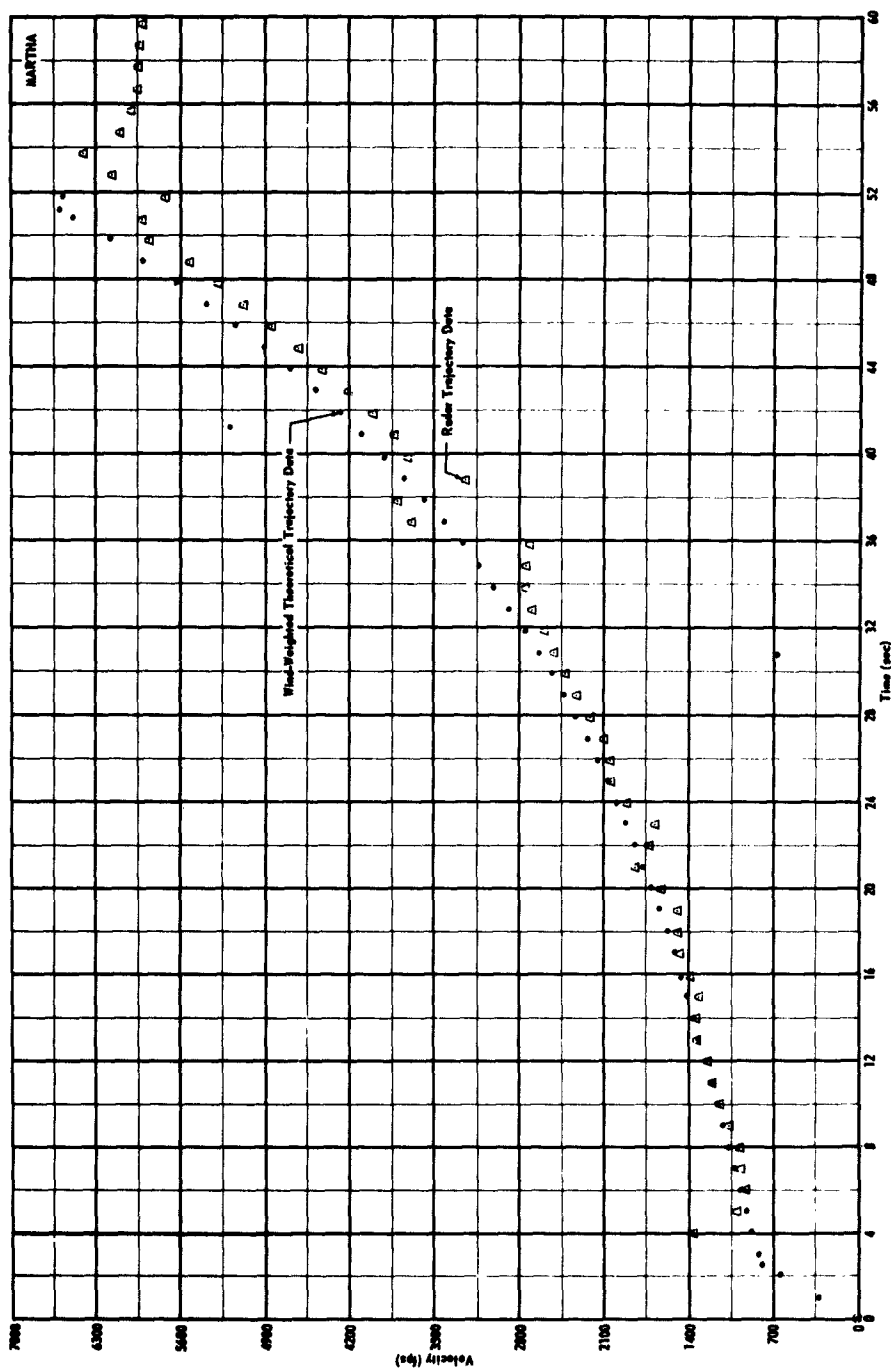


Fig. 44: Aerobee 150 (Martha) Velocity vs. Time (Trajectory Through Burnout).

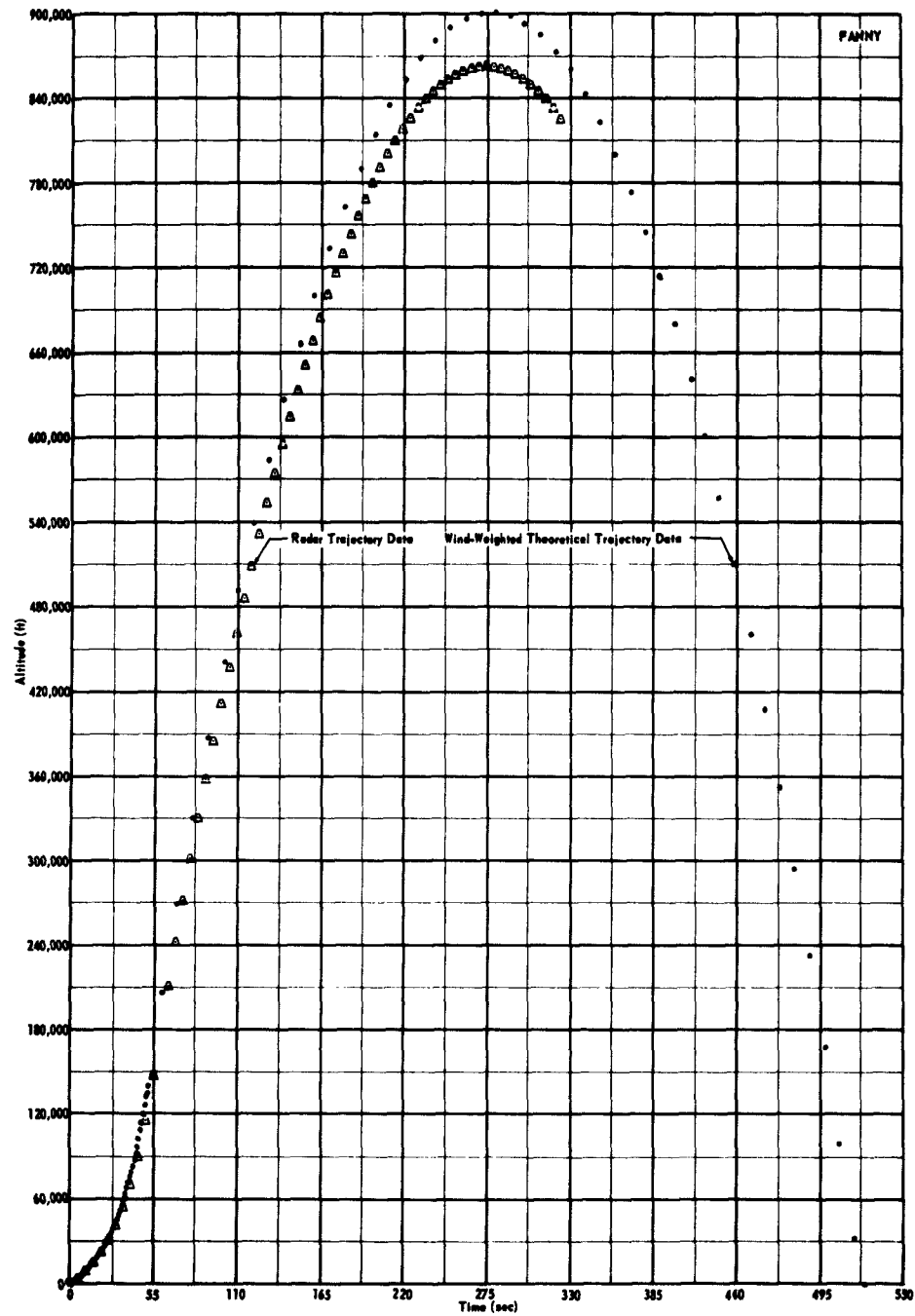


Fig. 45: Aerobee 150 (Fanny) Altitude vs. Time (Entire Trajectory).

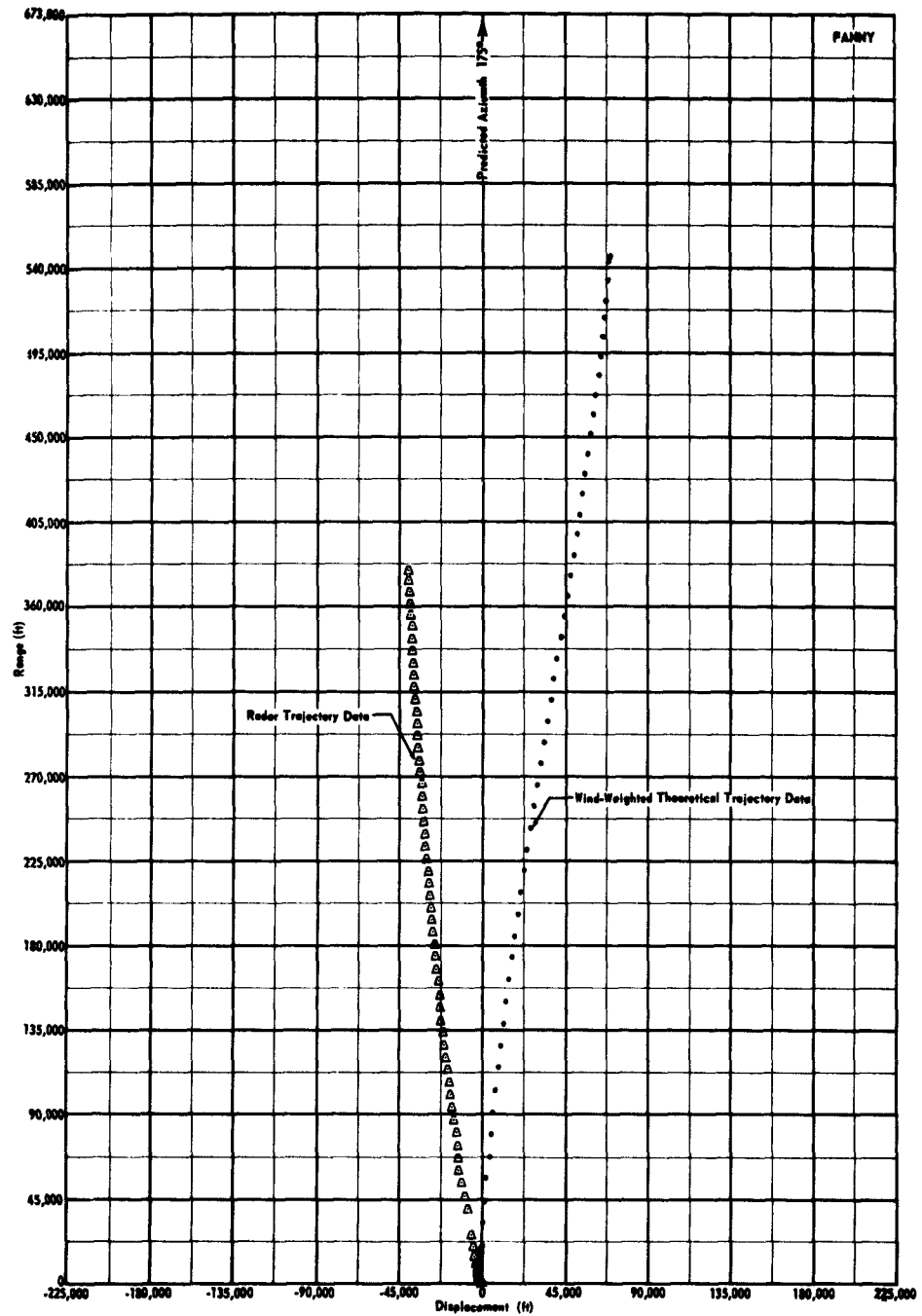


Fig. 46: Aerobee 150 (Fanny) Range vs. Displacement (Entire Trajectory).

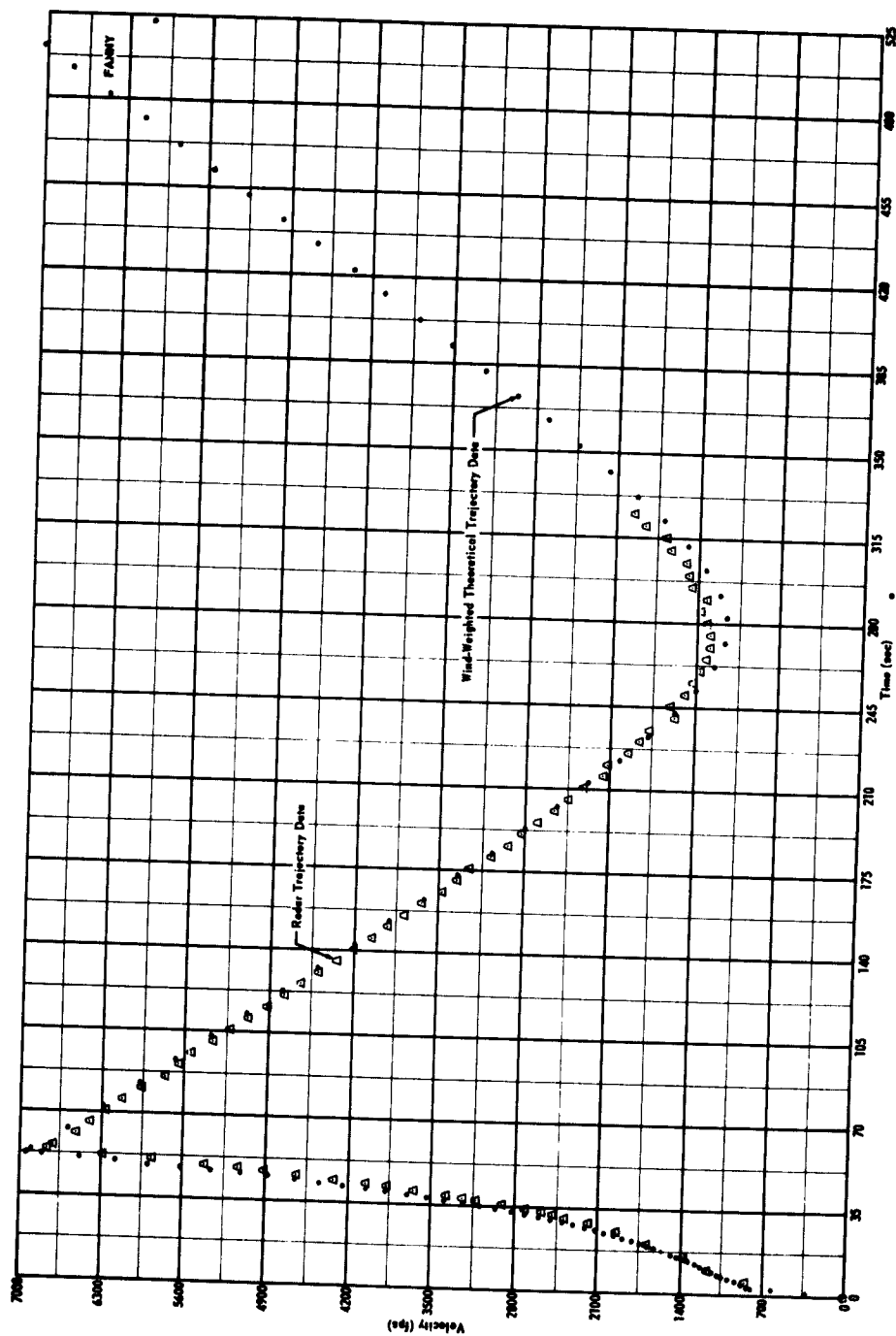


Fig. 47: Aerobee 150 (Fanny) Velocity vs. Time (Entire Trajectory).

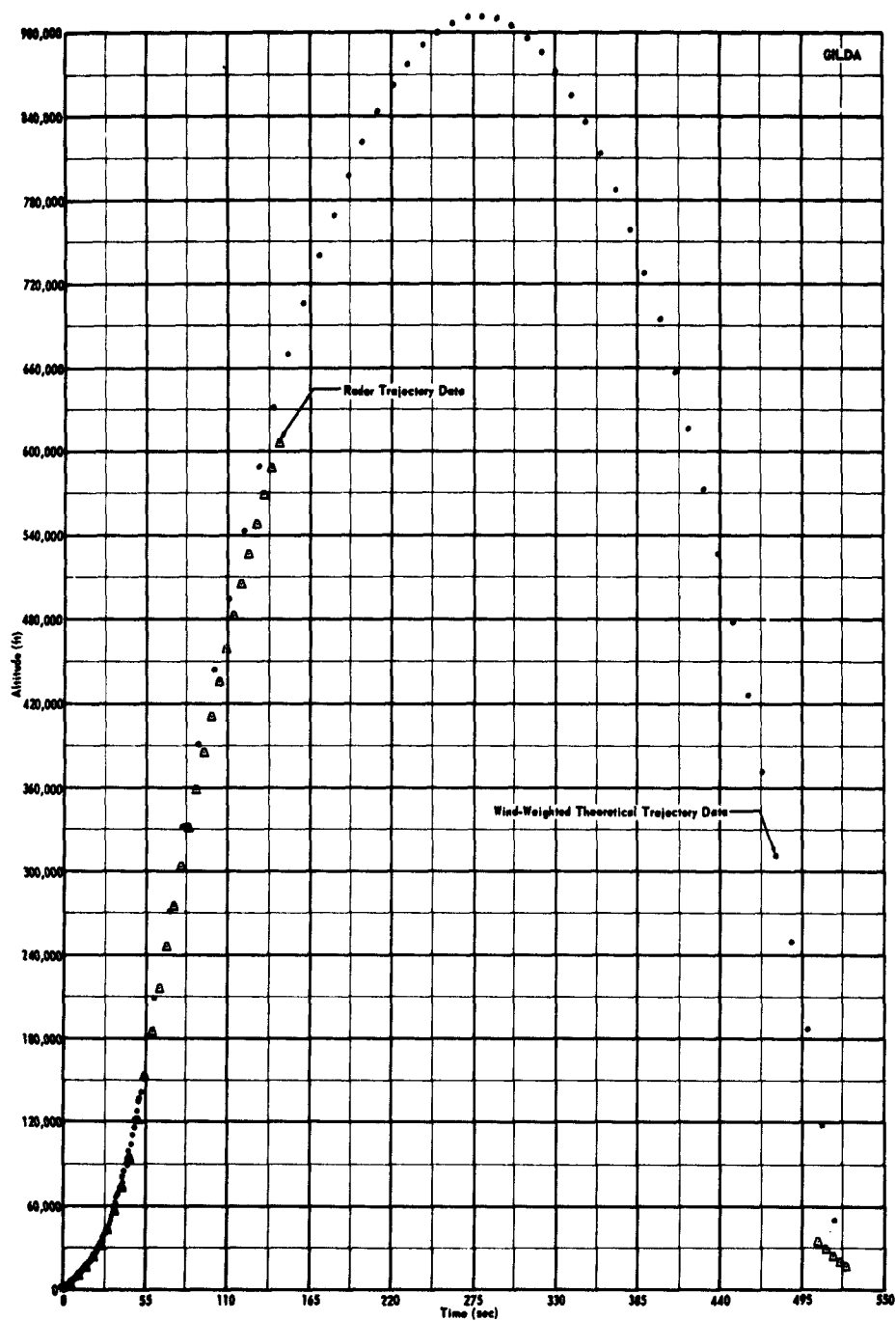


Fig. 48: Aerobee 150 (Gilda) Altitude vs. Time (Entire Trajectory).

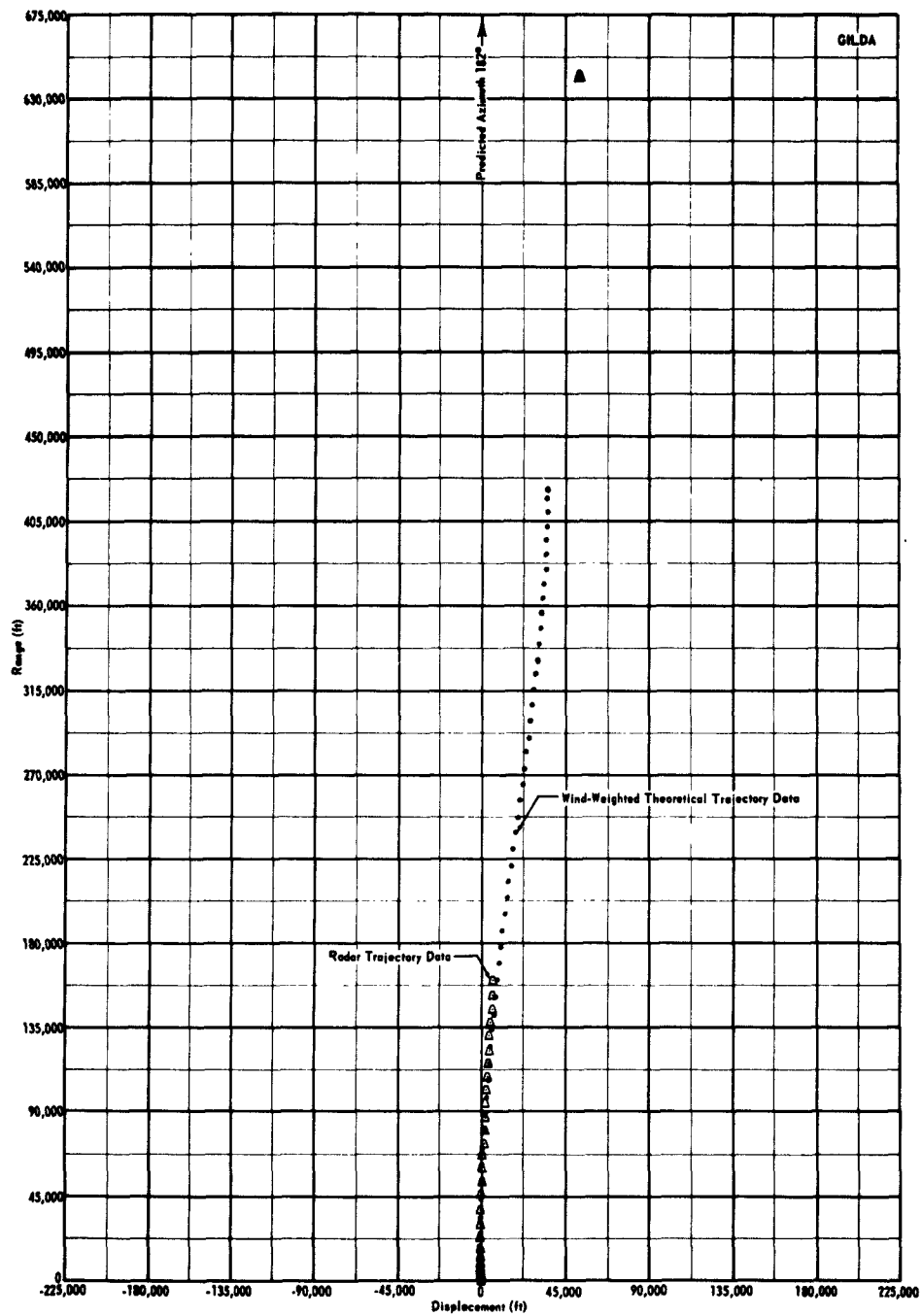


Fig. 49: Aerobee 150 (Gilda) Range vs. Displacement (Entire Trajectory).

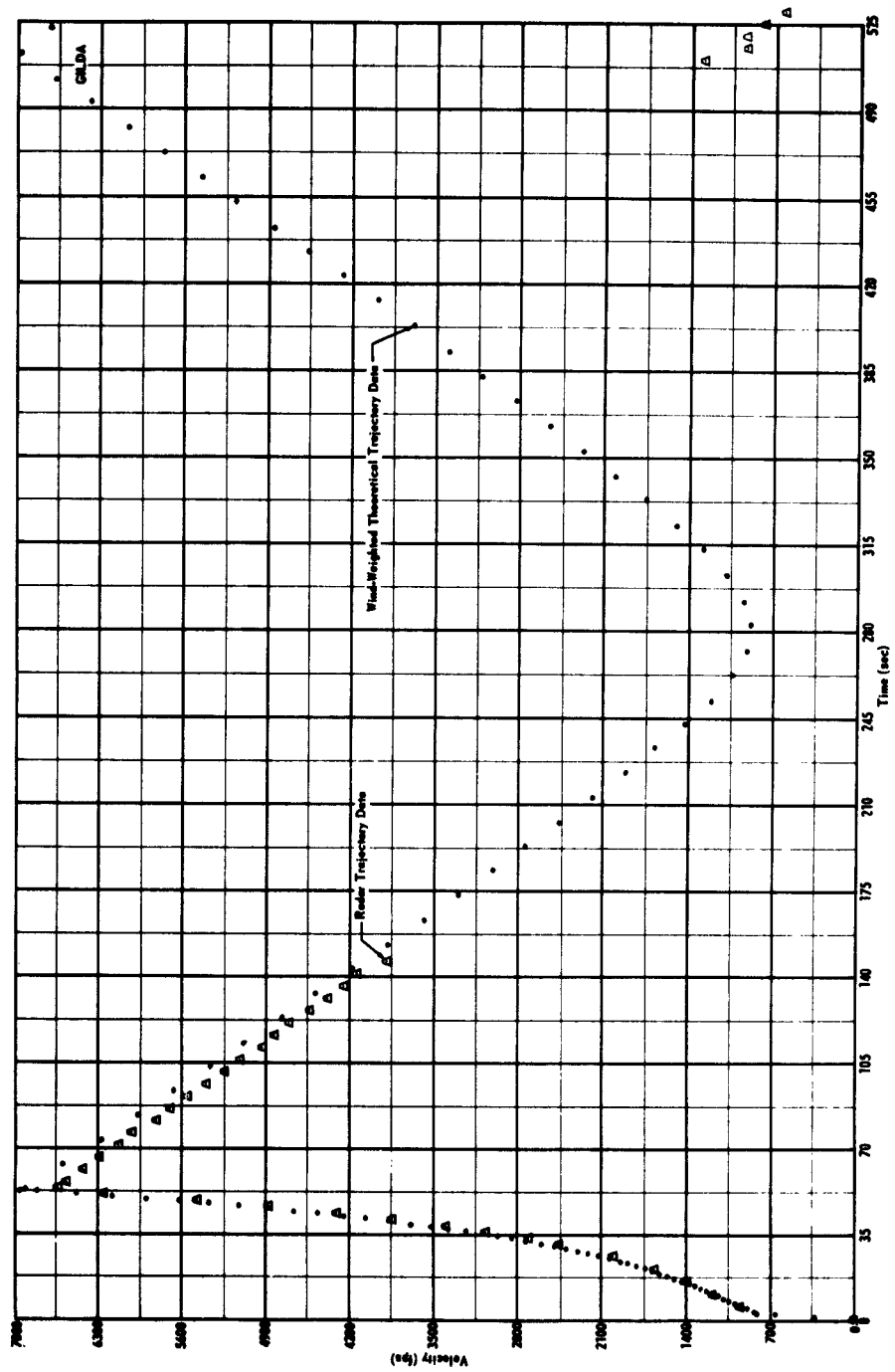


Fig. 50: Aerobee 150 (Gilda) Velocity vs. Time (Entire Trajectory).

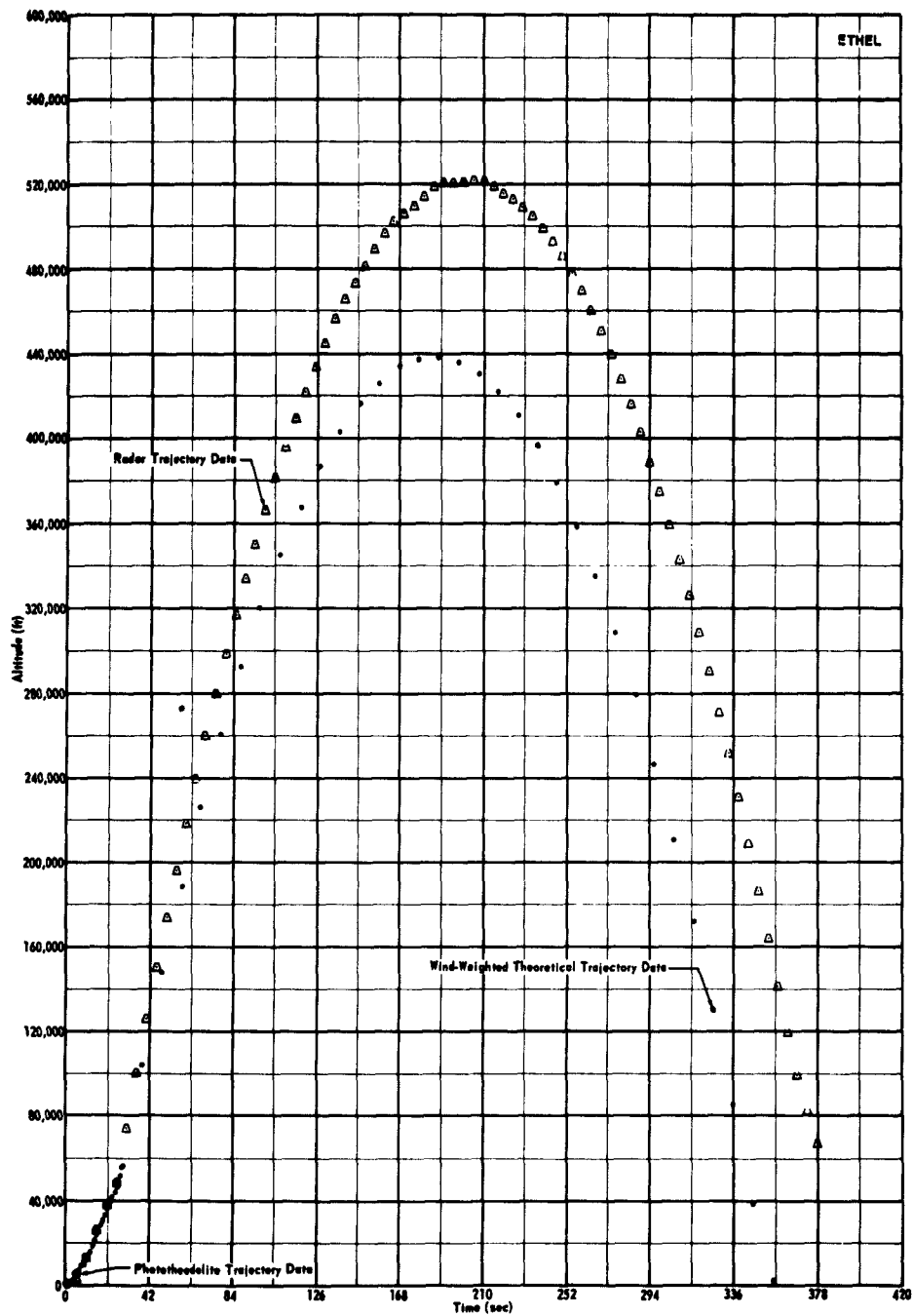


Fig. 51: Honest John-Nike-Nike (Ethel) Altitude vs. Time (Entire Trajectory).

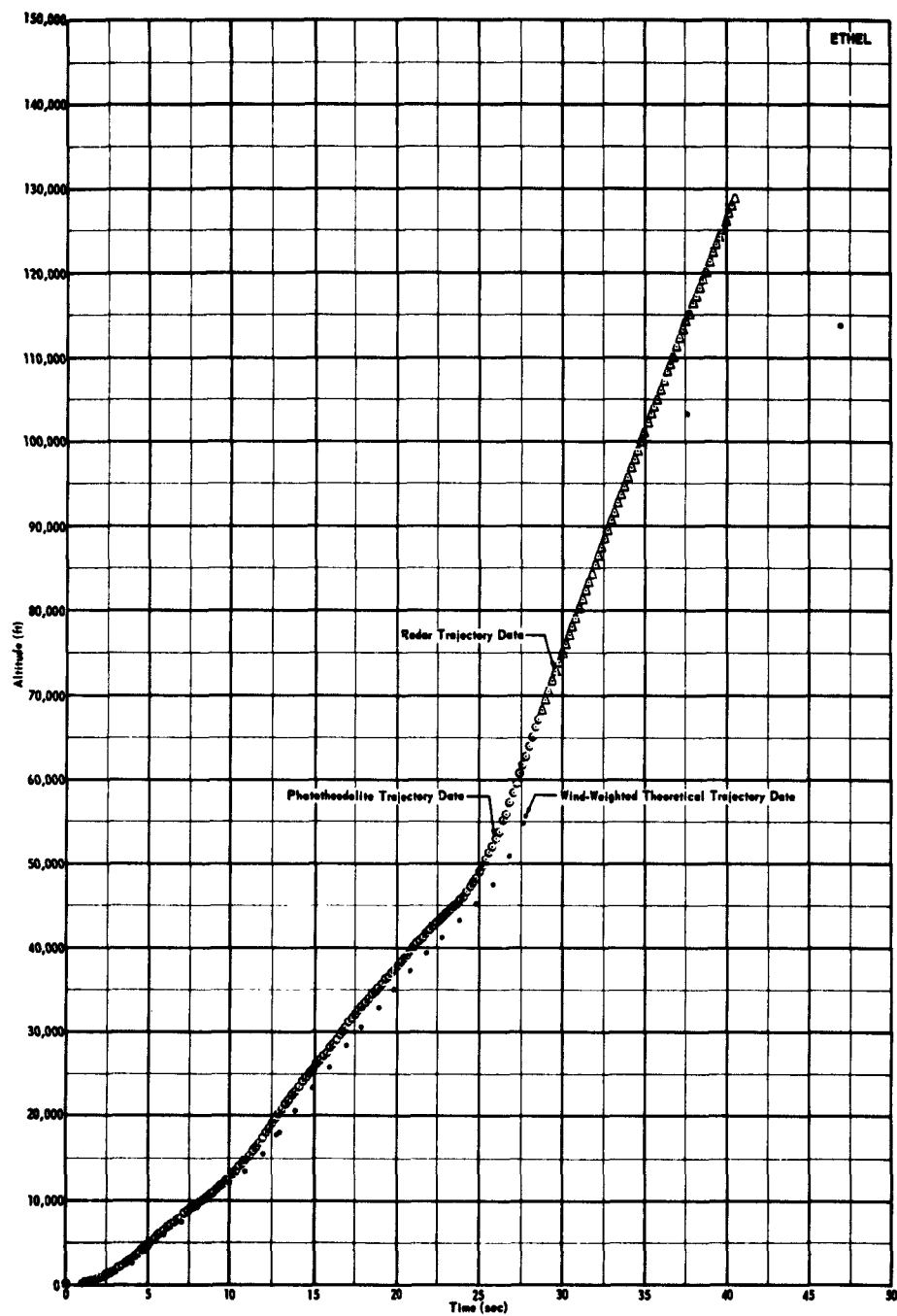


Fig. 52: Honest John-Nike-Nike (Ethel) Altitude vs. Time (Trajectory Through Burnout).

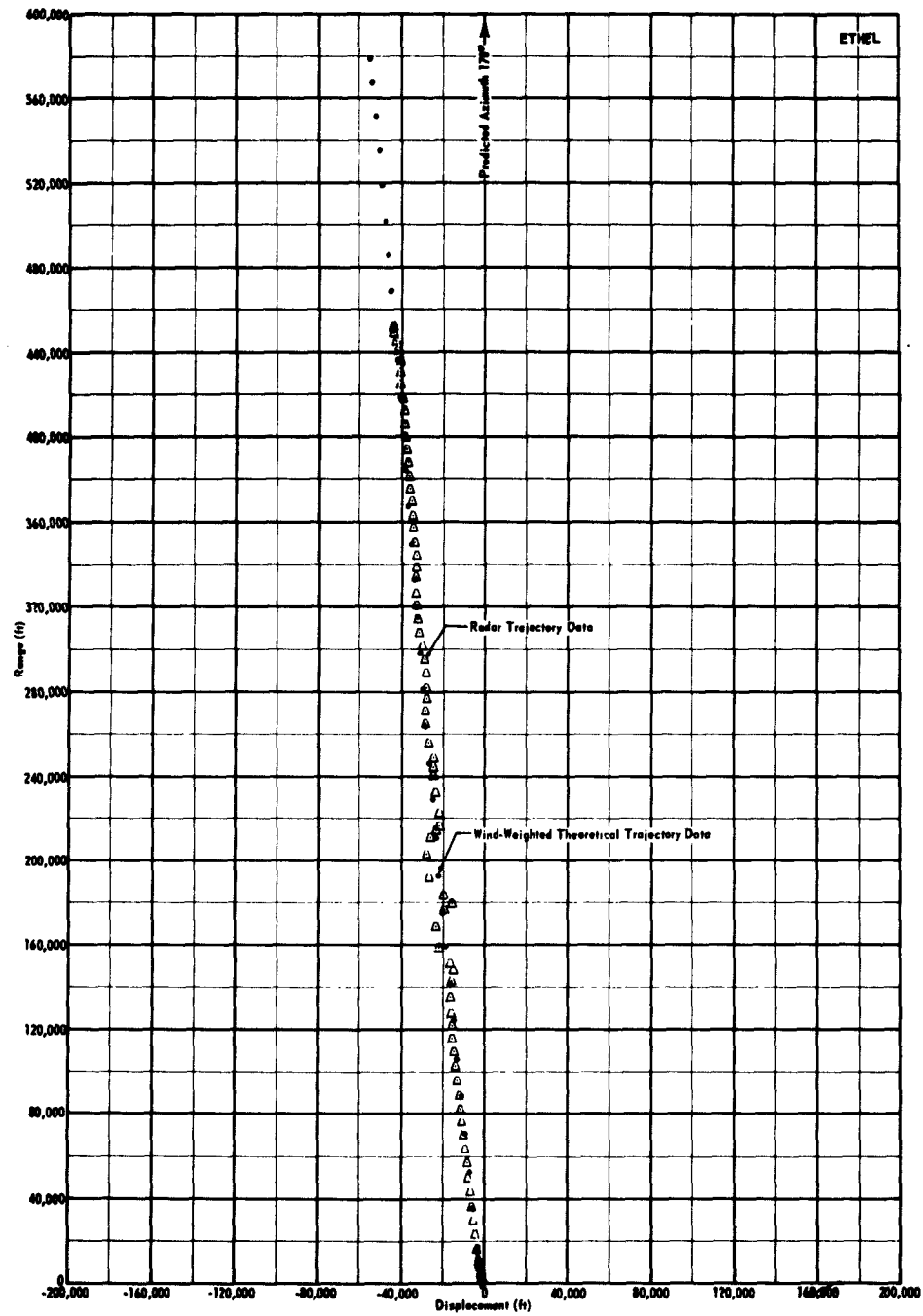


Fig. 53: Honest John-Nike-Nike (Ethel) Range vs. Displacement (Entire Trajectory).

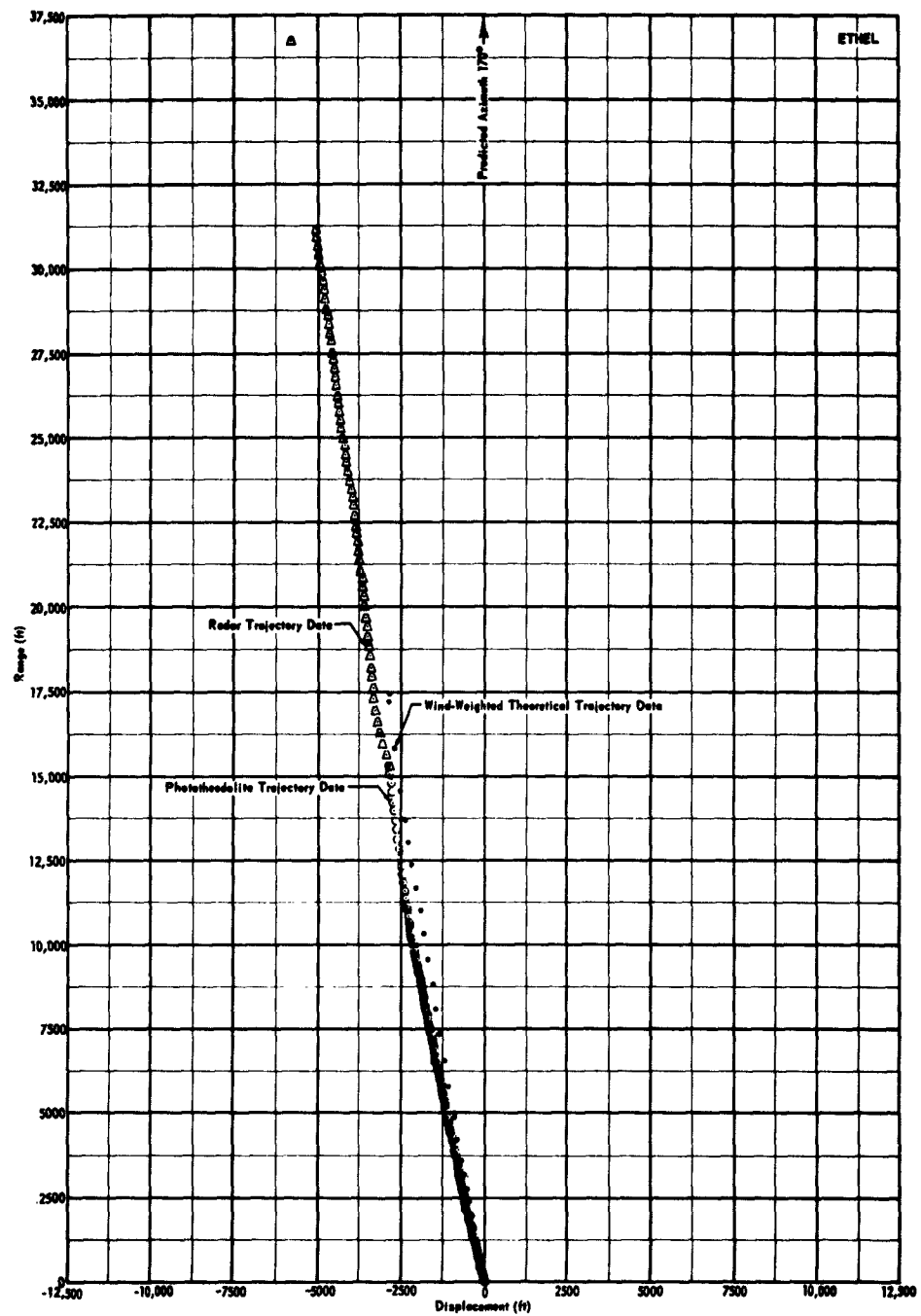


Fig. 54: Honest John-Nike-Nike (Ethel) Range vs. Displacement Trajectory Through Burnout).

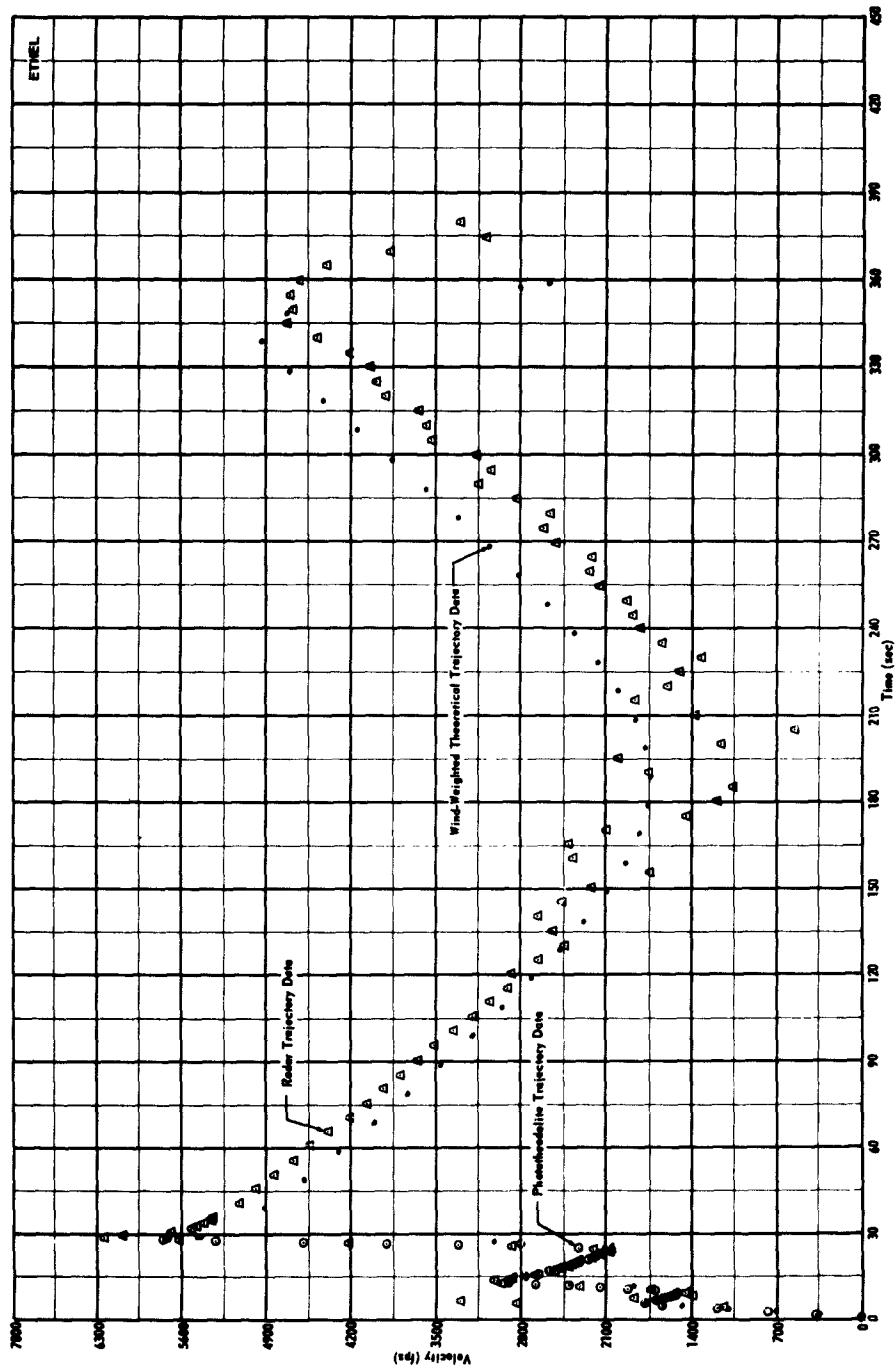


Fig. 55: Honest John-Nike-Nike (Ethel) Velocity vs. Time (Entire Trajectory).

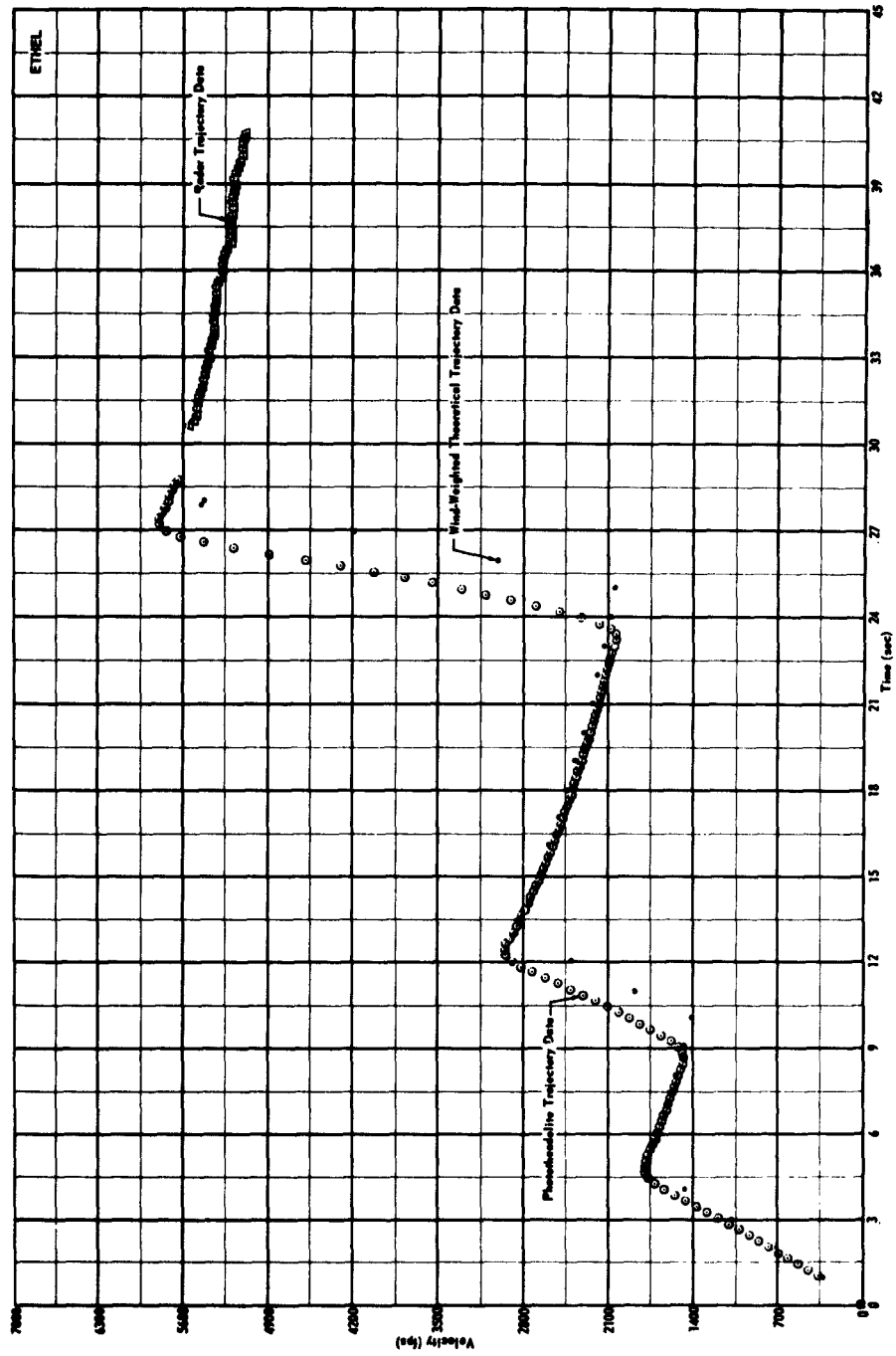


Fig. 56: Honest John-Nike (Ethel) Velocity vs. Time (Trajectory Through Burnout).

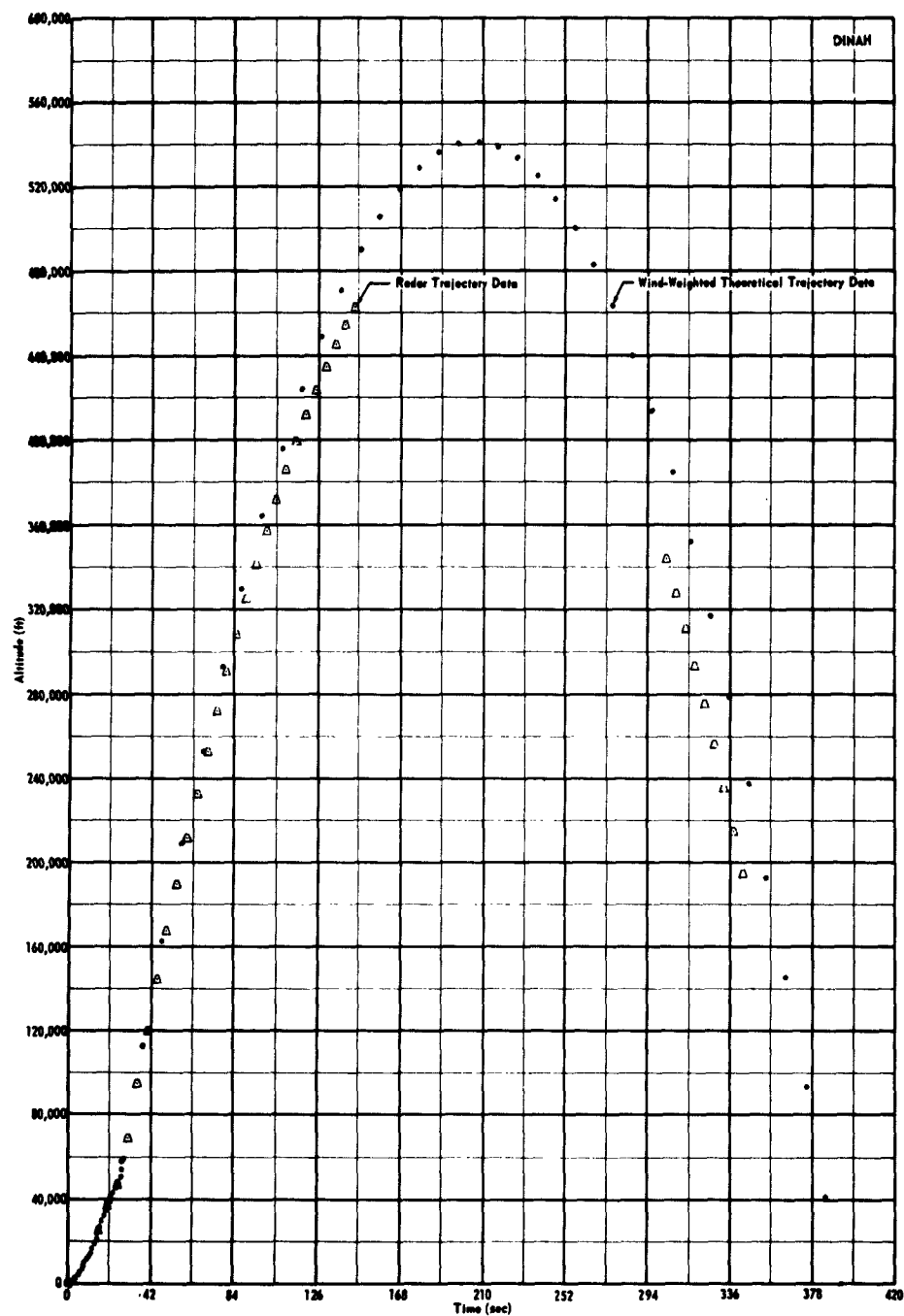


Fig. 57: Honest John-Nike-Nike (Dinah) Altitude vs. Time (Entire Trajectory).

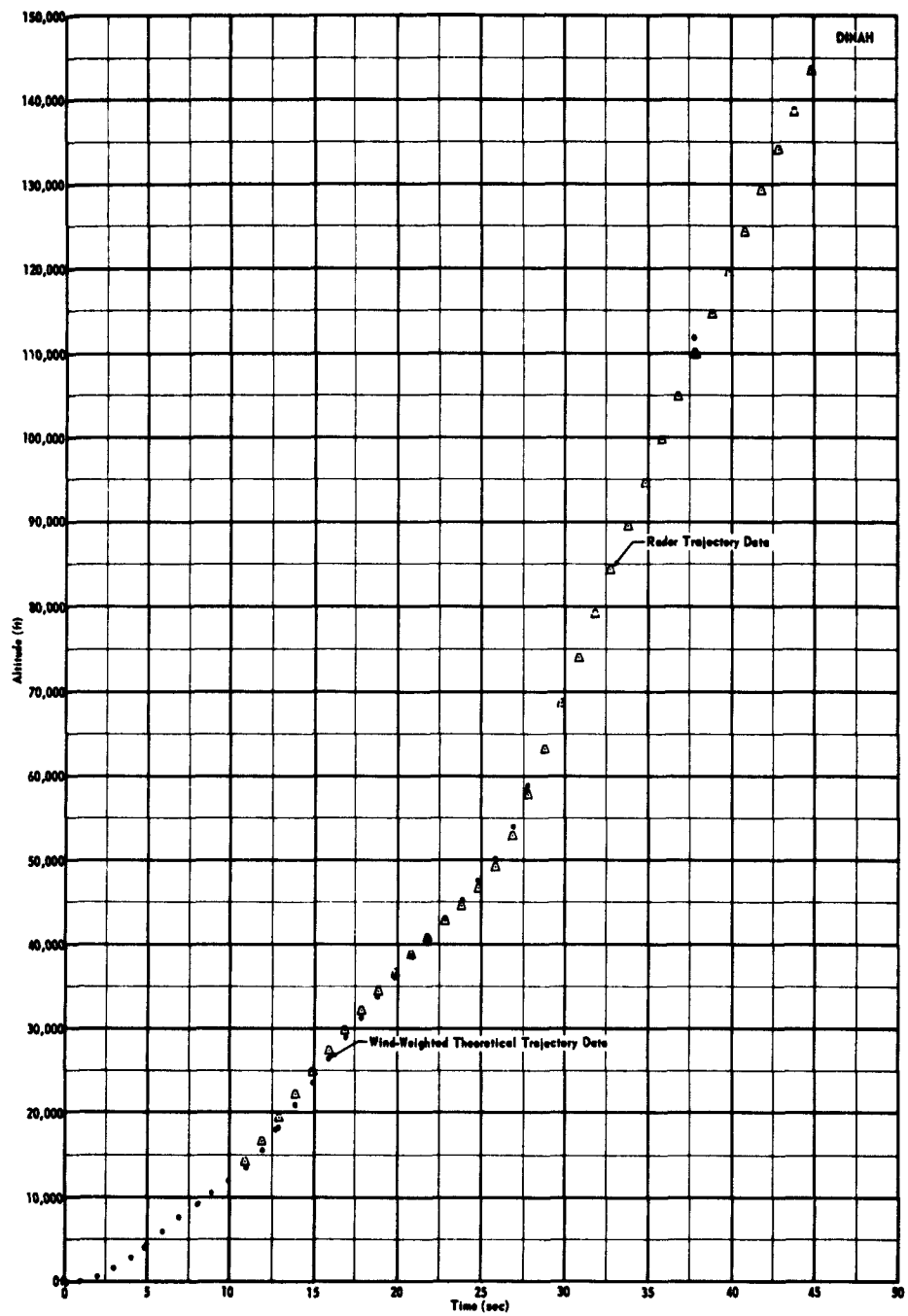


Fig. 58: Honest John-Nike-Nike (Dinah) Altitude vs. Time (Trajectory Through Burnout).

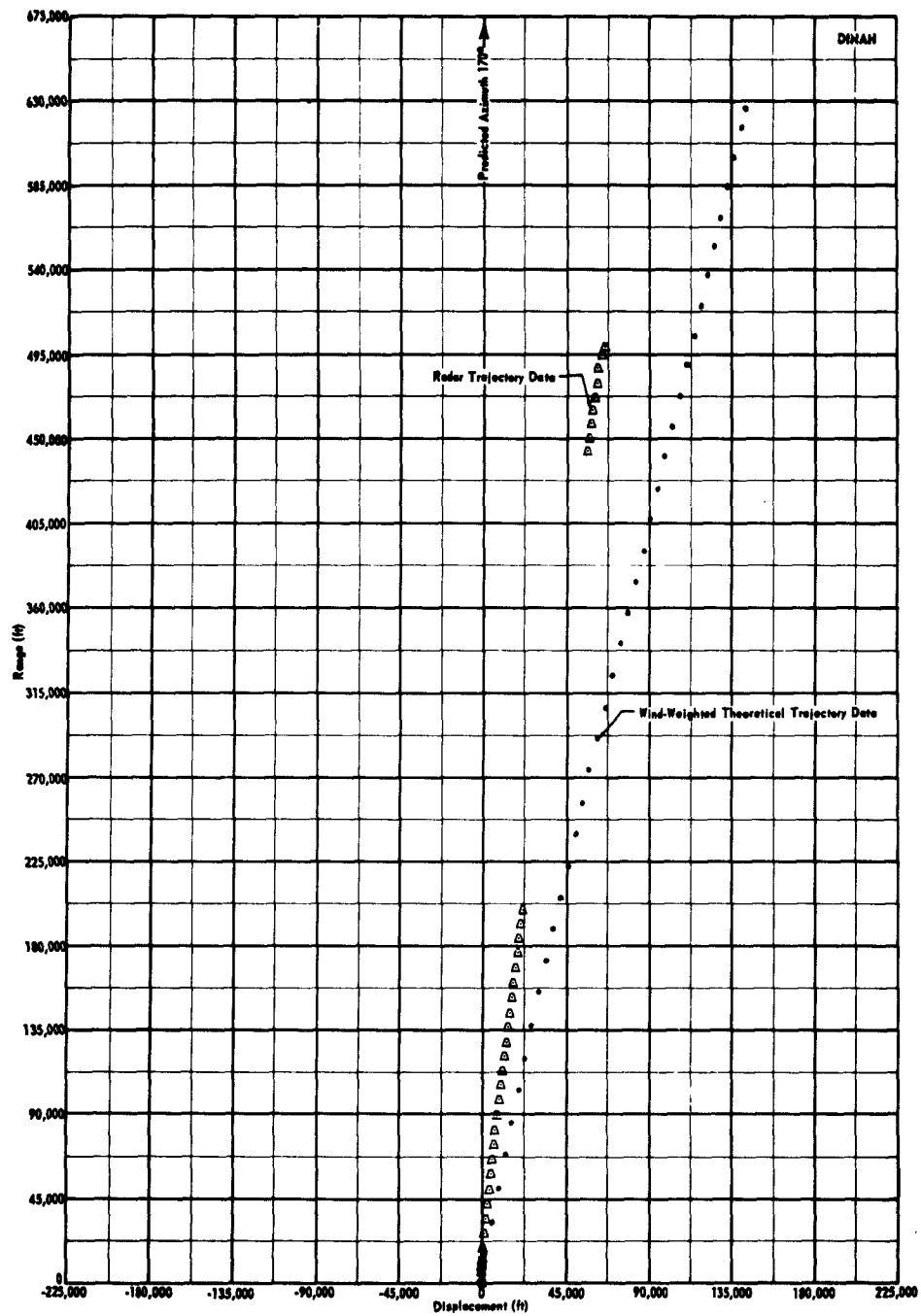


Fig. 59: Honest John-Nike-Nike (Dinah) Range vs. Displacement (Entire Trajectory).

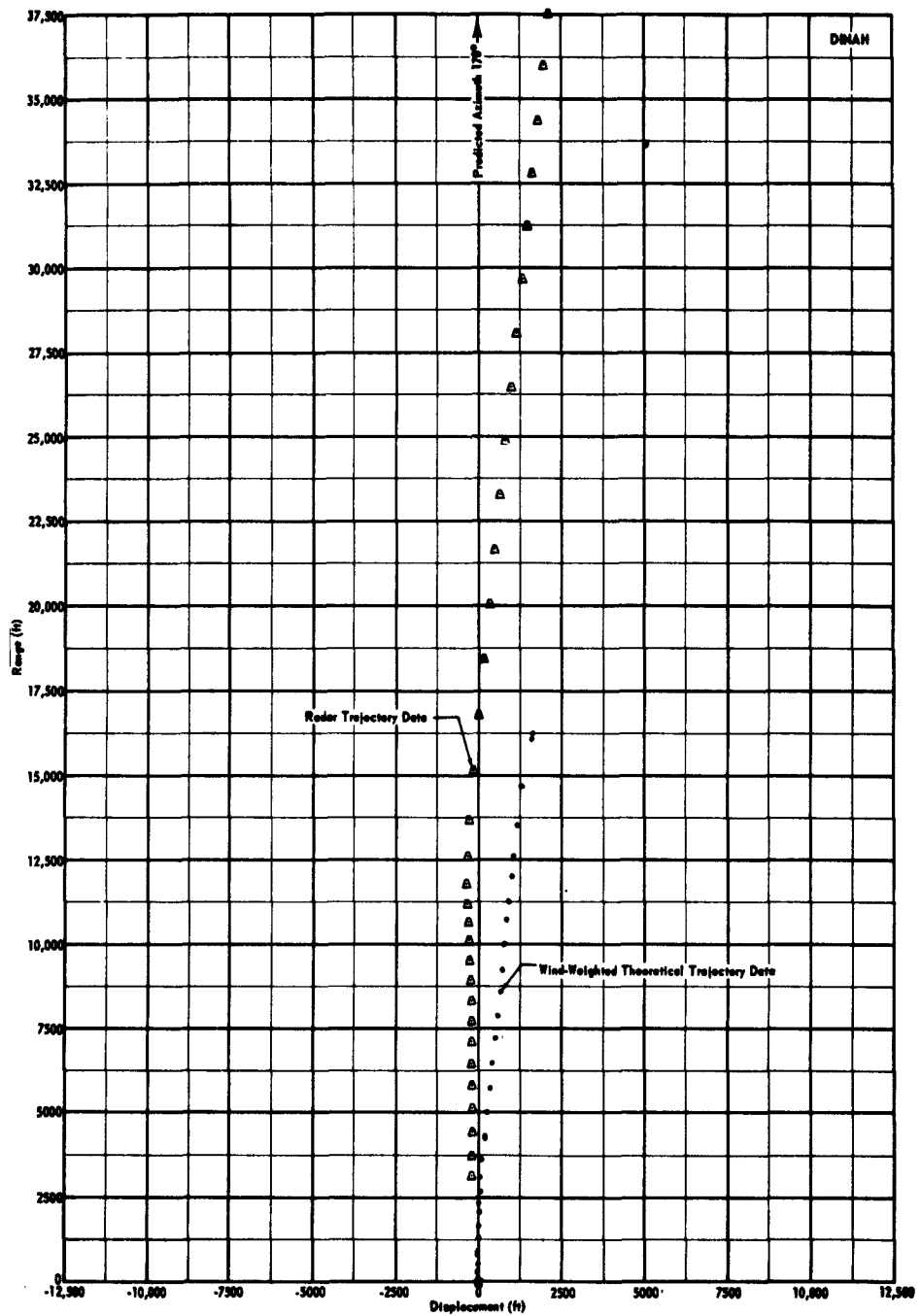


Fig. 60: Honest John-Nike-Nike(Dinah) Range vs. Displacement (Trajectory Through Burnout).

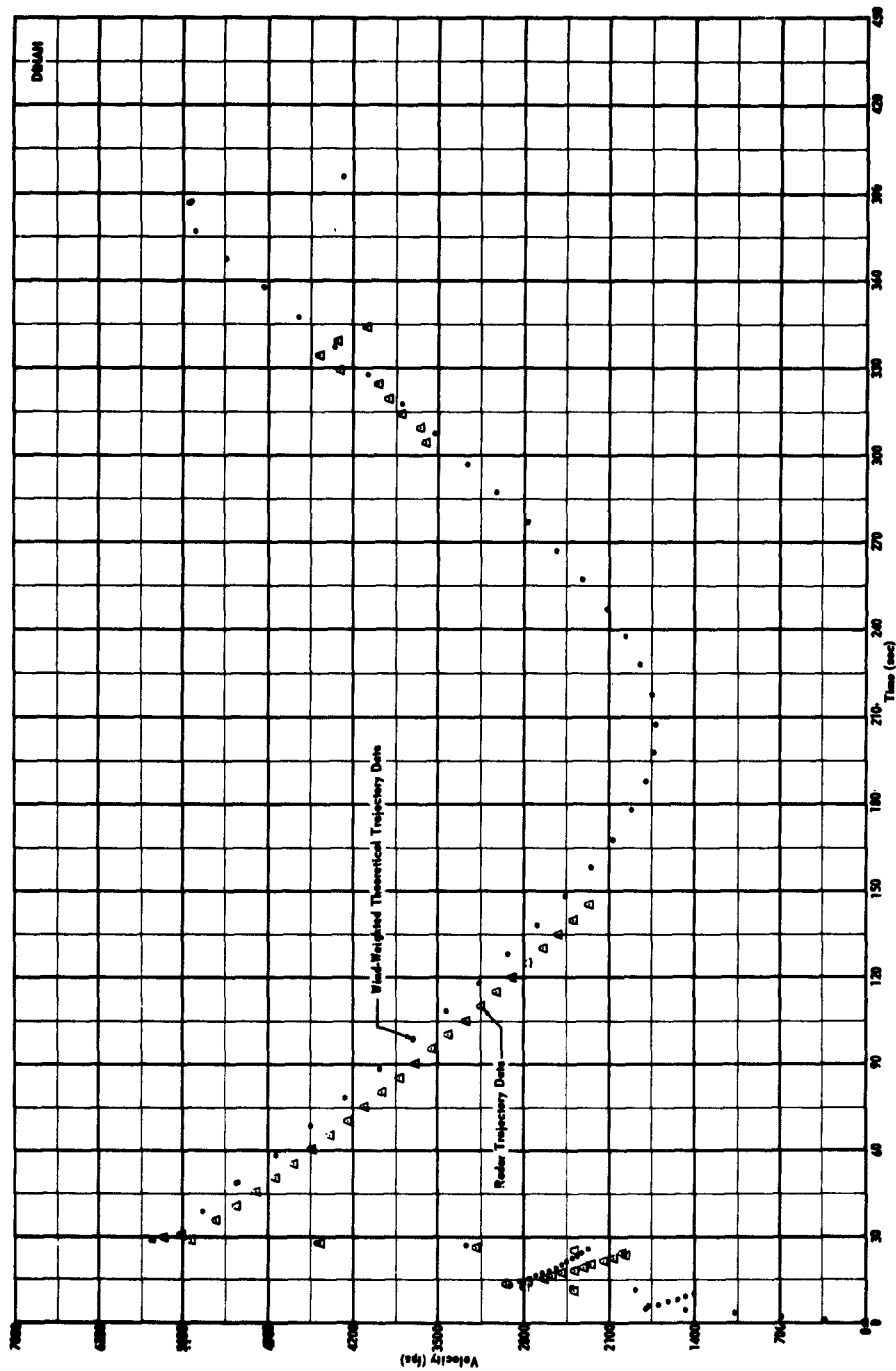


Fig. 61: Honest John-Nike-Nike (Dinah) Velocity vs. Time (Entire Trajectory).

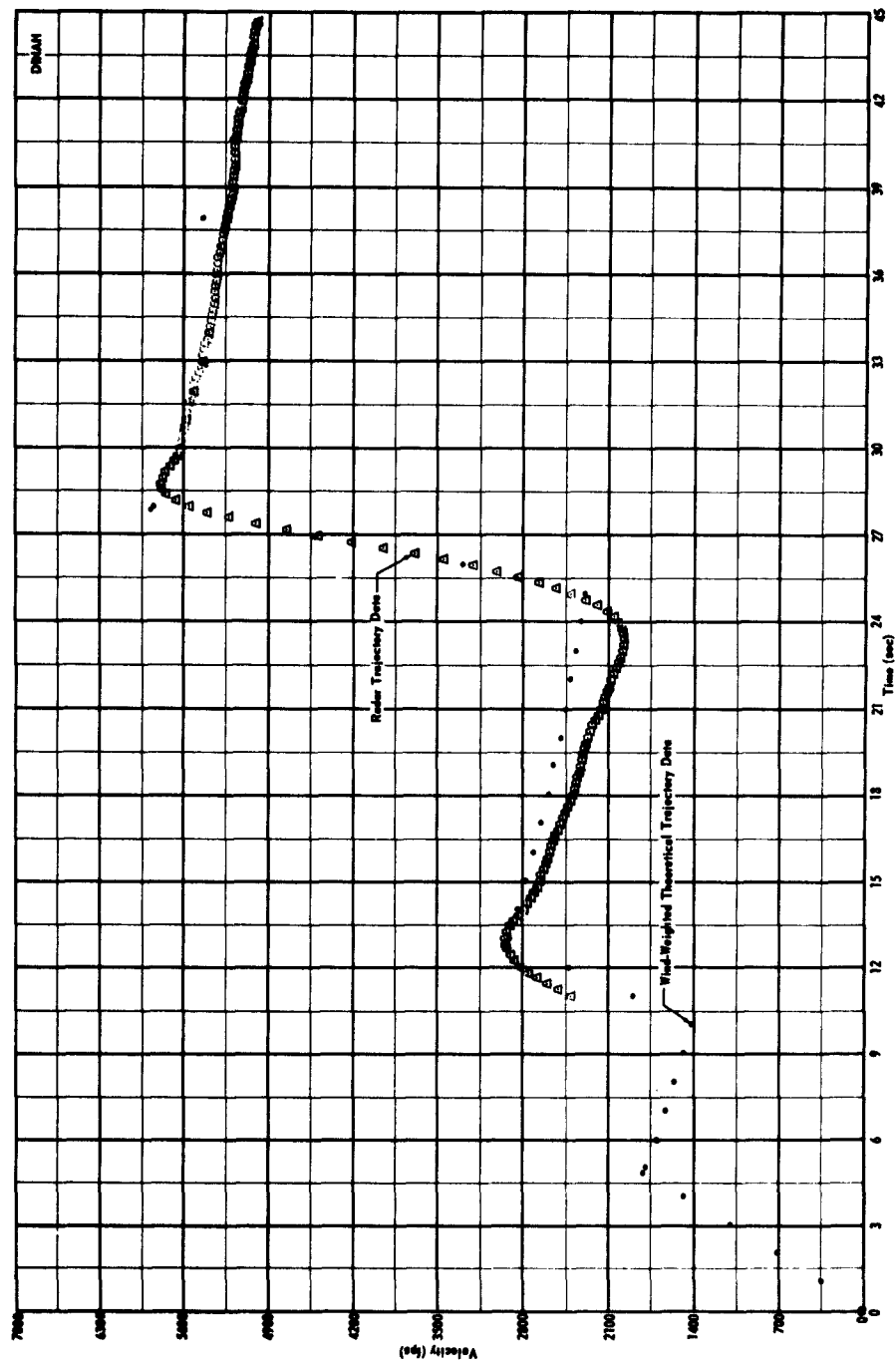


Fig. 62: Honest John-Nike-Nike (Dinah) Velocity vs. Time (Trajectory Through Burnout).

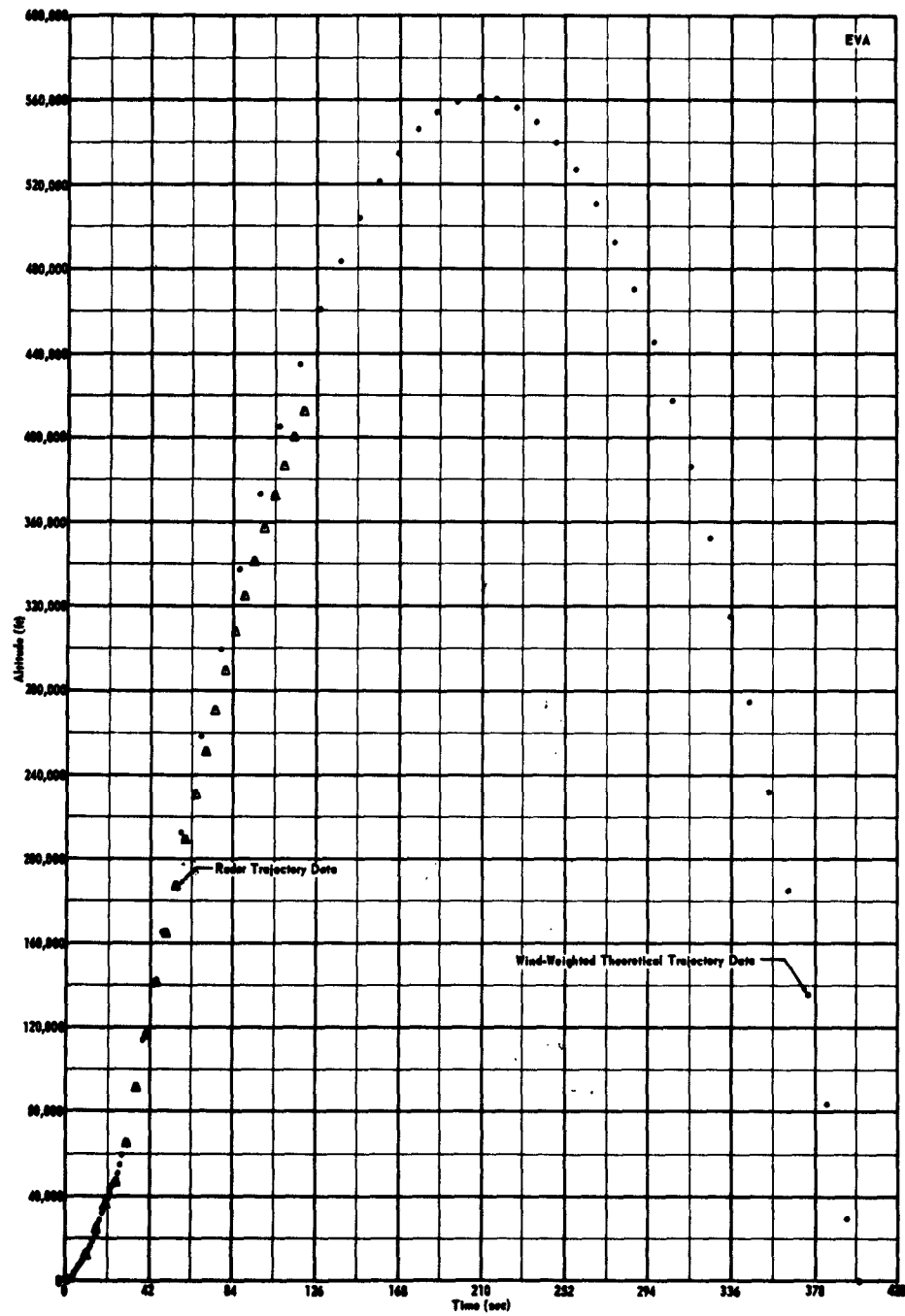


Fig. 63: Honest John-Nike-Nike (Eva) Altitude vs. Time (Entire Trajectory).

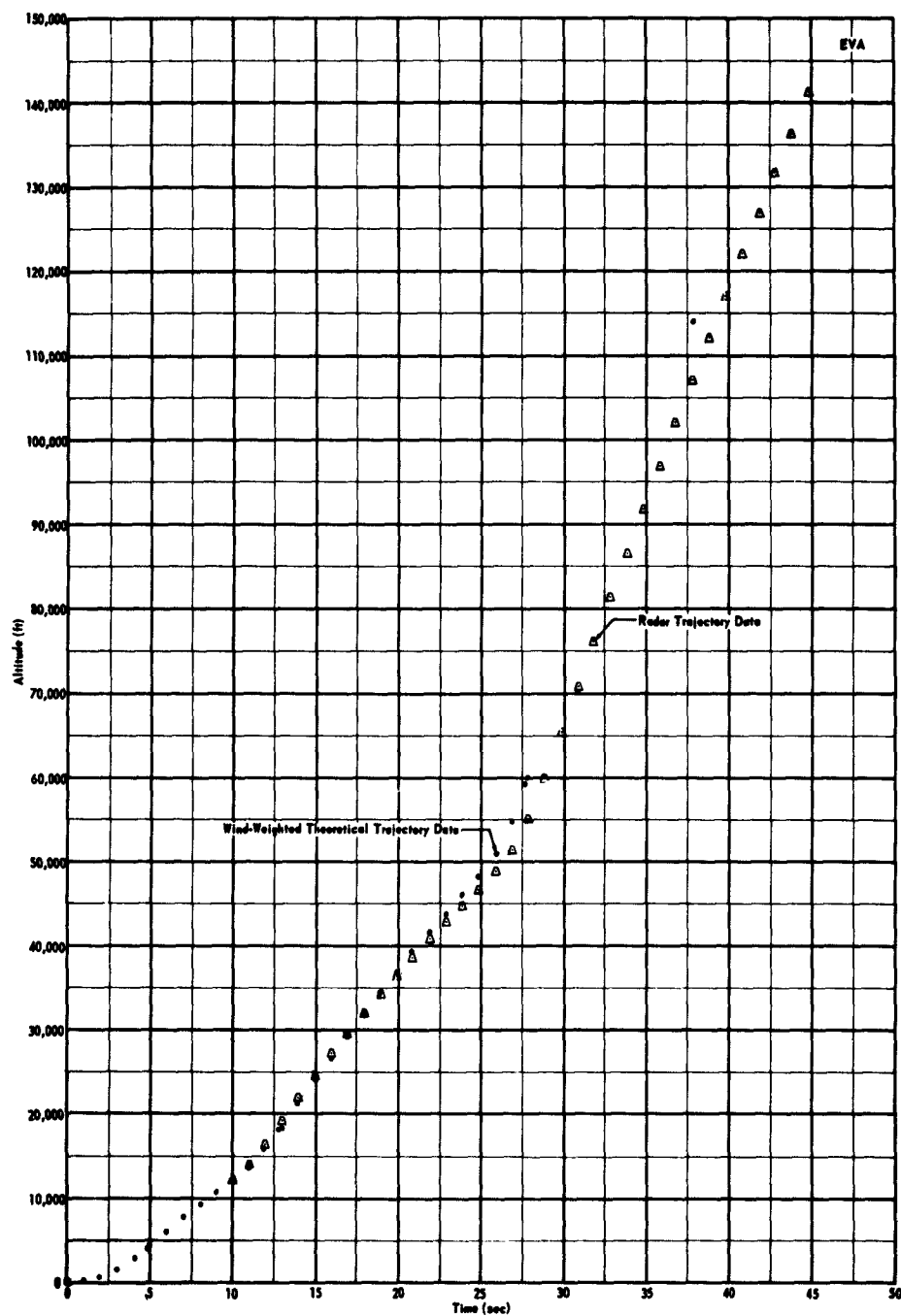


Fig. 64: Honest John-Nike-Nike (Eva) Altitude vs. Time (Trajectory Through Burnout).

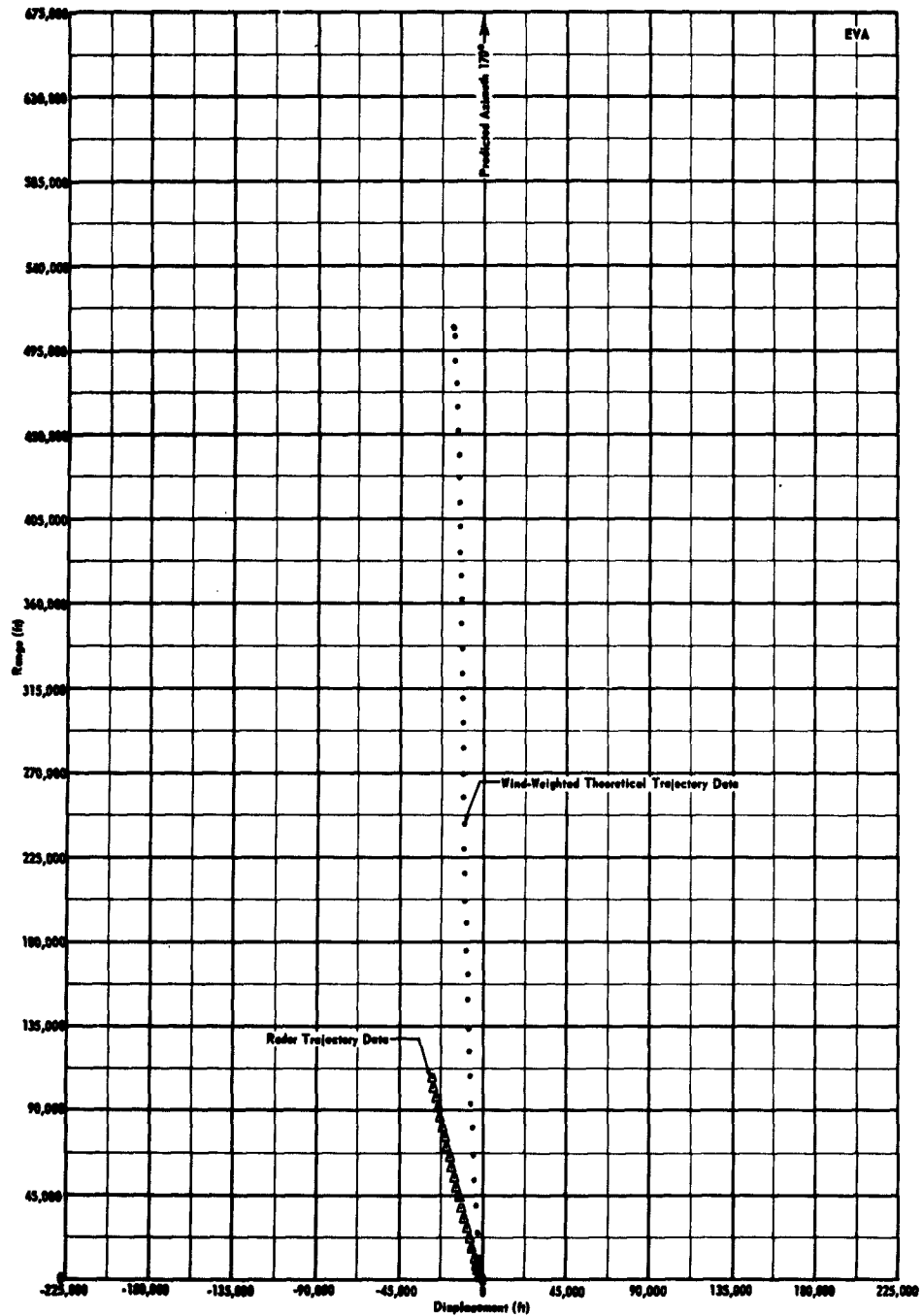


Fig. 65: Honest John-Nike-Nike (Eva) Range vs. Displacement (Entire Trajectory).

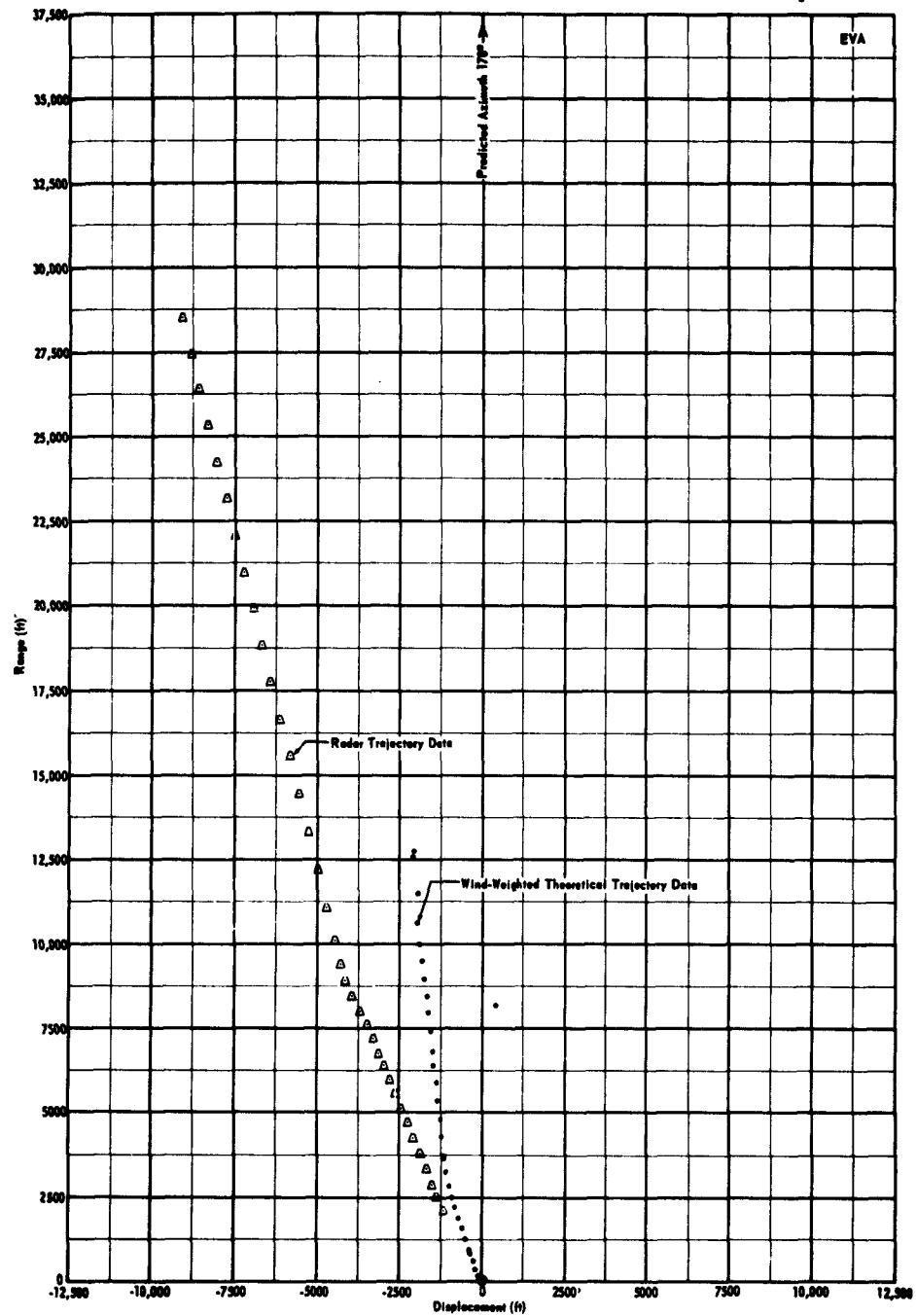


Fig. 66: Honest John-Nike-Nike (Eva) Range vs. Displacement (Trajectory Through Burnout).

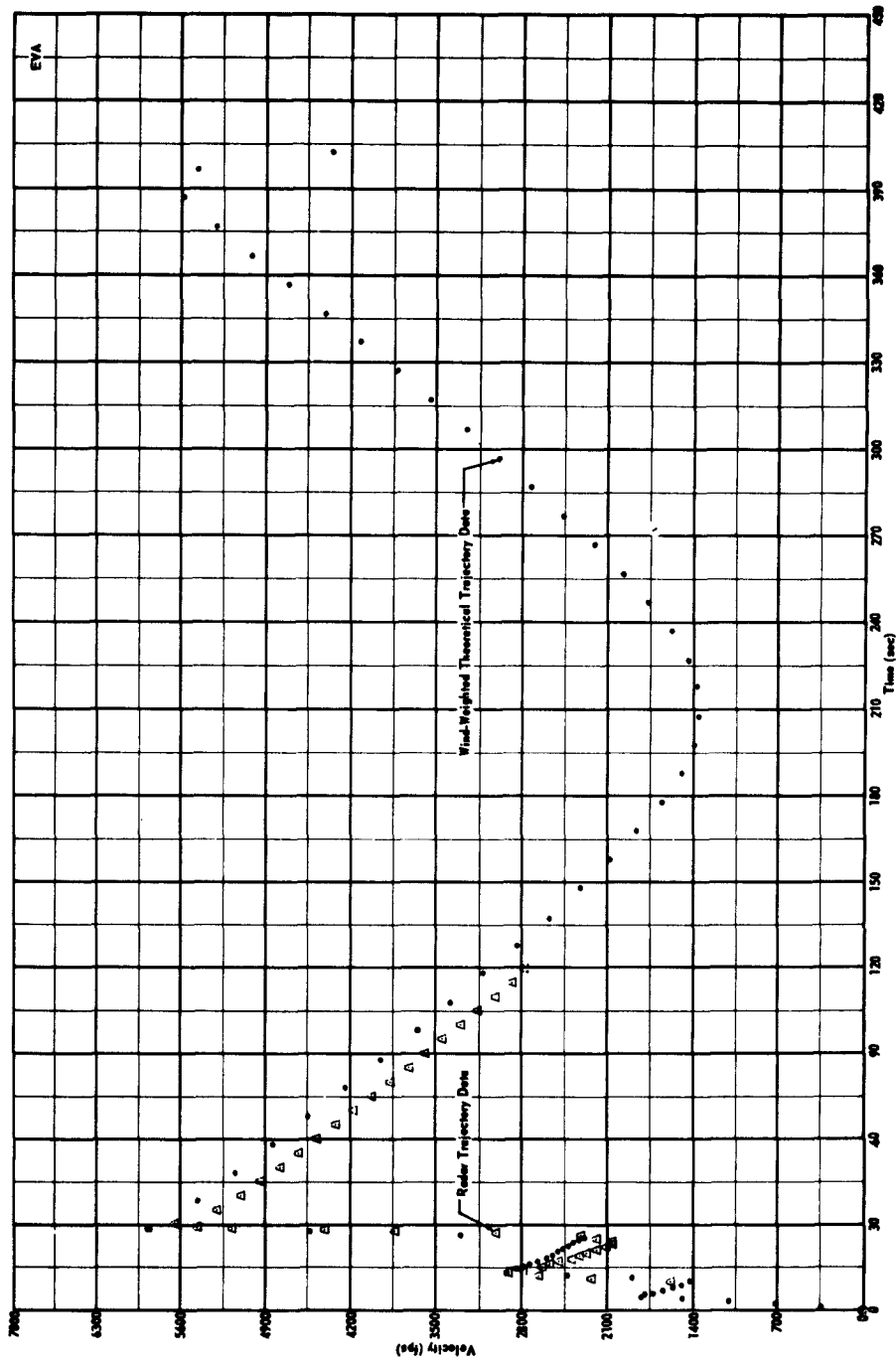


Fig. 67: Honest John-Nike-Nike (Eva) Velocity vs. Time (Entire Trajectory)

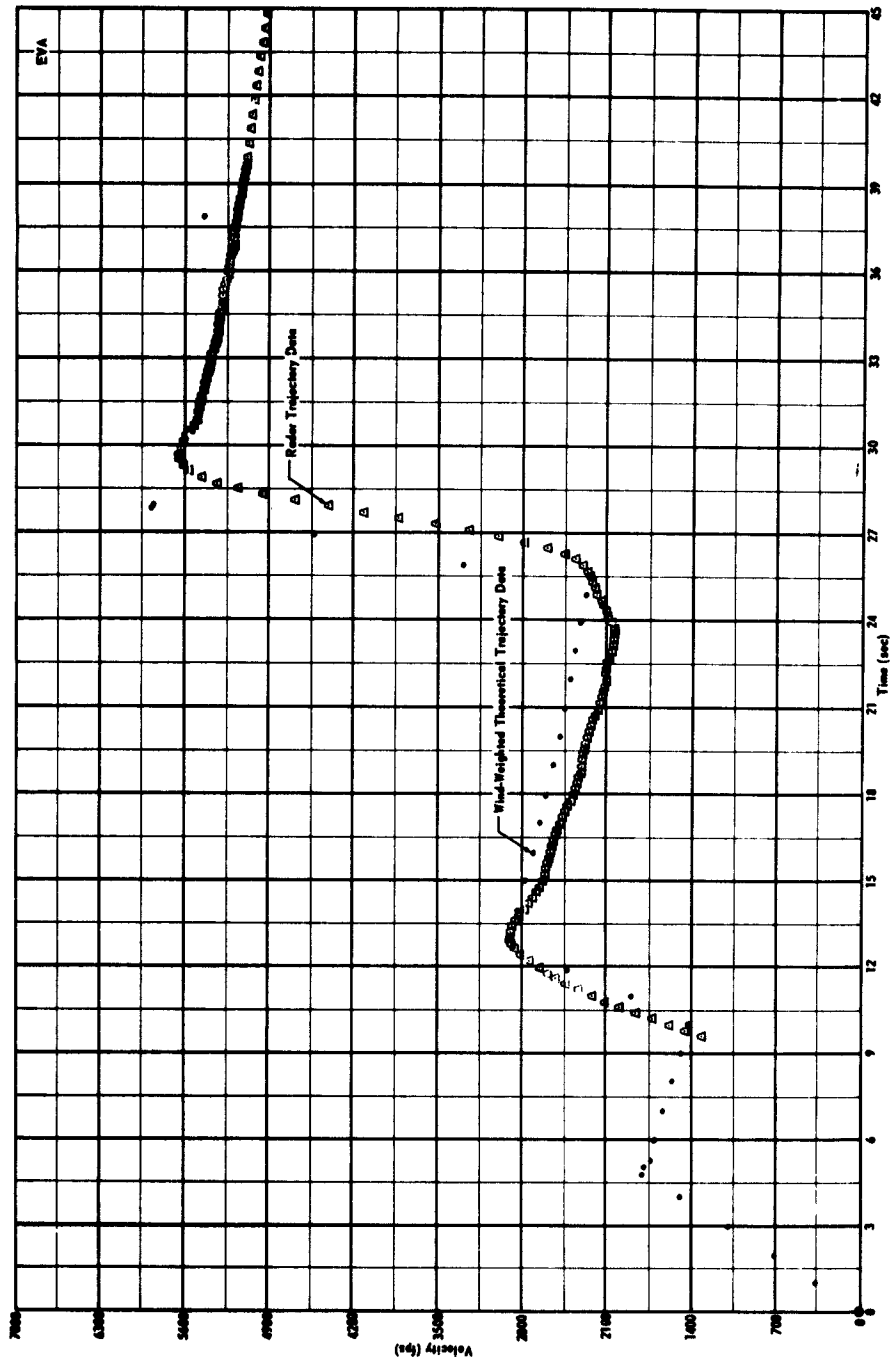


Fig. 68: Honest John-Nike-Nike (Eva) Velocity vs. Time (Trajectory Through Burnout).

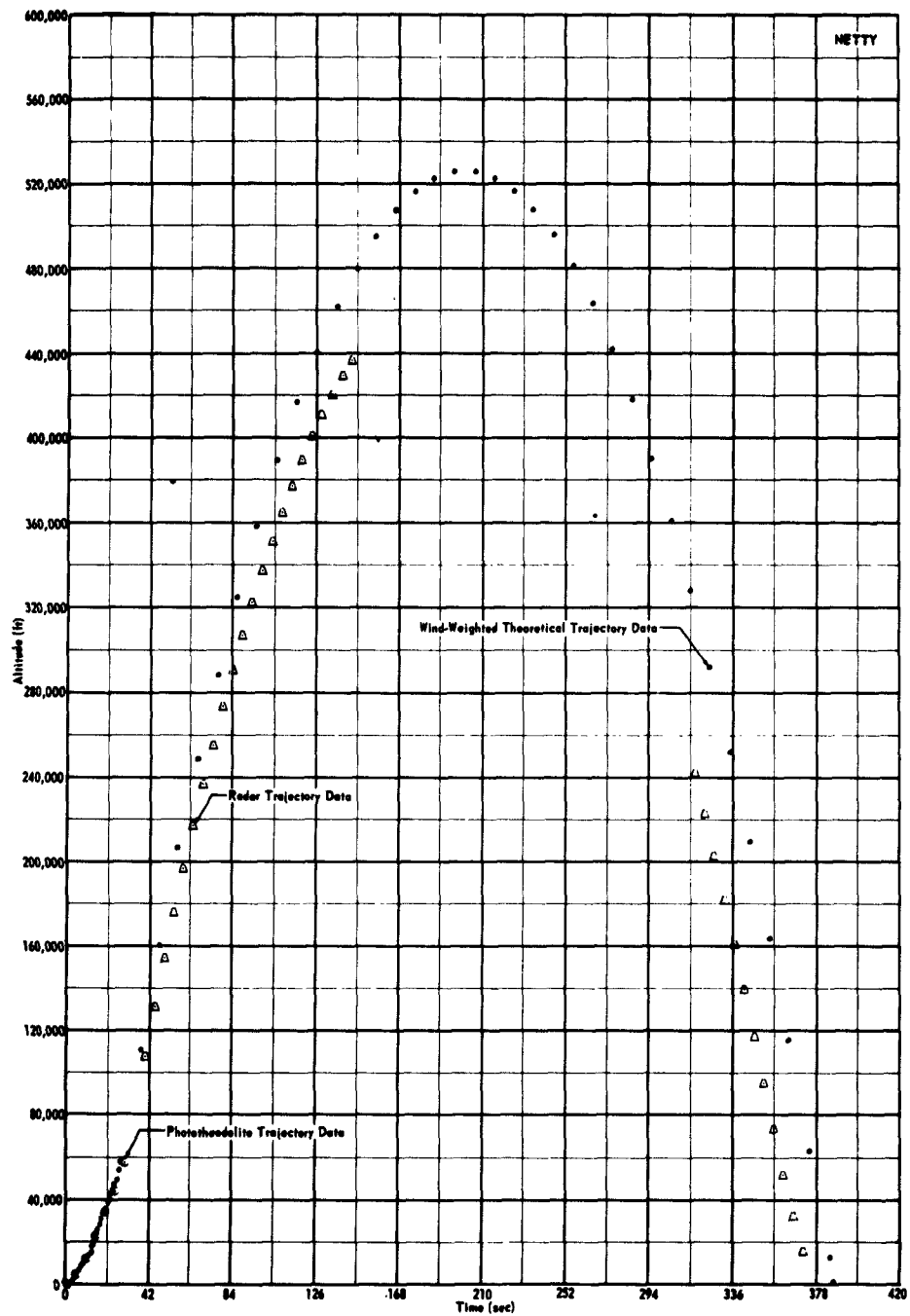


Fig. 69: Honest John-Nike-Nike (Netty) Altitude vs. Time (Entire Trajectory).

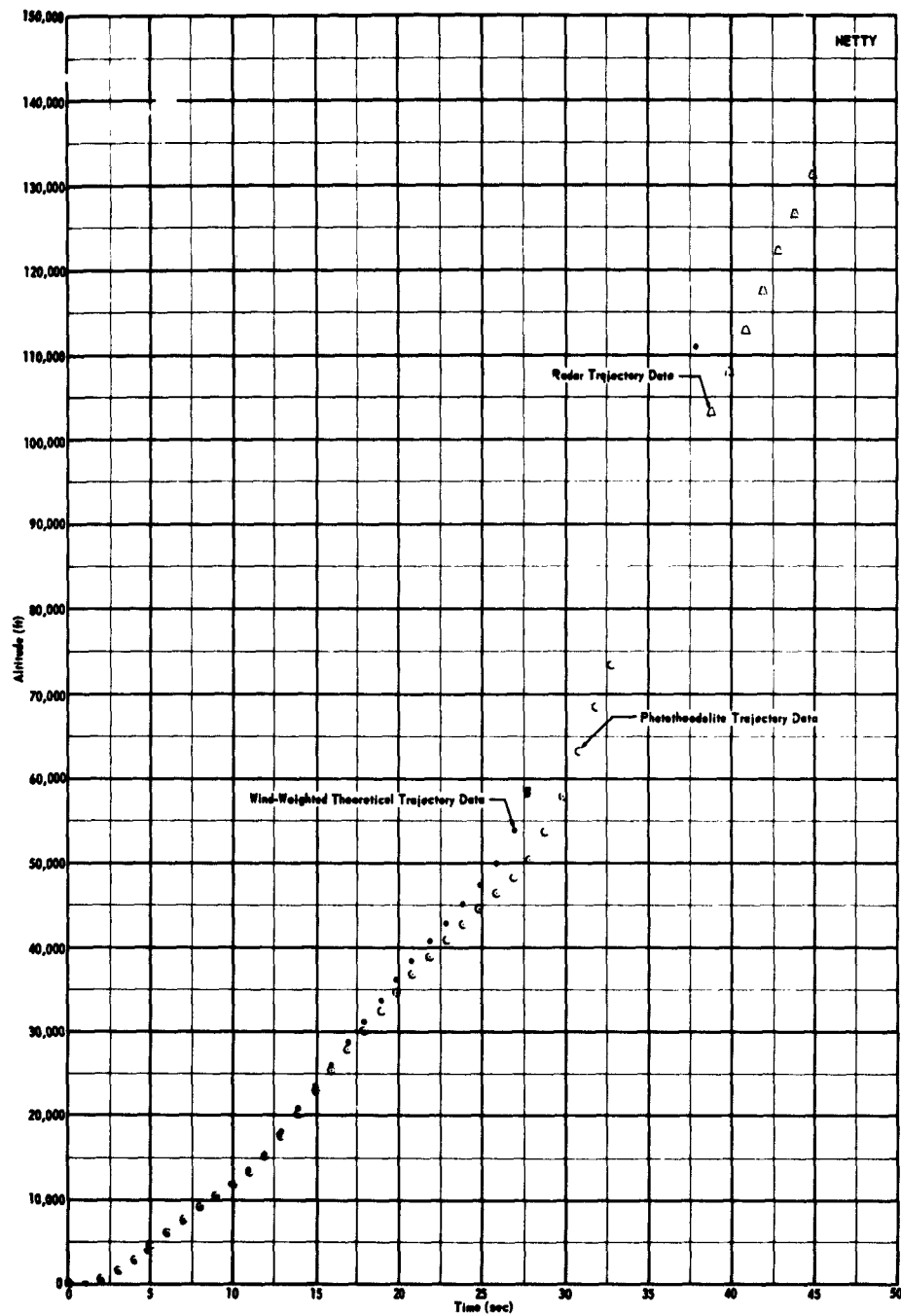


Fig. 70: Honest John-Nike-Nike (Netty) Altitude vs. Time (Trajectory Through Burnout).

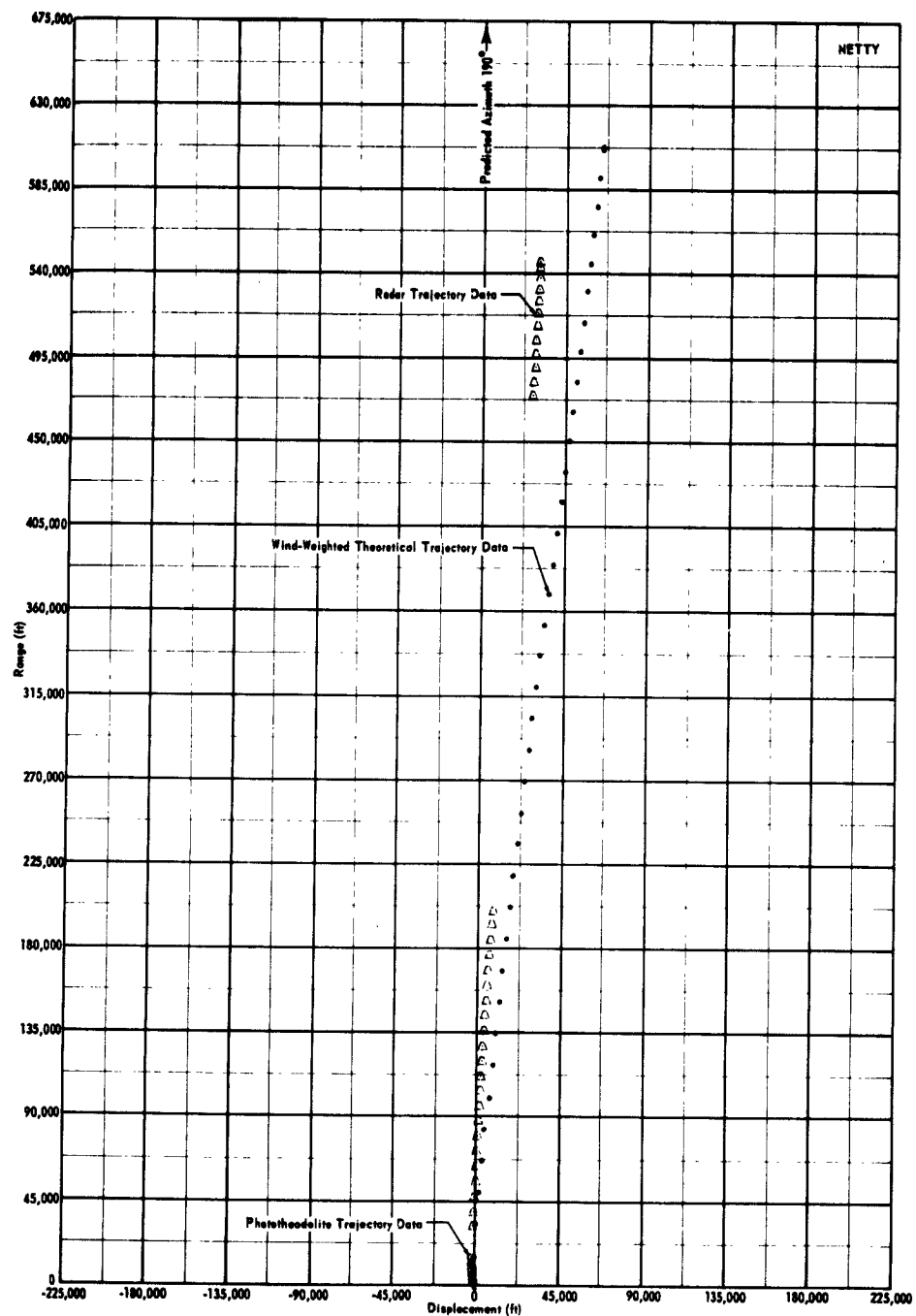


Fig. 71: Honest John-Nike-Nike (Netty) Range vs. Displacement (Entire Trajectory).

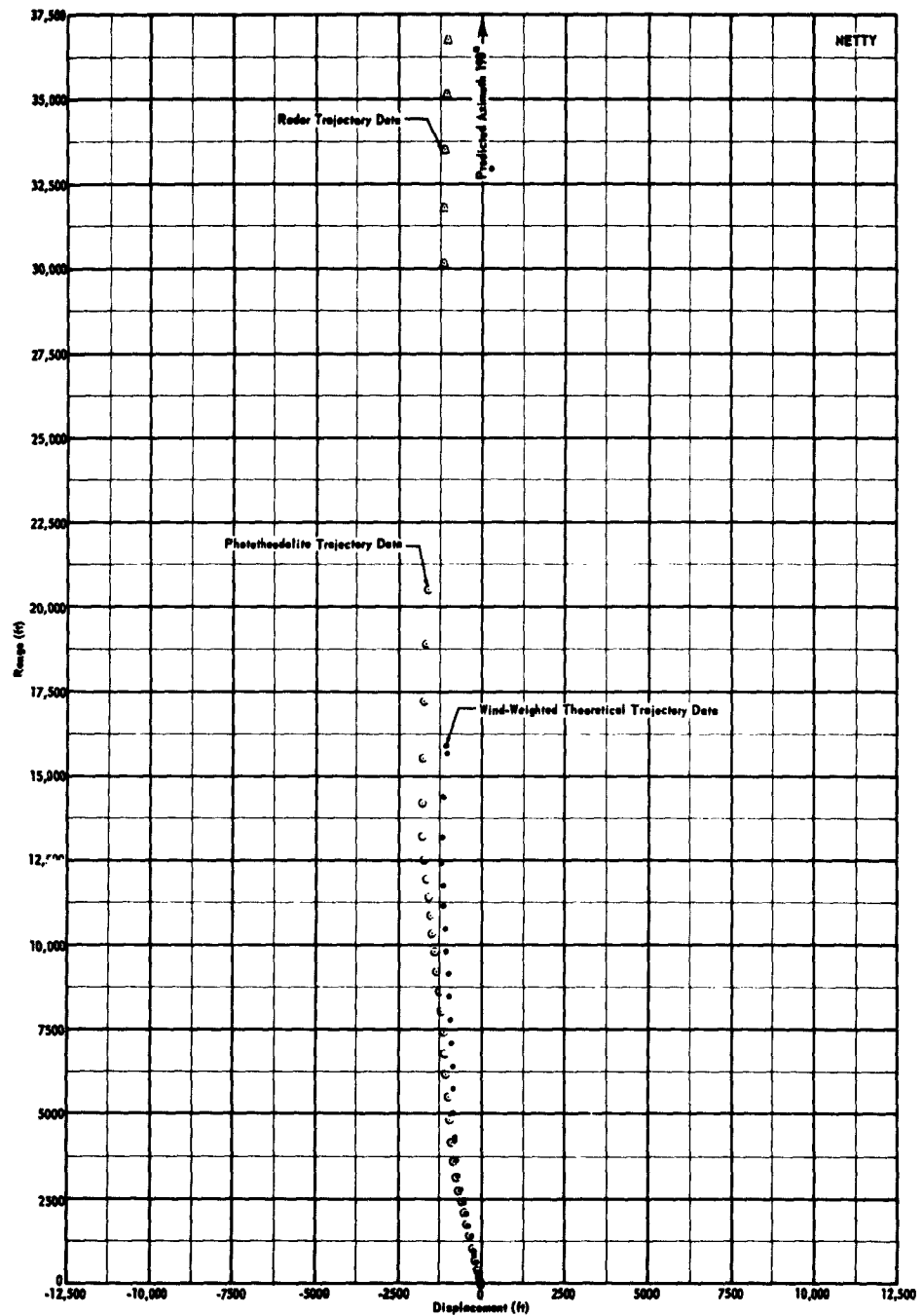


Fig. 72: Honest John-Nike-Nike (Netty) Range vs. Displacement (Trajectory Through Burnout).

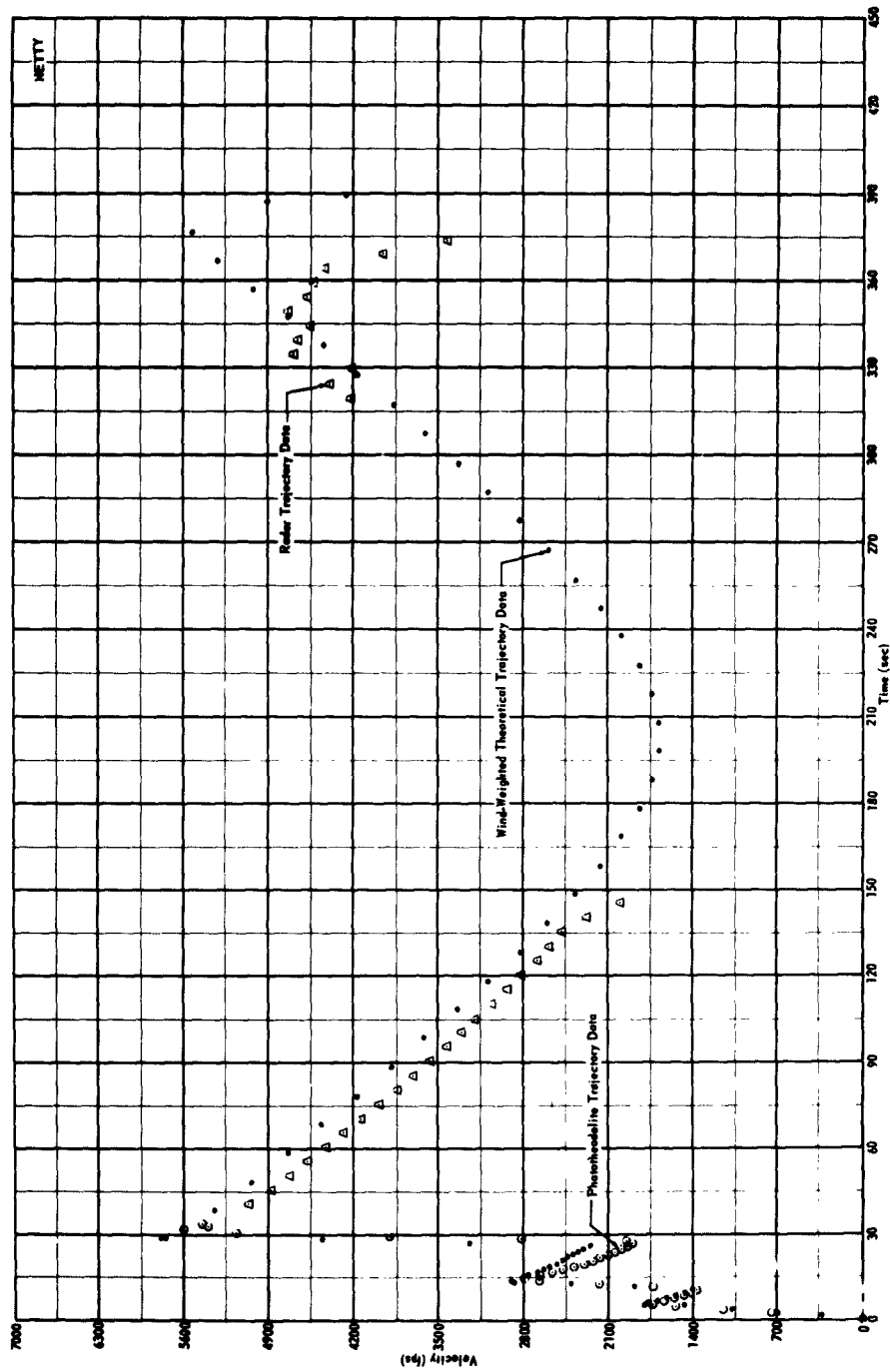


Fig. 73: Honest John-Nike-Nike (Netty) Velocity vs. Time (Entire Trajectory).

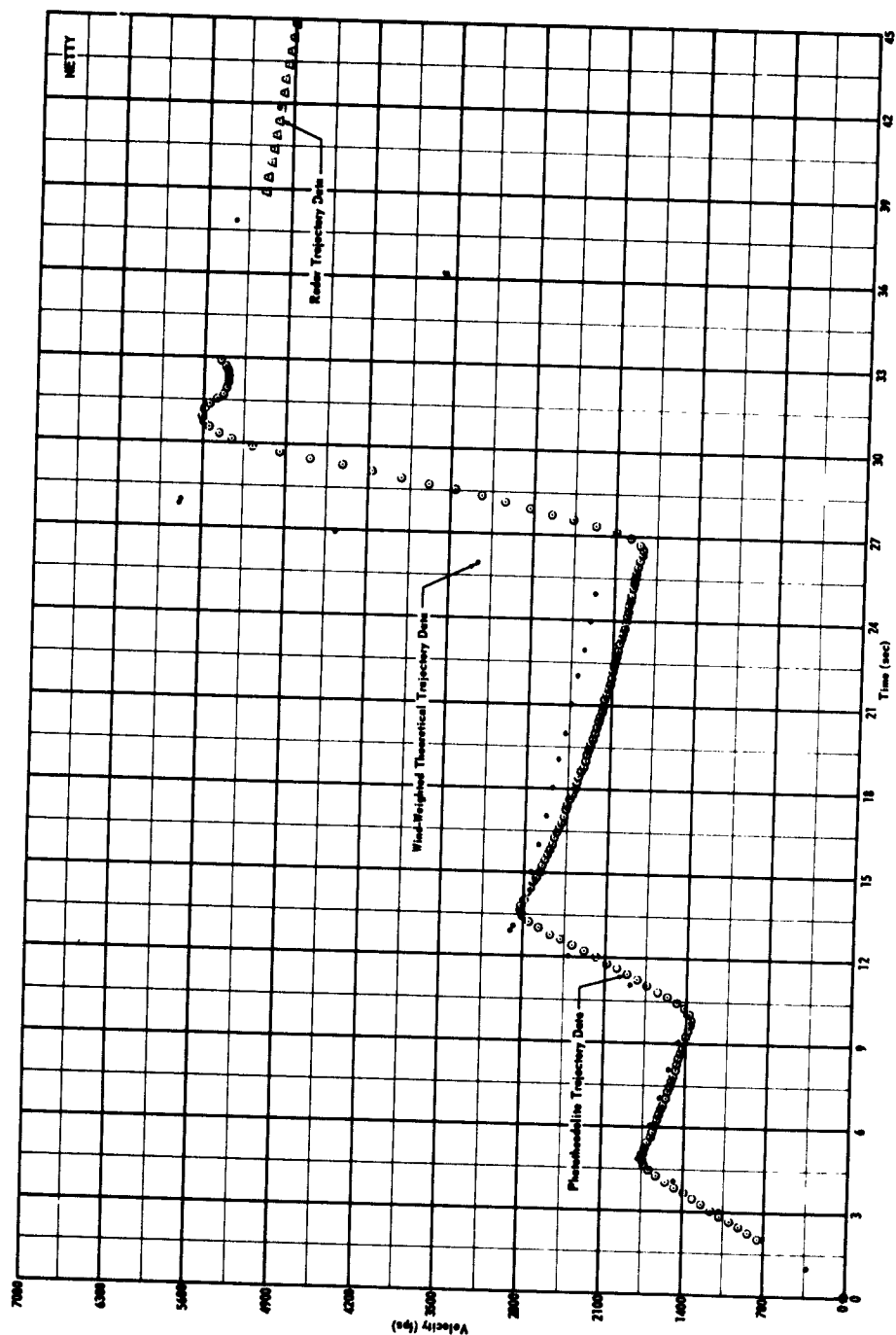


Fig. 74: Honest John-Nike-Nike (Netty) Velocity vs. Time (Trajectory Through Burnout).

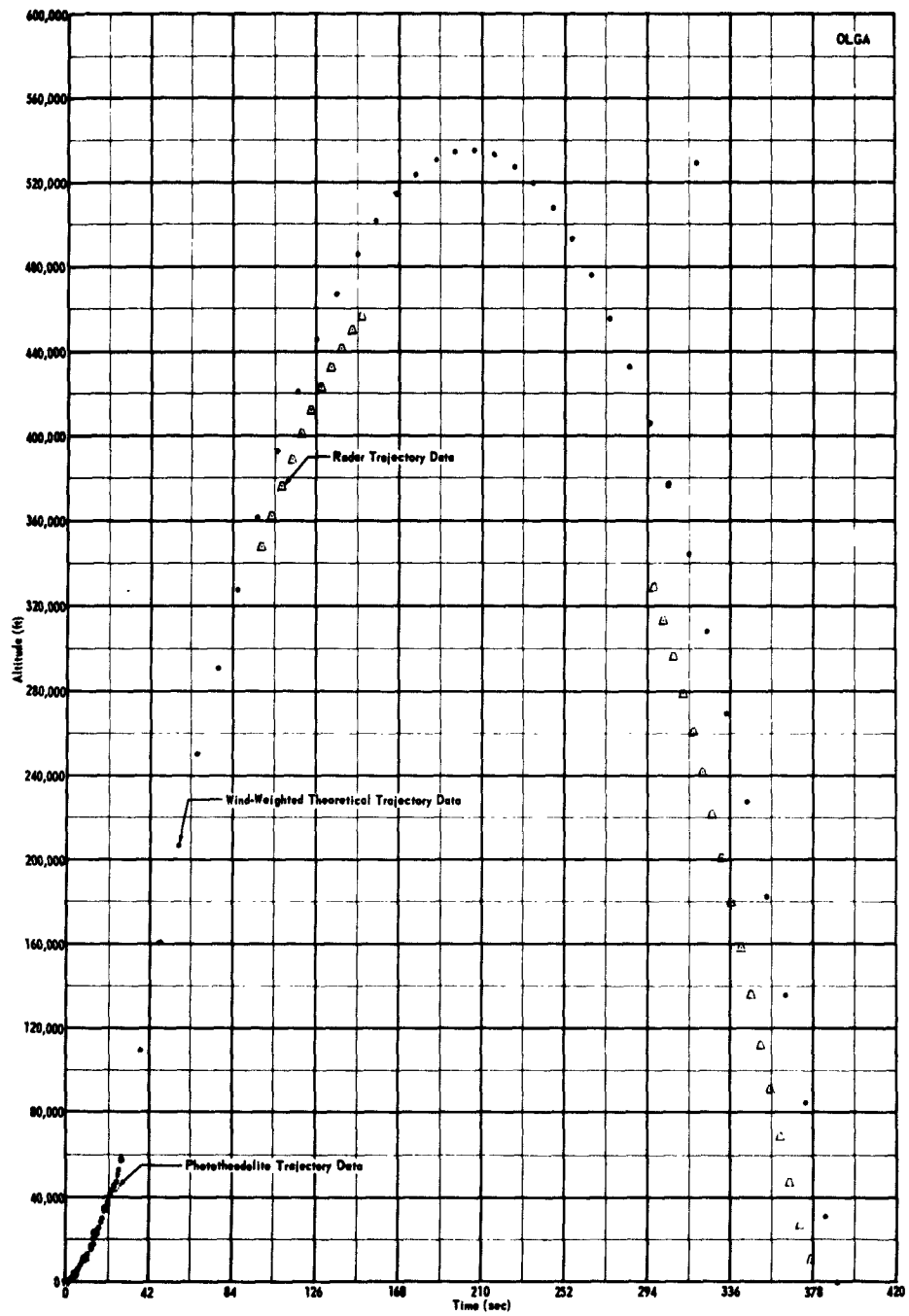


Fig. 75: Honest John-Nike-Nike (Olga) Altitude vs. Time (Entire Trajectory).

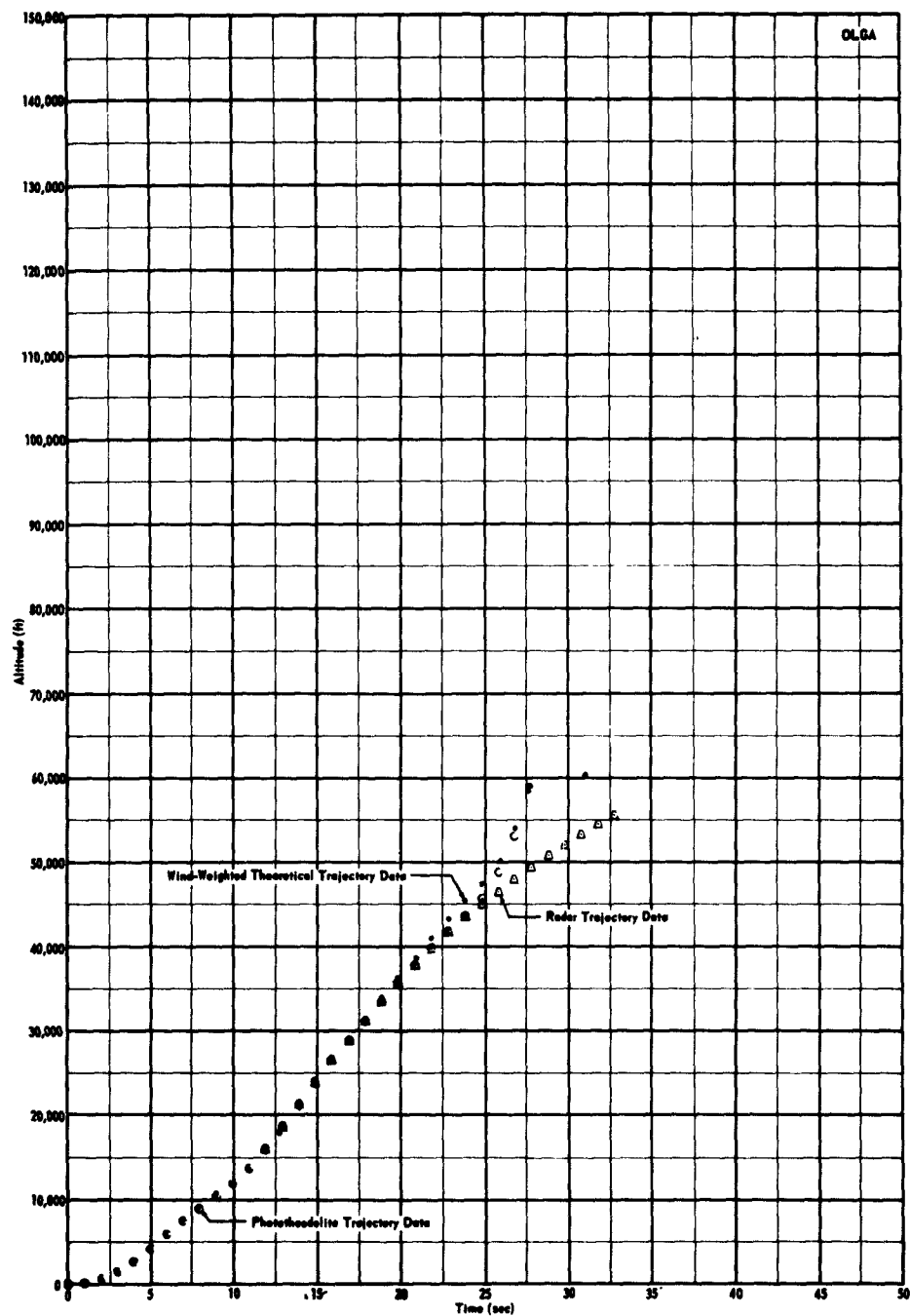


Fig. 76: Honest John-Nike-Nike (Olga) Altitude vs. Time (Trajectory Through Burnout).

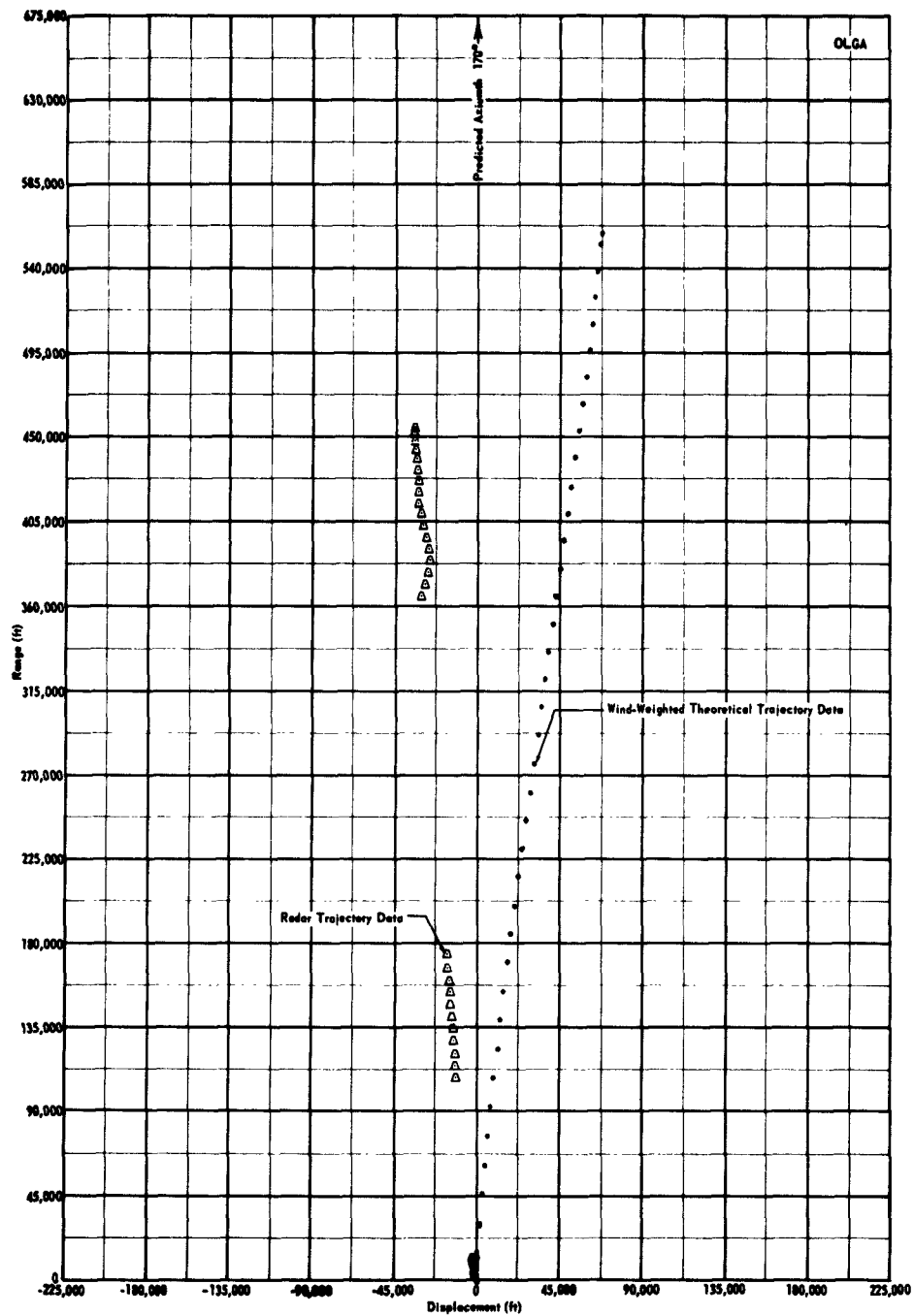


Fig. 77: Honest John-Nike-Nike (Olga) Range vs. Displacement (Entire Trajectory).

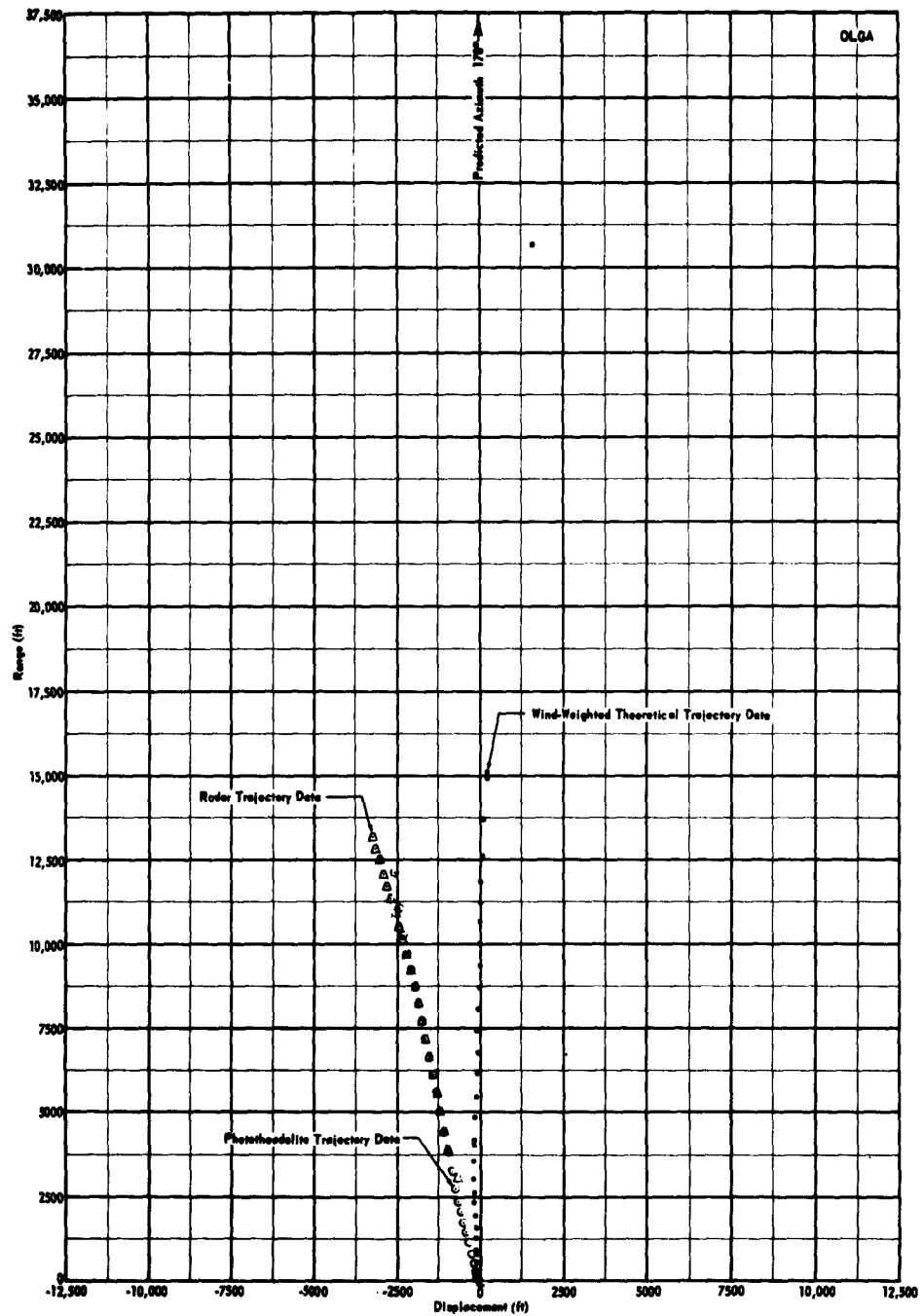


Fig 78: Honest John-Nike-Nike (Olga) Range vs. Displacement (Trajectory Through Burnout).

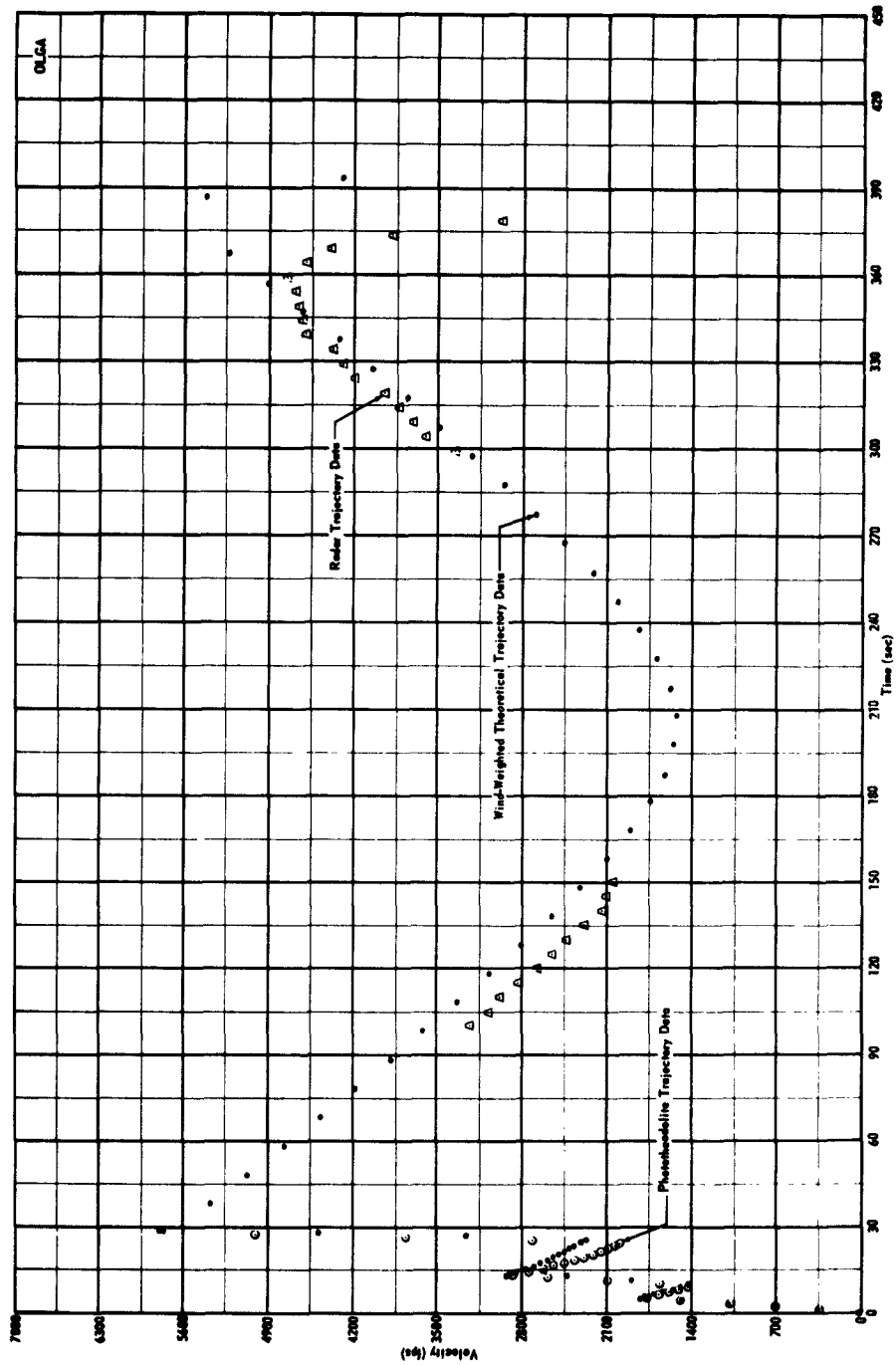


Fig. 79: Honest John-Nike-Nike (Olga) Velocity vs. Time (Entire Trajectory).

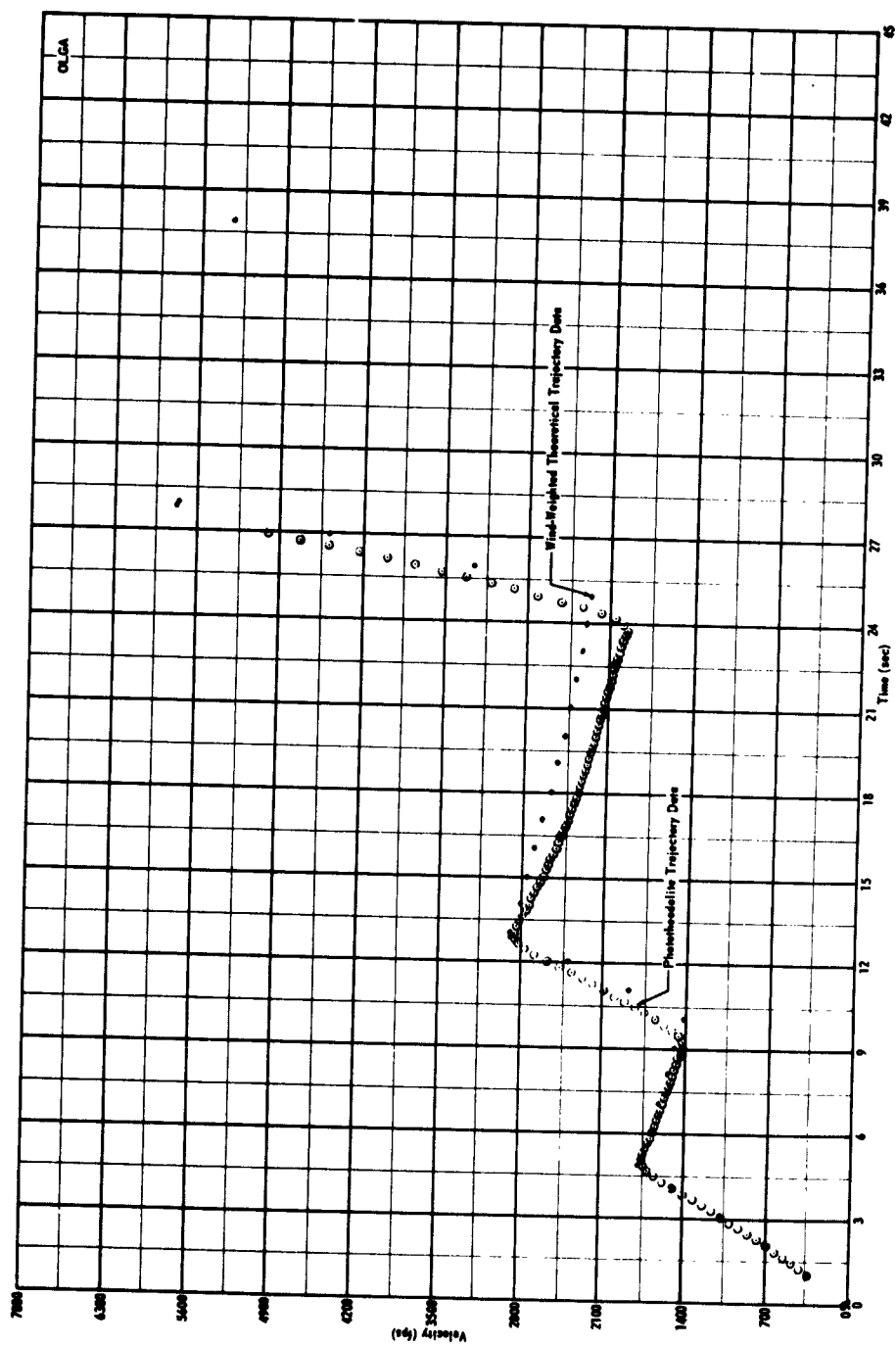


Fig. 80: Honest John-Nike-Nike (Olga) Velocity vs. Time (Trajectory Through Burnout).

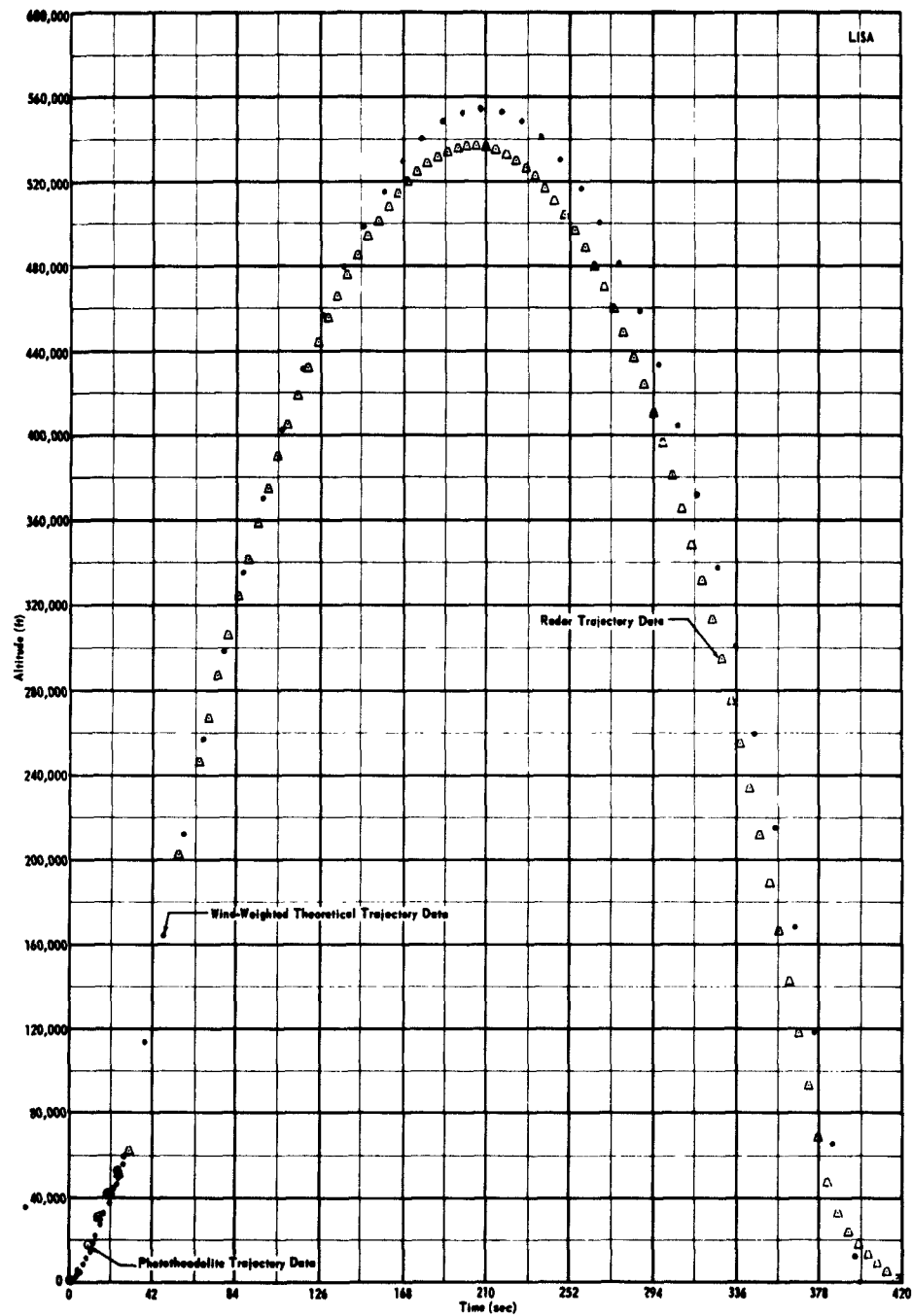


Fig. 81: Honest John-Nike-Nike (Lisa) Altitude vs Time (Entire Trajectory)

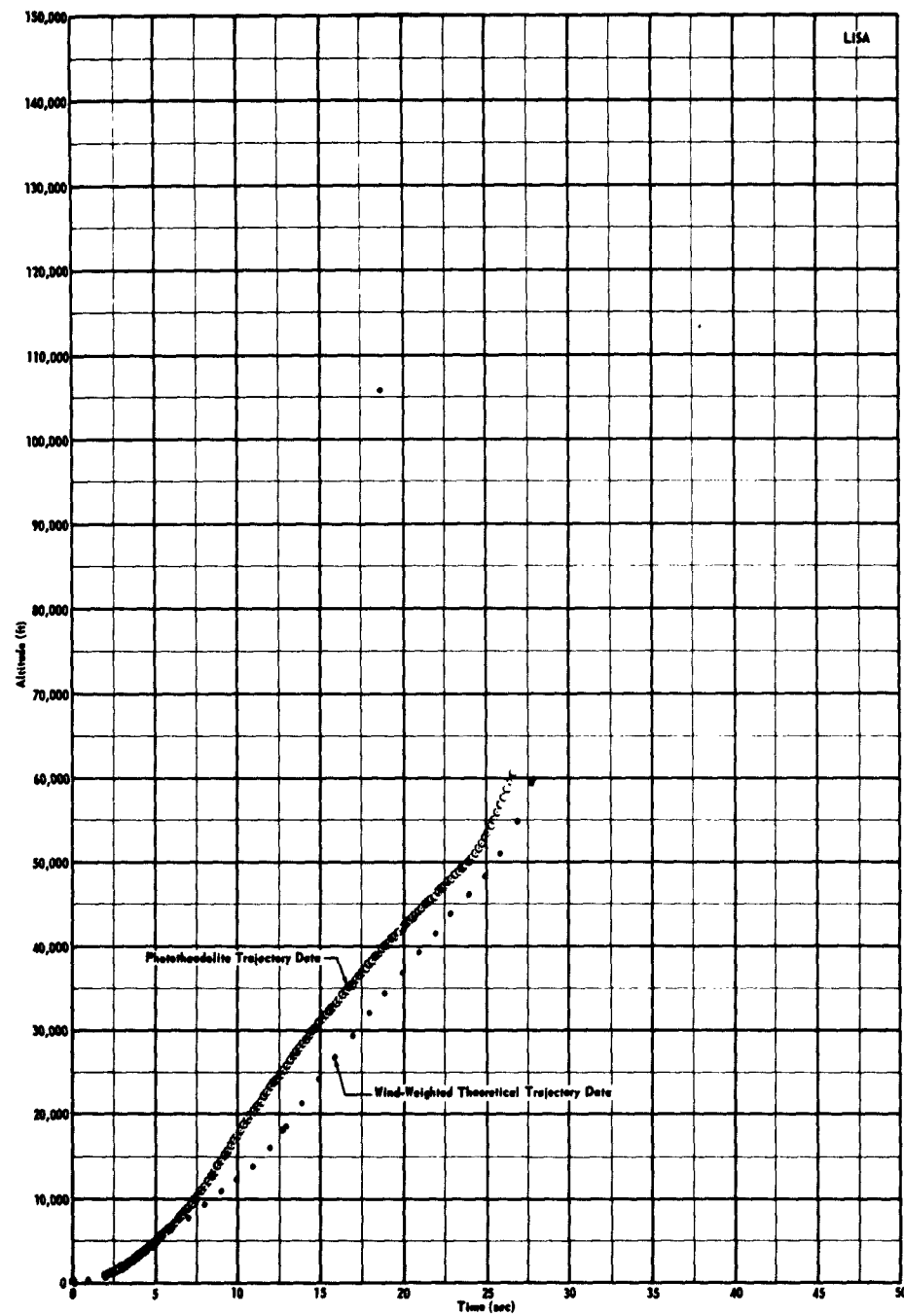


Fig. 82: Honest John-Nike-Nike (Lisa) Altitude vs. Time (Trajectory Through Burnout).

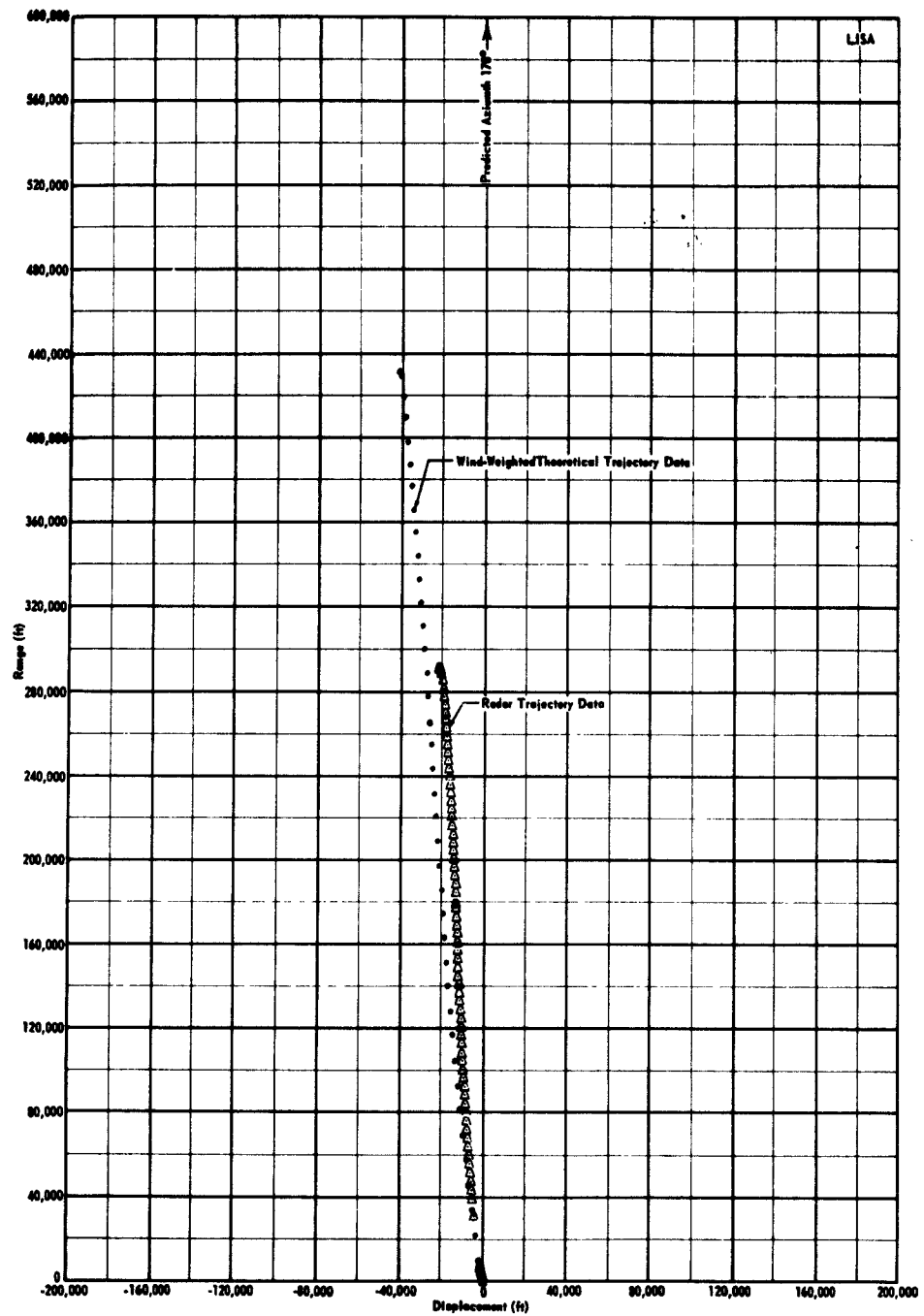


Fig 83: Honest John-Nike-Nike (Lisa) Range vs. Displacement (Entire Trajectory)

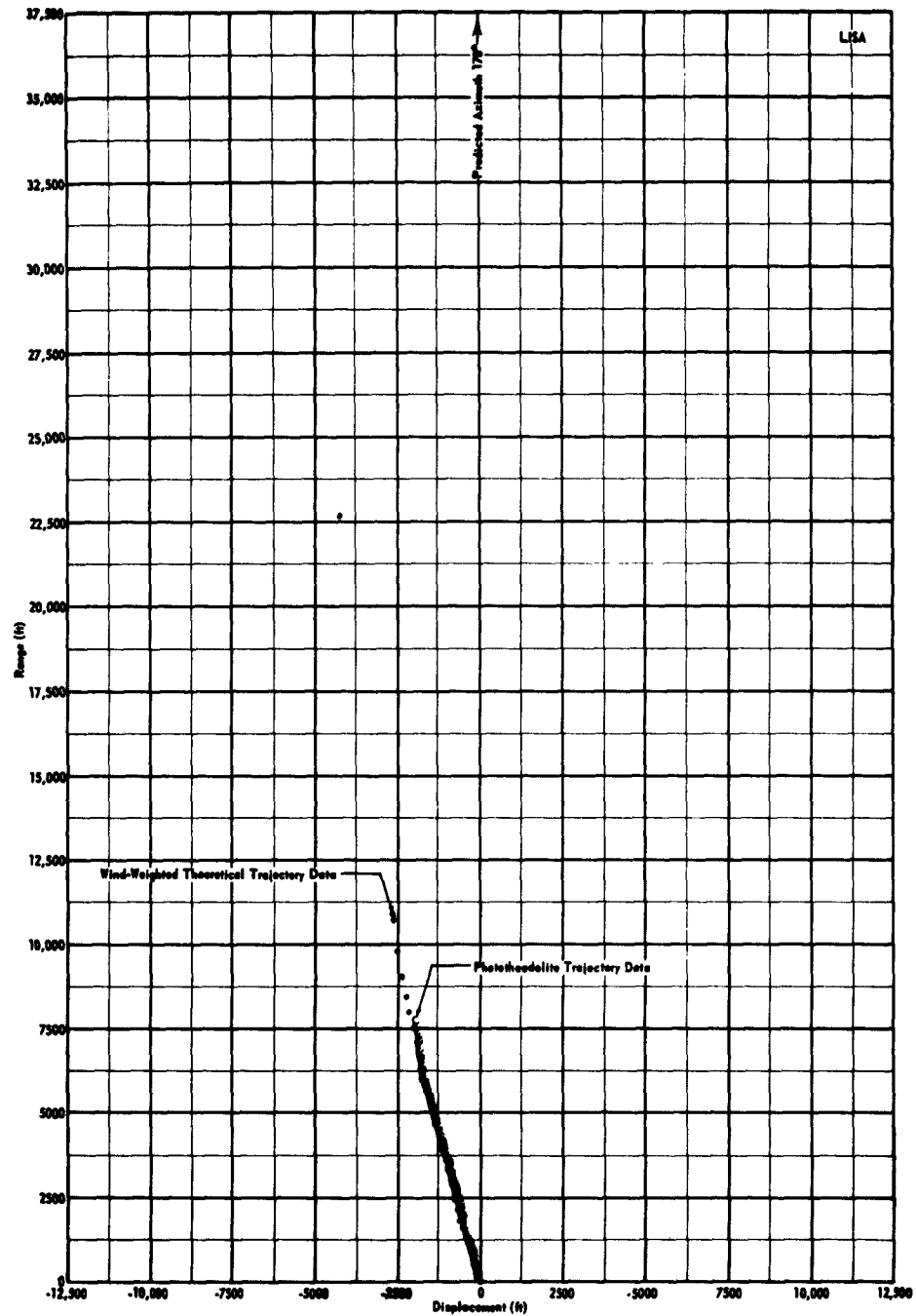


Fig. 84: Honest John-Nike-Nike (Lisa) Range vs. Displacement (Trajectory Through Burnout).

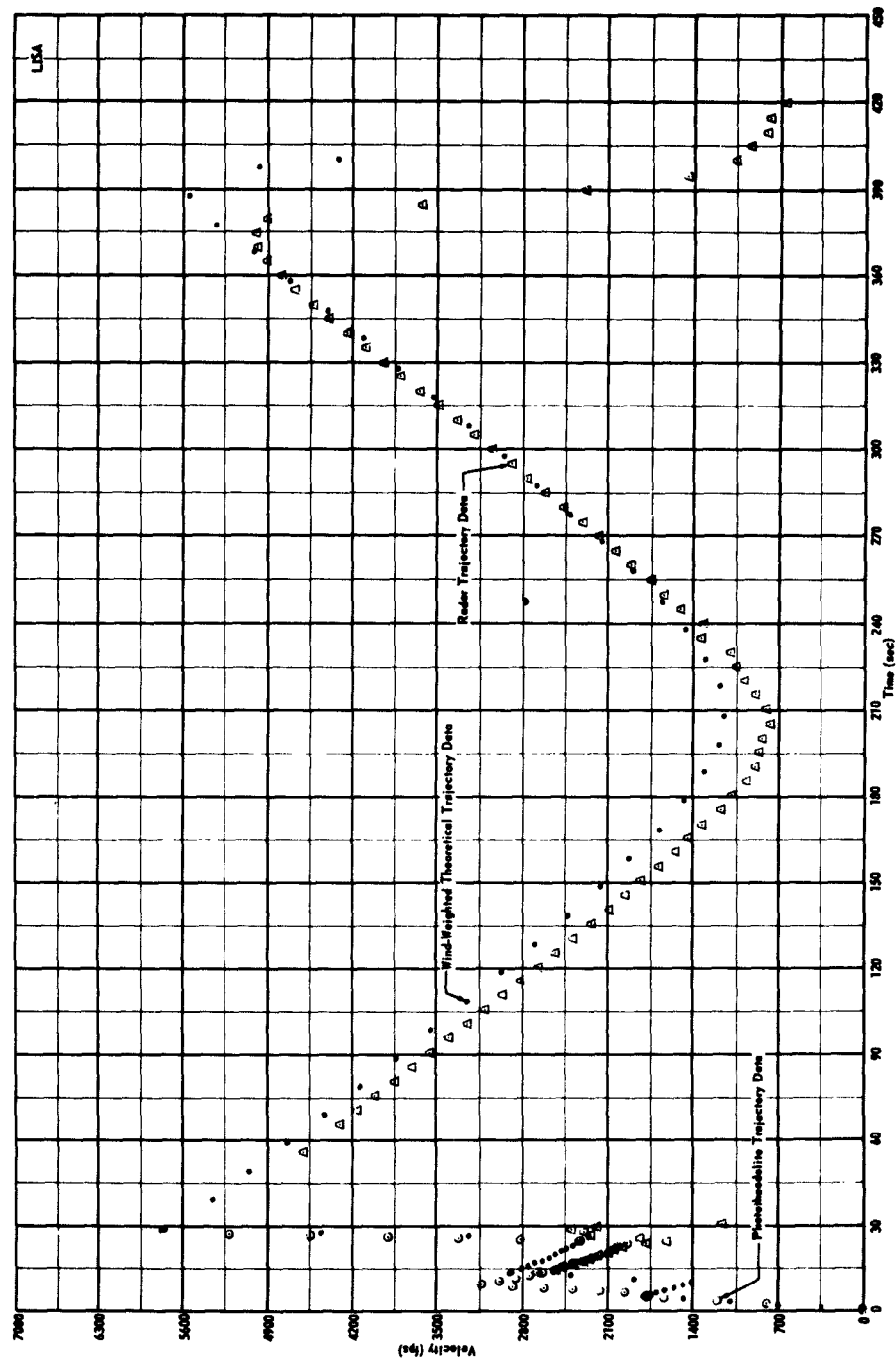


Fig. 85: Honest John-Nike-Nike (Lisa) Velocity vs. Time (Entire Trajectory).

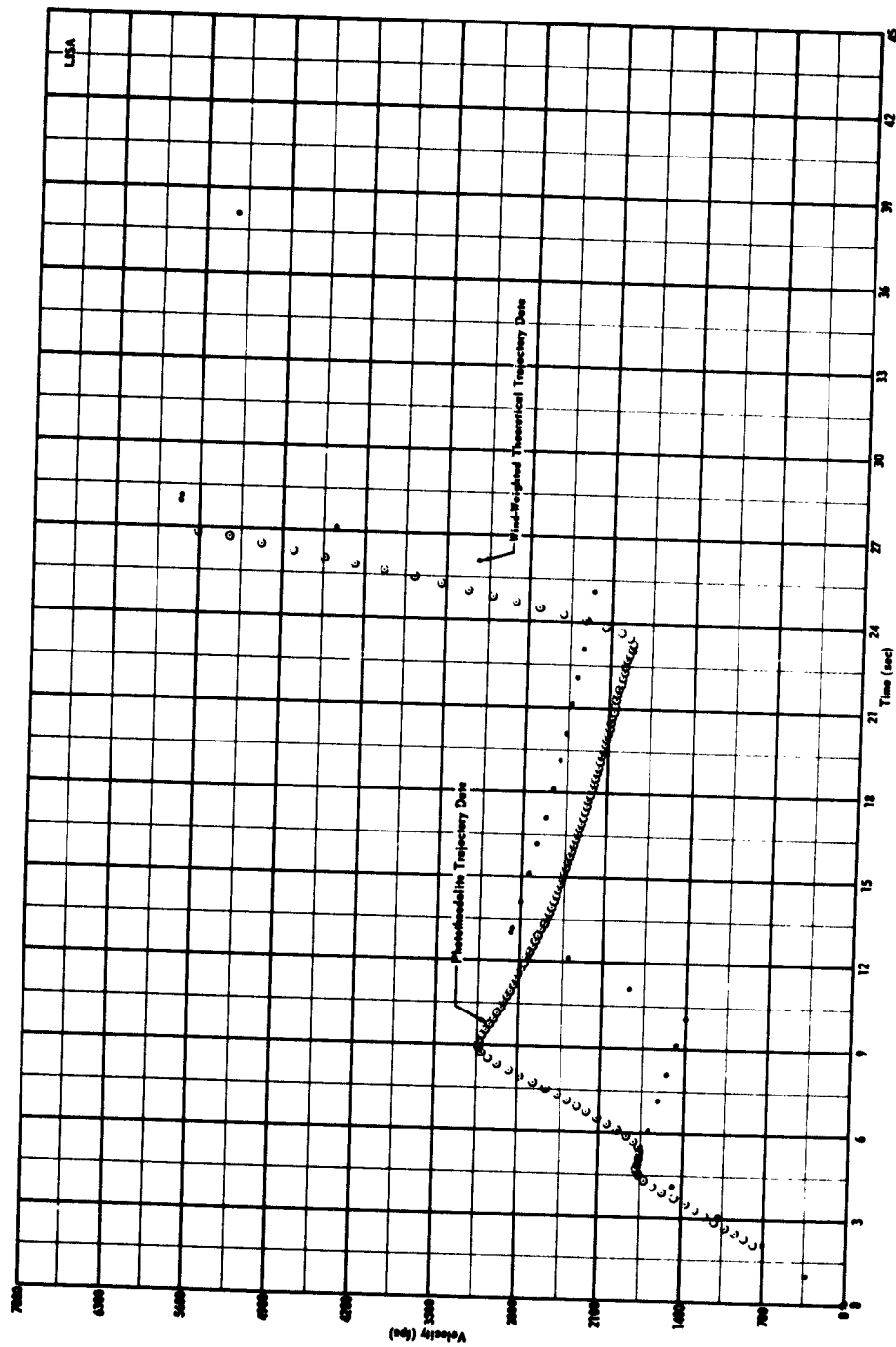


Fig. 86: Honest John-Nike-Nike (Lisa) Velocity vs. Time (Trajectory Through Burnout).

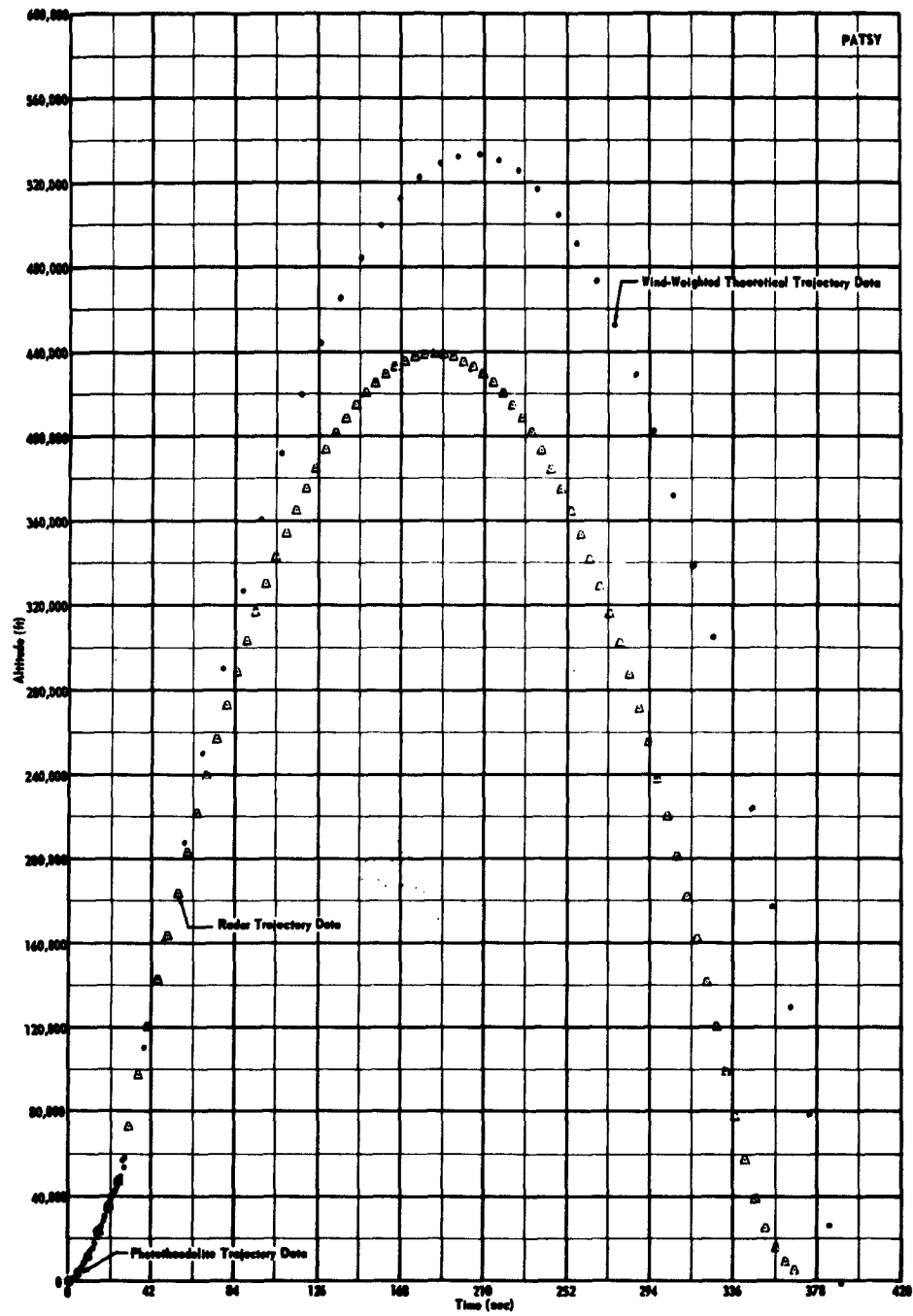


Fig. 87: Honest John-Nike-Nike (Patsy) Altitude vs. Time (Entire Trajectory).

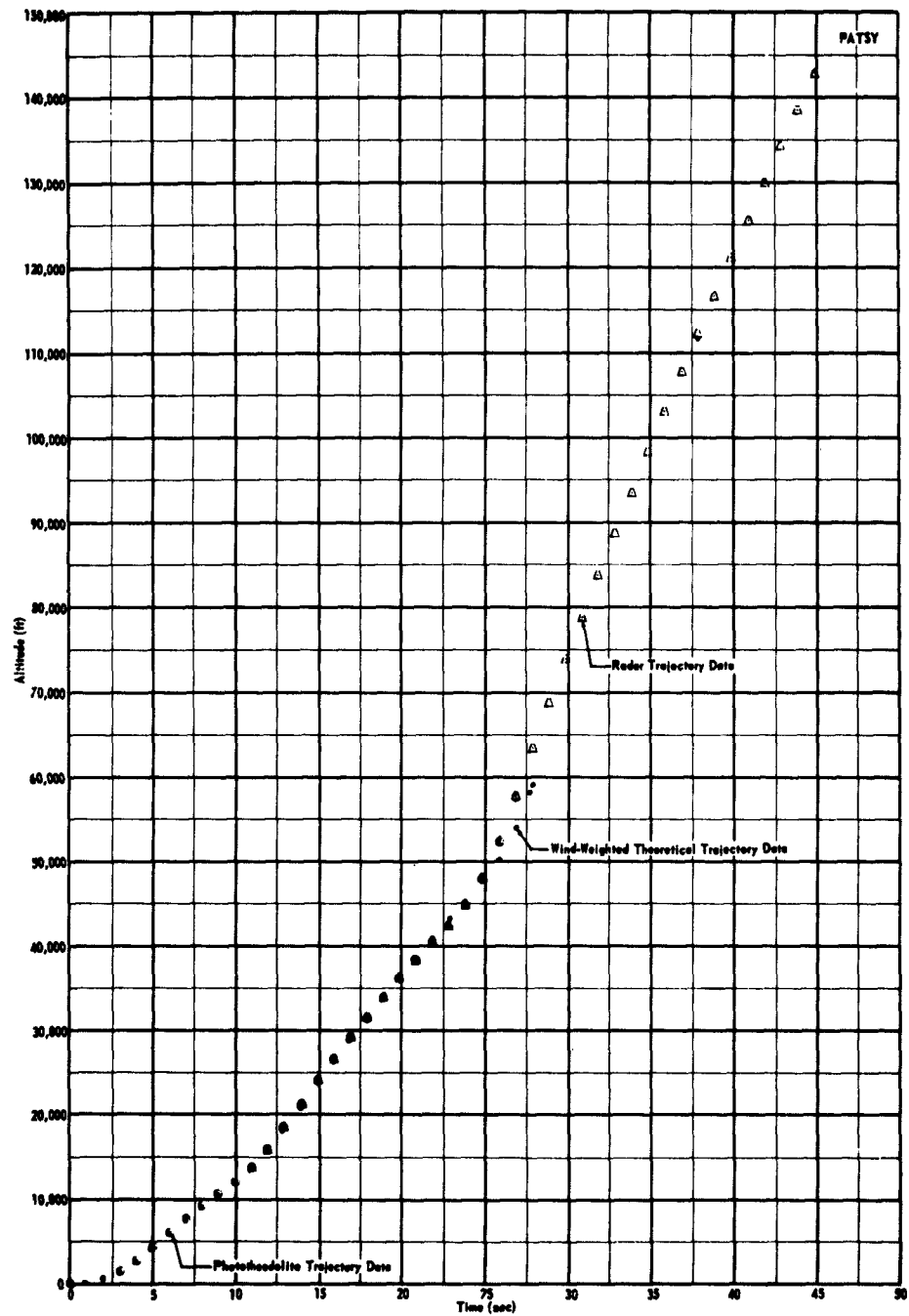


Fig. 88: Honest John-Nike-Nike (Patsy) Altitude vs. Time (Trajectory Through Burnout) .

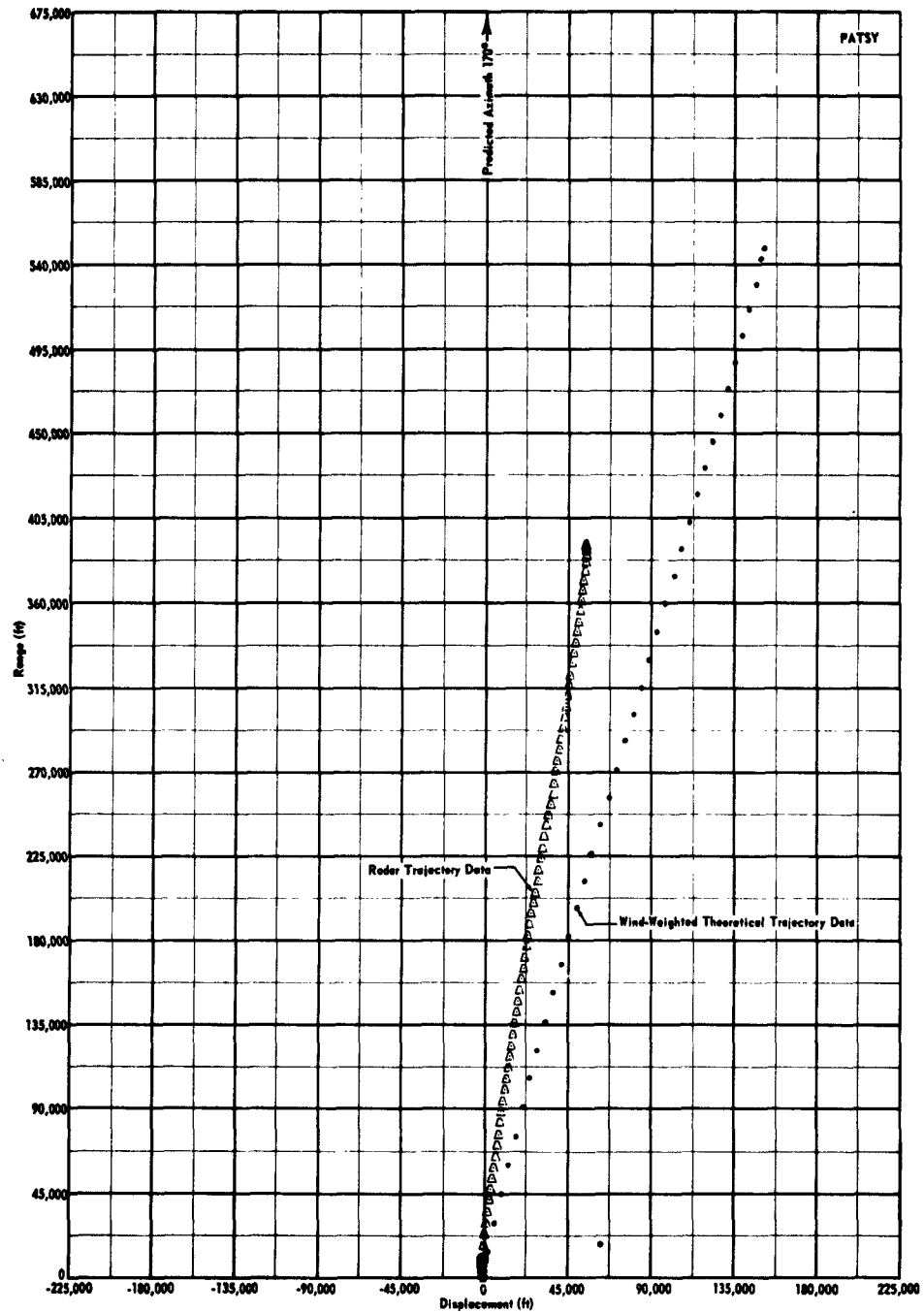


Fig. 89: Honest John-Nike-Nike (Patsy) Range vs. Displacement (Entire Trajectory).

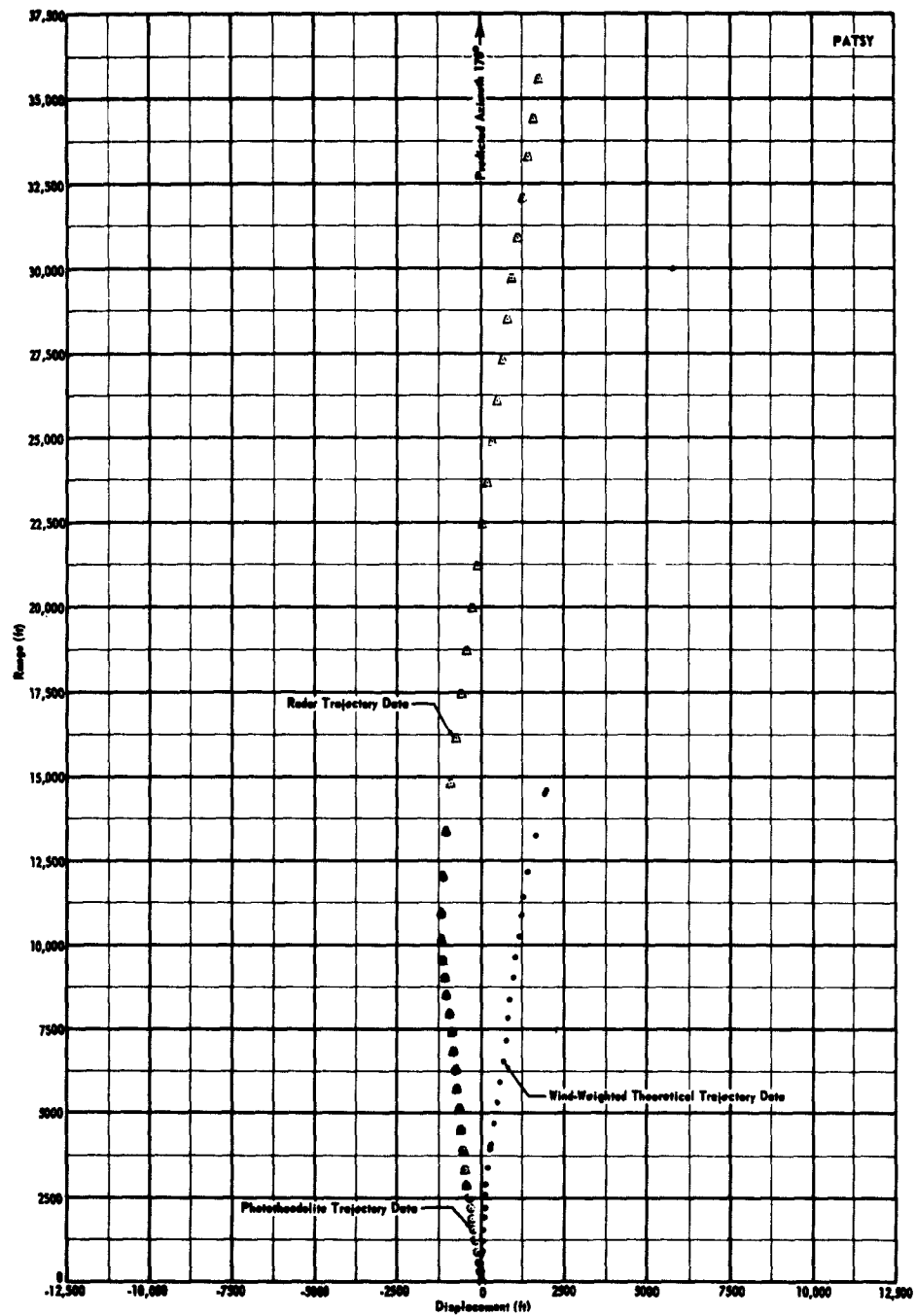


Fig. 90: Honest John-Nike-Nike (Patsy) Range vs. Displacement (Trajectory Through Burnout).

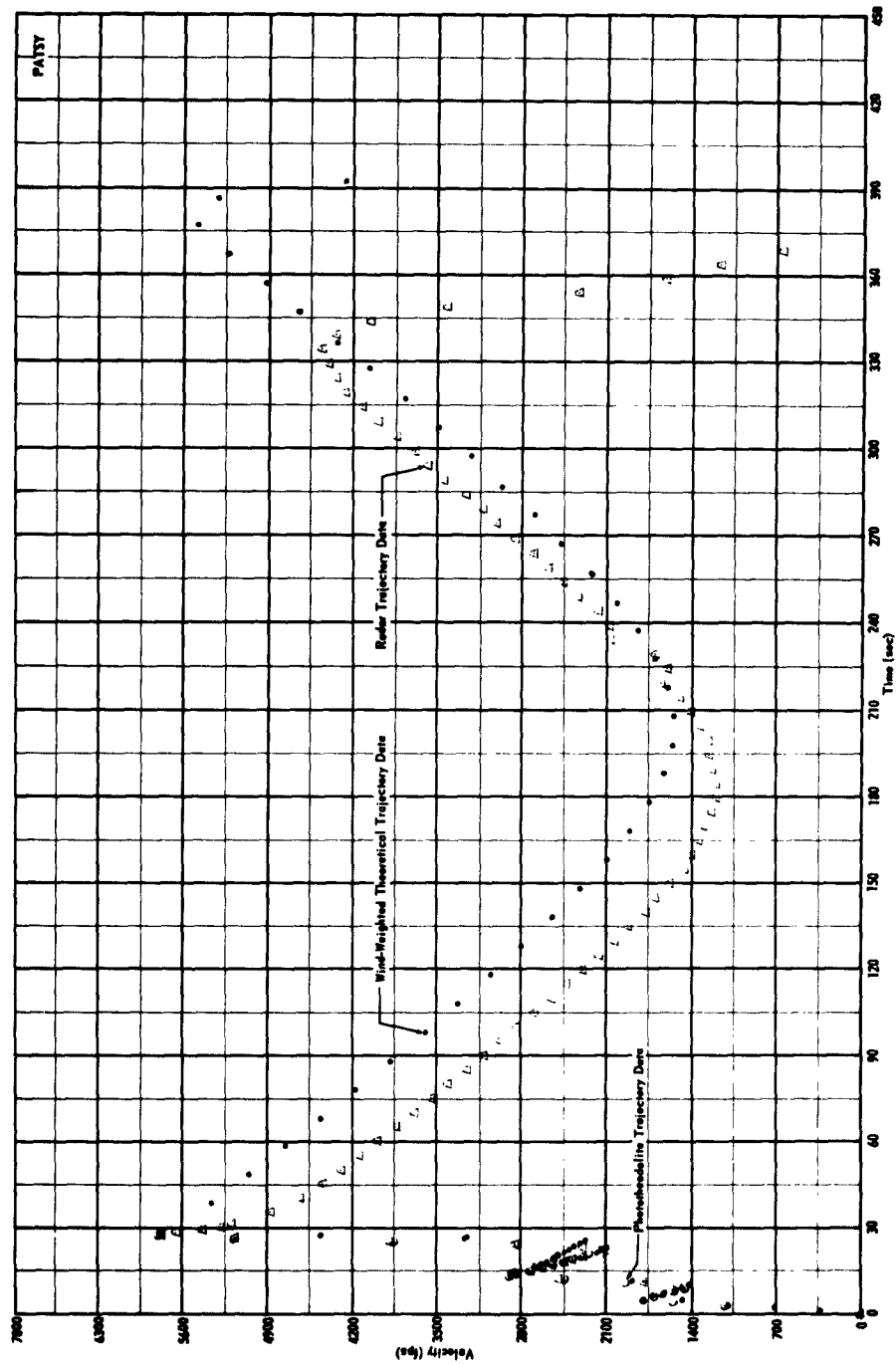


Fig. 91: Honest John-Nike-Nike (Patsy) Velocity vs. Time (Entire Trajectory).

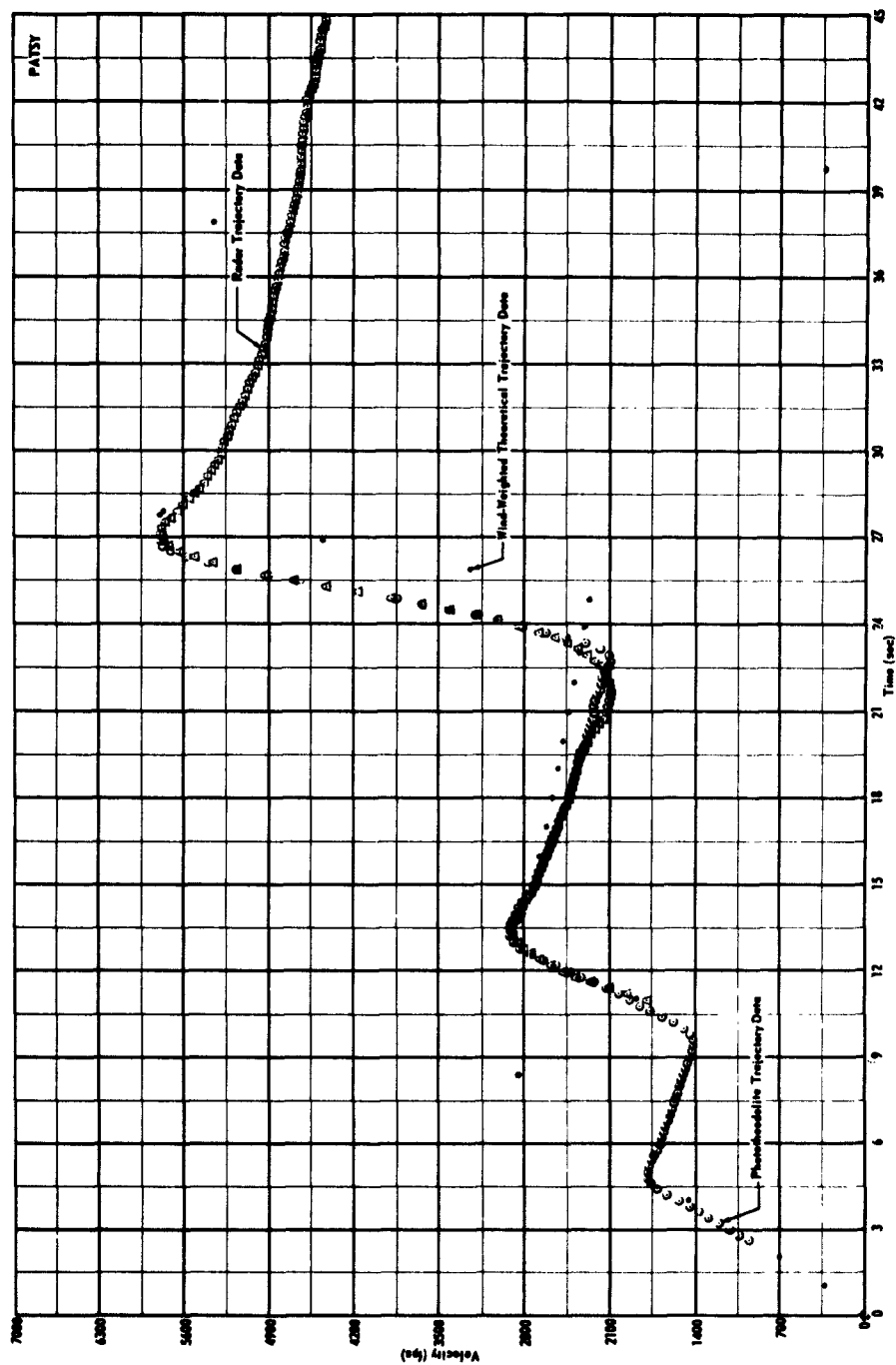


Fig. 92: Honest John-Nike-Nike (Patsy) Velocity vs. Time (Trajectory Through Burnout).

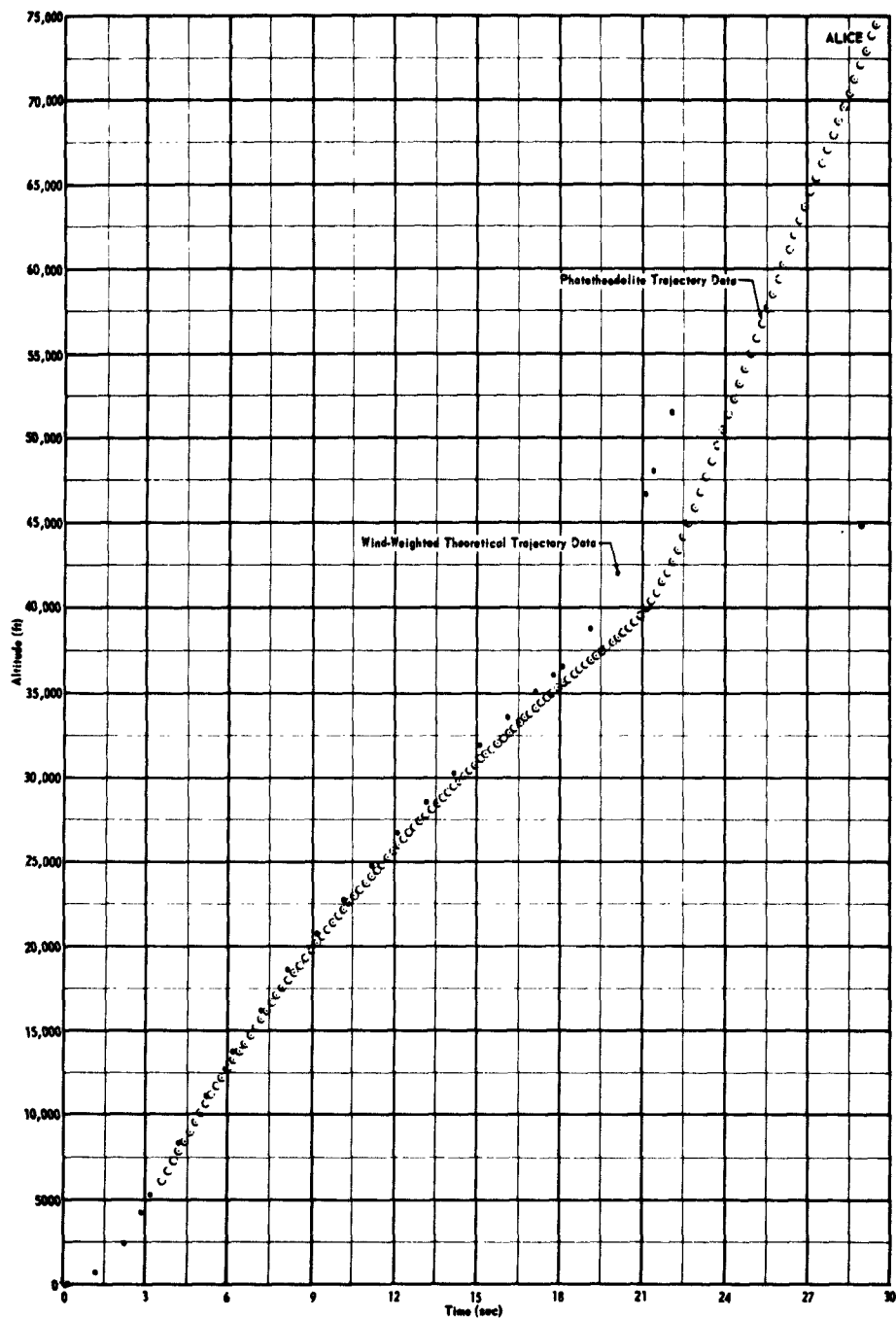


Fig. 93: Nike-Cajun (Alice) Altitude vs. Time (Trajectory Through Burnout).

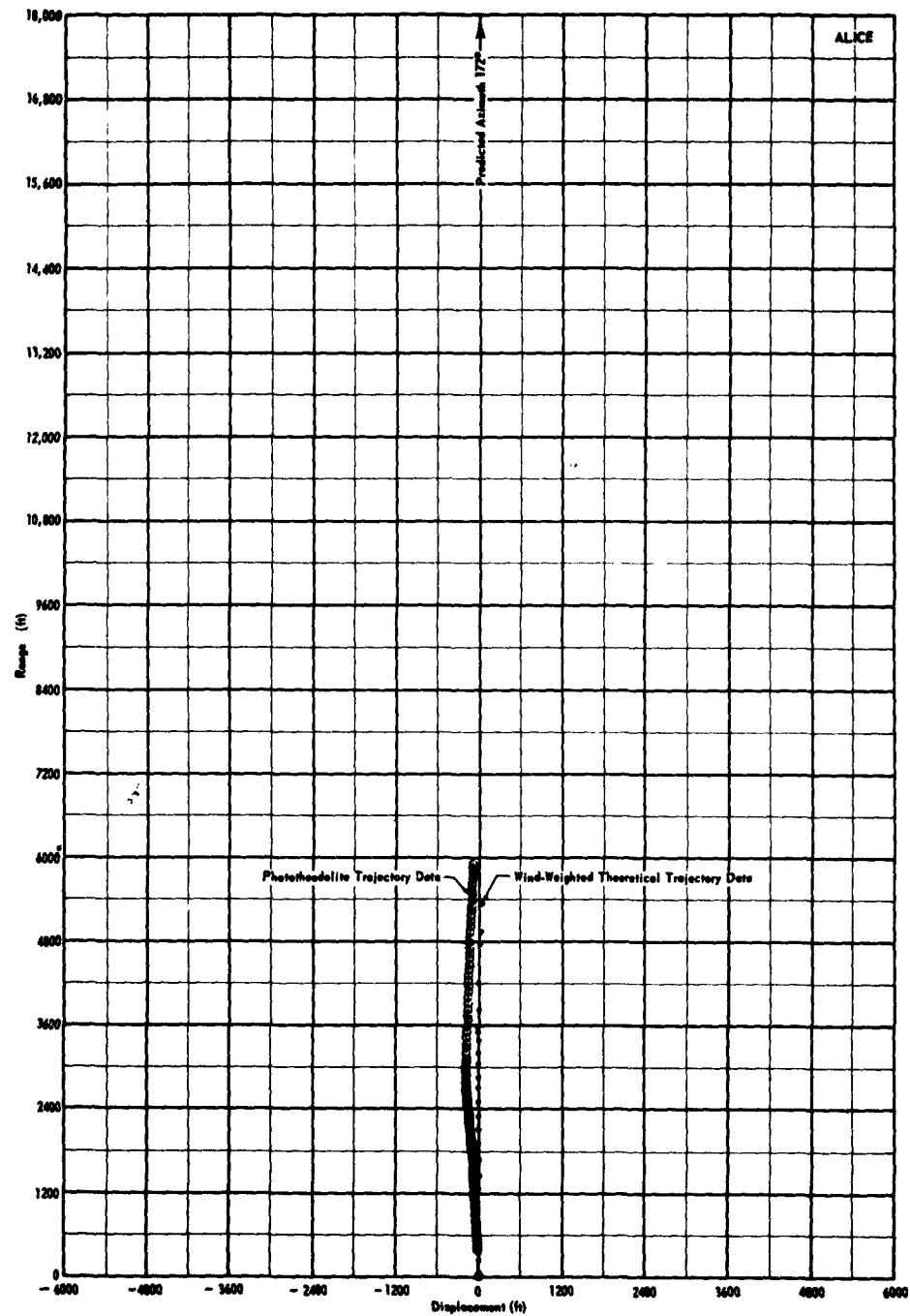


Fig. 94: Nike-Cajun (Alice) Range vs. Displacement (Trajectory Through Burnout).

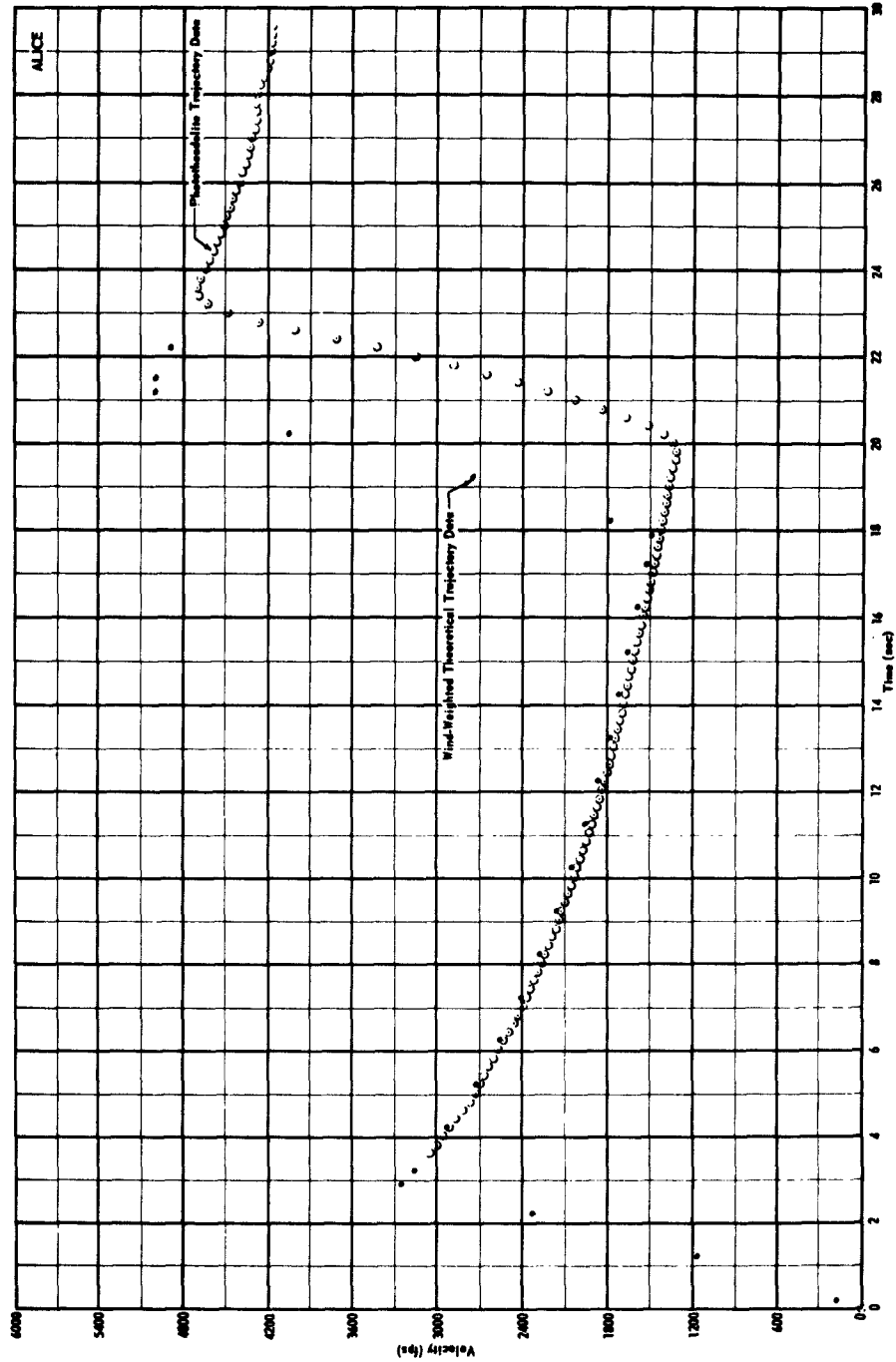


Fig. 95: Honest John-Nike-Nike (Alice) Velocity vs. Time (Trajectory Through Burnout).

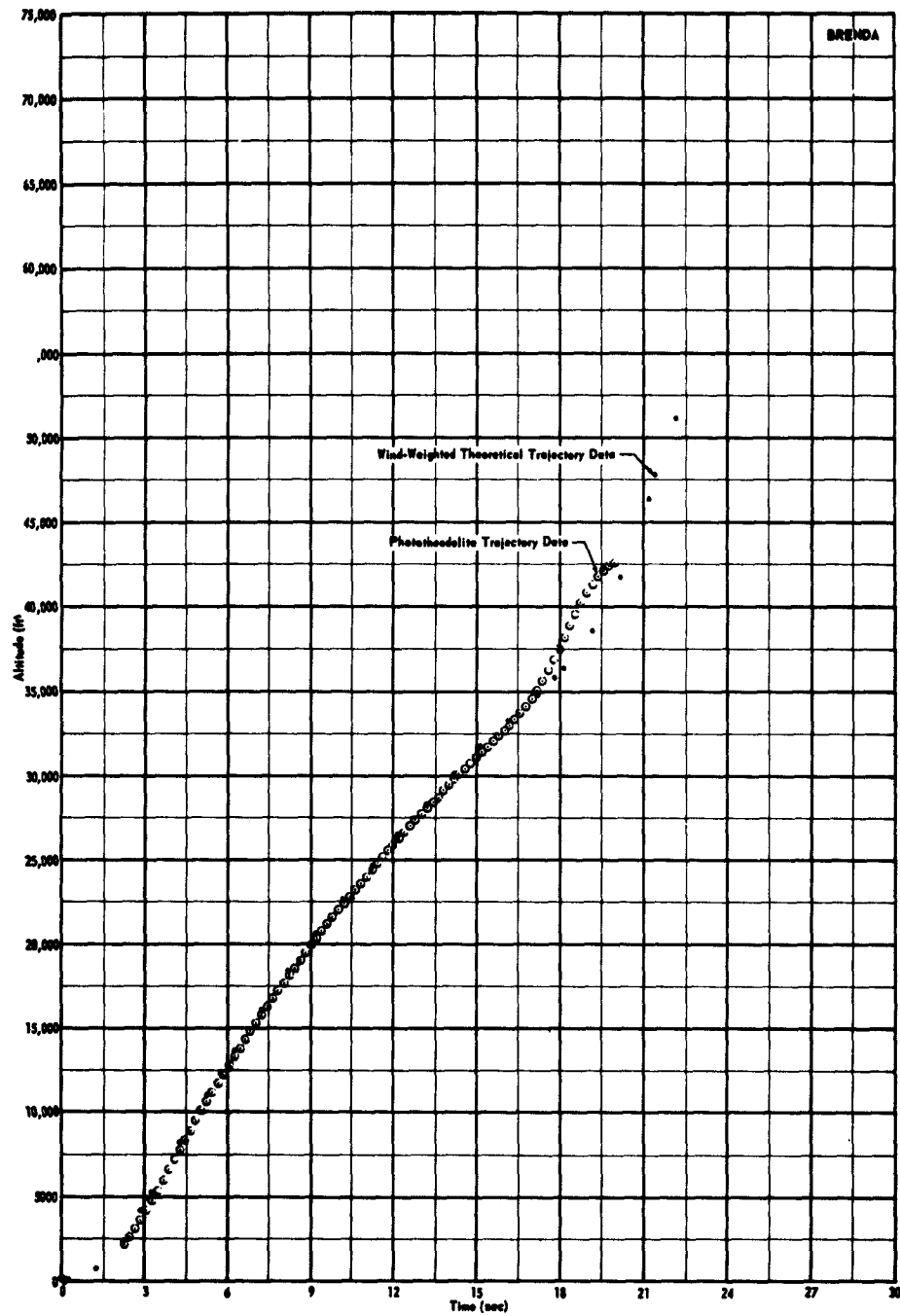


Fig. 96: Nike-Cajun (Brenda) Altitude vs. Time (Trajectory Through Burnout).

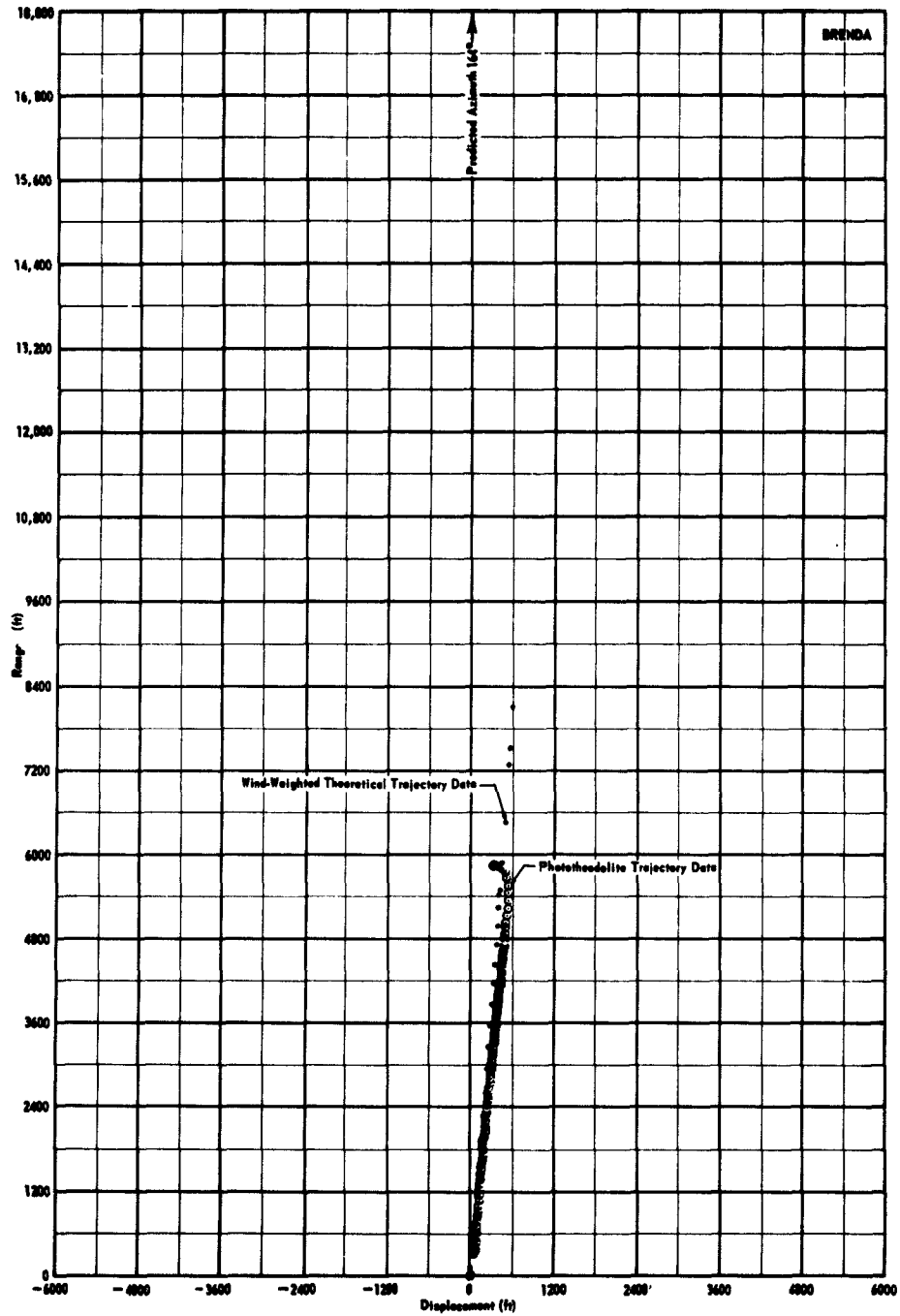


Fig. 97: Nike-Cajun (Brenda) Range vs. Displacement (Trajectory Through Burnout).

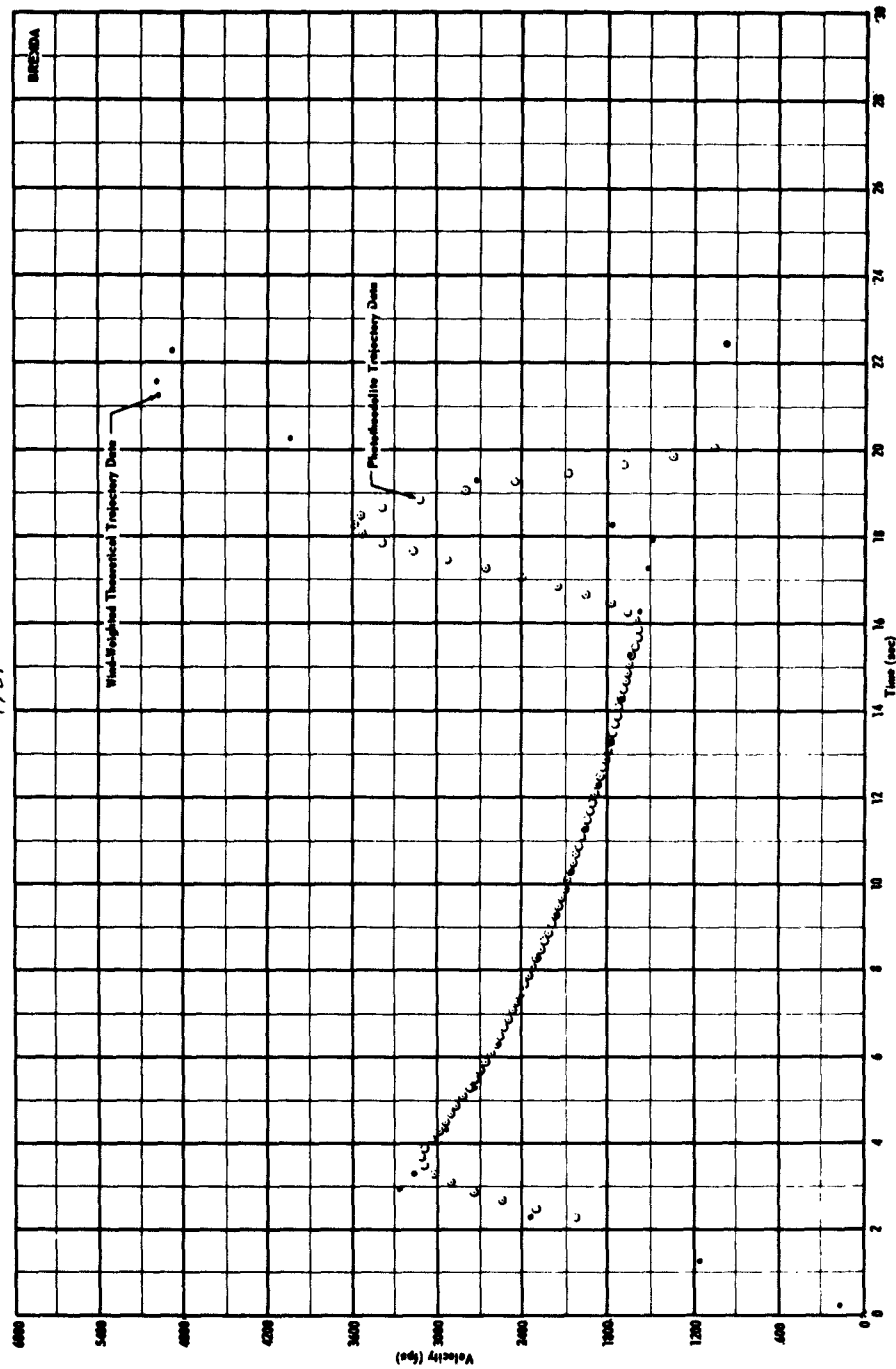


Fig. 98: Nike-Cajun (Brenda) Velocity vs. Time (Trajectory Through Burnout).

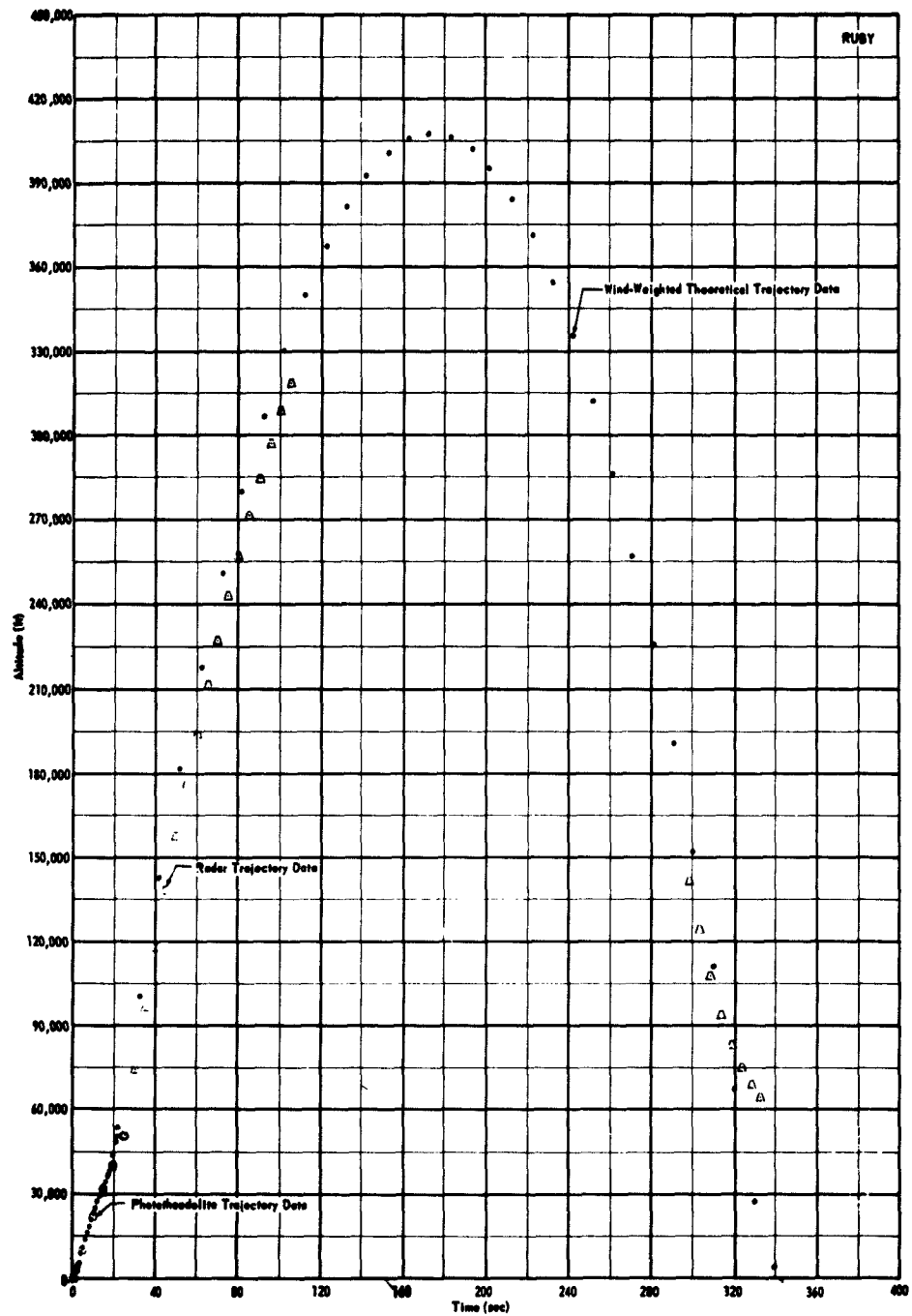


Fig. 99: Nike-Cajun (Ruby) Velocity vs. Time (Entire Trajectory).

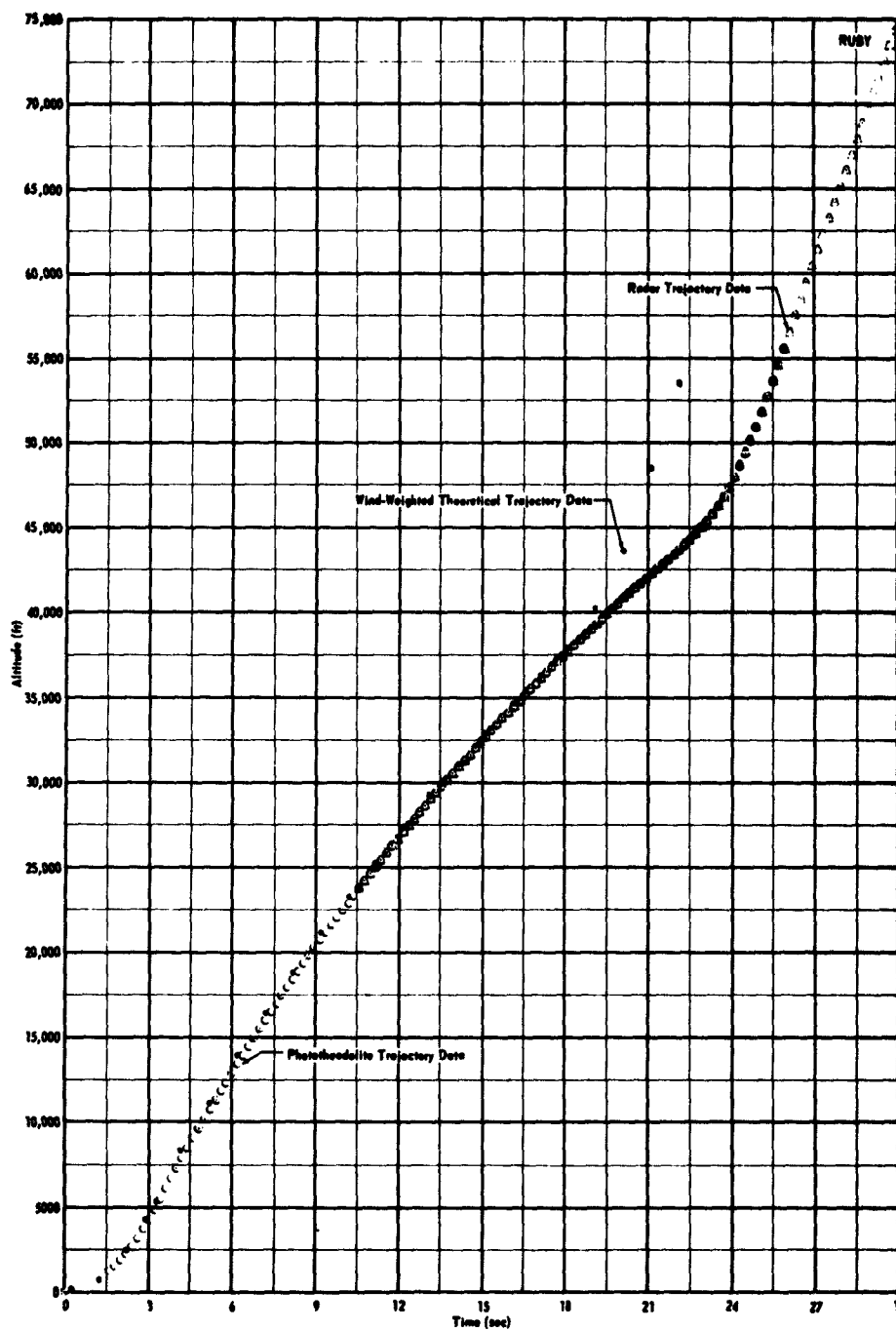


Fig. 100: Nike-Cajun (Ruby) Altitude vs. Time (Trajectory Through Burnout).

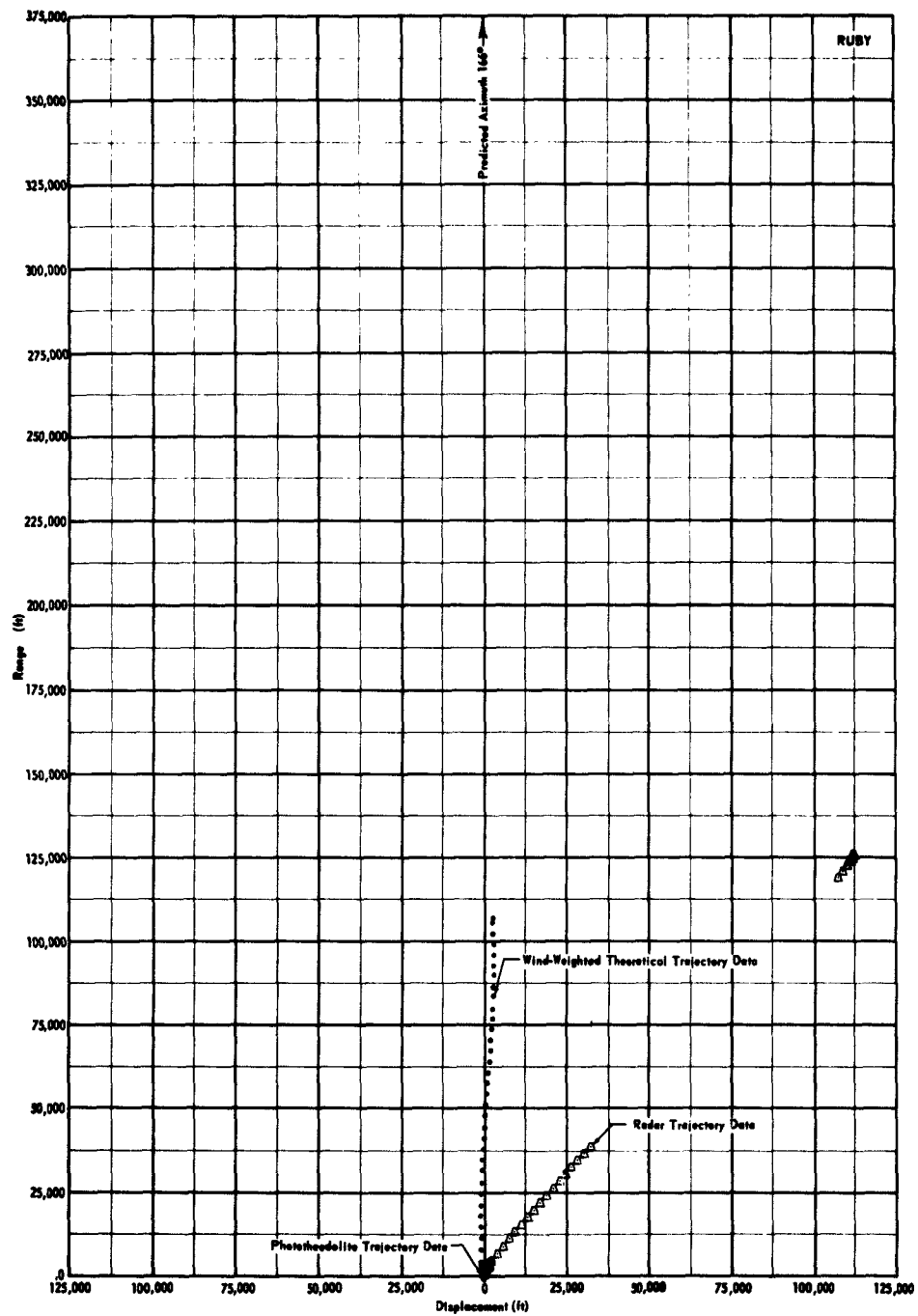


Fig. 101: Nike-Cajun (Ruby) Range vs. Displacement (Entire Trajectory).

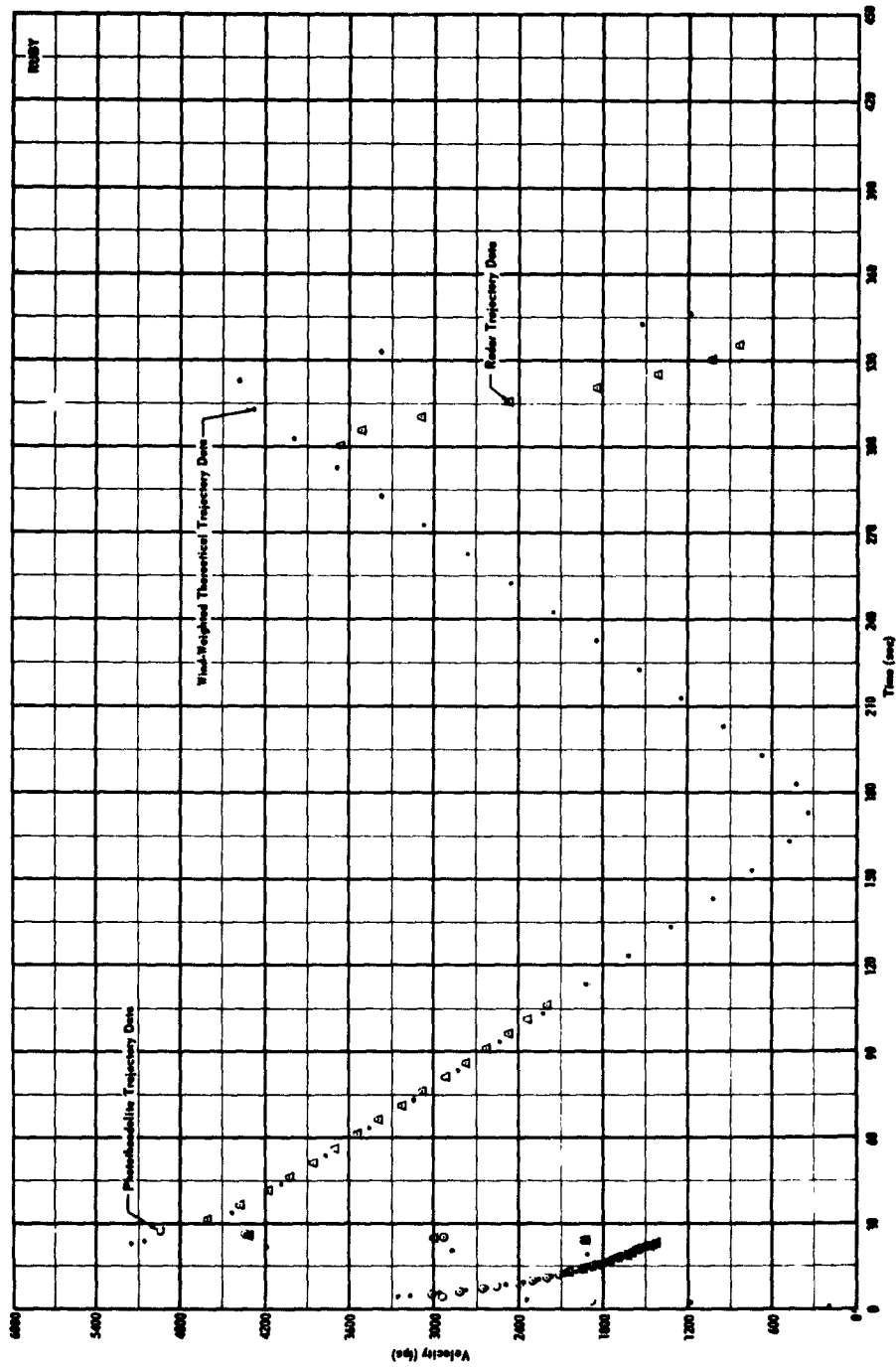


Fig. 102: Nike-Cajun (Ruby) Velocity vs. Time (Entire Trajectory).

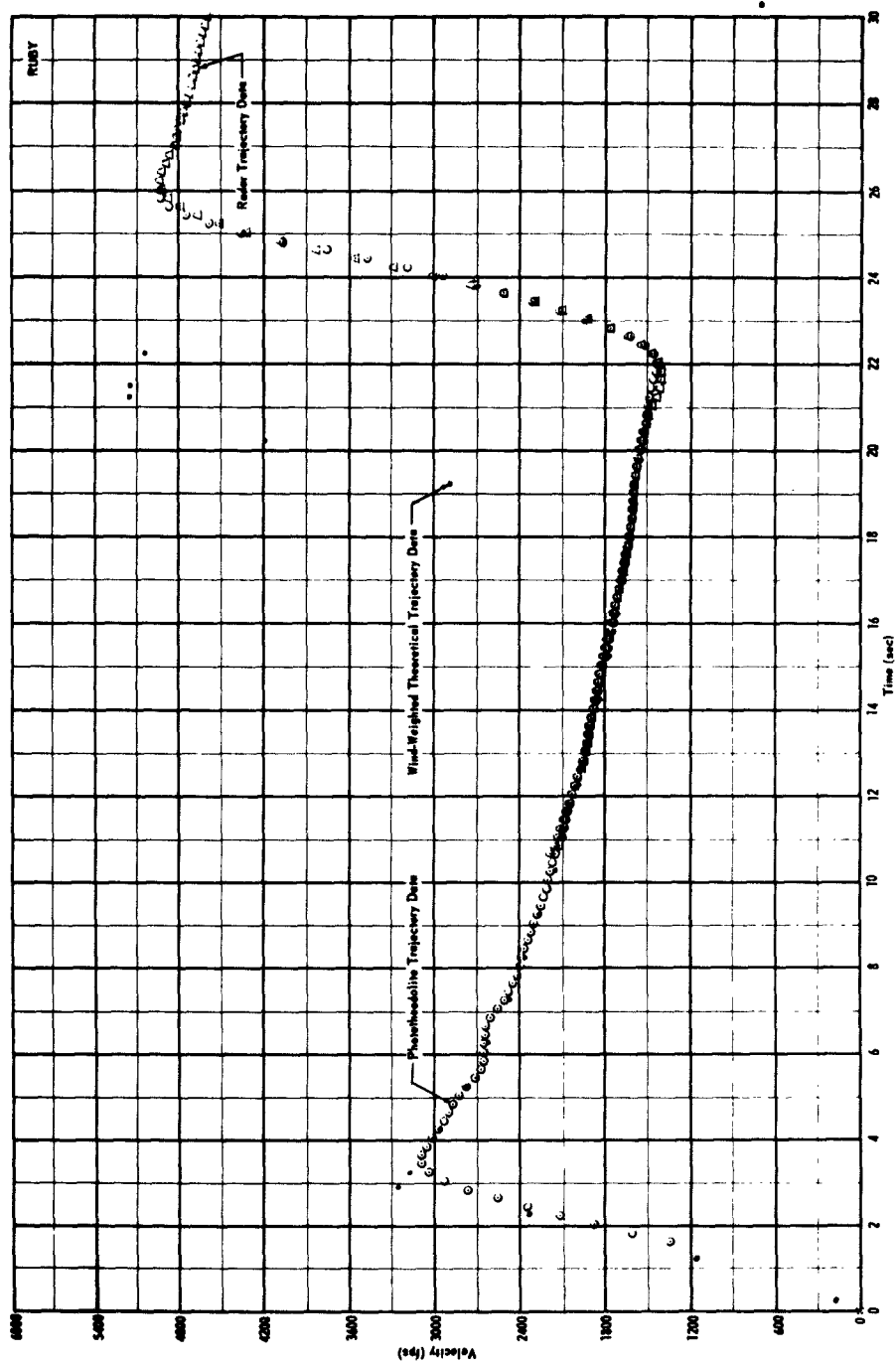


Fig. 103: Nike-Cajun (Ruby) Velocity vs. Time (Trajectory Through Burnout).

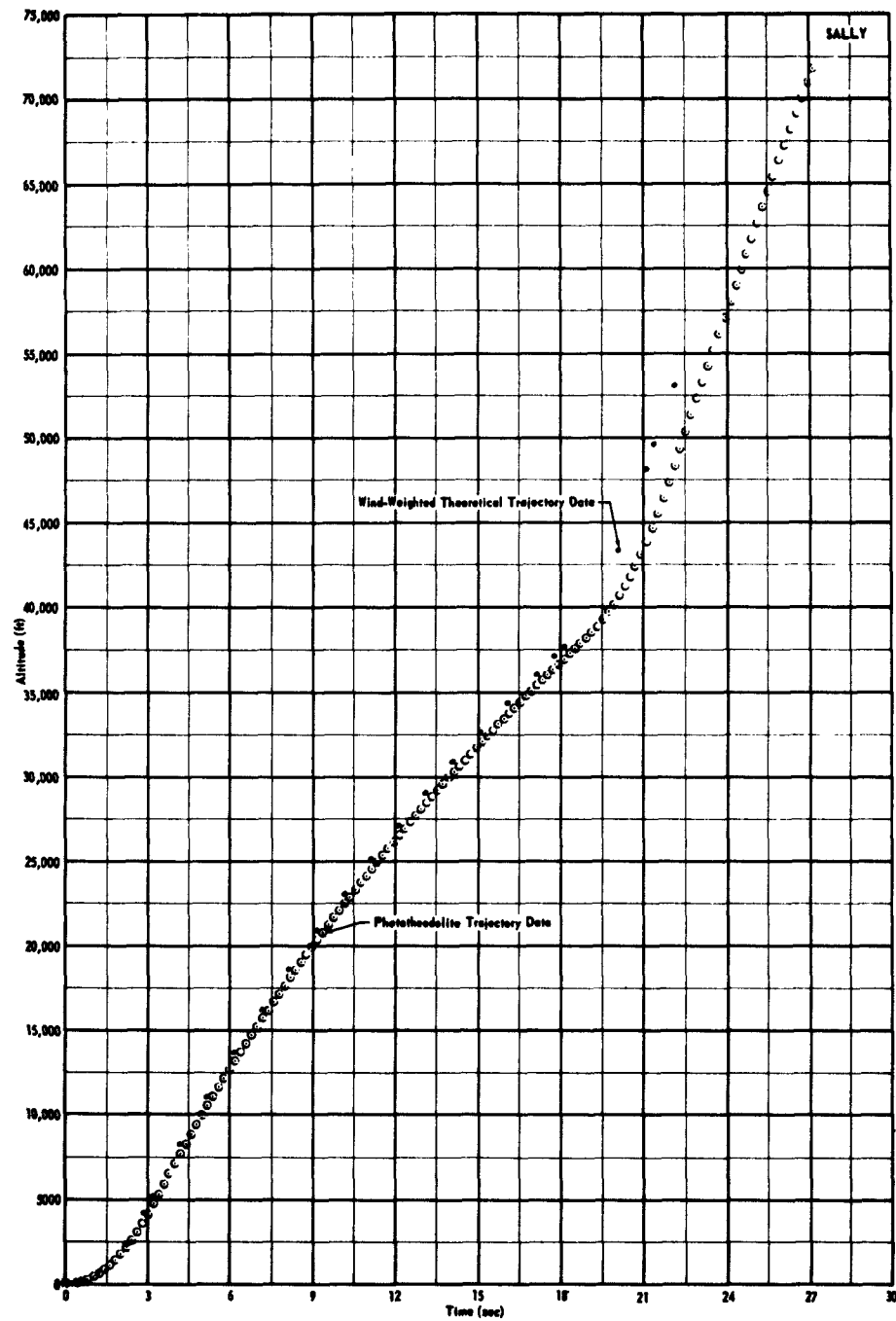


Fig. 104: Nike-Cajun (Sally) Altitude vs. Time (Trajectory Through Burnout).

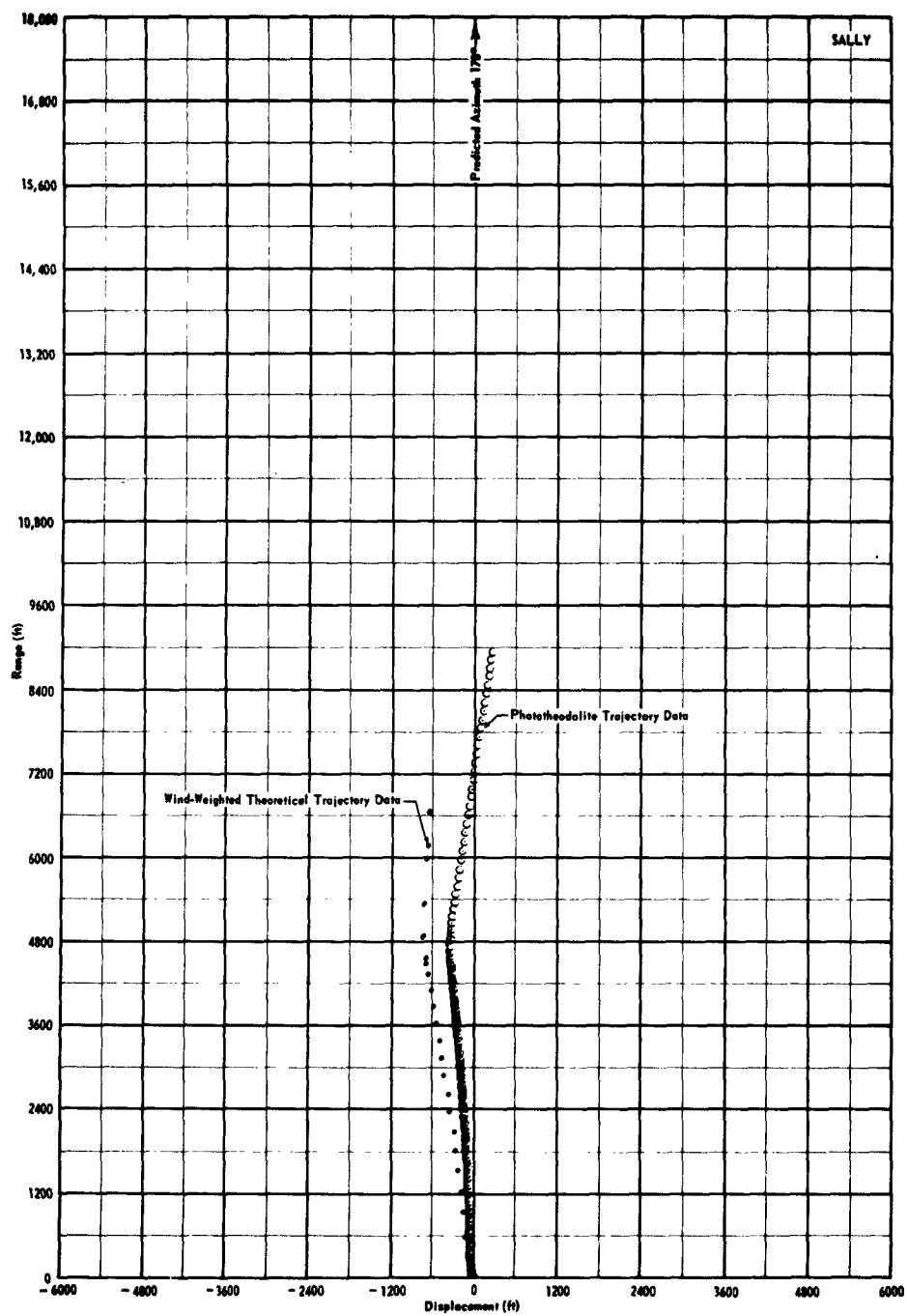


Fig. 105: Nike-Cajun (Sally) Range vs. Displacement (Trajectory Through Burnout).

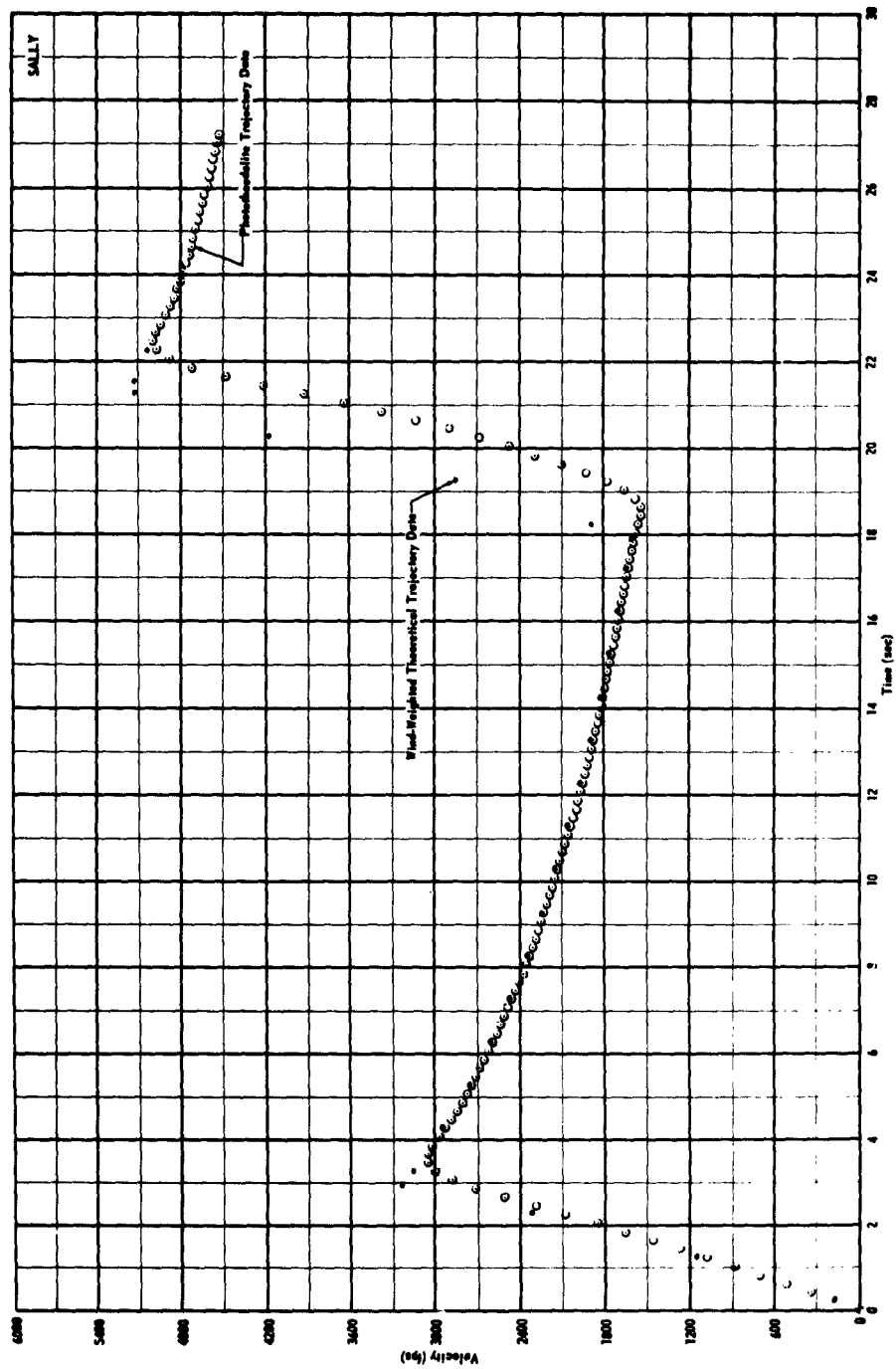


Fig. 106: Nike-Cajun (Sally) Velocity vs. Time (Trajectory Through Burnout).

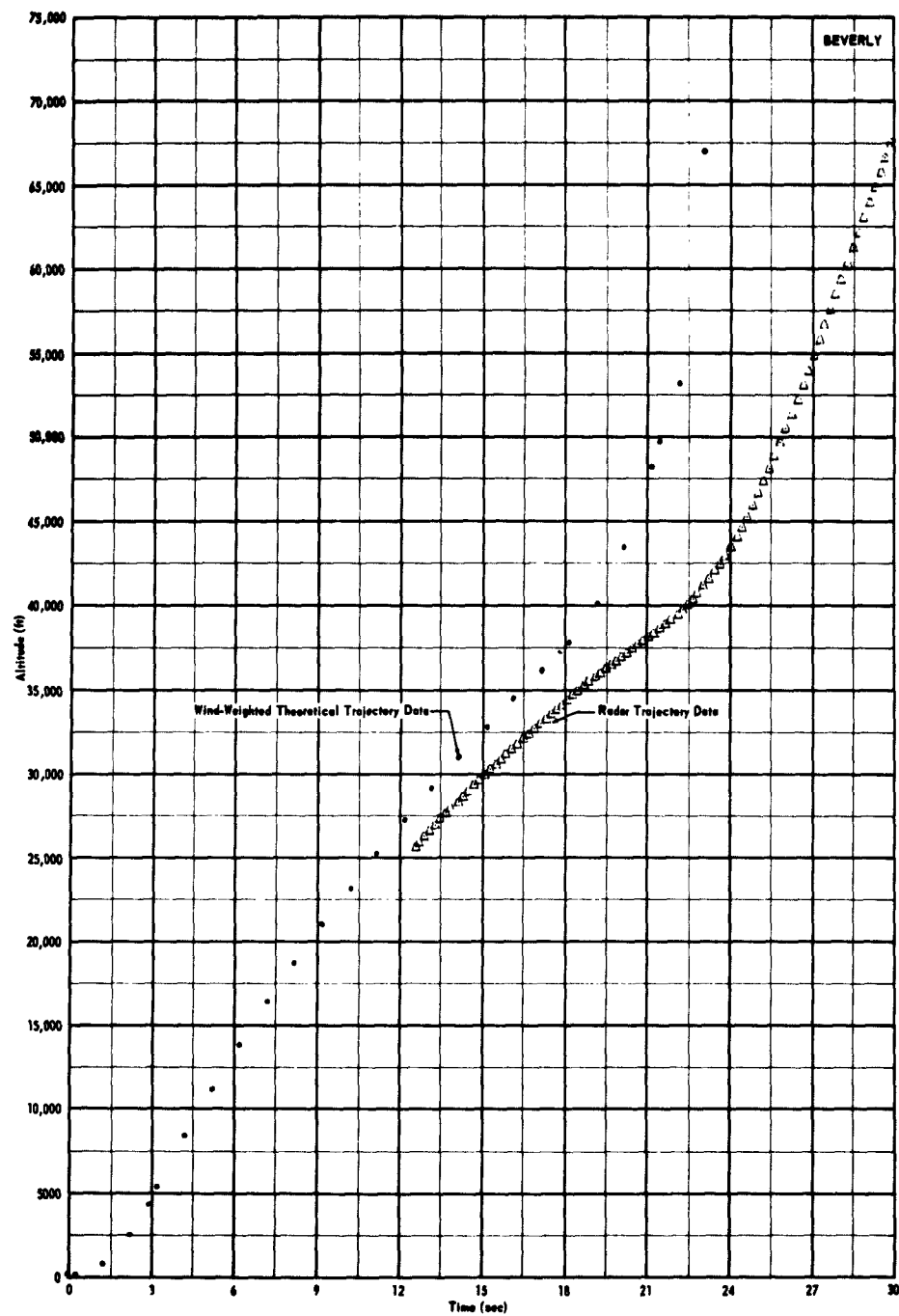


Fig. 107: Nike-Cajun (Beverly) Altitude vs. Time (Trajectory Through Burnout).

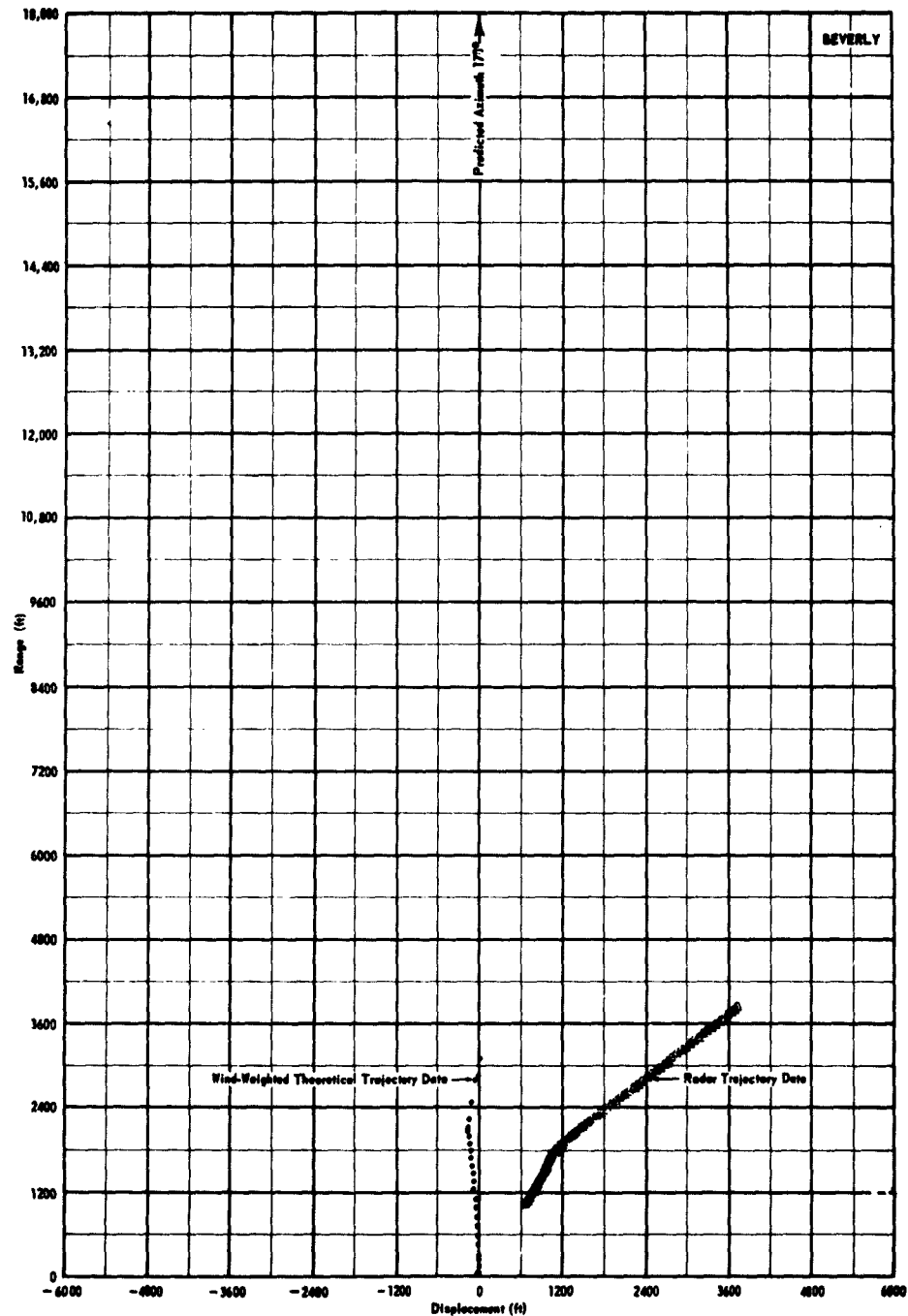


Fig. 108: Nike-Cajun (Beverly) Range vs. Displacement (Trajectory Through Burnout).

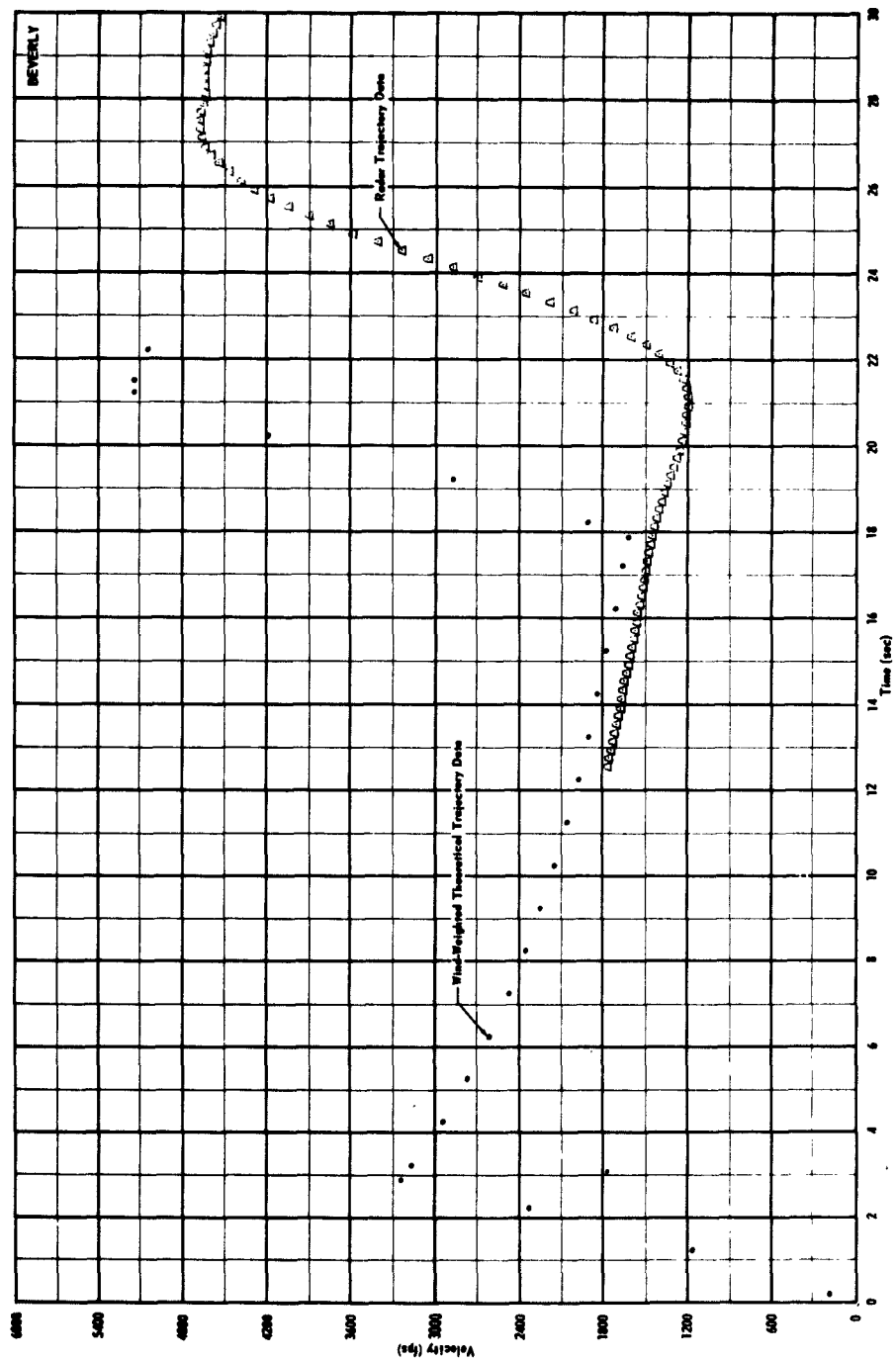


Fig. 109: Nike-Cajun (Beverly) Velocity vs. Time (Trajectory Through Burnout).

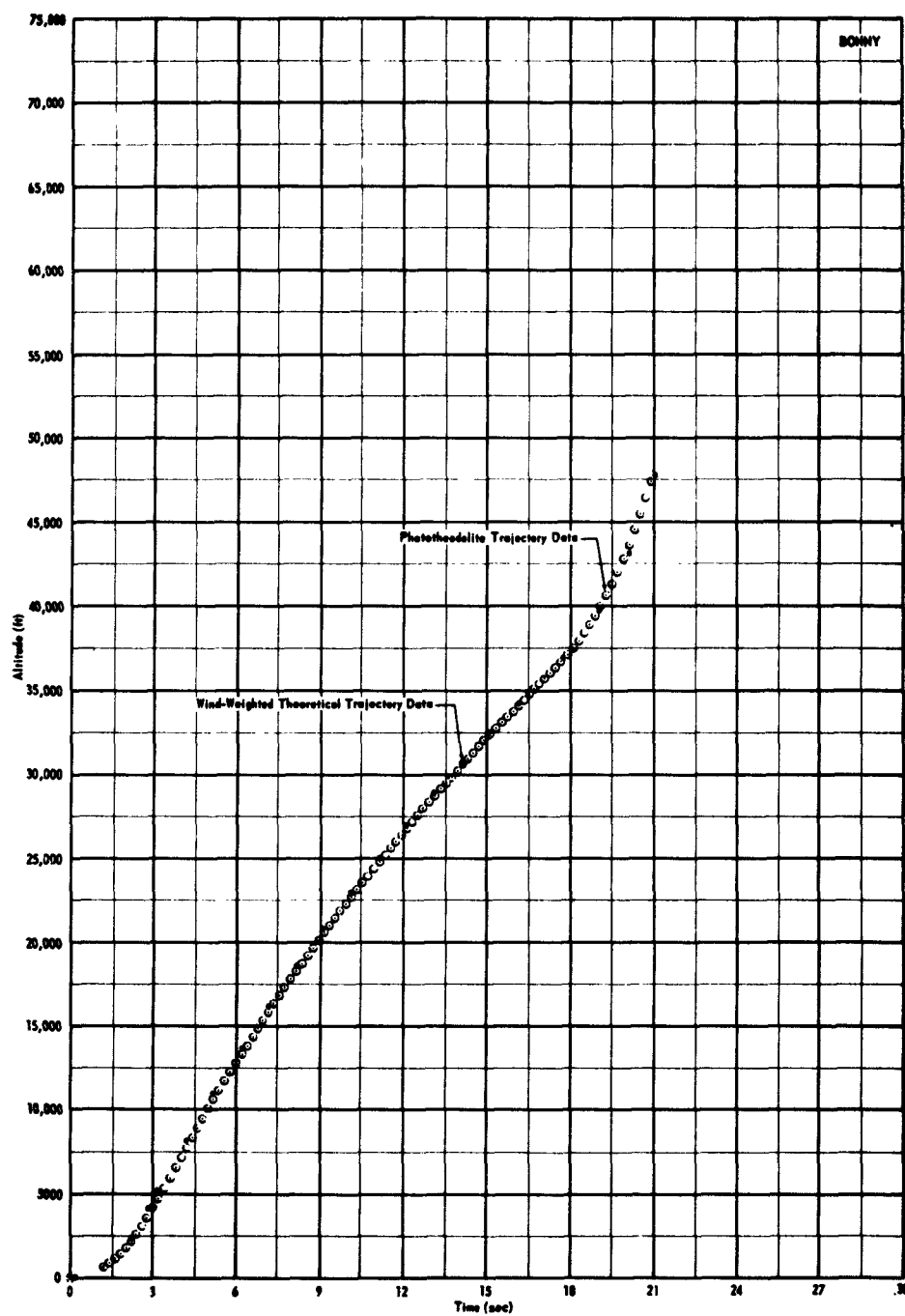


Fig. 110: Nike-Cajun (Bonny) Altitude vs. Time (Trajectory Through Burnout).

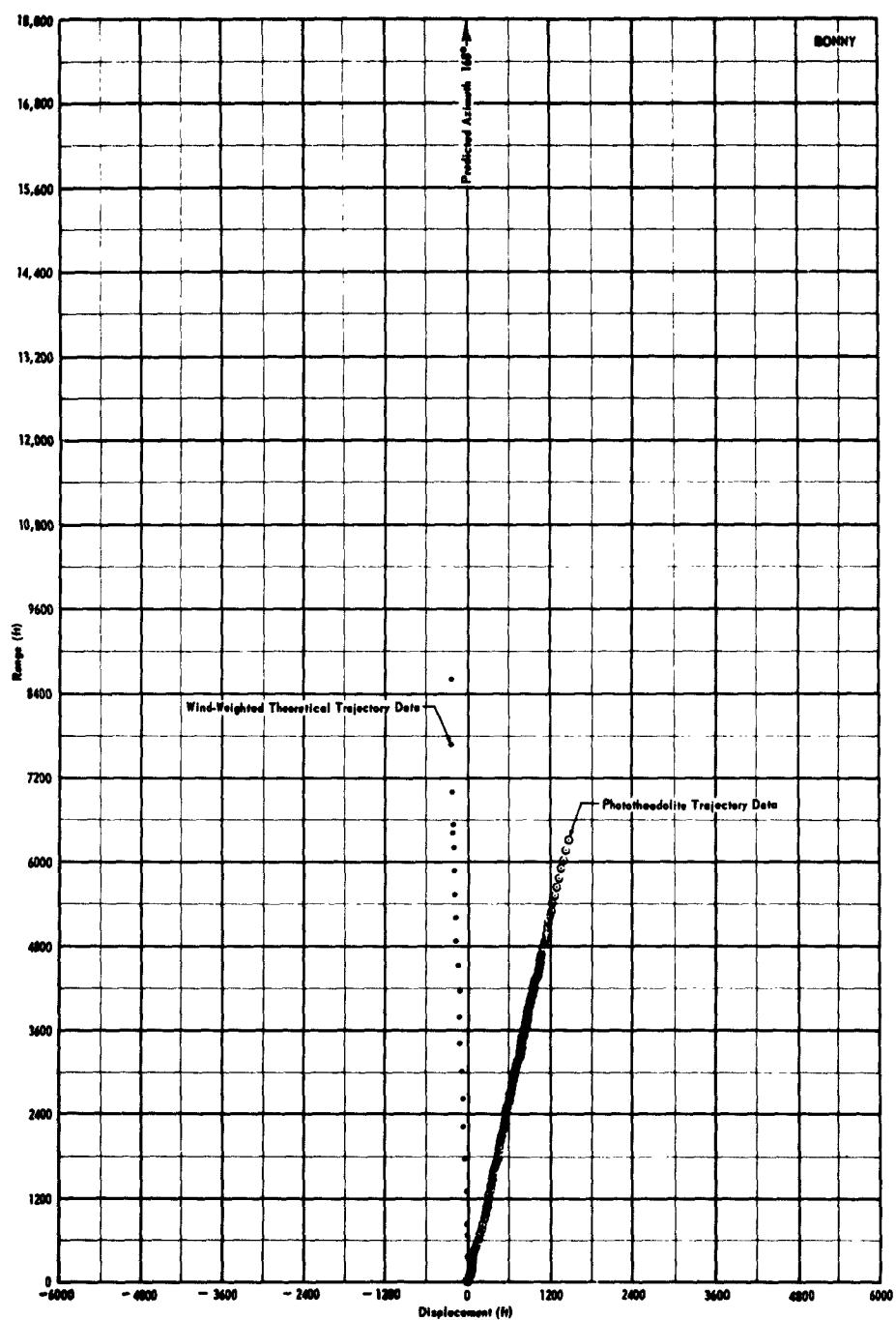


Fig. 111: Nike-Cajun (Bonny) Range vs. Displacement (Trajectory Through Burnout).

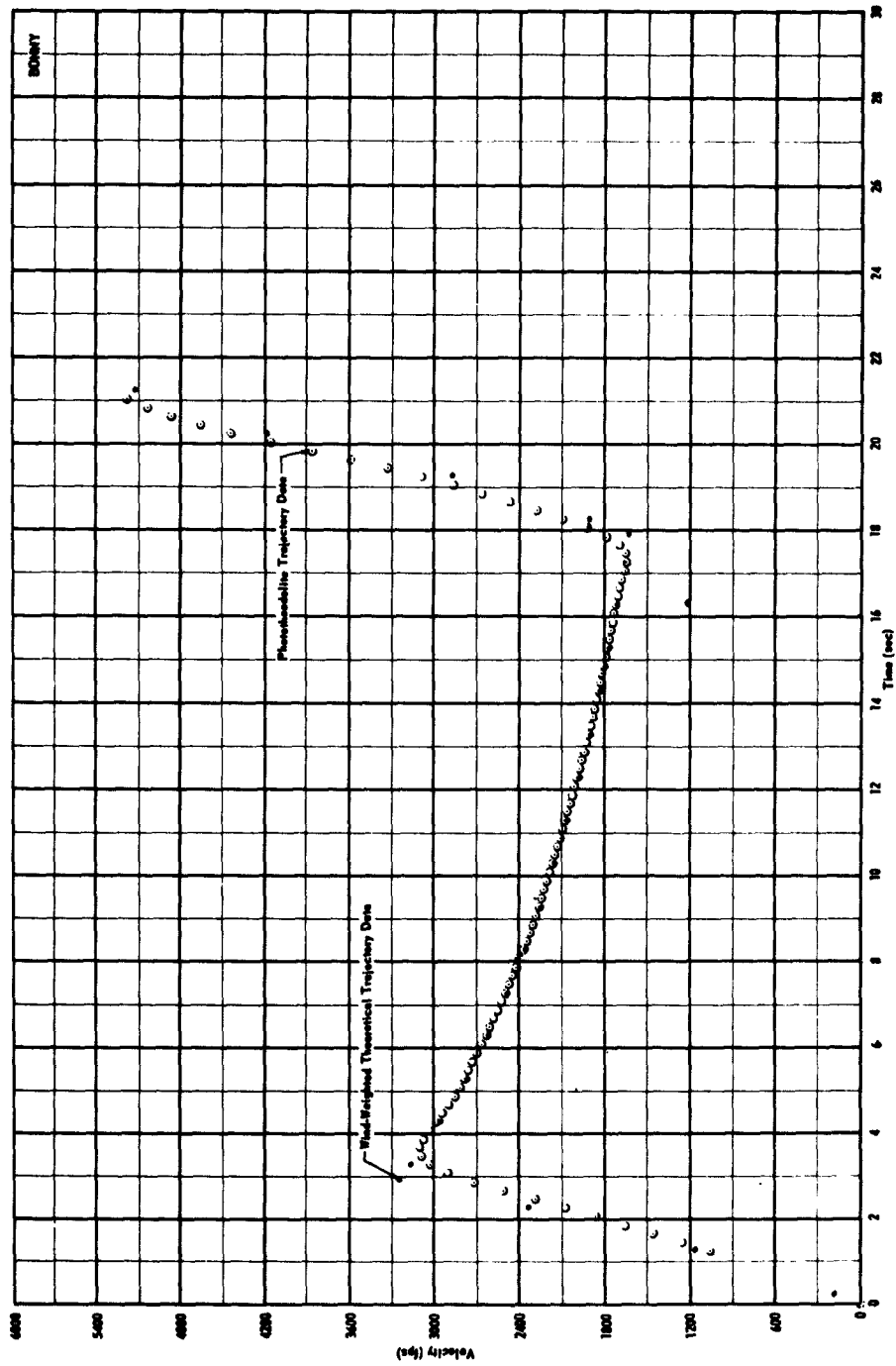


Fig. 112: Nike-Cajun (Bonny) Velocity vs. Time (Trajectory Through Burnout).

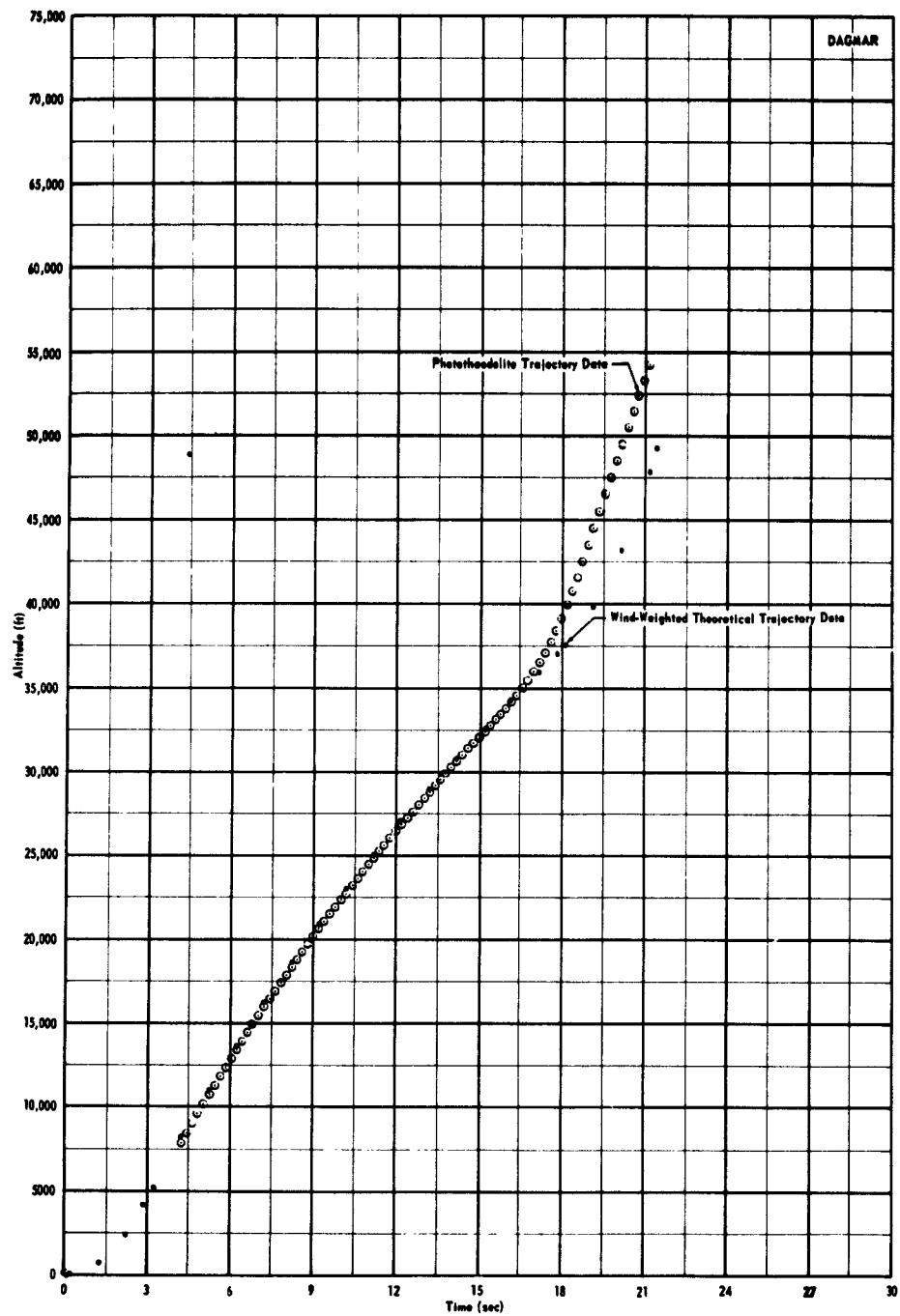


Fig. 113: Nike-Cajun (Dagmar) Altitude vs. Time (Trajectory Through Burnout).

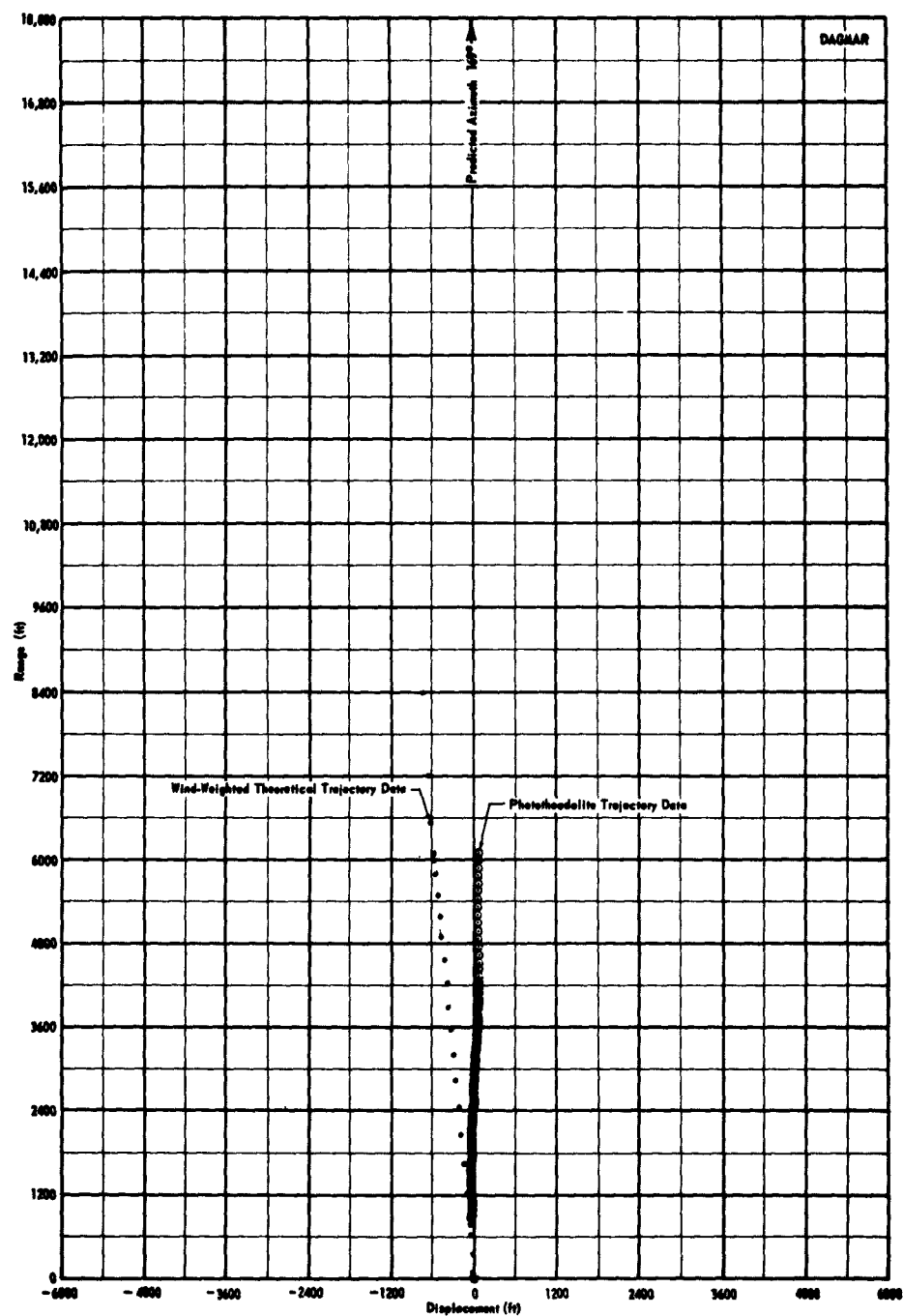


Fig. 114: Nike-Cajun (Dagmar) Range vs. Displacement (Trajectory Through Burnout).

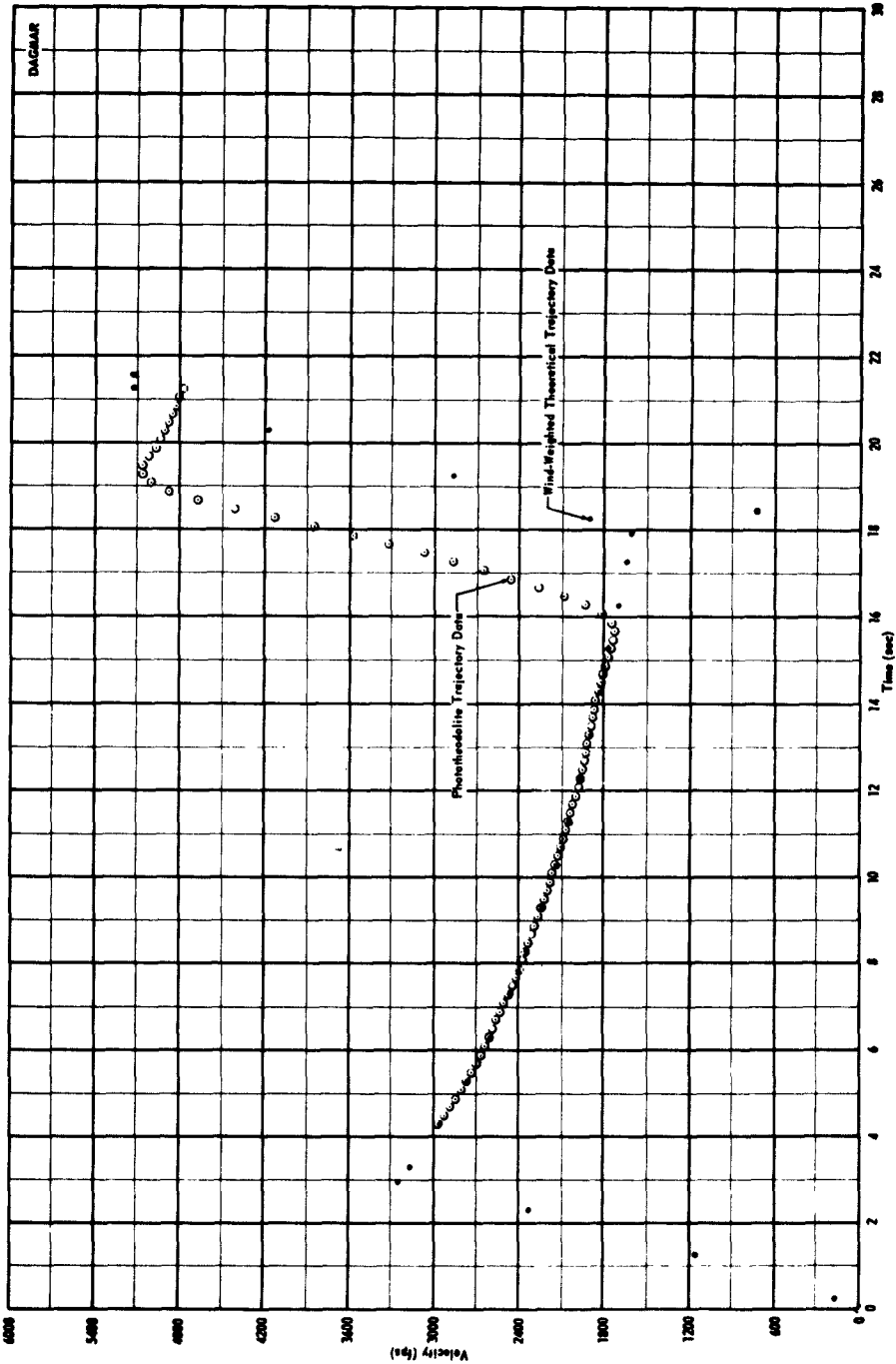


Fig. 115: Nike-Cajun (Dagmar) Velocity vs. Time (Trajectory Through Burnout).

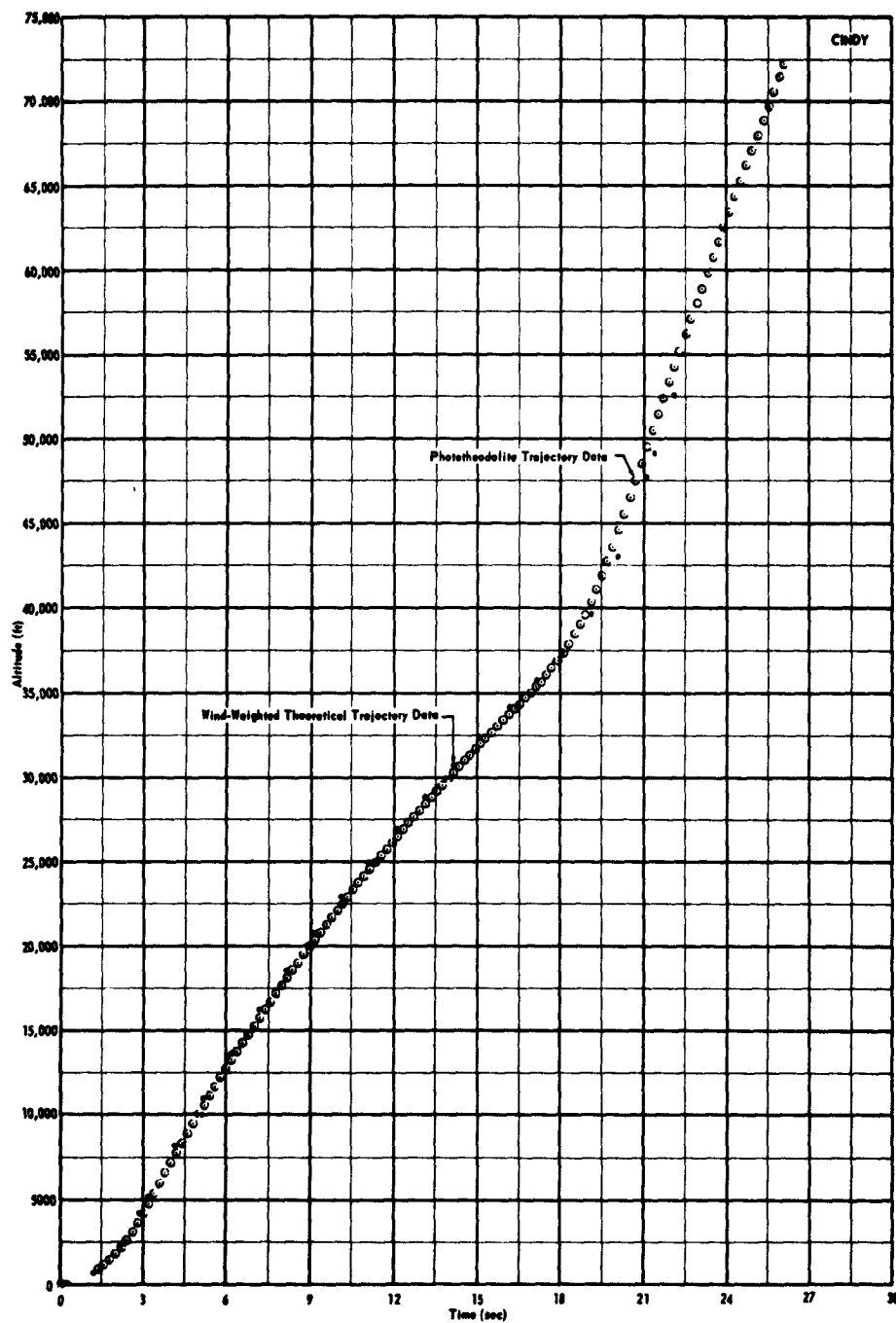


Fig. 116: Nike-Cajun (Cindy) Altitude vs. Time (Trajectory Through Burnout).

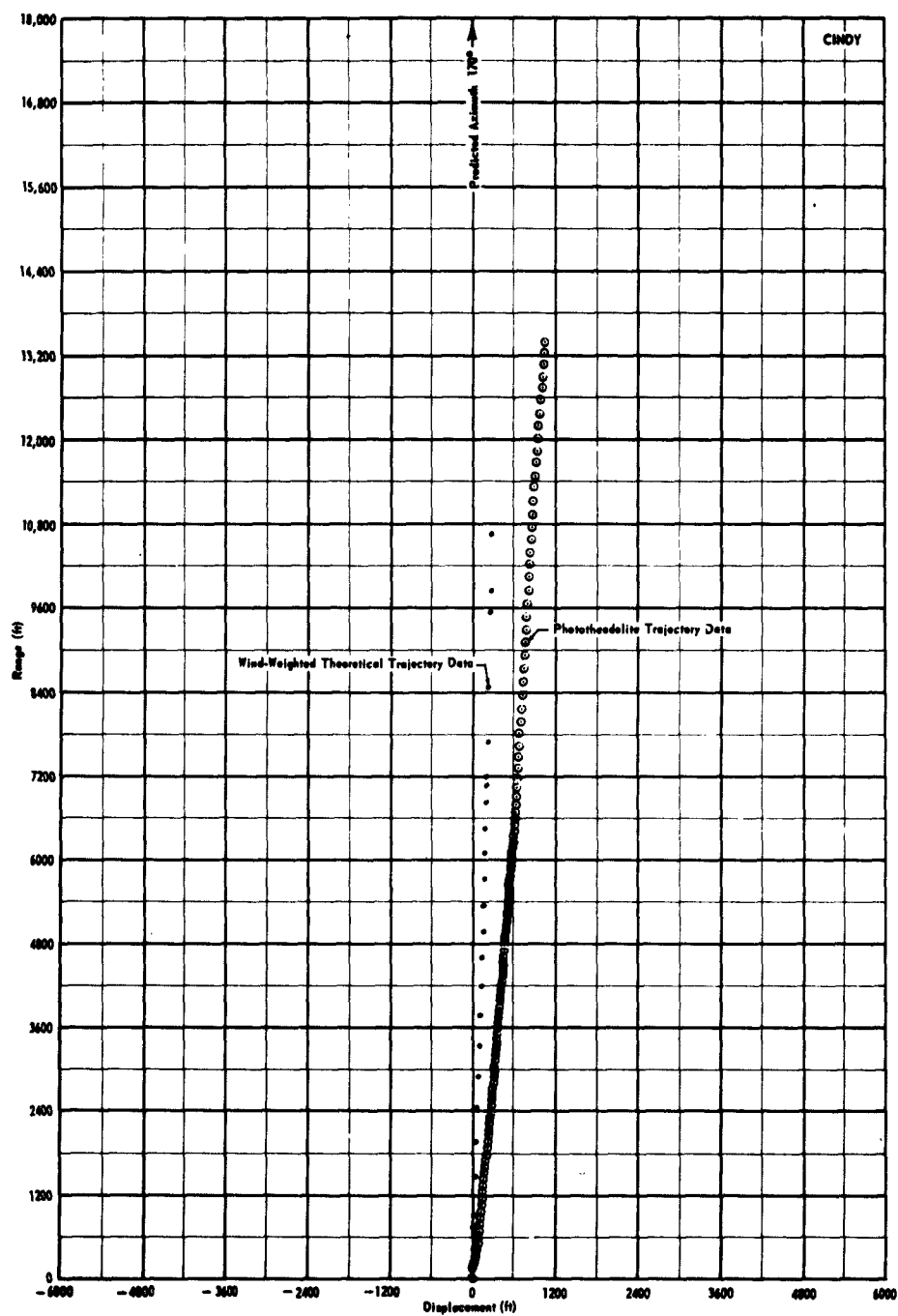


Fig. 117: Nike-Cajun (Cindy) Range vs. Displacement (Trajectory Through Burnout).

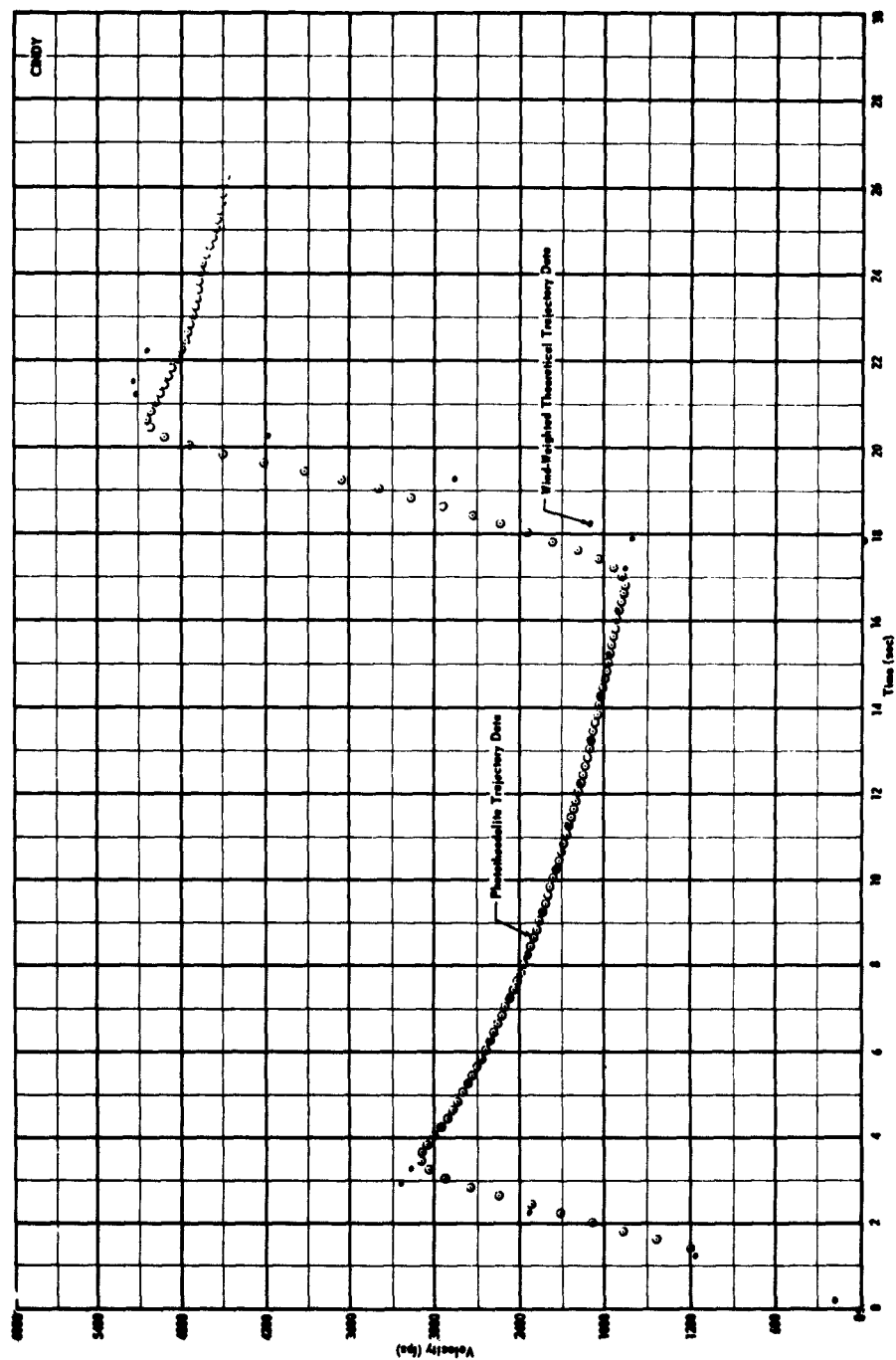


Fig. 118: Nike-Cajun (Cindy) Velocity vs. Time (Trajectory Through Burnout).

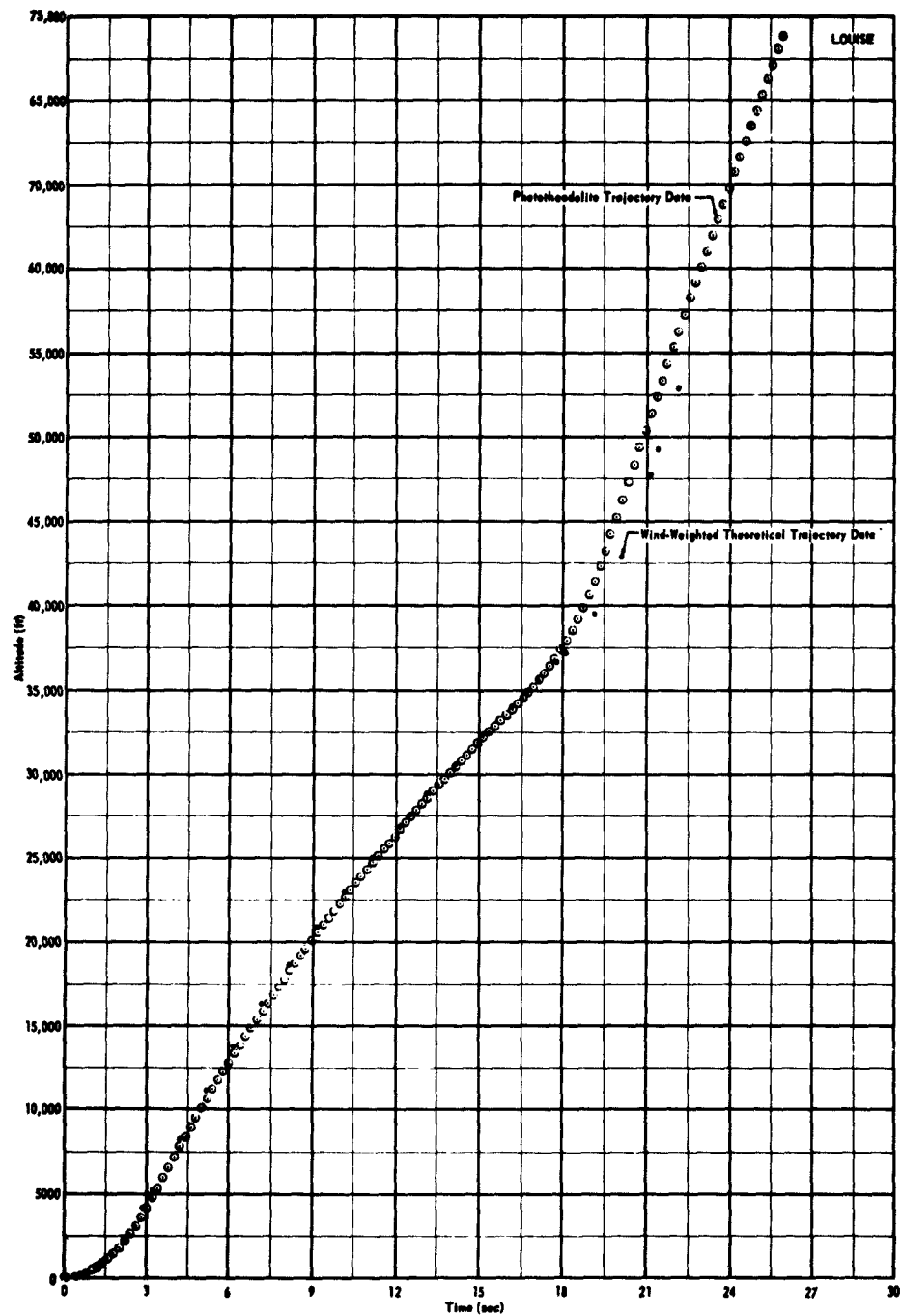


Fig. 119: Nike-Cajun (Louise) Altitude vs. Time (Trajectory Through Burnout).

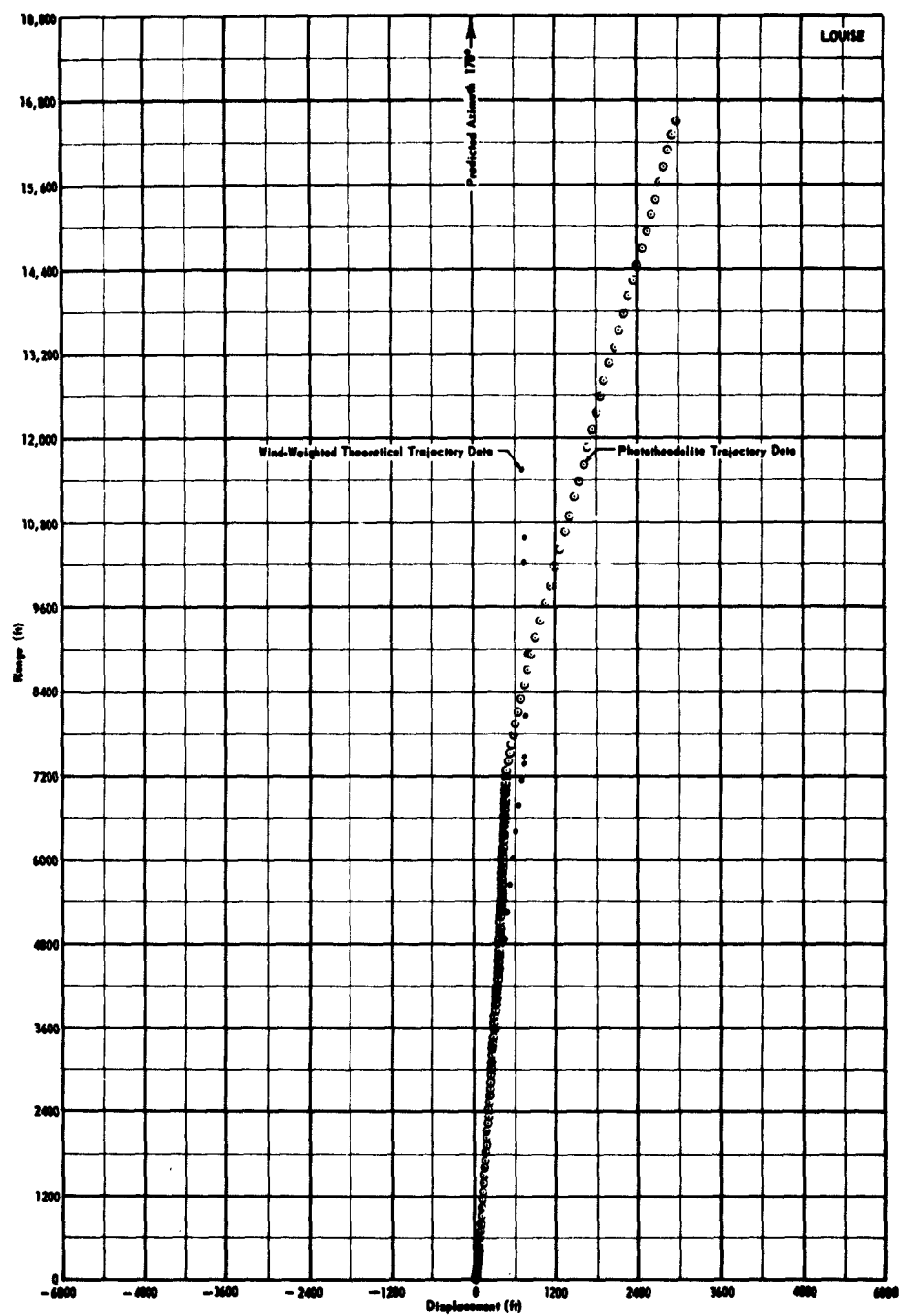


Fig. 120: Nike-Cajun (Louise) Range vs. Displacement (Trajectory Through Burnout).

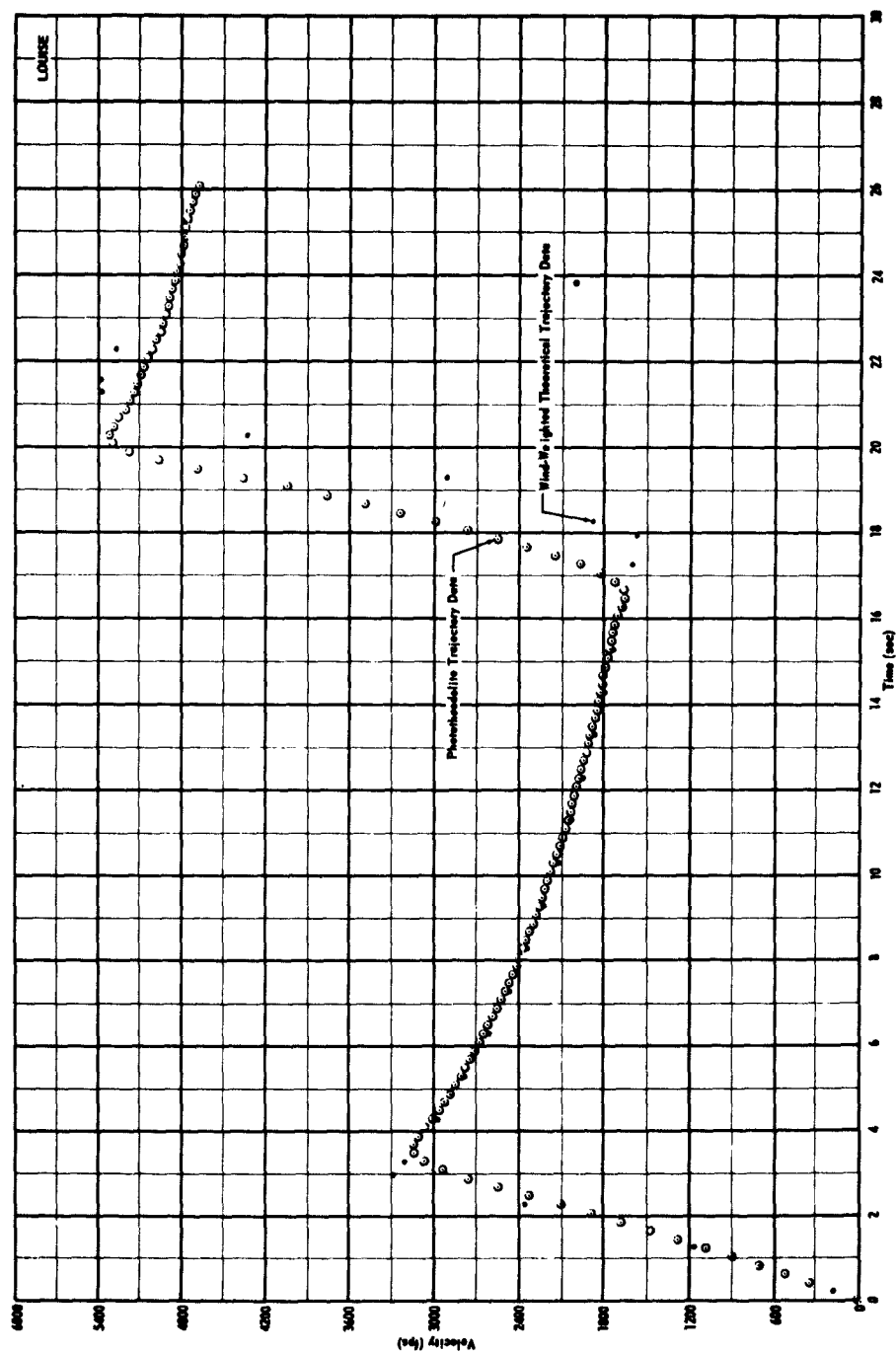


Fig. 121: Nike-Cajun (Louise) Velocity vs. Time (Trajectory Through Burnout).

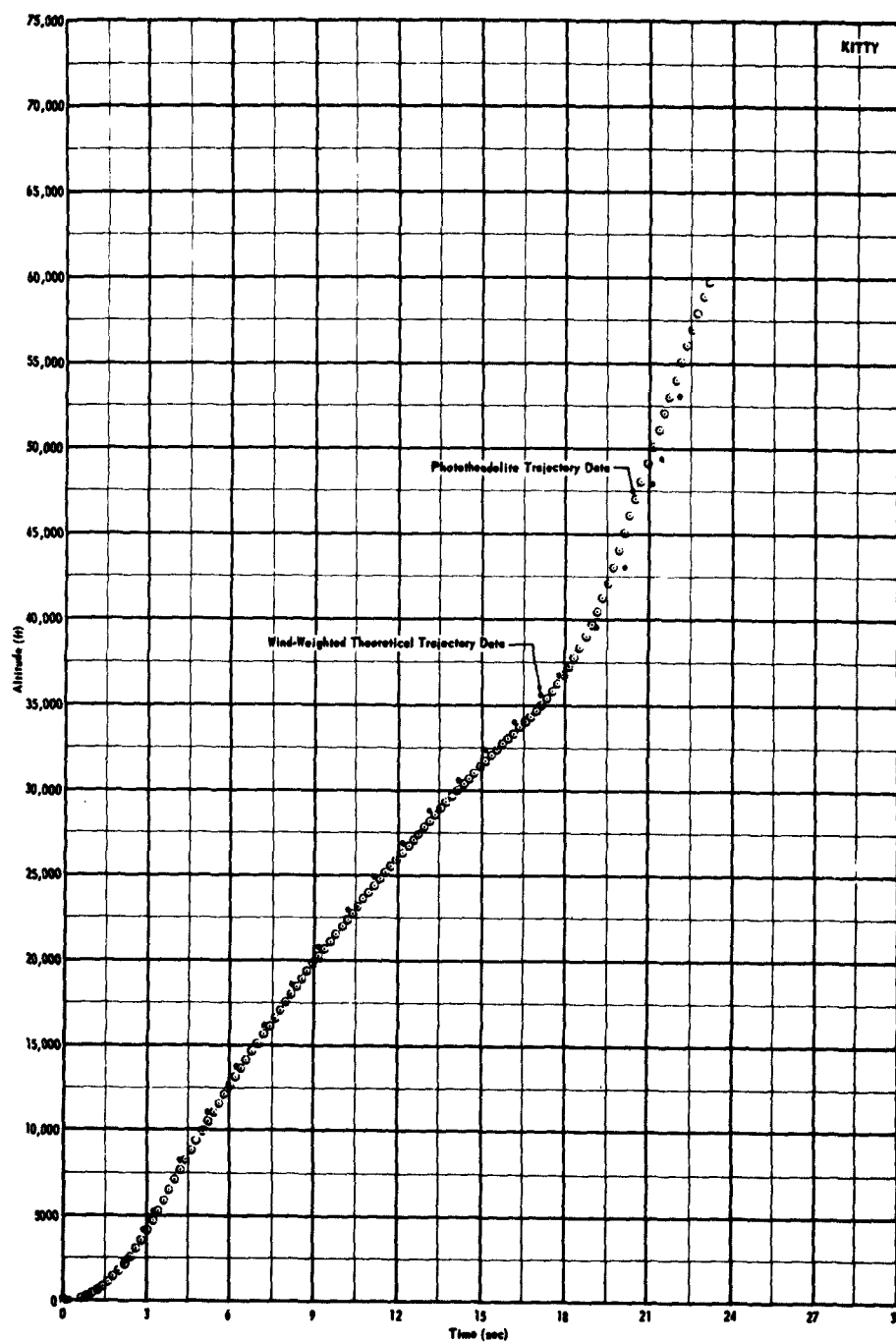


Fig. 122: Nike-Cajun (Kitty) Altitude vs. Time (Trajectory Through Burnout).

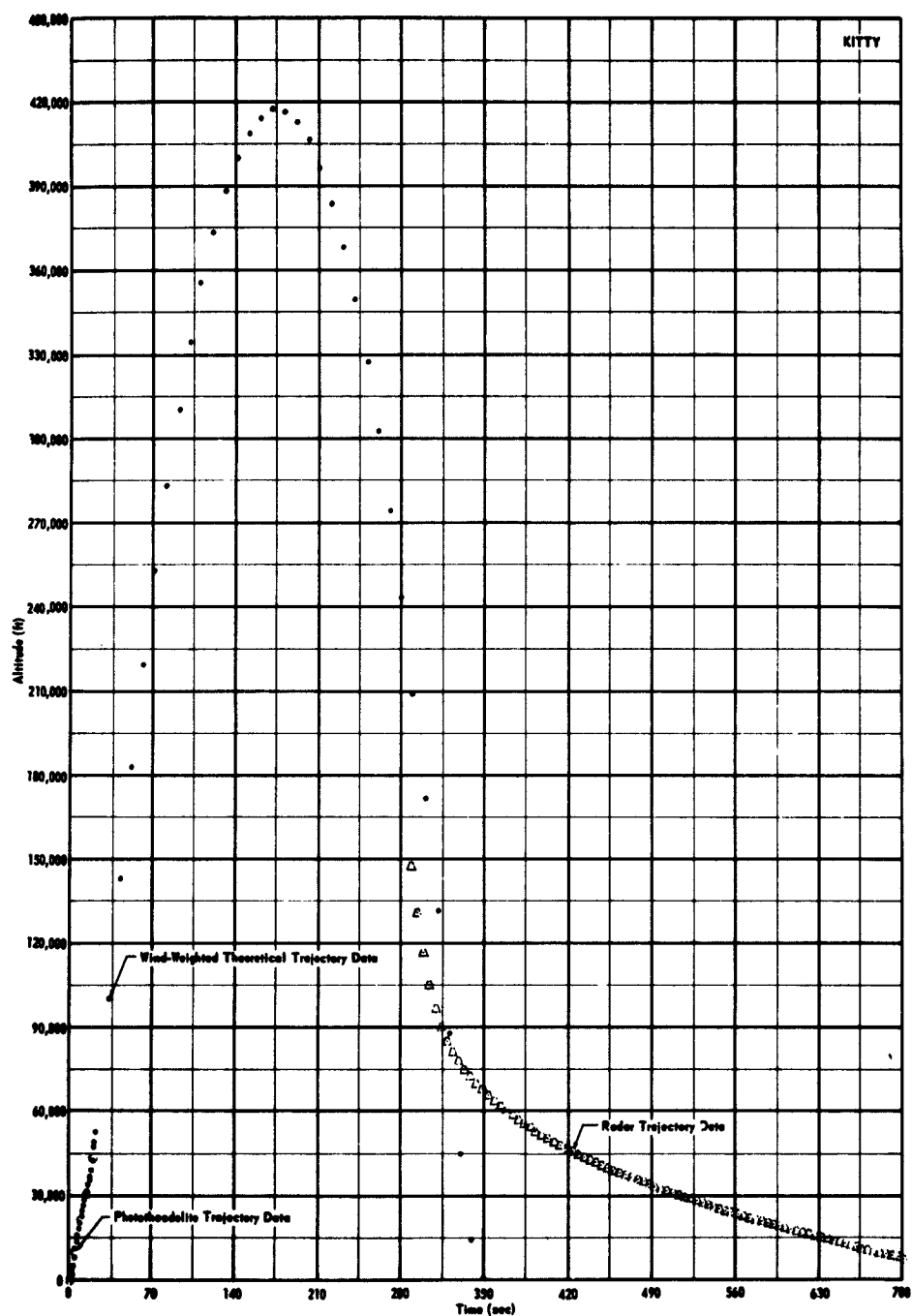


Fig. 123: Nike-Cajun (Kitty) Altitude vs. Time (Entire Trajectory).

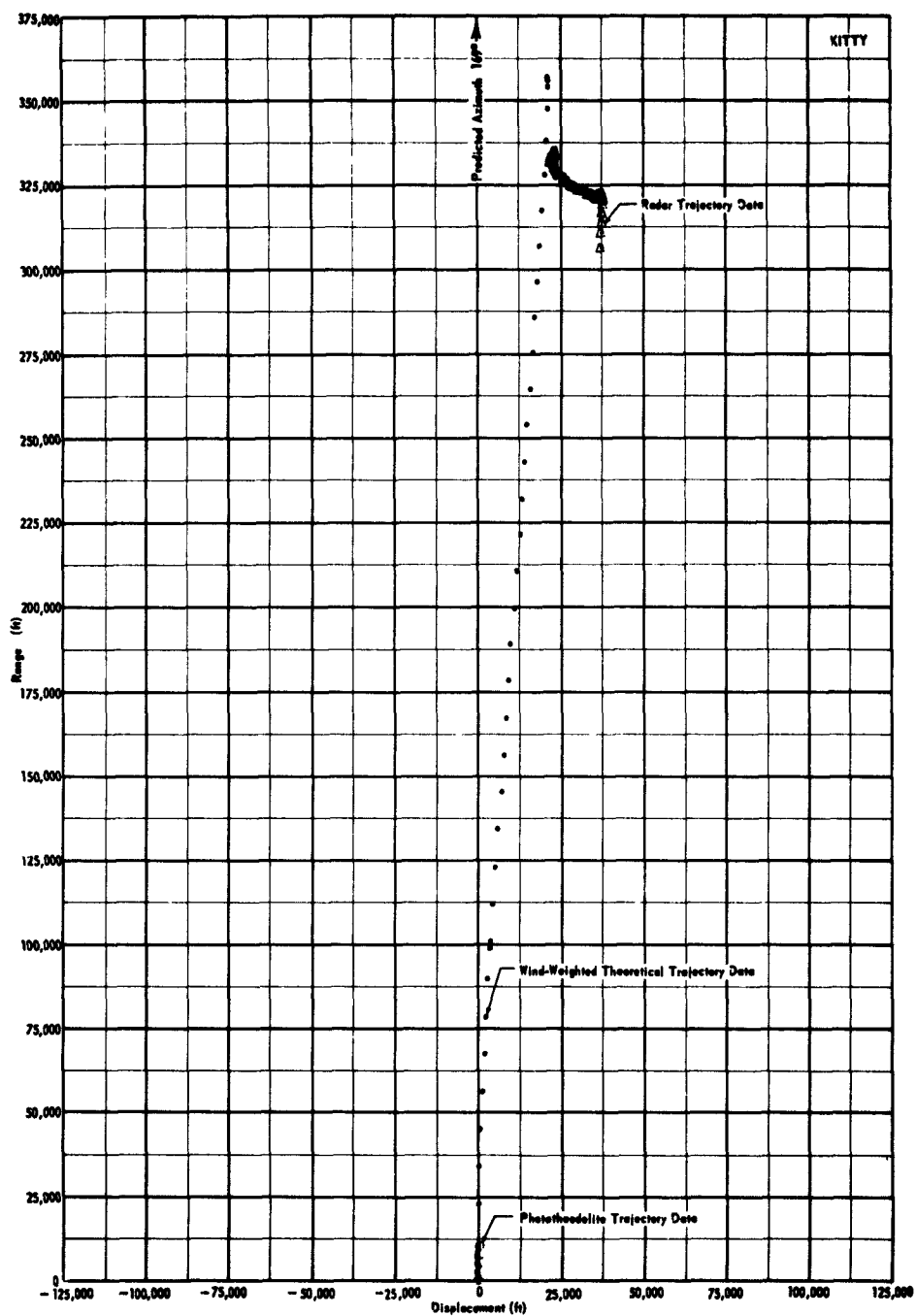


Fig. 124: Nike-Cajun (Kitty) Range vs. Displacement (Entire Trajectory).

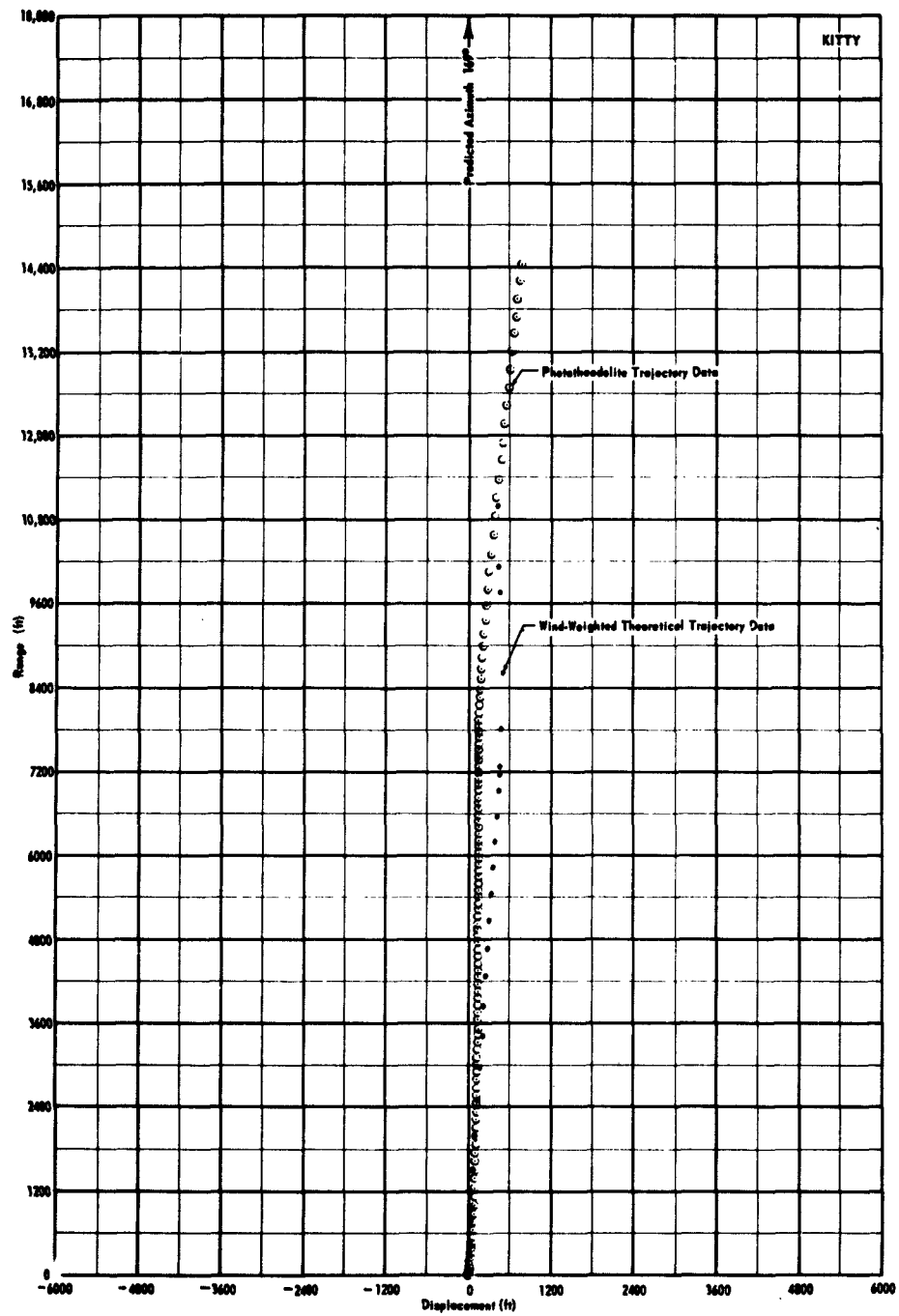


Fig. 125: Nike-Cajun (Kitty) Range vs. Displacement (Trajectory Through Burnout).

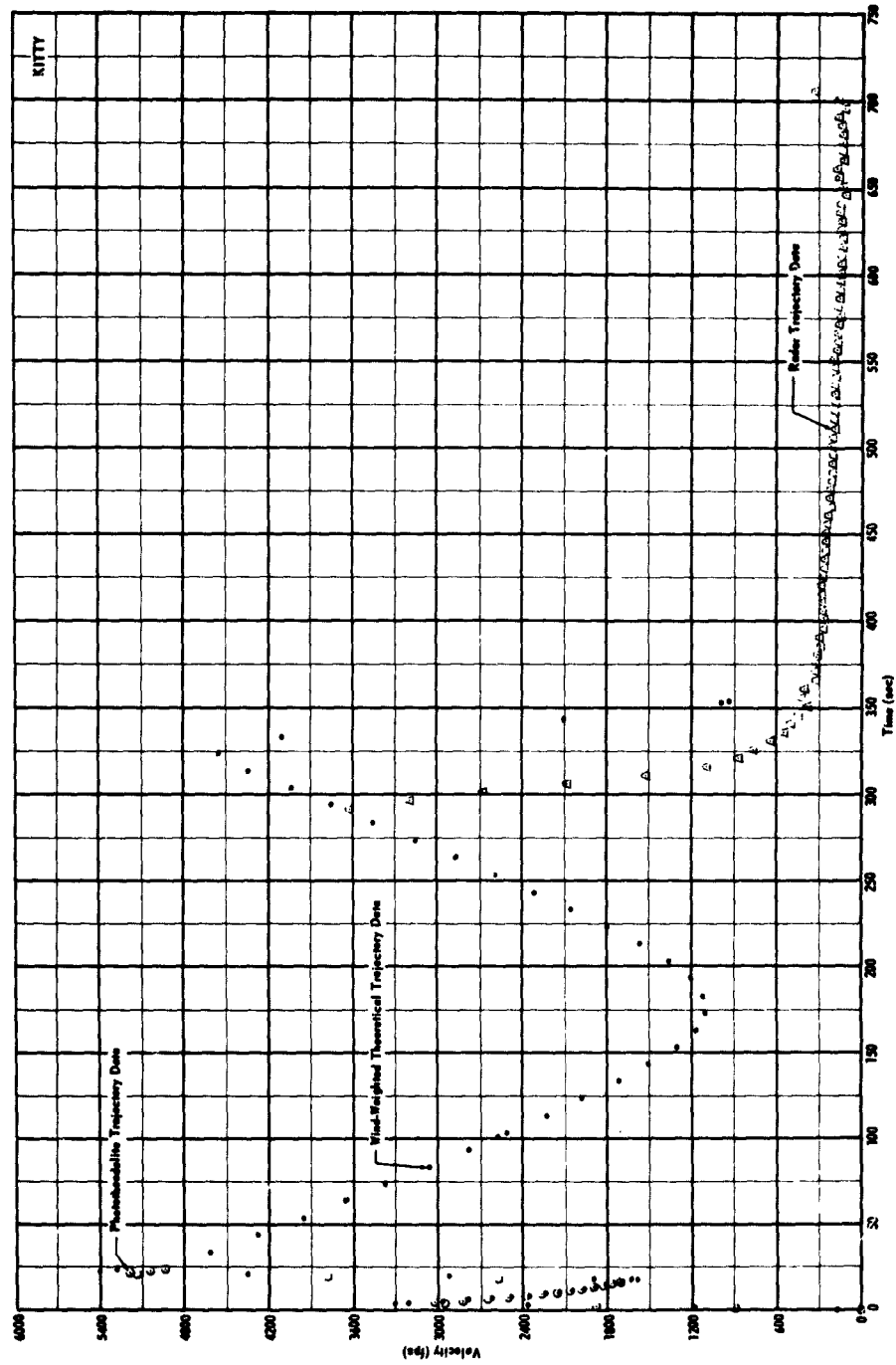


Fig. 126: Nike-Cajun (Kitty) Velocity vs. Time (Entire Trajectory).

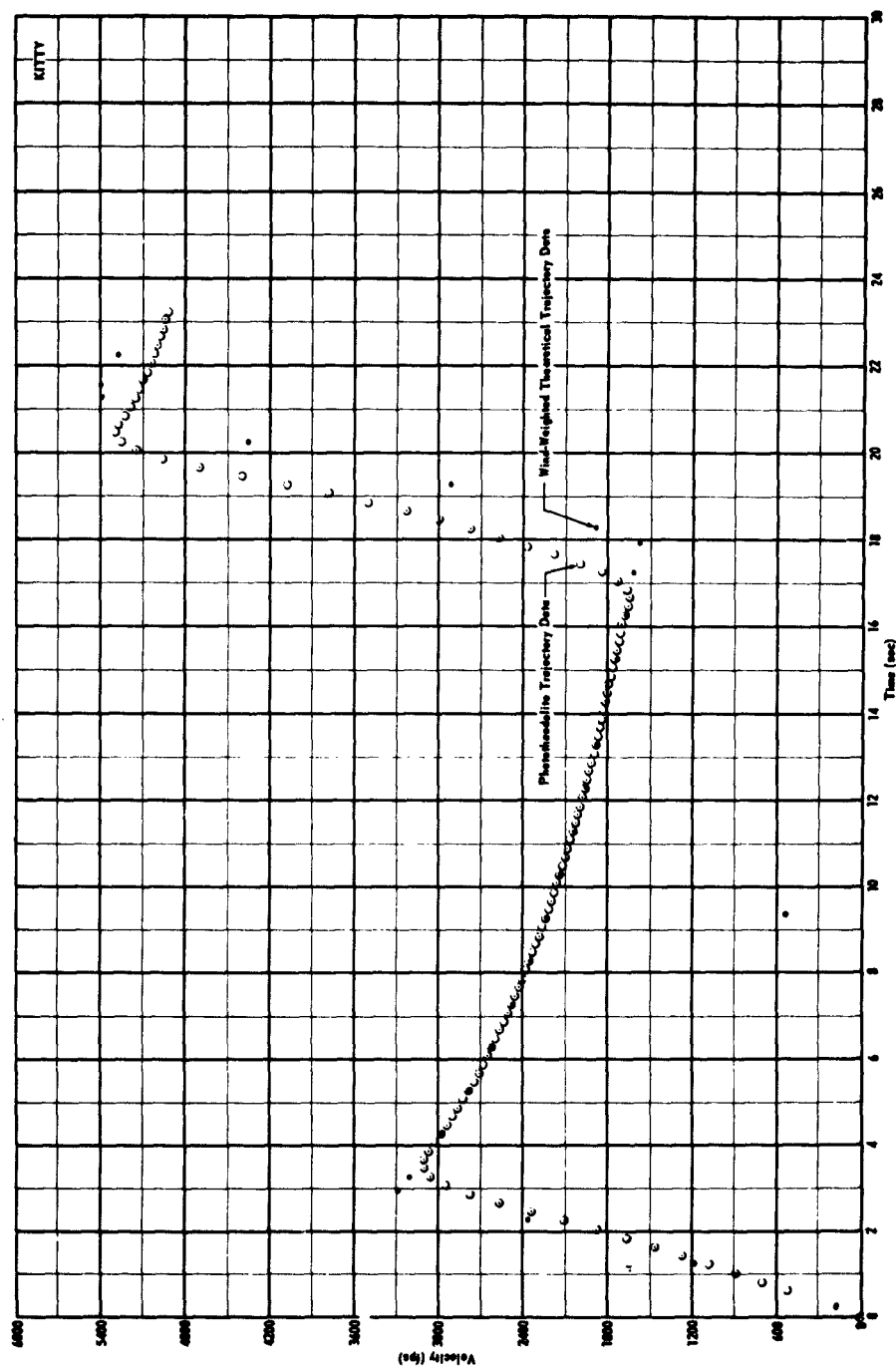


Fig. 127: Nike-Cajun (Kitty) Velocity vs. Time (Trajectory Through Burnout).

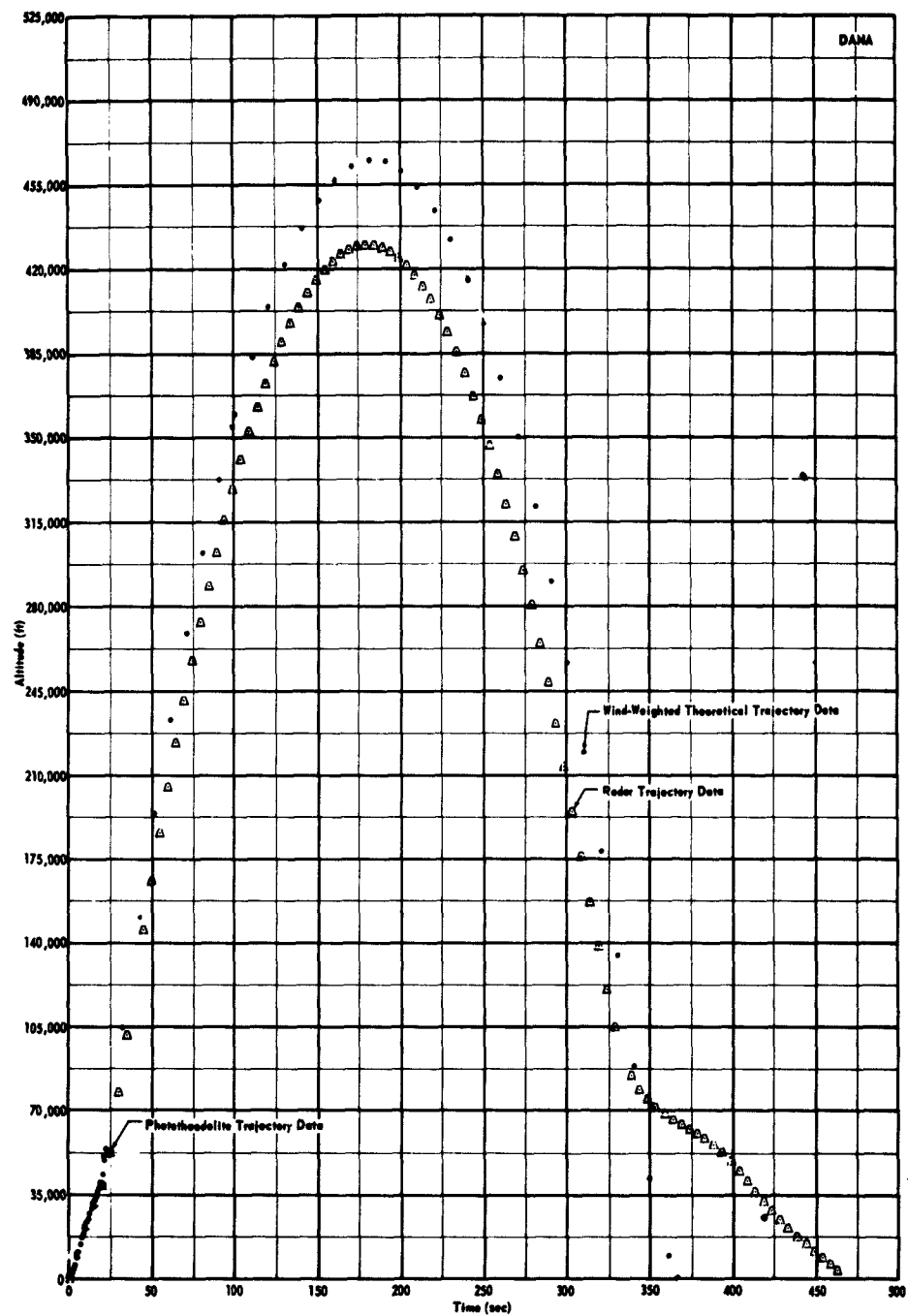


Fig. 128: Nike-Cajun (Dana) Altitude vs. Time (Entire Trajectory).

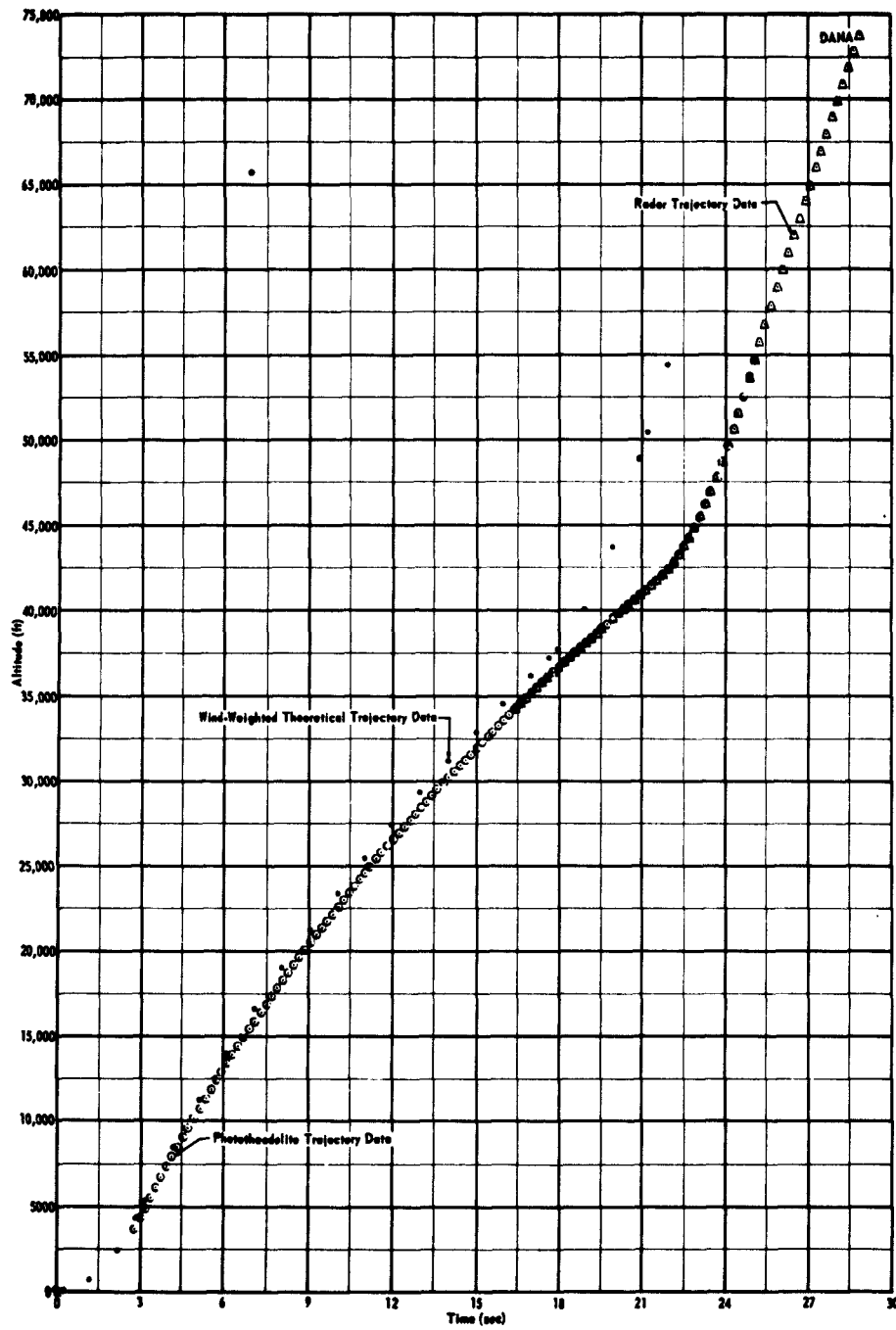


Fig. 129: Nike-Cajun (Dana) Altitude vs. Time (Trajectory Through Burnout).

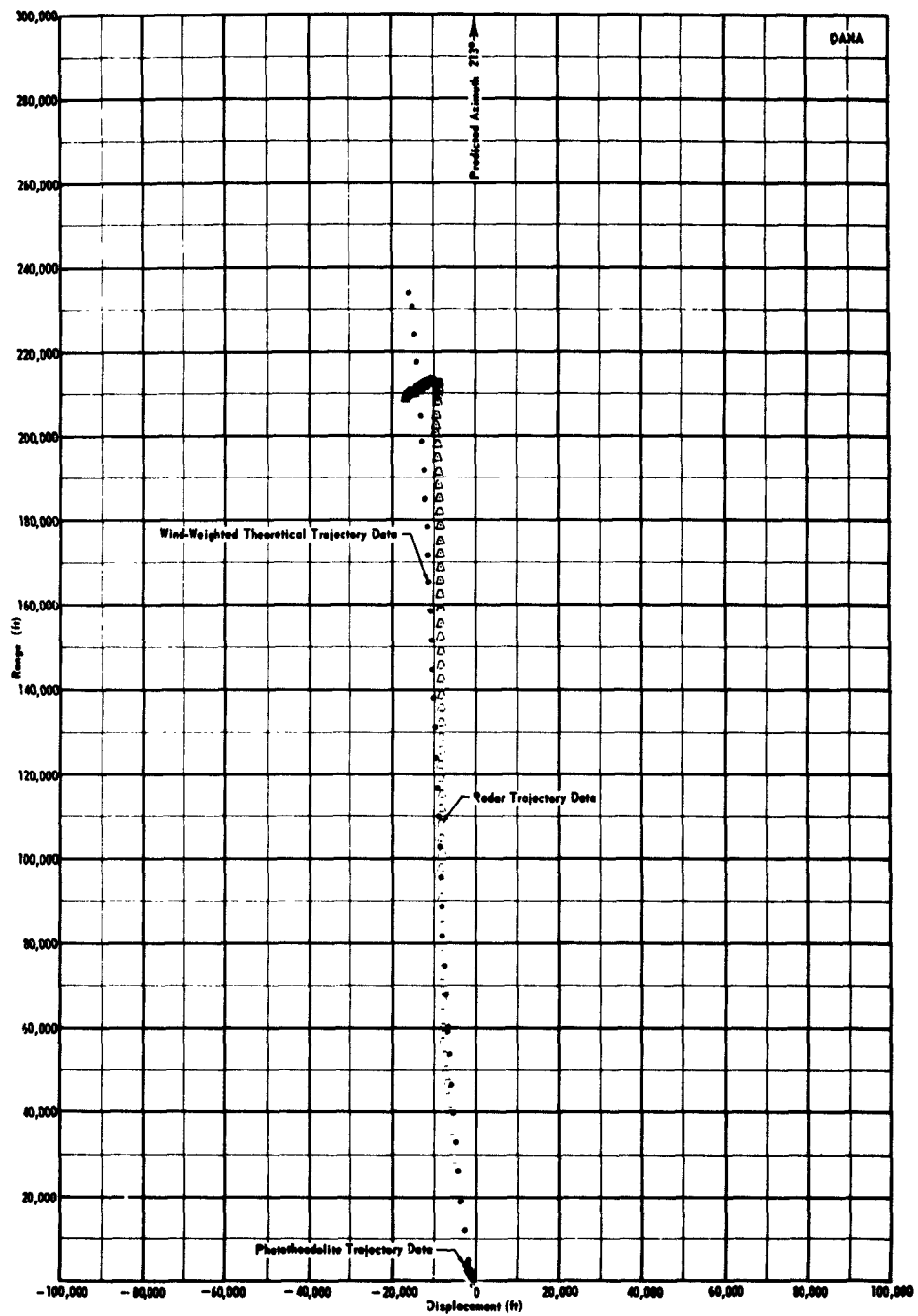


Fig. 130: Nike-Cajun (Dana) Range vs. Displacement (Entire Trajectory).

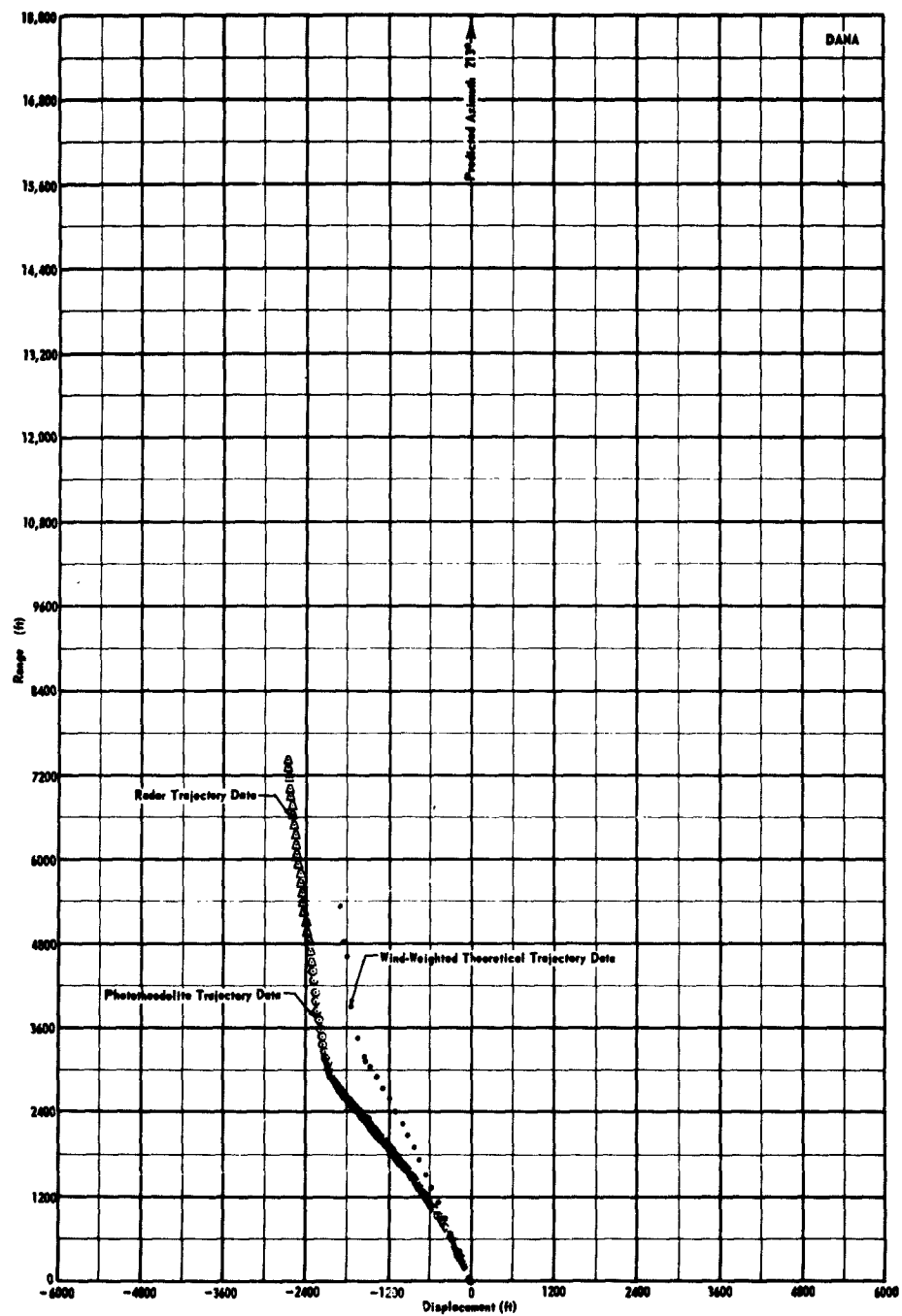


Fig. 131: Nike-Cajun (Dana) Range vs. Displacement (Trajectory Through Burnout).

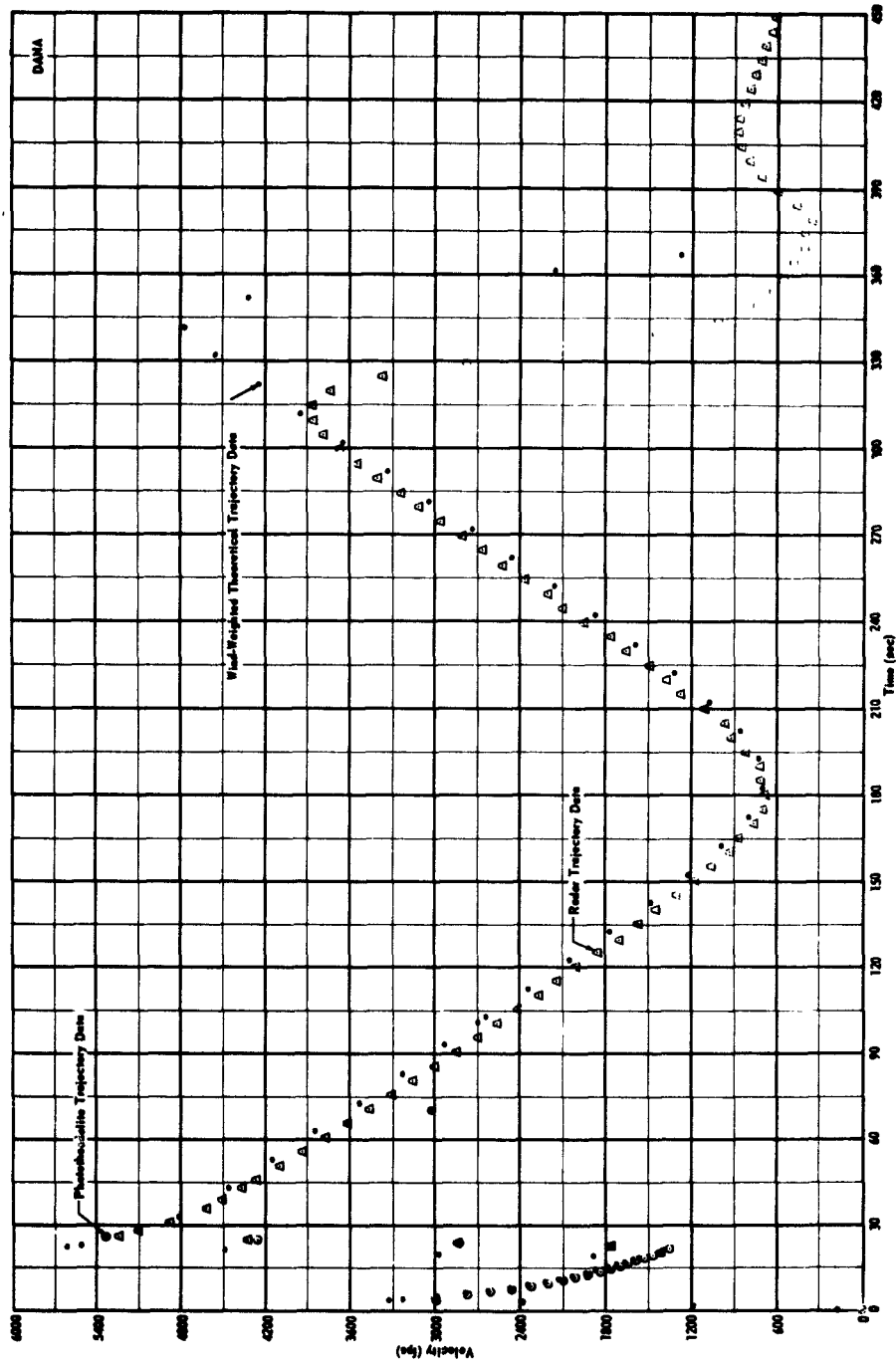


Fig. 132: Nike-Cajun (Dana) Velocity vs. Time (Entire Trajectory).

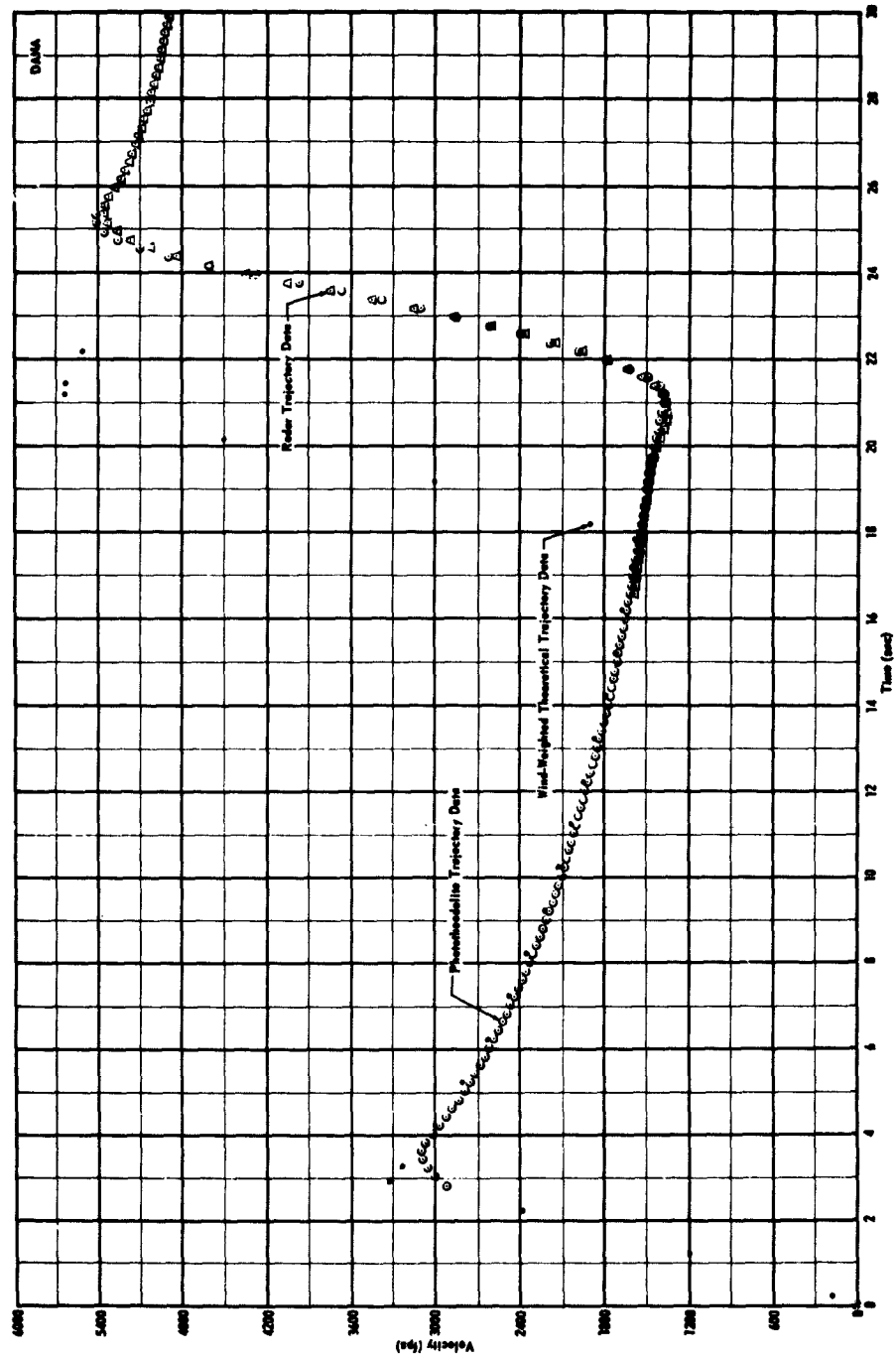


Fig. 133: Nike-Cajun (Dana) Velocity vs. Time (Trajectory Through Burnout).

REFERENCES

1. APMC-AIDR-62-29, Dispersion Study for the Honest John-Nike-Nike, unclassified report, dated December 1962.
2. APMC-AIDR-62-31, Dispersion Study for the Aerobee 150, unclassified report, dated December 1962.
3. APMC-AIDR-63-7, Dispersion Study for the Nike-Cajun, unclassified report, dated January 1963.
4. APMC-AIDR-63-18, Dispersion Study for the Nike-Apache, unclassified report, dated February 1963.

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1 Space-General Corporation, El Monte, California
1 Space-General Corporation, Almagordo, New Mexico
2 Atlantic Research Corporation, El Monte, California
2 Atlantic Research Corporation, Alexandria, Virginia
1 Chance-Vought Corporation, Astronautics Division
1 Geophysics Corporation of America, Physics Research Division
1 Thiokol, Elkton Division
1 Device Development Corporation
1 Armour Research Foundation, Physical Chemistry Research
1 Oklahoma State University, Research Foundation
1 Georgia Institute of Technology
1 University of Georgia, Department of Physics
1 University of Michigan
30 ASTIA (TIPCR)
APGC
15 PGWHP
1 PGWRR
1 PGWT
1 PGWF
1 PGOPW
1 FGOOS
1 PGOOC
1 PGVMS-6
1 FGAPT
3 PGAFI
3 PGEH

Air Proving Ground Center, Eglin Air Force Base, Florida Rpt. No. AFPC-TDR-63-19, FIREFLY III, SOUNDING ROCKET LAUNCH- ING REPORT (33 Vehicles Launched 15 October - 15 December 1962). Vol. 1 Launch, Vehicles, and Data Reduction. Final report, April 1963, 164 p., incl. illus., tables. Unclassified report Thirty-three sounding rockets (15 Nike-Cajun, 4 Nike-Apache, 9 Honest John-Nike-Nike, and 5 Aerobee 150) were launched from the Aerospace Launching Facility, Eglin Gulf Test Range, Florida. These launchings were conducted in support of Project Firefly III, directed by the Geo- physics Research Directorate, Air Force Cambridge Research Labora- tories, Office of Aerospace Research. The overall report, consisting of Volumes 1 and 2, describes the sounding rockets, ballistic computations, range support, and the launch and flight data obtained. Specifically, Vol- ume 2 presents only the theoretical and empirical vehicle trajectory data tabulated at the Air Proving Ground Center. 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