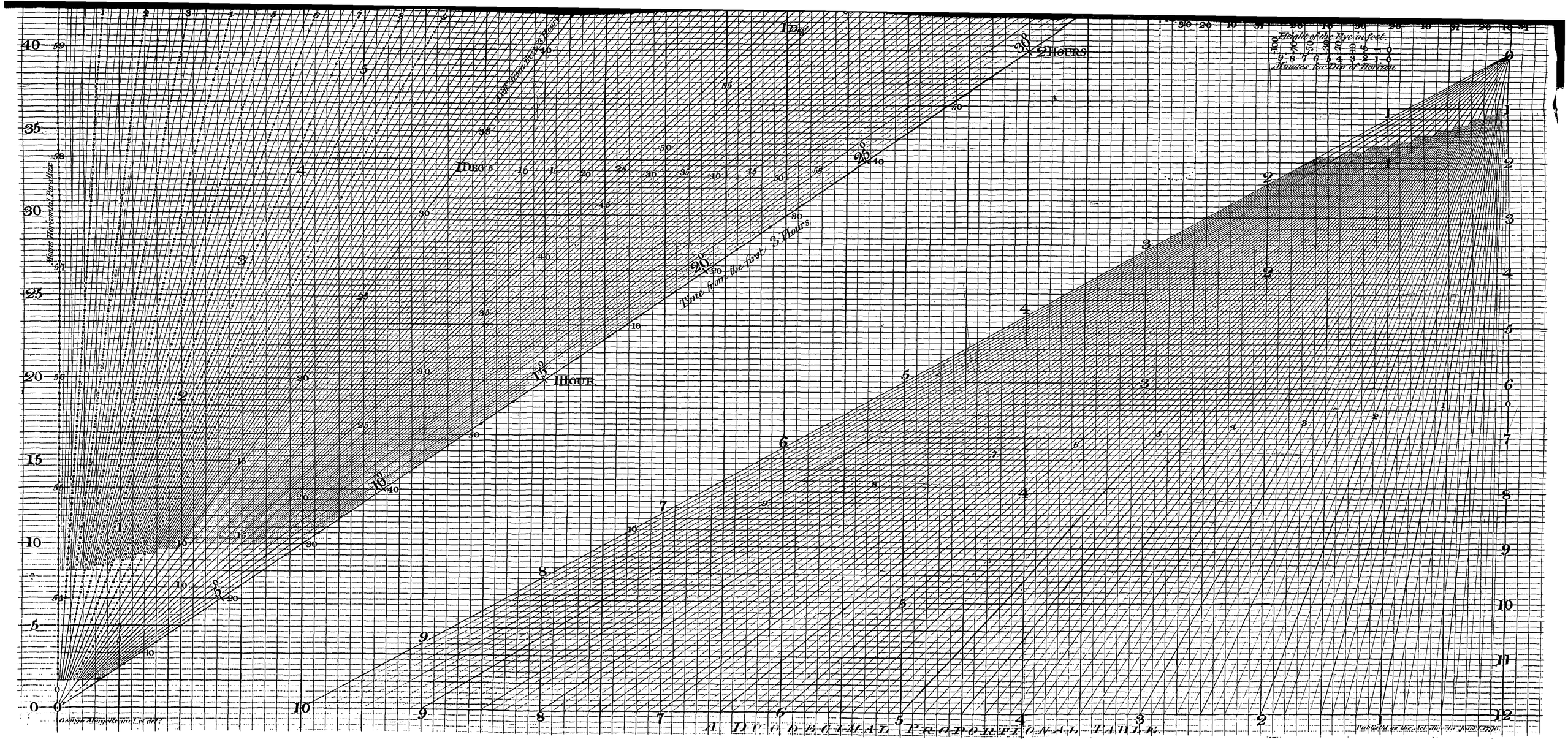
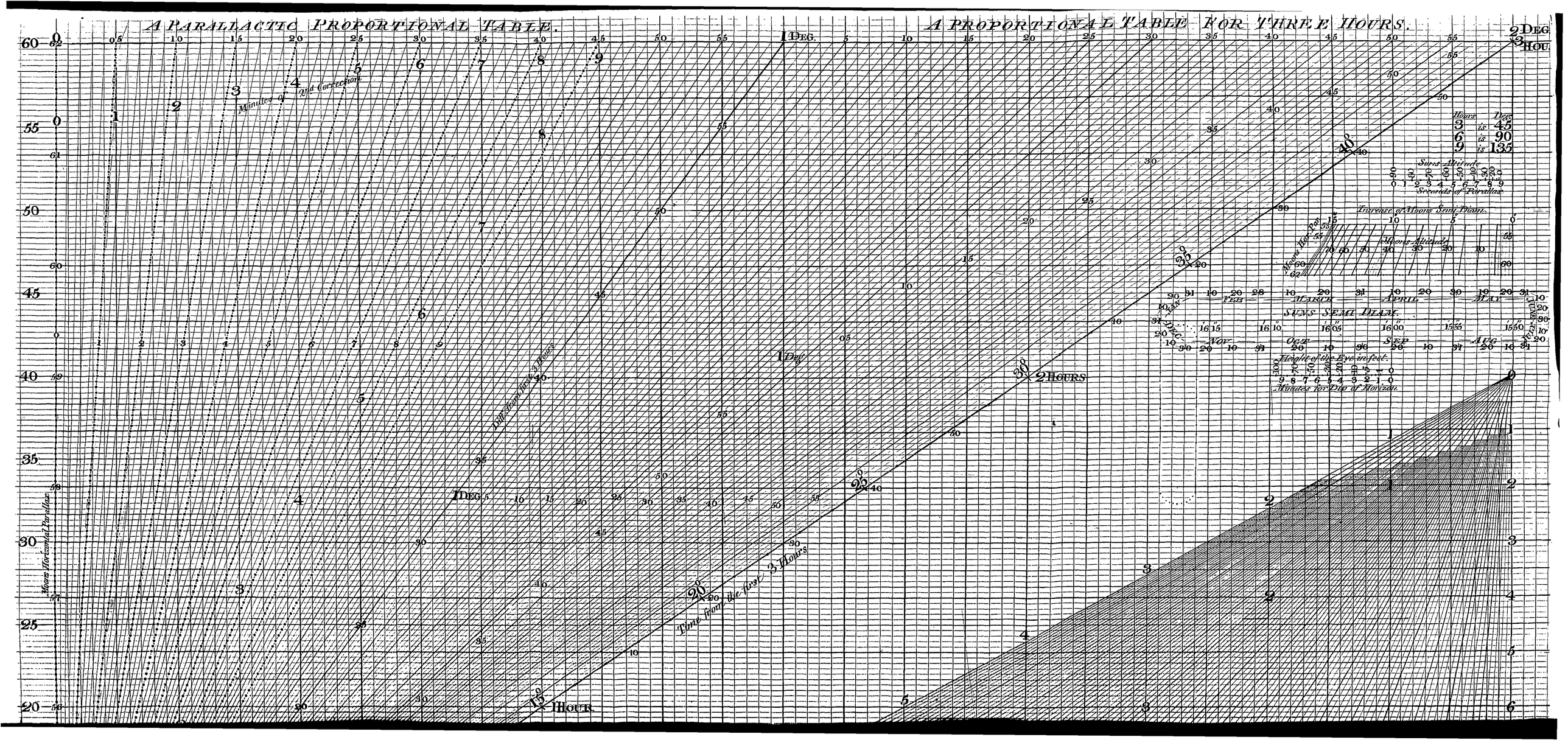

A Decimal Proportional Table.
Hours Horizontal Pendulum
Time from the first 3 Hours
1 Hour
2 Hours
1 Deg
Height of the Eye in feet.
Minutes for Dip of Horizon.


A PARALLACTIC PROPORTIONAL TABLE.
A PROPORTIONAL TABLE FOR THREE HOURS.
Moon's Horizontal Parallax
Minutes of 2nd Correction
1 Deg.
2 Deg.
1 Hour
2 Hours
3 Hours
Time from the first 3 Hours
Time from the last 3 Hours
Hours Deg.
3 is 45
6 is 90
9 is 135
Sun's Altitude
Seconds of Parallax
Increase of Moon's Semi Diam.
Moon's Hor. Par.
Moon's Altitude
Feb
March
April
May
Jan
Dec
Nov
Oct
Sep
Aug
Jul
Sun's Semi Diam.
Height of the Eye in feet.
Minutes for Dip of Horizon.

W Walker 1790

Margetts's Longitude Tables

for Correcting the Effect of

PARALLAX and REFRACTION,

On the Observed Distance taken between the

MOON *and the* **SUN**, *or a fixed* **STAR**,

Whereby the True Distance is Accurately Obtain'd,

and the Corresponding Time at Greenwich,

FOUND BY

INSPECTION.

London:

Printed for the Author, No 42, Penton Street, Islington;

and Sold by Mr. Elmsly, Bookseller in the Strand, and Messrs. Gilbert & Wright, Opticians, Leadenhall Street;

where the Author will attend in order to give a full Explanation of his Method of finding the Longitude.

TO

HIS ROYAL HIGHNESS

PRINCE WILLIAM HENRY,

DUKE OF CLARENCE AND ST. ANDREWS IN GREAT BRITAIN,

EARL OF MUNSTER IN IRELAND,

KNIGHT OF THE MOST NOBLE ORDERS

OF THE

GARTER AND THISTLE,

THIS

NEW METHOD OF WORKING

LUNAR OBSERVATIONS

FOR

FINDING THE LONGITUDE AT SEA,

AND

IMPROVEMENT OF NAVIGATION,

IS, BY PERMISSION, DEDICATED BY

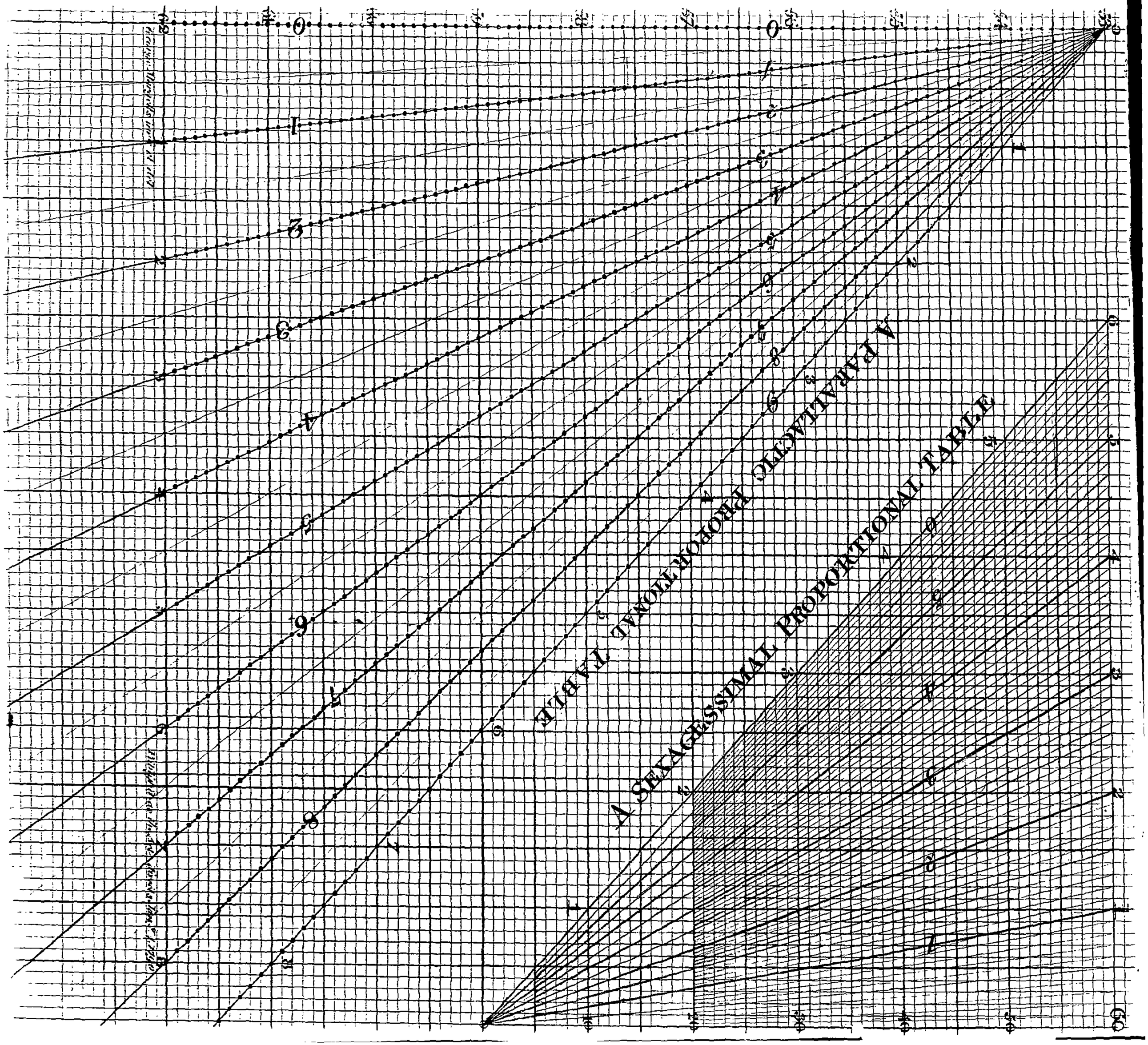
HIS ROYAL HIGHNESS's

MOST OBEDIENT AND OBLIGED

HUMBLE SERVANT,

No. 42, Penton Street, Islington,
May 17, 1790.

GEORGE MARGETTS.


A SEXAGESSIMAL PROPORTIONAL TABLE
A DUODECIMAL PROPORTIONAL TABLE
A TWELFTH

INTRODUCTION.

THESE Tables, with the Nautical Almanac, contain every thing requiſite for finding the Longitude at Sea by Lunar Obſervations. In this method, the angular diſtance between the neareſt limbs of the Sun and Moon, or between the Moon's limb and a fixed Star, muſt be carefully meaſured with a good Hadley's Quadrant or Sextant, and at the ſame time, the apparent altitude of both the objects muſt be taken, if it can be done conveniently. The exact time when the Moon's limb is brought in contact with the Sun or a Star, muſt alſo be carefully noted by a watch, previouſly regulated to the time at the ſhip, unleſs the altitude of the Sun or Star, be taken at the ſame inſtant that the diſtance is obſerved, and in a proper ſituation for finding the apparent time at the ſhip.

But theſe obſervations being made from the ſurface of the earth, and not from the earth's center, the diſtance ſo obſerved will be conſiderably affected by the Moon's Parallax; it will alſo be affected by the refraction of the atmoſphere; and on theſe two accounts the Moon always appears below her true place. But the Sun and Stars always appear above their true place in the heavens, conſequently the obſerved diſtance will at ſome times be much greater, and at other times much leſs than the true diſtance of the objects, according to their ſituation in the heavens.

Therefore as the true diſtance of the objects muſt be accurately obtained, in order to aſcertain the longitude of the ſhip: to perform this Problem by calculation is at preſent one of the moſt difficult operations that Navigation labours under.

Theſe Tables are therefore intended to ſave the time and trouble of a long numerical calculation; for it often happens, that the other eſſential duties on ſhip-board do not leave time for performing ſuch difficult operations; whereas the navigator having made the neceſſary obſervations, he may, by immediate inſpection, in theſe Tables find the correction neceſſary to be applied to his obſerved diſtance, in order to reduce it to the true diſtance of the centers.

The Author, however, does not pretend by theſe Tables to determine the Longitude more exactly than it may be done by a rigorous calculation; but the eaſe and correctneſs with which the effects of Parallax and Refraction may be obtained by them, will, he hopes, recommend his Tables to the attention of the Public; for it is well known that the moſt able and expert calculators themſelves are frequently liable to make miſtakes in long calculations, which, of courſe, deranges the whole operation; ſo that even to them theſe Tables will be of conſiderable uſe, were it only for a check on their calculating the effect of Parallax and Refraction.

By theſe Tables the operation may be performed in all caſes with ſuch great exactneſs, as to render the trouble of calculation entirely unneceſſary, unleſs the Moon's place was accurately

known

known to a Second, and the Sextant capable of meaſuring an angle to a much greater degree of nicety than it will do at preſent; for the greateſt error which can ever ariſe in the reſult given by theſe Tables, will never amount to an angle large enough to be diſtinguiſhed in reading off from the moſt accurate inſtrument; ſo that if there ſhould be an error of 6 or 8, or even 10 Seconds, yet, the eaſe and expedition with which Lunar diſtances are cleared from the effects of Parallax and Refraction, by this Method, will enable the navigator to make and compute a greater number of obſervations, which will naturally tend to correct each other. Beſides, by theſe Tables a perſon of the moſt ordinary capacity may be fully inſtructed, in the ſpace of little more than an hour, ſo as to be capable of going through the whole proceſs; for, although it may be neceſſary to uſe different methods of calculation, in order for the learner to ſee the near agreement in the reſults, and to underſtand the reaſon of the different corrections neceſſary to be applied, yet, in moſt of the methods of ſolving this problem hitherto made public, there is not any great light thrown on the nature of the proceſs, ſo as to enable him clearly to underſtand why he is to perform this or that part of the operation.

It is to be obſerved, that theſe Tables are conſtructed for the apparent diſtances, and the apparent altitudes, of the centers, of the heavenly bodies, whoſe diſtances are obſerved, and that therefore, the obſervation having been made of their limbs, and not of their centers, a correction muſt be made in order to obtain the apparent diſtance, and the apparent altitudes of the centers, before the Tables can be uſed for clearing the diſtance from the effects of parallax and refraction.

This correction is equally neceſſary in every other method of ſolving this problem, whether by thoſe recommended in the Nautical Almanac, and Requiſite Tables; or by the large book of Tables of Parallax and Refraction.

If the diſtance between the neareſt limbs of the Sun and Moon be obſerved, the two ſemi-diameters, corrected for the time of the obſervation, muſt be added to the diſtance on the Quadrant, or Sextant, and the ſum is the apparent diſtance of the centers: but the Moon's ſemi-diameter, in the Nautical Almanac, muſt be increaſed by the number of ſeconds which are found againſt her altitude and horizontal parallax, in a ſmall table made for that purpoſe.

If the diſtance of a Star from the Moon's neareſt limb be obſerved, the Star having no viſible diameter, the Moon's ſemi-diameter alone, increaſed as above directed, muſt be added to the obſerved diſtance; but if the diſtance of the Star be obſerved from the Moon's remote limb, the Moon's ſemi-diameter muſt be ſubtracted from the diſtance on the Sextant, and the reſult will be the apparent diſtance of the centers.

To the altitude of the Sun, Moon, or Star on the Quadrant, a correction muſt alſo be made for the height of the eye above the ſurface of the water; this correction is called the dip of the horizon, and is expreſſed in a ſmall Table, conſtructed for that purpoſe, to every height of the eye as far as one hundred feet, which is probably more than will ever be required. The altitudes of the Sun and Moon muſt alſo be corrected for their ſemi-diameters.

If the altitude of the Sun's lower limb be obſerved, the difference between the dip of the horizon and the Sun's ſemi-diameter muſt be added to his altitude on the Quadrant; but if the altitude of his upper limb be obſerved, both his ſemi-diameter and the dip muſt be ſubtracted from the obſerved altitude; but no allowance is to be made for refraction, as the Tables are adapted to the apparent altitudes.

If

If the altitude of the Moon be obſerved, the allowance to be made is the ſame as for the altitude of the Sun, that is, it muſt be corrected, both for the height of the eye and ſemi-diameter, increaſed as has been directed above.

If a Star's altitude be obſerved, it having no viſible diameter, the only correction to be made is to ſubtract the dip from the obſerved altitude of the Star, according to the height of the eye above the ſurface of the water.

Having thus reduced the obſervations to the apparent diſtance and altitudes of the centers, the obſerver is prepared to uſe the Tables.

DESCRIPTION *and* USE *of the* TABLES.

Of the Tables for ſhewing the Correction to be applied for the effect of Parallax and Refraction on Lunar Obſervations.

Theſe are a ſet of Linear Tables, made for every degree of Diſtance, between the Sun and Moon, or between the Moon and a fixed Star, from 20 to 120 degrees of diſtance, and are engraved on upwards of 70 Copper-plates.

The largeſt figures or number on each plate are the degrees of apparent diſtance between the centers of the Moon, and Sun, or Star, for which that plate gives the correction; each plate from 20 to 59 degrees contains one degree of diſtance; and from 60 to 90, each plate contains two degrees; but they have no connection with each other. The top degrees continue up to 90, and the degrees at the bottom go back from 91 to 120 degrees of diſtance.

The perpendicular lines, numbered at the top and bottom of each plate, repreſent the degrees of the Moon's apparent altitude, increaſing from 5 degrees at the right hand, to 90 degrees of altitude at the left hand of the Tables.

The oblique curved lines repreſent the degrees of the Sun or Star's apparent altitude, increaſing from 5 degrees, which is always the loweſt oblique curved line, to 90 degrees of altitude, and are numbered on every tenth line, in the body of the Table, with their proper degrees of altitude.

The horizontal lines, numbered in large figures round the left hand boundary of the curved lines, and alſo in ſome of the plates with ſmaller figures in the margin at the ſides, expreſs minutes of correction: theſe muſt always be ſubtracted from the apparent diſtance of the centers, if the altitudes of the Moon, and the Sun, or Star, interſect each other in the upper part of any degree of diſtance; but if the point of interſection fall below the line marked O, (which is the place where the effect changes from — to +) the correction muſt always be added to the apparent diſtance of the centers. This correction is called the firſt arc, and corrects or clears the diſtance from the whole effect of parallax and refraction, for 53 minutes of the Moon's horizontal parallax; the tables being laid down from actual calculations made for that purpoſe.

The dotted curves, which run nearly horizontal in every degree of diſtance, likewiſe repreſent minutes of correction, and are each of them numbered in the body of the Tables, increaſing both ways from O, which is near the line marked O of the firſt correction, up to 9 minutes at the top of every diſtance, but their extent down varies in the different plates, being leſs as the degrees of diſtance increaſe, as far as 85 degrees, where the dotted line marked O is the loweſt in the Tables, but beyond 85 degrees of diſtance it falls below the Table, and is therefore not inſerted. This correction is likewiſe to be ſubtracted from the apparent diſtance, if both the altitudes meet in the upper part of any degree of diſtance; but if the point of interſection fall below the dotted curve marked O, which is the place where this effect changes from — to +, the correction muſt be added to the apparent diſtance, and the reſult will be the true diſtance of the centers, for the moon's horizontal parallax at 62 minutes; this correction is for the effect of parallax alone, and is for the difference between 53, and 62 minutes of the moon's horizontal parallax.

In theſe Tables the effect of the Sun's parallax is not taken into the account, it being ſo ſmall, that the error in the true diſtance on that account will never amount to 9 ſeconds of a degree, even when the Sun has but 5 degrees of altitude and the Moon is then in the ſame vertical circle over him. This correction may be eaſily introduced, as well as that for the change in the ſtate of the atmoſphere; but the error in the longitude ariſing from theſe cauſes will never amount to more than 4 or 5 miles, ſo that I choſe to leave them out rather than to perplex and embarraſs the operation.

Of the ſmall Parallactic Proportional Table for finding the ſecond Arc.

In this Table the horizontal lines, numbered on the left hand ſide, repreſent the minutes, &c. of the Moon's horizontal Parallax, each ſpace being 6 ſeconds of a degree. The angular dotted lines in this Table correſpond with the dotted curves in the degrees of diſtance; and the perpendicular lines at the angle of meeting ſhew the correction for the ſecond arc: each of theſe ſpaces are 6 ſeconds of a degree. This Table folds out for uſe at the beginning of the book, next after the title page.

Of the Sexageſimal Proportional Table for reducing the Corrections to the odd Minutes, of Apparent Diſtance.

In this Table (which is on the ſame plate with that laſt deſcribed) the horizontal lines, numbered on the right ſide, are for the minutes of apparent diſtance; the angular lines repreſent the change in the correction for a degree of diſtance, and the perpendicular lines at the angle of meeting ſhew the proportional part, this is to be added or ſubtracted, according as the correction is greater or leſs at the next degree.

This Table will likewiſe be found uſeful in working any other ſexageſimal proportion, wherein the angular lines may repreſent either minutes, ſeconds, or whole numbers, and the perpendicular lines will ſhew the proportional part againſt the minutes, &c. for which a proportion may be required, and will always be of the ſame denomination as the angular lines.

Of the large Three Hour Proportional Table for reducing the Obſervation to the correſponding Time at Greenwich.

In this Table the angular lines are for the difference between two of the diſtances contained in the Nautical Almanac, one of them being greater, and other leſs, than the true corrected dif-

diſtance of the obſervation; this difference will always fall between the angular lines of one and two degrees, towards the right hand of the Table, the perpendicular lines are for the difference between the firſt of thoſe diſtances, and the true diſtance of the obſervation, and the horizontal lines at the angle of meeting, ſhew the time which muſt be added to the time taken out with the firſt diſtance, from the Nautical Almanac, the ſum will be the time at Greenwich correſponding with the obſervation. This table will alſo be uſeful for turning time into degrees, and vice verſa; this is done by the dots along the diagonal line, correſponding with the time.

The dotted angular lines in the firſt part of this Table will likewiſe ſerve as a parallactic Table for finding the ſecond arc, wherein the horizontal lines for the Moon's parallax are each of them three ſeconds of a degree, and the perpendicular lines for the correction, are each of them twelve ſeconds.——The whole of this Table will likewiſe ſerve for ſexageſimal proportions to any degree of exactneſs that may be required.

At the bottom corner of the large plate is a triangular duodecimal Table, uſeful for reducing the Sun or Moon's longitude, right aſcenſion, declination, &c. to any time after noon or midnight, and for many other purpoſes. The principles of all theſe Tables are the ſame, therefore a farther explanation is unneceſſary ſince they are readily and without difficulty applied to ſuch purpoſe as the nature of the caſe may require.

This plate likewiſe contains ſeveral other uſeful Tables; viz. A Table for turning time into degrees, and vice verſa, at every 3 hours.

A Table for ſhewing the Sun's parallax in altitude, to parts of a ſecond, according to his altitude.

A Table for ſhewing the augmentation of the Moon's ſemi-diameter, to parts of a ſecond, according to her altitude and horizontal parallax.

A Table for ſhewing the Sun's ſemi-diameter, to parts of a ſecond, for any day in the year.

A Table for ſhewing the dip of the horizon, to parts of a minute, according to the height of the eye above the ſurface of the ſea.

Of the Table (or Formulæ) for the Calculation.

In the right hand pages are contained fifteen formulæ, in each of which there is room for inſerting the whole proceſs of finding the longitude, after the obſervations have been corrected for the ſemi-diameters and dip of the horizon. The apparent time of the ſhip being given.

Rules for uſing the Tables.

Find in the Tables the degree of diſtance correſponding with the degrees of the corrected obſervation (neglecting the odd minutes, &c.) and in one of the formulæ ſet down the altitude of the Moon, the altitude of the Sun, or Star, the Moon's horizontal parallax, and the apparent diſtance of the centers; theſe four being the neceſſary data for clearing the diſtance from parallax and refraction. Then find the Moon's altitude among the perpendicular lines, and the Sun or Star's altitude among the oblique curved lines, and trace them along till they meet, on which place ſet the point of a pin, or the very fine point of a pencil: Among the horizontal lines obſerve the correction anſwering to this point, and if it be above the line marked **O**, the correction muſt be ſubtracted: this will always be the caſe when the diſtance is above 95 degrees,

degrees, and much oftener than otherwiſe, in all other diſtances. But if the point where the two altitudes meet happen below the line marked O, this correction muſt always be added to the apparent diſtance. The ſpace between any two horizontal lines is 1 minute or 60 ſeconds of a degree; therefore in eſtimating for the ſeconds, care muſt be taken to make the proper allowance: thus, if the point fall in the middle of a ſpace, 30 ſeconds muſt be allowed; if it fall at one third part of a ſpace, it is 20 ſeconds; a quarter of a ſpace is 15 ſeconds; a fifth part is 12 ſeconds, and a ſixth part is 10 ſeconds, &c. The eſtimating to the intermediate portions of a minute will ſoon become familiar.

Having eſtimated and ſet down this correction with its proper ſign, for the firſt arc, take notice of the ſituation of the point with regard to the dotted curves, and take out the argument for finding the ſecond arc, obſerving to eſtimatefor the odd ſeconds in the manner that has been deſcribed in taking out the firſt arc, look for the minutes and ſeconds thus found among the dotted angular lines in the parallactic proportional Table, and the Moon's horizontal parallax, among the horizontal lines numbered at the ſide towards the left hand, and the vertical line which paſſes through the point where theſe meet ſhews the minutes and ſeconds which are to be ſet down in the line for the ſecond arc; this arc is always to be added to the firſt arc for the total, whether it be + or —, unleſs the point where the altitudes meet, fall between the dotted curve marked O, and the line marked O, for the firſt correction; but if the point falls between thoſe lines, the two arcs have contrary ſigns, and the difference between them muſt be taken for the total, which has always the ſame ſign with the greater, and is the true correction at the even degree of diſtance: but it will ſeldom happen in this ſituation. Repeat the operation in the next greater degree of diſtance; and ſet it down in the vacant ſpace to the left of the other, (as in the following examples) then take the difference between them, which ſet down in the line of difference for 1 degree, with the ſign + if the laſt correction be greateſt, but — if it be leſs: and in the ſmall ſexageſimal Table, find the odd minutes, &c. of diſtance at the ſide and the difference for 1 degree, among the angular lines, and take out the proportional part from the perpendicular lines; this being applied, according to its ſign, to the total or correction at the even degree, will give the true correction required, and being properly applied to the apparent diſtance, the reſult will be the true diſtance of the objects. It may ſometimes happen, when the correction at the firſt degree of diſtance is only a few ſeconds +, that the correction at the next degree, will be a few ſeconds —, in this caſe the ſum of both is the difference for a degree of diſtance, and the proportional part thereof muſt be taken for the odd minutes, but this circumſtance will not happen above once in a hundred obſervations.

Having thus found the true diſtance of the centers, find, in the Nautical Almanac, where it falls between two of thoſe diſtances, and ſet the firſt of them down, beneath the true diſtance in the formulæ, and alſo the hour; take the difference between them, and ſet it beneath, in the line againſt diff. Find alſo the difference between the two diſtances in the Nautical Almanac, and ſet it down in the line diff. in 3 hours; then in the large 3 hours proportional Table find the firſt of theſe differences among the perpendicular lines, and the other difference among the angular lines, and where they meet, ſet a fine point, and the horizontal lines will ſhew the proportional part; (or ſubſtract the proportional logarithm of the laſt difference from that of the firſt, and the remainder is the proportional logarithm of the time;) this being added to the time of the firſt diſtance before ſet down, the ſum is the apparent time at Greenwich when the obſervation was made. The difference between this and the apparent time at the ſhip gives the ſhip's longitude in time, and may be changed into degrees by the table mentioned above; and is eaſt, if the time at the ſhip be greater than the time at Greenwich, but weſt, if the time at the ſhip be leſs than the time at Greenwich.

The

The Author laid the plan of his Tables before the Honourable Court of Directors of the United East India Company, with a petition for their patronage and support. It was referred from thence to the Captains in the Company's service, from whom (after an investigation, by working several observations) the Author received the following approbation of their utility:

JERUSALEM COFFEE-HOUSE, March 3, 1790.

"WE, the underwritten Commanders, in the service of the Honourable East India Company, "having seen Mr. MARGETTS' method of working Lunar Observations, do hereby testify our "approbation thereof, as being sufficiently near the truth to answer in all cases, for clearing "Lunar Distances from the effects of Parallax and Refraction.

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J. P. LARKINS,
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After the above approbation had been presented to the Committee of Shipping, the Court of Directors ordered their Treasurer to pay the Author a subscription of 120 Guineas.

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Mr. Thomas Turner, of the Rodney East Indiaman.
Mr. Henry Wilson, jun. Hawke East Indiaman.
Mr. Ebenezer Roebuck, Essex East Indiaman.
Mr. Patrick Burt, Dublin East Indiaman.
Mr. George Barnes, Bombay.

ADVERTISEMENT.

In finding the longitude at sea by Lunar Observations three persons have always been thought requisite to make the necessary observations, and the process at land has been attended with still greater difficulty, on account of the altitudes not being easily obtained; but with the assistance of a set of Tables which the author is now publishing by subscription, the process of finding the longitude, either at sea or land, requires only the observation of taking the Moon's distance from the Sun or Star, for the watch having been previously set to the apparent time, the altitude of the Moon and the Sun, or Star, required, in order to correct the distance, may be found by inspection. The time at the ship, from an altitude, may also be found by inspection, for the purpose of setting the watch. The azimuth may likewise be found by inspection; and a single altitude of the Sun, Moon, Star, or Planet, with the horary angle, if taken within three hours of the Meridian, will give the latitude of the ship by inspection; and the same altitudes which are taken for the purpose of clearing the distance, will at all times determine the latitude if they are taken with any degree of accuracy.

EXEMPLIFICATION of the TABLES.

EXAMPLE I.

The apparent altitude of the moon's center being 12°. 30′, when that of a ſtar was 24°. 48′, the moon's horizontal parallax 56′. 15″, and the apparent diſtance of the moon's center from the ſtar 51°. 28′. 35″, required the true diſtance?

In 51 degrees of diſtance find 12°. 30′ among the perpendicular lines, and 24°. 48′ among the oblique curved lines, and where they meet make a point, and the firſt correction, among the horizontal lines, will be —17′. 35″ this is to be ſubtracted, becauſe the the point is above the line marked (O) at the ſide of the Table; having ſet this correction down for the firſt arc with the ſign —, obſerve, that the point falls a little beyond the third dotted curve, above that marked (O.) Then in the Parallactic Table find the moon's horizontal parallax 56′. 15″, at the left ſide; and againſt it make a point, bearing the ſame proportion, viz. a little beyond the dotted line marked 3; and the ſecond correction correſponding with this point, found among the perpendicular lines, is —1′. 8″ to be ſubtracted; the ſum of theſe two arcs is —18′. 43″ for the correction at 51 degrees of diſtance; but the apparent diſtance being 51°. 28′. 35″, the ſame muſt be repeated in 52 degrees of diſtance, where the firſt correction is —17′. 33″, and the ſecond correction —1′. 7″, their ſum —18′. 40″ will be the correction at 52 degrees of diſtance, the difference between them is only 3″ for a degree of diſtance, therefore —18′. 42″ is the true correction at the apparent diſtance 51°. 28′. 35″, and being ſubtracted therefrom, the remainder 51°. 9′. 53″ is the true diſtance of the objects. *Note.* In the requiſite Tables, the true diſtance of this obſervation by Lyon's method, is 51°. 9′. 50″; and by Dunthorne's method with five places of figures, it is 51°. 9′. 52″.

EXAMPLE II.

Admit the apparent altitude of the moon's center to be 55°. 56′, that of a ſtar 19°. 18′, the moon's horizontal parallax 60′. 5″, and the apparent diſtance of the moon's center from the ſtar 50°. 8′. 41″, the apparent time at the ſhip being 9 h. 32 m. 28 s. The true diſtance in the Nautical Almanac at nine hours is 51°. 44′. 54″, and the difference in the next three hours —1°. 28′. 54″, required the true diſtance of the moon's center from the ſtar, and alſo the longitude of the ſhip?

In 50 degrees of diſtance find the moon's altitude 55°. 56′ among the perpendicular lines, and the ſtar's altitude 19°. 18′ among the oblique curved lines, and a point being made at the angle of meeting, the correction anſwering thereto, among the horizontal lines, is + 16′. 2″ this is to be added, becauſe the point is below the line marked (O) at the ſide of the Table. Having ſet this correction down for the firſt arc with the ſign + the point is obſerved to fall almoſt between the ſecond and third dotted curves, below that marked (O); then in the Parallactic Table find the moon's horizontal parallax 60′. 5″ on the ſide, and againſt it make a point, bearing the ſame proportion, viz. almoſt half way beyond the dotted angular line marked 2, and ſecond correction among the perpendicular lines is + 1′. 52″ this is to be added, becauſe below the dotted curve marked (O), the ſum of theſe two arcs + 17′. 54″, is the correction at 50 degrees of diſtance, but the apparent diſtance being 50°. 8′. 41″, the ſame muſt be repeated in 51 degrees of diſtance, where the firſt correction is + 15′. 5″, and the ſecond + 1′. 45″, their ſum + 16′. 50″ is the correction at 51 degrees; the difference for one degree is —1′. 4″, and for 8′. 41″, it is 9 ſeconds, therefore the correction at 50°. 8′. 41″ is + 17′. 45″, and being added thereto, gives 50°. 26′. 26″ for the true diſtance of the objects; this diſtance is 1°. 18′. 28″ leſs than the diſtance at 9 hours. Therefore in the 3 hour Proportional Table find 1°. 18′. 28″ among the perpendicular lines, and 1°. 28′. 54″, the moon's motion in three hours, among the angular lines, and a point being made at the angle of meeting, will ſhew the correſponding time among the horizontal lines, to be 2 h. 38 m. 46 s. and being added to 9 hours, gives 11 h. 38 m. 46 s. for the apparent time at Greenwich, which is 2 h. 6 m. 11 s. more than the time of the obſervation at the ſhip, equal to 31°. 33′ of longitude weſt from Greenwich. The whole of this proceſs is ſet down in the Third Example, with the difference of 4 ſeconds, in the true diſtance, being the reſult of another operation.

EXAMPLES.

EXAMPLE III. *Cor. from* (51) *Diſt.* 50 *deg.*

	°	′	″			°	′	″
Moon's app. alt.	55	56	0	1ſt arc. (+ 15′ 9″)	+	16	5	
Star's app. alt.	19	18	0	2d do. (+ 1 45)	+	1	53	
Moon's hor. par.	0	60	5	Total (+ 16 54)	+	17	58	
App. diſtance	50	8	41	Diff. for 1 deg.	—	1	4	
True diſtance	50	26	30	Do. for 8′ 41″	—	0	9	
Do. at 9 hours	51	44	54	Correction	+	17	49	
Difference	1	18	24	Time at Greenw.	11h	38	46	
Diff. in 3 hours	1	28	54	Time at Ship	9h	32	28	
Longitude	31	34	W	Diff. Weſt	2h	16	18	

EXAMPLE IV. *Cor. from* (60) *Diſt.* 59 *deg.*

	°	′	″			°	″
Moon's app. alt.	27	2	0	1ſt arc. (—37 6)	—	36	52
Sun's app. alt.	59	12	0	2d do. (— 5 6)	—	5	4
Moon's hor. par.	0	59	58	Total (—42 12)	—	41	56
App. diſtance	59	25	34	Diff. for 1 deg.	+	0	16
True diſtance	58	43	31	Do. for 25′ 34″	+	0	7
Do. at 6 hours	58	11	54	Correction	—	41	3
Difference	0	31	37	Time at Greenw.	6h	56	52
Diff. in 3 hours	1	40	5	Time at Ship	2,4h	55	10
Longitude	105	25	W	Diff. W.	7h	1	42

In the Requiſite Tables, theſe Examples, calculated to ſix places of figures by Dunthorne's method, improved, give 50°. 26′. 30″ for the true diſtance of the Third Example, agreeing exactly with the above. In the Fourth Example, the true diſtance there given, is 58°. 43′. 29″, being two ſeconds leſs than in the above, equal to 1 mile difference in the Longitude.

E X A M P L E S.

EXAMPLE V. *Cor. from* (39) *Dist.* 38 *deg.*

	° ′ ″		° ′ ″
Moon's app. alt.	20 9 0	First arc. (+5 55)	+ 6 22
Star's app. alt.	12 27 0	2d do. (+0 27)	+ 0 28
Moon's hor. par.	0 57 24	Total (+6 22)	+ 6 50
App. distance	38 22 17	Diff. for 1 deg.	— 0 28
Correction	+ 6 40	Do. for 22′ 17″	— 0 10
True distance	38 28 57	Correction	+ 6 40
True Distance	38 28 56 by Dr. Shepherd's Tables		

EXAMPLE VI. *Cor. from* (46) *Dist.* 45 *deg.*

	° ′ ″		′ ″	° ′ ″
Moon's app. alt.	21 26 0	1st arc.	(—0 8)	+ 0 2
Star's app. alt.	15 54 0	2d do.	(—0 3)	— 0 2
Moon's hor. par.	0 56 30	Total	(—0 11)	0 0 0
App. distance	45 40 14	Diff. for 1 deg.		— 0 11
Correction	— 0 7	Do. for 40′ 14″		— 0 7
True distance	45 40 7	Correction		— 0 7
True Distance	45 40 7 by Dr. Shepherd's Tables			

EXAMPLE VII. *Cor. from* (66) *Dist.* 65 *deg.*

	° ′ ″		′ ″	° ′ ″
Moon's app. alt.	15 21 0	1st arc.	(—47 16)	— 47 29
Star's app. alt.	78 18 0	2d do.	(— 7 3)	— 7 4
Moon's hor. par.	0 60 25	Total	(—54 19)	— 54 33
App. distance	65 27 30	Diff. for 1 deg.		— 0 14
Correction	— 54 27	Do. for 27′ 30″		— 0 6
True distance	64 33 3	Correction		— 54 27
True Distance	64 32 59 by Dr. Shepherd's Tables			

EXAMPLE VIII. *Cor. from* (44) *Dist.* 43 *deg.*

	° ′ ″		′ ″	° ′ ″
Moon's app. alt.	9 37 0	1st arc.	(— 4 40)	— 4 32
Star's app. alt.	11 18 0	2d do.	(— 0 10)	— 0 10
Moon's hor. par.	0 54 42	Total	(— 4 50)	— 4 42
App. distance	43 35 42	Diff. for 1 deg.		+ 0 8
Correction	— 4 47	Do. for 35′ 42″		+ 0 5
True distance	43 30 55	Correction		— 4 47
True Distance	43 31 2 by the Requisite Tables			

EXAMPLE IX. *Cor. from* (36) *Dist.* 35 *deg.*

	° ′ ″		′ ″	° ′ ″
Moon's app. alt.	20 34 0	1st arc.	(— 0 31)	— 0 14
Star's app. alt.	17 40 0	2d do.	(— 0 4)	— 0 1
Moon's hor. par.	0 56 24	Total	(— 0 35)	— 0 15
App. distance	35 29 45	Diff. for 1 deg.		+ 0 20
Correction	— 0 25	Do. for 29′ 45″		+ 0 10
True distance	35 29 20	Correction		— 0 25
True Distance	35 29 20 by Dr. Shepherd's Tables			

EXAMPLE X. *Cor. from* (86) *Dist.* 85 *deg.*

	° ′ ″		′ ″	° ′ ″
Moon's app. alt.	30 0 0	1st arc.	(′ ″)	+ 2 44
Star's app. alt.	5 0 0	2d do.	( )	— 0 13
Moon's hor. par.	0 60 0	Total	( )	+ 2 31
App. distance	85 0 0			
Correction	+ 2 31			
True distance	85 2 31			
True Distance	85 2 27 by the Requisite Tables			

In this example the first arc being + and the second —, the difference between them is the total, which in this case is the correction, there being no odd minutes of distance.

EXAMPLE XI. *Cor. from* (50) *Dist.* 49 *deg.*

	° ′ ″		′ ″	° ′ ″
Moon's app. alt.	43 20 0	1st arc.	(+ 0 5)	+ 0 46
Star's app. alt.	27 15 0	2d do.	(— 0 6)	— 0 2
Moon's hor. par.	0 58 50	Total	(— 0 1)	+ 0 44
App. distance	49 17 21	Diff. for 1 deg.		— 0 45
Correction	+ 0 31	Do. for 17′ 21″		— 0 13
True distance	49 17 52	Correction		+ 0 31
True Distance	49 17 54 by Dr. Shepherd's Tables			

In this example the correction at 49 degrees being + and that at 50 degrees being —, their sum is the difference for a degree of distance; this is a circumstance that often occurs.

EXAMPLE XII. *Cor. from* (34) *Dist.* 33 *deg.*

	° ′ ″		′ ″	° ′ ″
Moon's app. alt.	64 30 0	1st arc.	(+ 0 50)	+ 1 42
Star's app. alt.	48 20 0	2d do.	(+ 0 2)	+ 0 3
Moon's hor. par.	0 55 29	Total	(+ 0 52)	+ 1 45
App. distance	33 15 0	Diff. for 1 deg.		— 0 53
Correction	+ 1 32	Do. for 15′ 0″		— 0 13
True distance	33 16 32	Correction		+ 1 32
True Distance	33 16 29 by Mr. Lyons			

EXAMPLE XIII. *Cor. from* (91) *Dist.* 90 *deg.*

	° ′ ″		′ ″	° ′ ″
Moon's app. alt.	22 15 0	1st arc.	(—30 57)	— 30 15
Star's app. alt.	21 35 0	2d do.	(— 3 12)	— 3 7
Moon's hor. par.	0 58 0	Total	(—34 9)	— 33 22
App. distance	119 20 34	Diff. for 1 deg.		+ 0 47
Correction	— 33 38	Do. for 20′ 34″		+ 0 16
True distance	118 46 56	Correction		— 33 38
True Distance	118 46 54 by Mr. Dunthorne's Method			

The Author rests the merit of his Work on the case and accuracy of its performance; for in the above Examples, which contain all the variety that ever can occur in practice, the greatest error in the longitude does not amount to 4 miles, and if the process of working in both degrees of distance had been omitted, and the correction taken from the nearest degree, the error in the longitude on that account would not amount to 8 miles in any one of the above examples; so that in general, the correction may be taken out from the nearest degree without much error in the longitude; in which case only 15 or 16 figures need ever be used to correct the observation, and express the true distance; but the process of working in both degrees being attended with so little trouble, it is proper to be done were it only for a check on the process. These Examples are placed in the same manner as the operation should be set down in the Formula for finding the Longitude.

A TABLE for finding the LONGITUDE by LUNAR OBSERVATIONS,

Having the Apparent Distance of the Moon from the Center of the Sun or a fixed Star; & the Apparent Altitudes of their Centers.

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	D	M	S		D	M	S
Moons app. Alt.				1.st Arc.	—		
Suns app. Alt.				2.nd d.o	—		
Moons Hor. Par:				Total	—		
app. Distance				diff for 1 Deg:	—		
true Distance				diff for ′ ″	—		
d.o at Hours				Correction	—		
difference —				Time at Greenw.h	H	M	S
d.o in 3 Hours				Time at Ship			
Longitude				Difference —			

	D	M	S		D	M	S
Moons app. Alt.				1.st Arc.	—		
Stars app. Alt.				2.nd Arc.	—		
Moons Hor. Par.				Total	—		
app. Distance				diff for 1 Deg:	—		
true Distance				diff. for ′ ″	—		
d.o at Hours				Correction	—		
difference —				Time at Greenw.h	H	M	S
d.o in 3 Hours				Time at Ship			
Longitude				Difference —			

	D	M	S		D	M	S
Moons app. Alt.				1.st Arc.	—		
Suns app. Alt.				2.nd d.o	—		
Moons Hor. Par.				Total	—		
app. Distance				diff. for 1 Deg:	—		
true Distance				diff. for ′ ″	—		
d.o at Hours				Correction	—		
difference —				Time at Greenw.h	H	M	S
d.o in 3 Hours				Time at Ship			
Longitude				Difference —			

	D	M	S		D	M	S
Moons Alt.				1.st Arc.	—		
Stars Alt.				2.nd Arc.	—		
Hor. Par:				Total	—		
App. Dist.				Diff. for 1 Deg.	—		
True Dist.				Diff. for ′ ″	—		
d.o at bo.				Corr:	—		
Diff. —				Time at Greenw.h	H	M	S
Diff. in 3 bo.				Time at Ship			
Longitude				Diff. —			

	D	M	S		D	M	S
Moons Alt.				1.st Arc.	—		
Suns Alt.				2.nd Arc.	—		
Hor. Par:				Total	—		
App. Dist.				Diff. for 1 Deg.	—		
True Dist.				Diff. for ′ ″	—		
d.o at bo.				Corr:	—		
Diff. —				Time at Greenw.h	H	M	S
Diff. in 3 bo.				Time at Ship			
Longitude				Diff. —			

	D	M	S		D	M	S
Moons Alt.				1.st Arc.	—		
Stars Alt.				2.nd Arc.	—		
Hor. Par.				Total	—		
App. Dist.				Diff. for 1 Deg.	—		
True Dist.				Diff. for ′ ″	—		
d.o at bo.				Corr:	—		
Diff. —				Time at Greenw.h	H	M	S
Diff. in 3 bo.				Time at Ship			
Longitude				Diff. —			

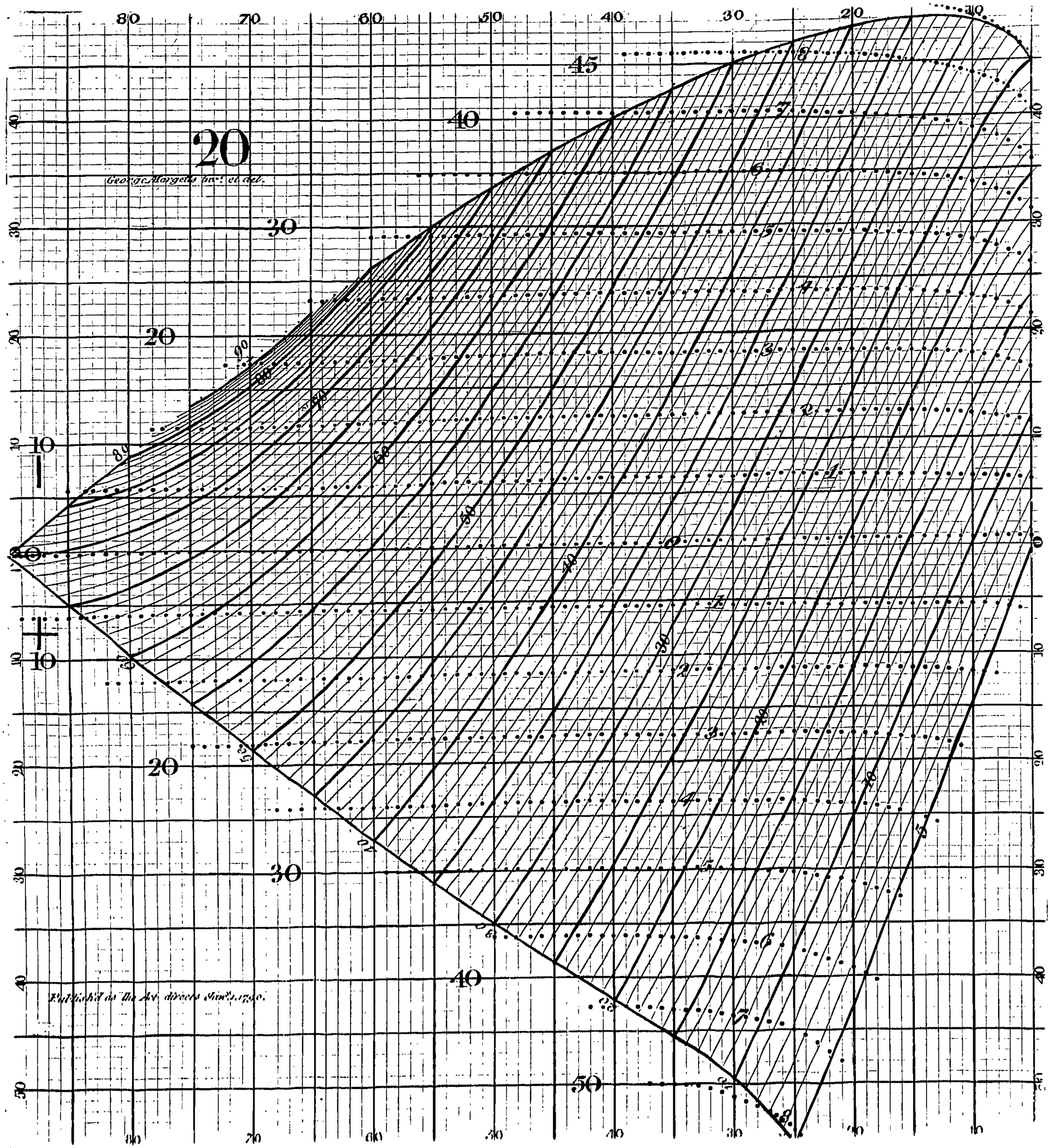
	D	M	S		D	M	S
Moons Alt.				1.st Arc.	—		
Sums Alt.				2.nd Arc.	—		
Hor. Par.				Total	—		
App. Dist.				Diff. for 1 Deg.	—		
True Dist.				Diff. for ′ ″	—		
d.o at bo.				Corr:	—		
Diff. —				Time at Greenw.h	H	M	S
Diff. in 3 bo.				Time at Ship			
Longitude				Diff. —			

	D	M	S		D	M	S
Moons Alt.				1.st Arc.	—		
Stars Alt.				2.nd Arc.	—		
Hor. Par.				Total	—		
App. Dist.				Diff. for 1 Deg.	—		
True Dist.				Diff. for ′ ″	—		
d.o at bo.				Corr.	—		
Diff. —				Time at Greenw.h	H	M	S
Diff. in 3 bo.				Time at Ship			
Longitude				Diff. —			

	D	M	S		D	M	S
Moons Alt.				1.st Arc.	—		
Sums Alt.				2.nd Arc.	—		
Hor. Par.				Total	—		
App. Dist.				Diff. for 1 Deg.	—		
True Dist.				Diff. for ′ ″	—		
d.o at bo.				Corr.	—		
Diff. —				Time at Greenw.h	H	M	S
Diff. in 3 bo.				Time at Ship			
Longitude				Diff. —			

	D	M	S		D	M	S
Moons Alt.				1.st Arc.	—		
Stars Alt.				2.nd Arc.	—		
Hor. Par.				Total	—		
App. Dist.				Diff. for 1 Deg.	—		
True Dist.				Diff. for ′ ″	—		
d.o at bo.				Corr.	—		
Diff. —				Time at Greenw.h	H	M	S
Diff. in 3 bo.				Time at Ship			
Longitude				Diff. —			

	D	M	S		D	M	S
Moons Alt.				1.st Arc.	—		
Sums Alt.				2.nd Arc.	—		
Hor. Par.				Total	—		
App. Dist.				Diff. for 1 Deg.	—		
True Dist.				Diff. for ′ ″	—		
d.o at bo.				Corr.	—		
Diff. —				Time at Greenw.h	H	M	S
Diff. in 3 bo.				Time at Ship			
Longitude				Diff. —			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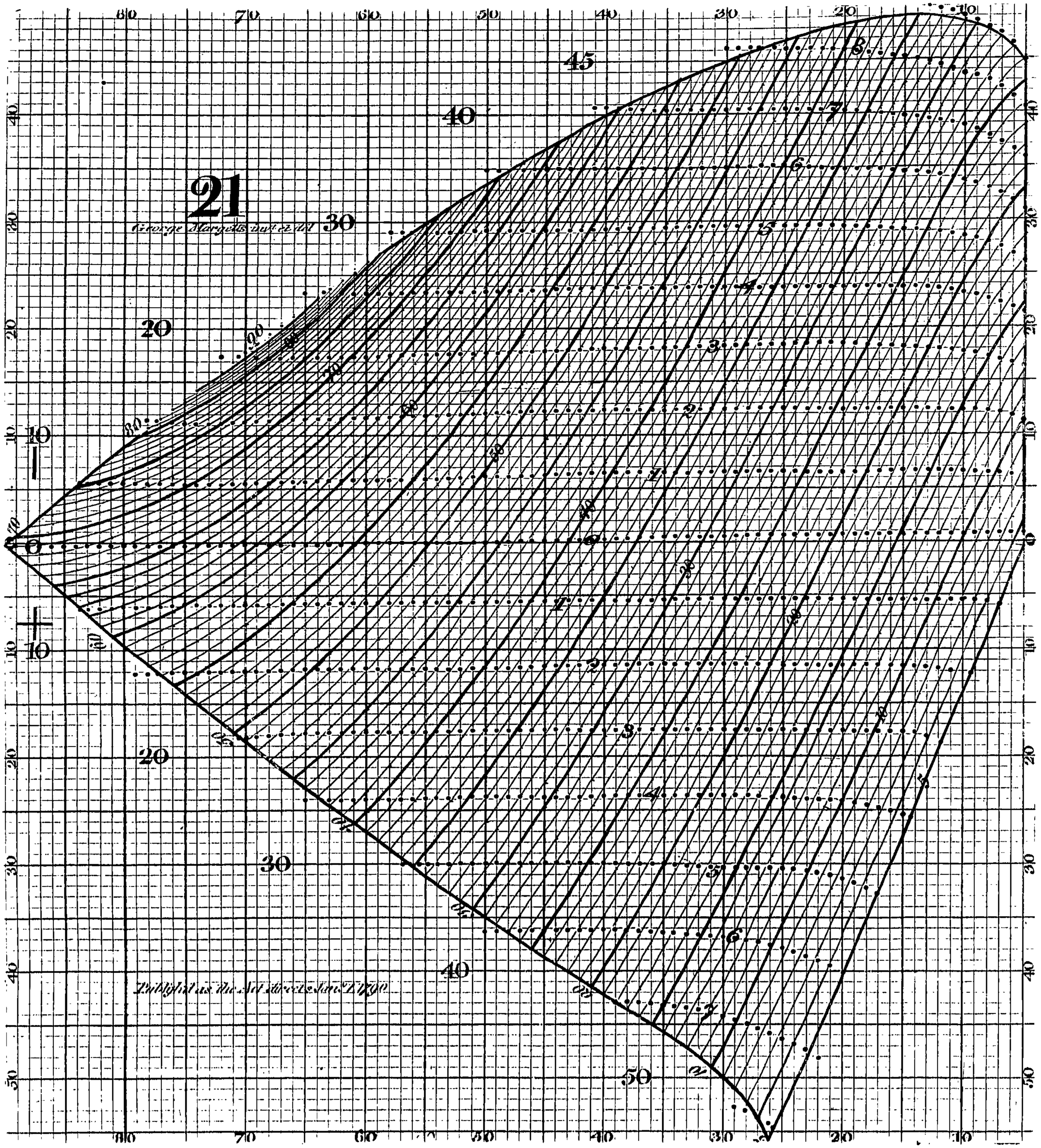
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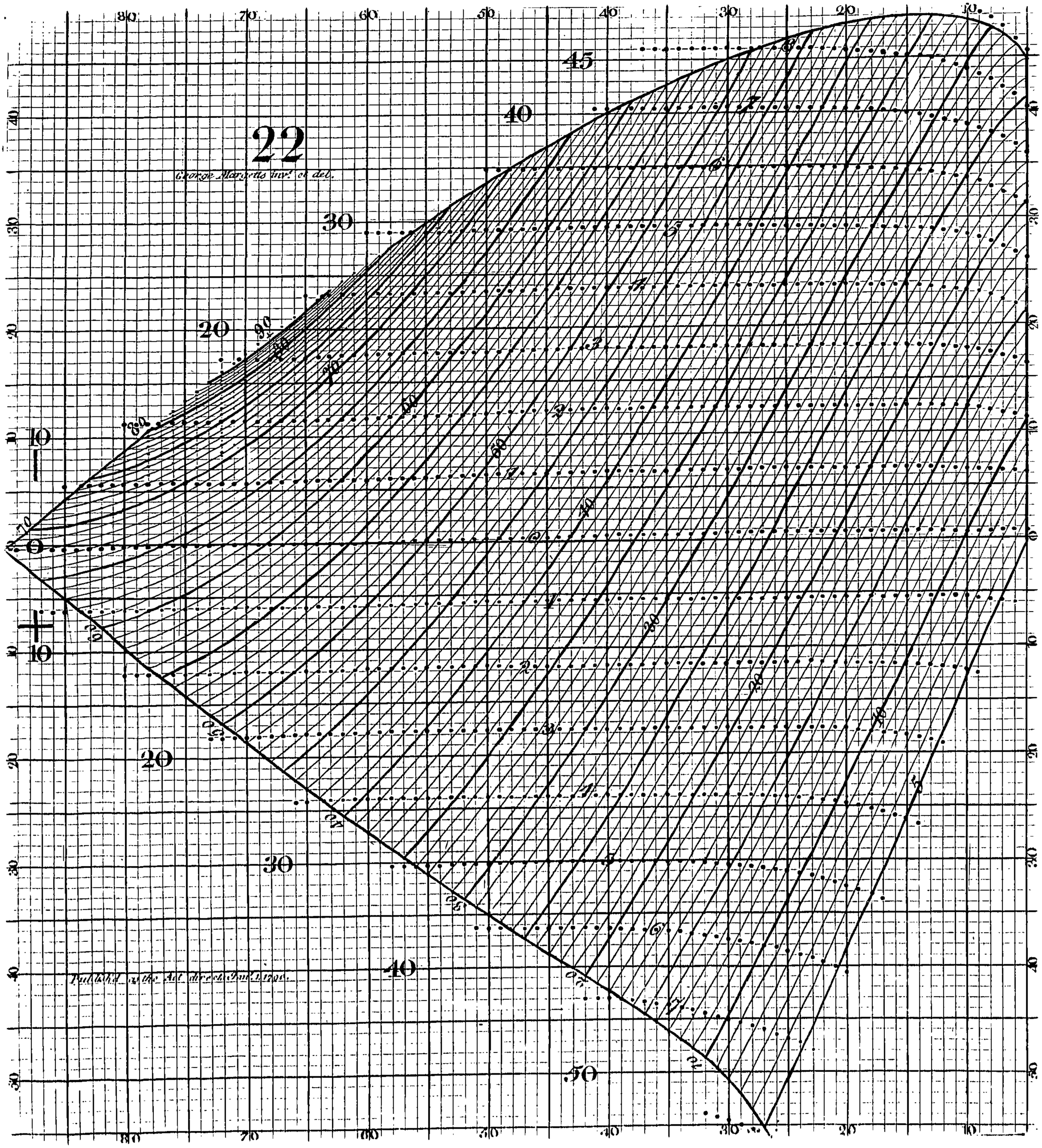
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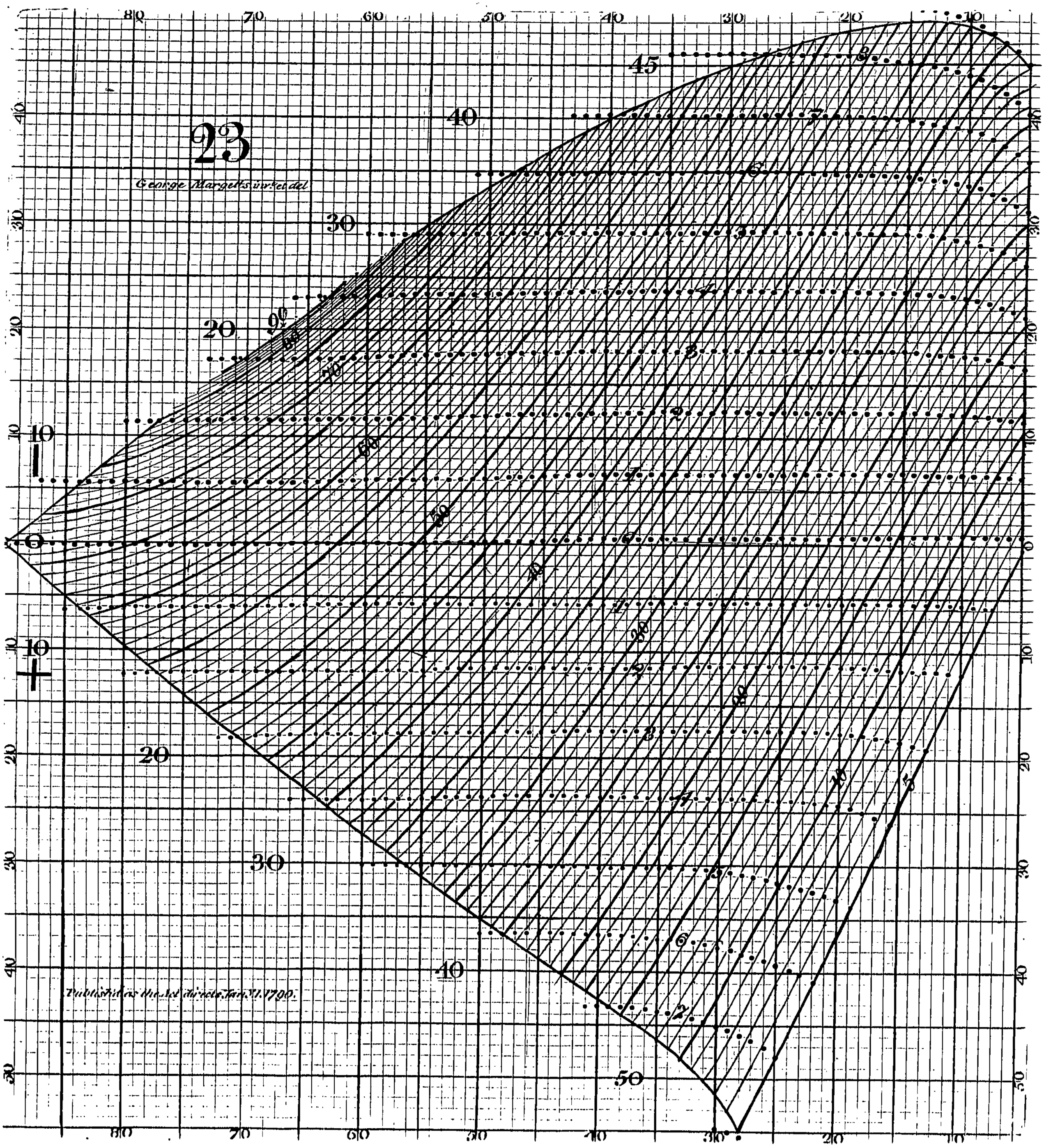
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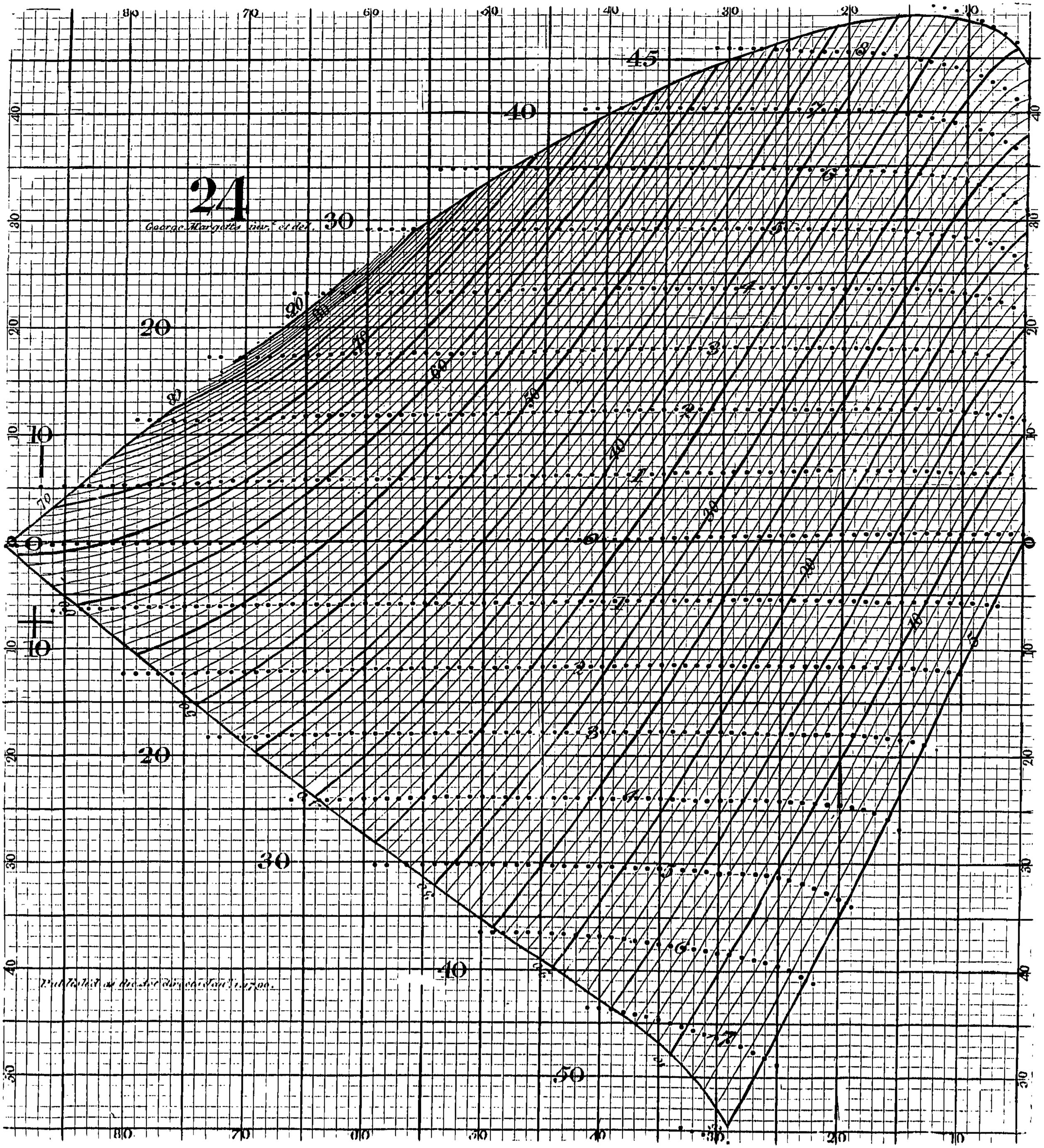
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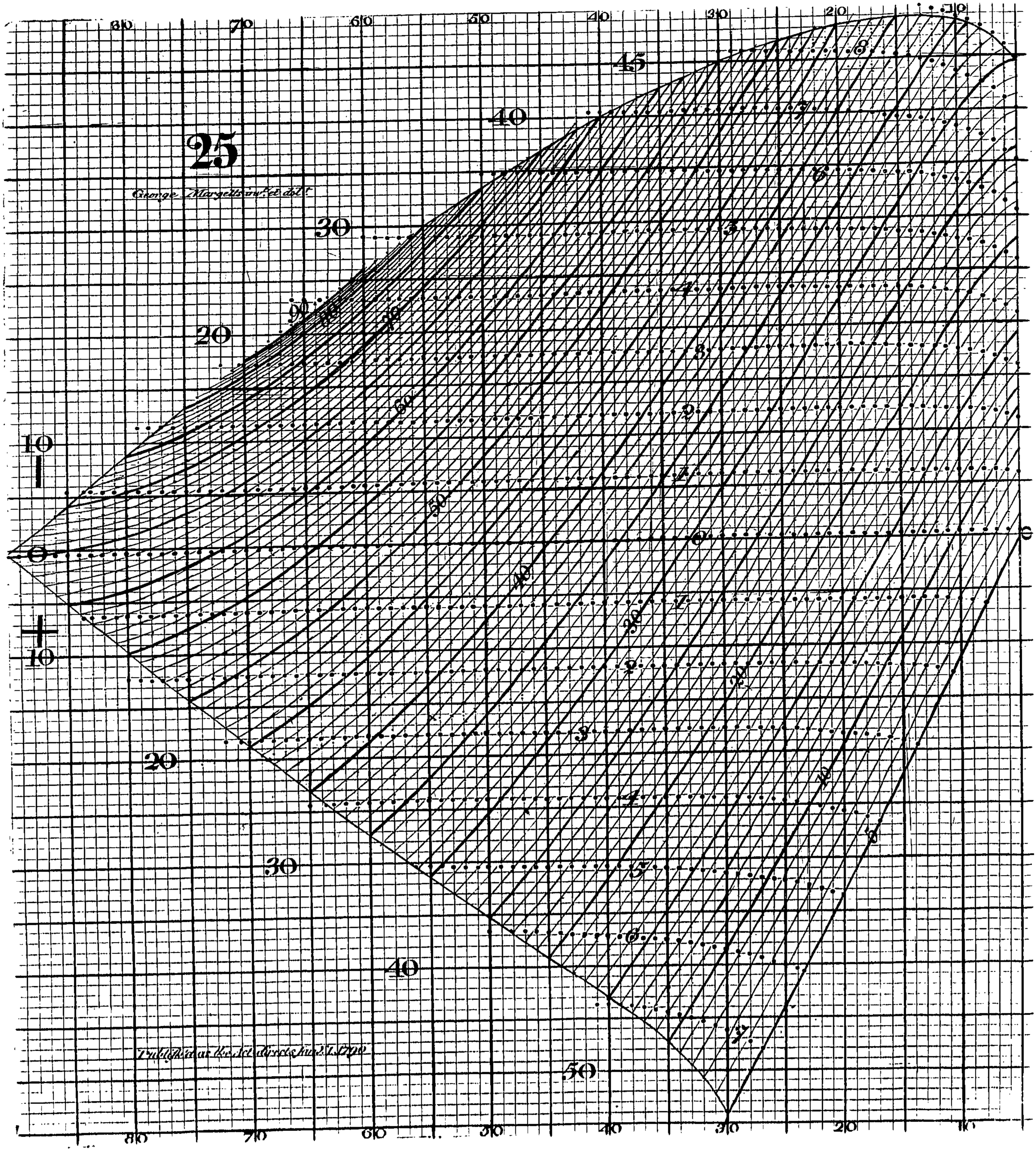
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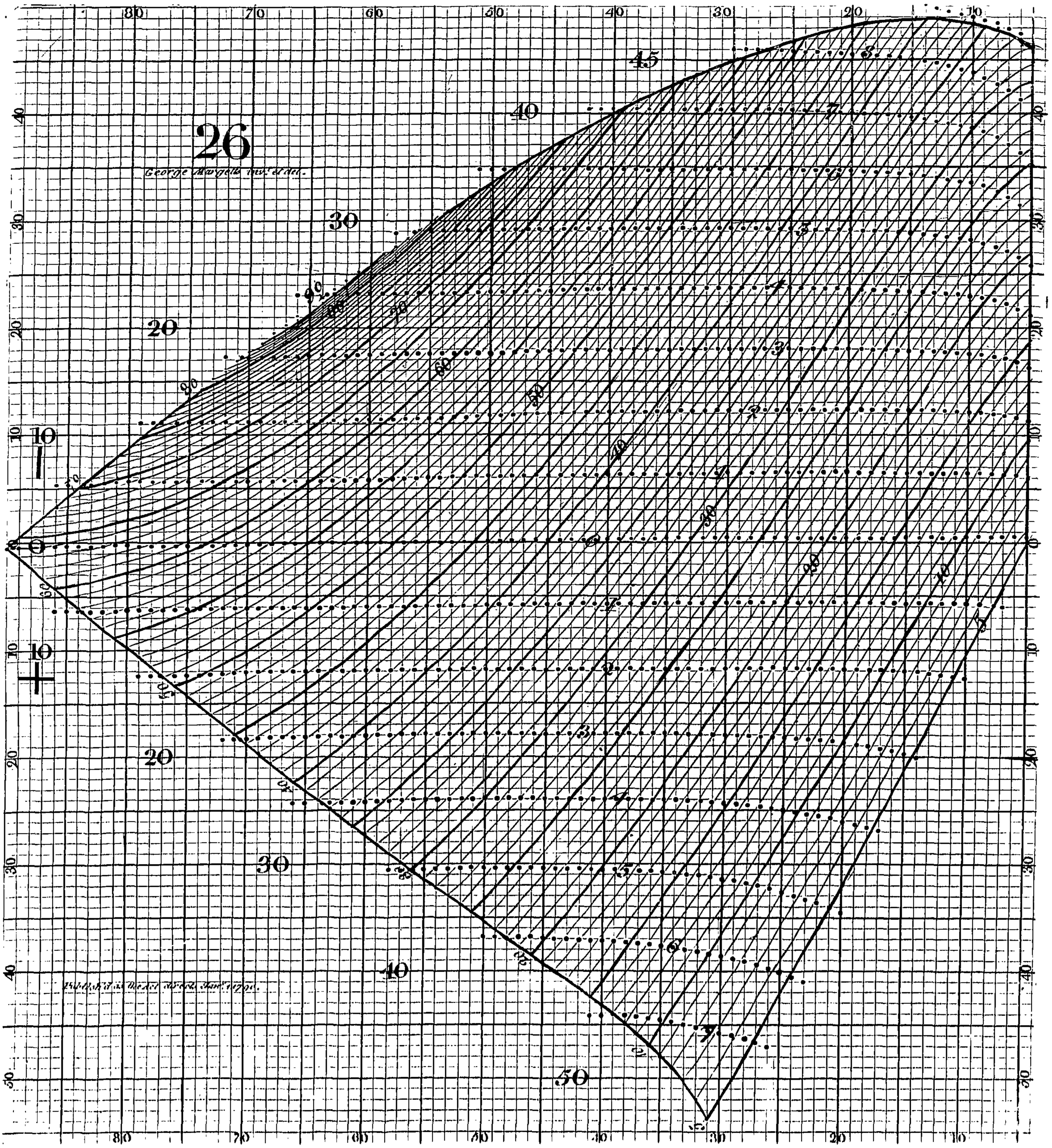
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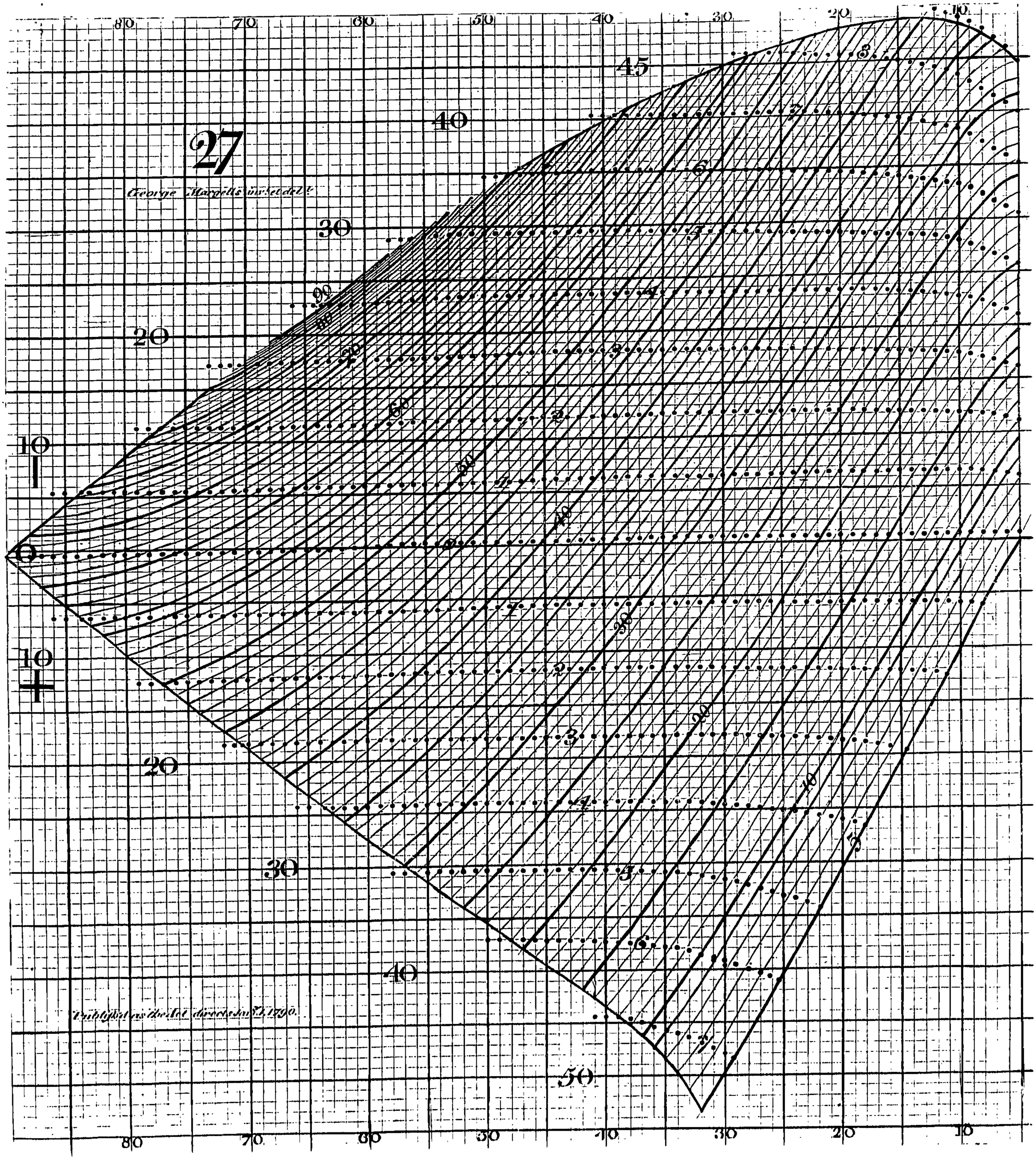
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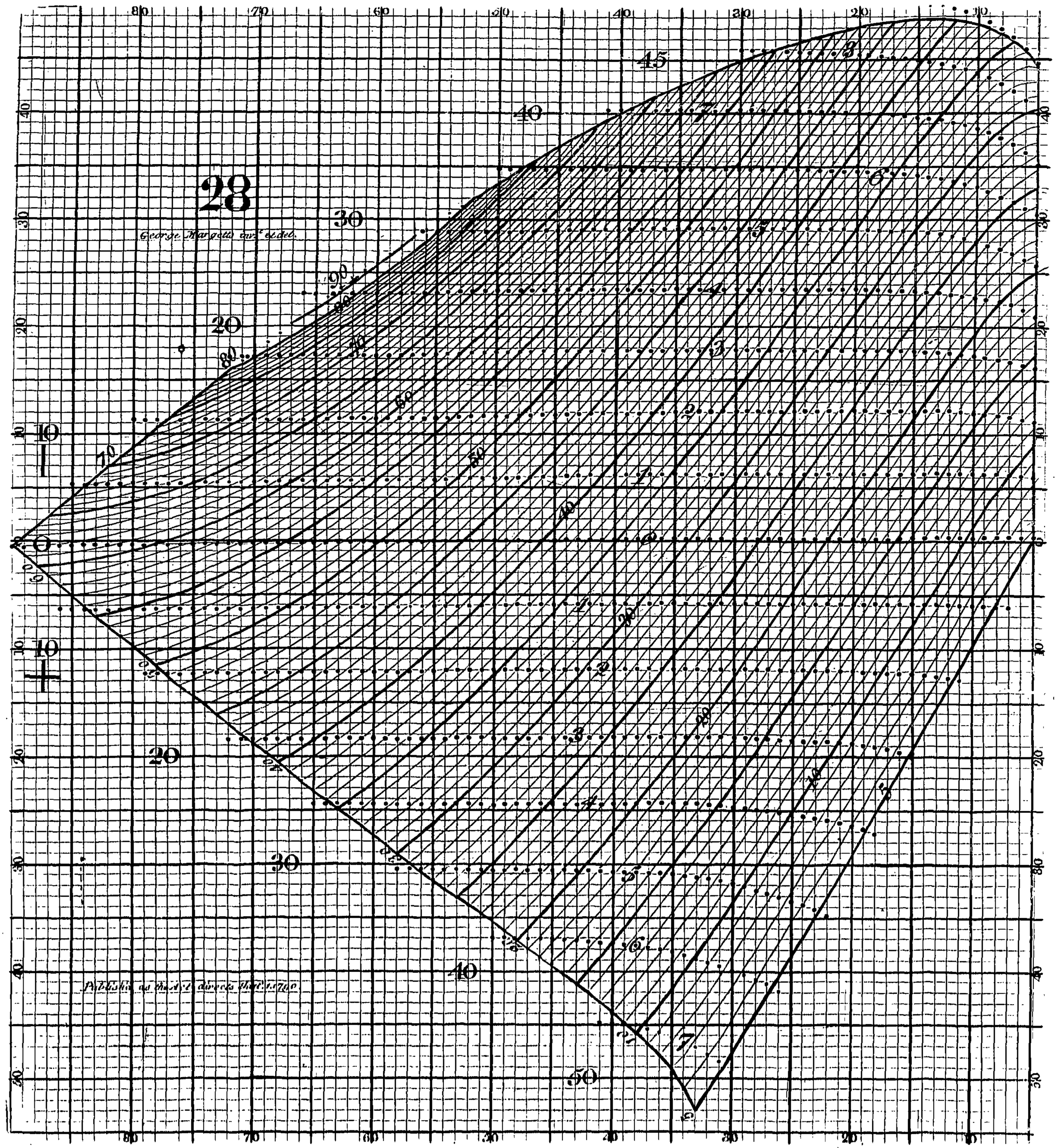
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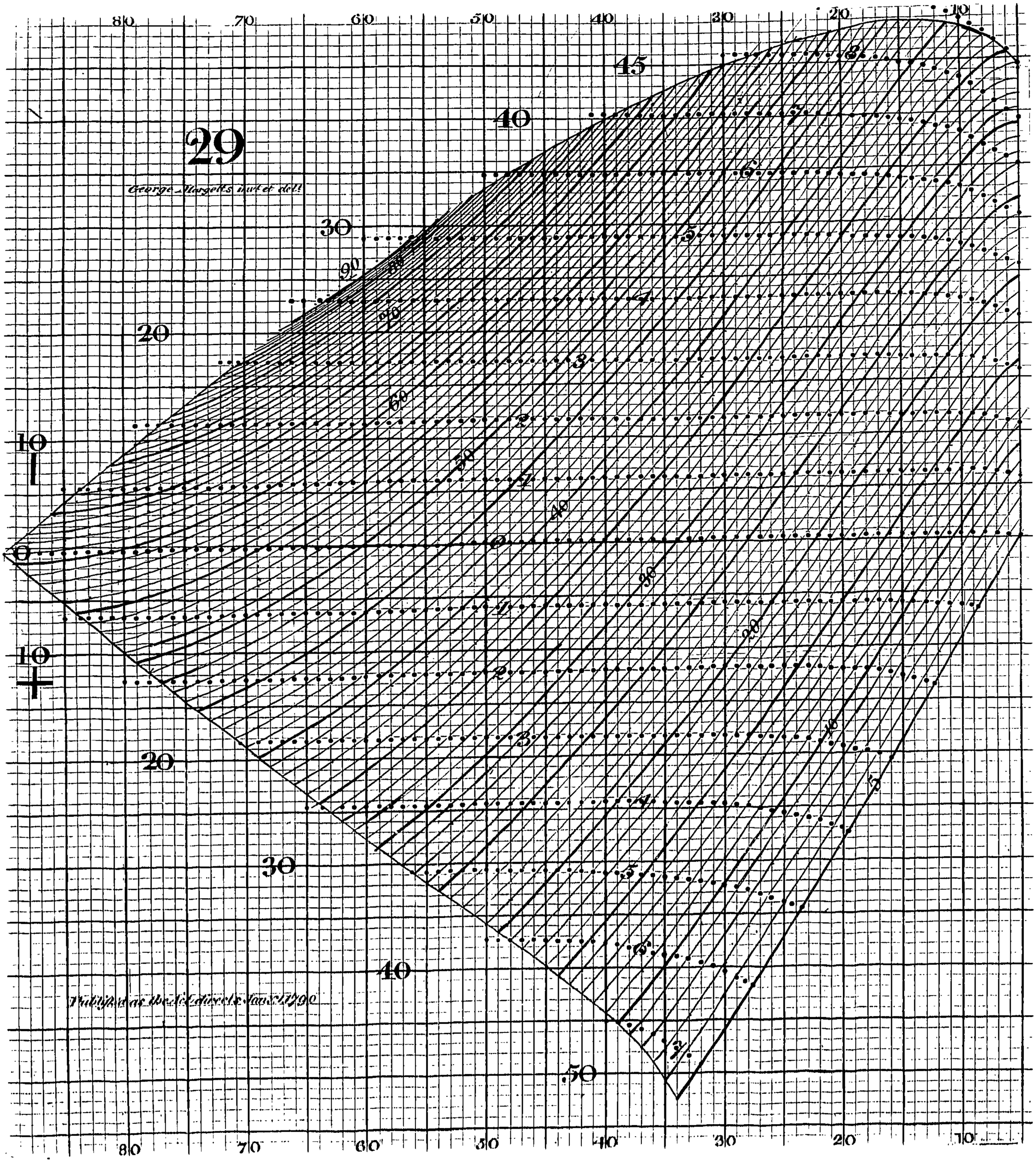
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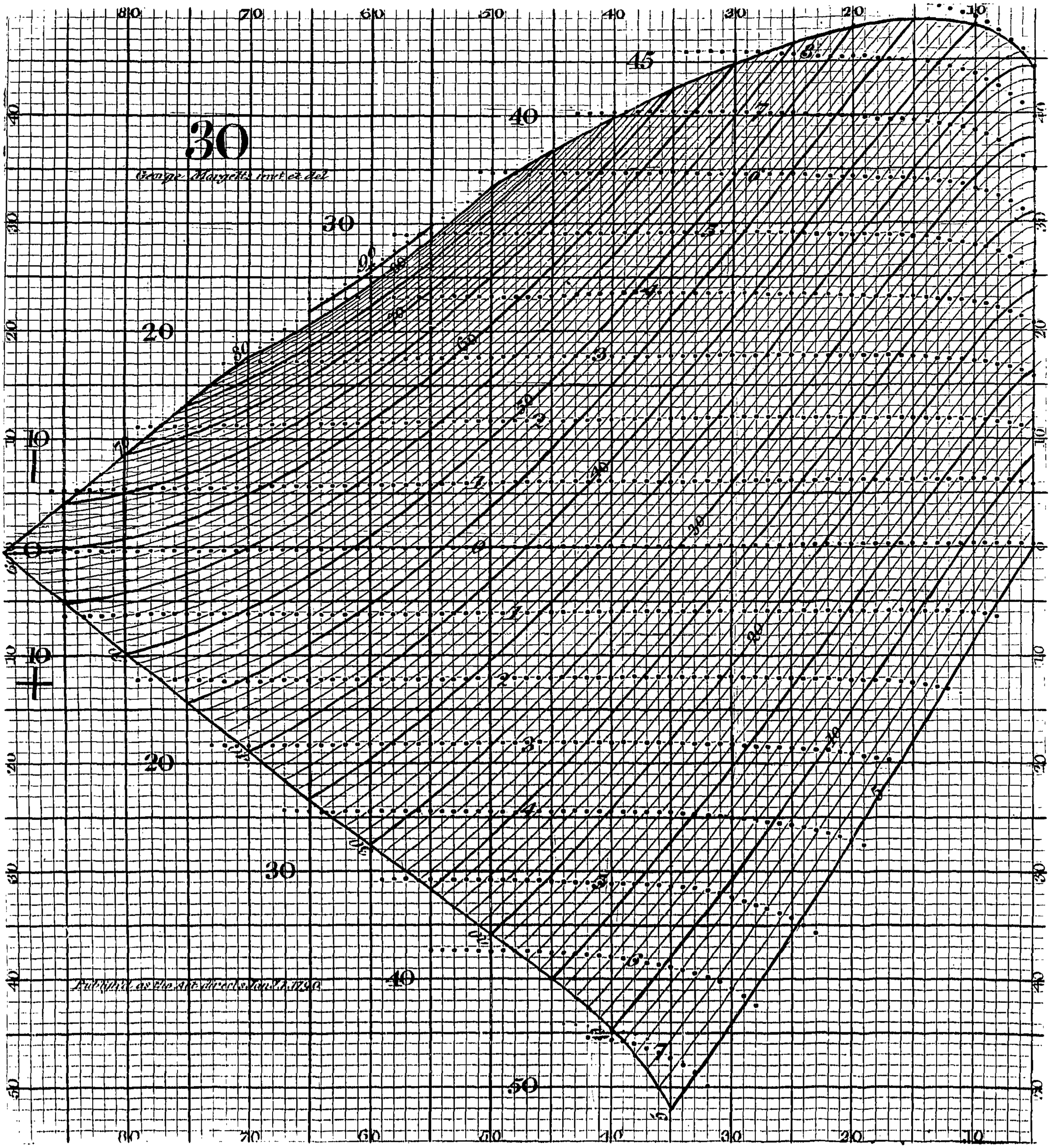
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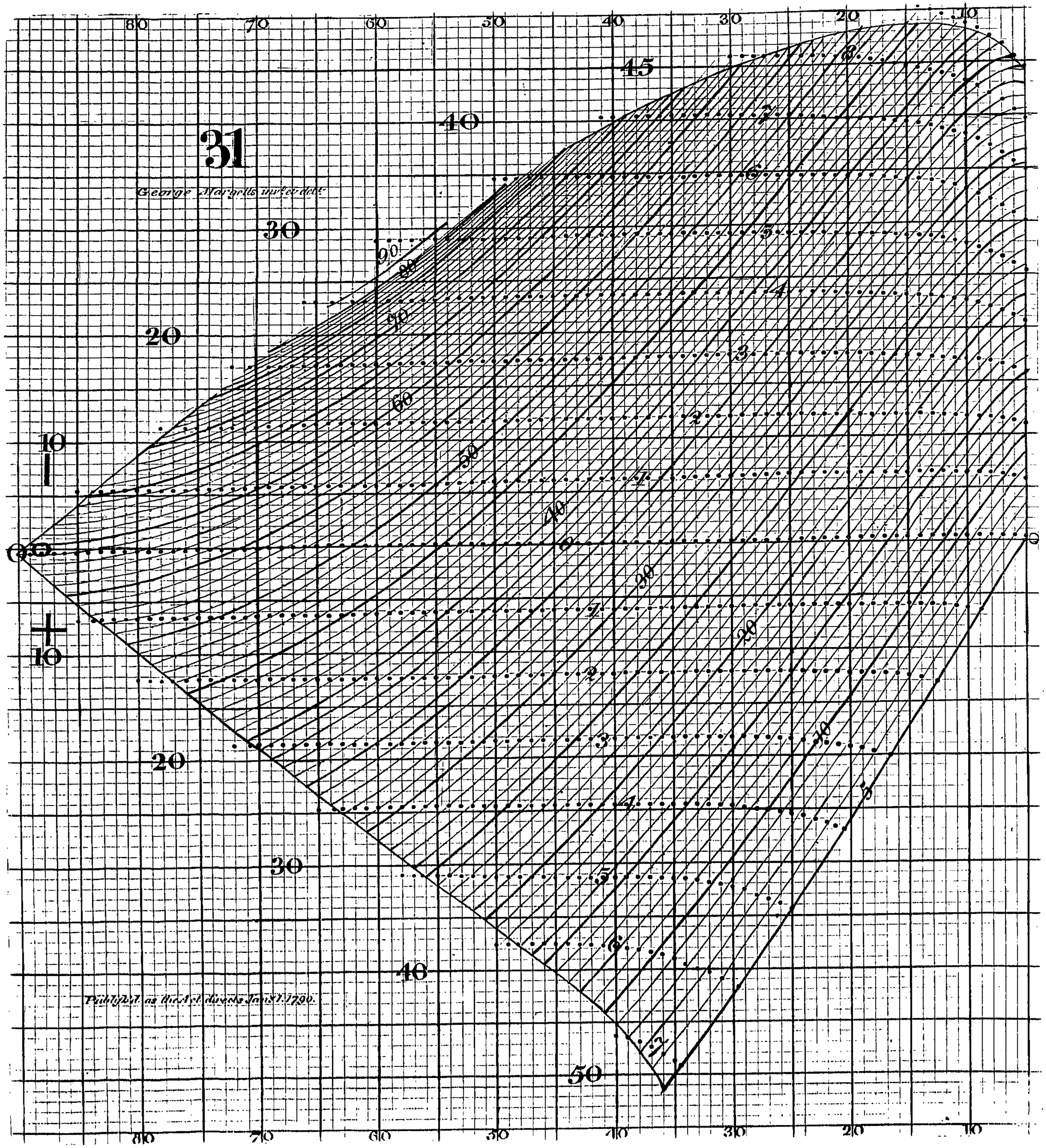
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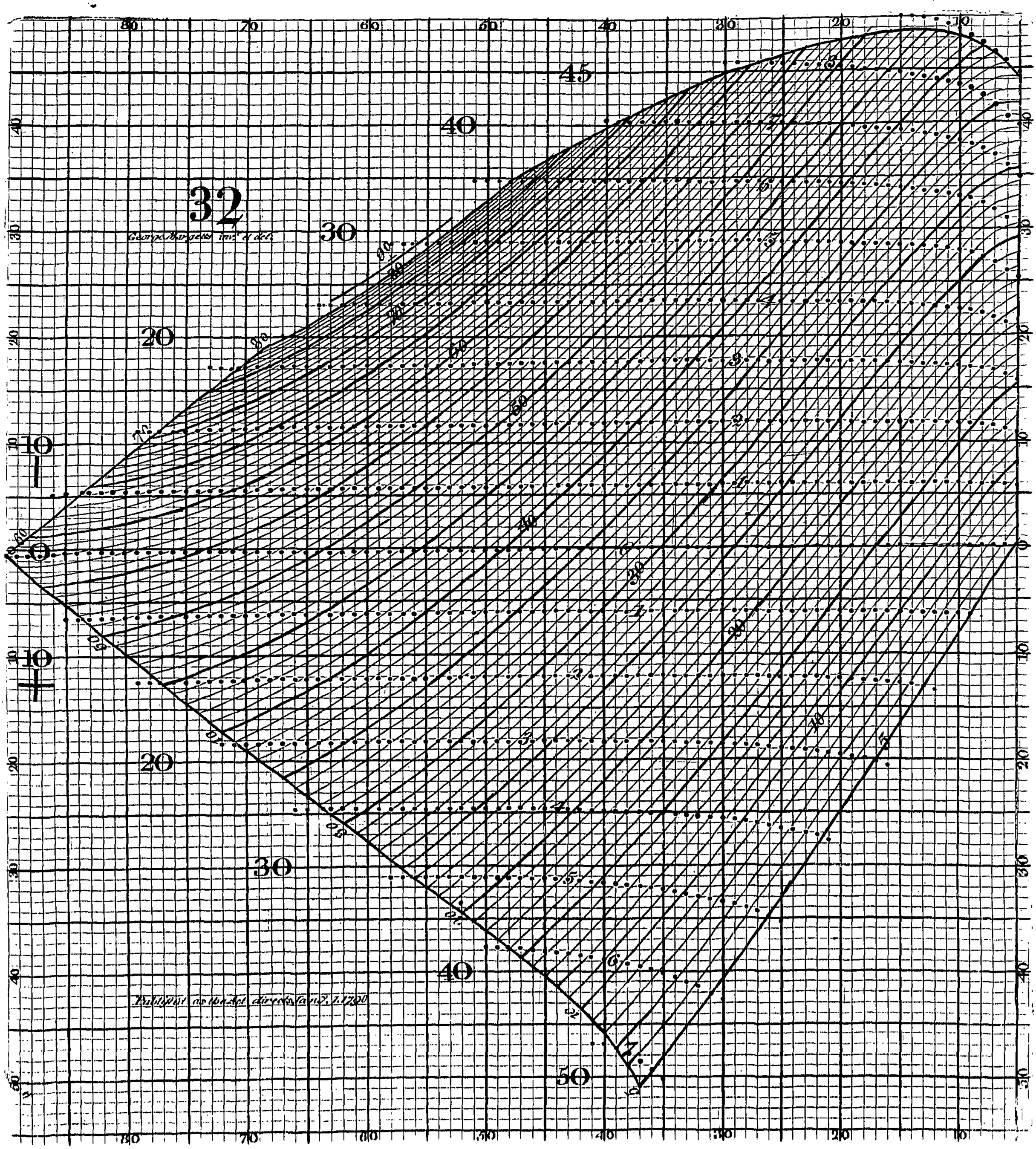
Published as the Act directs Jan.y 1.st 1790.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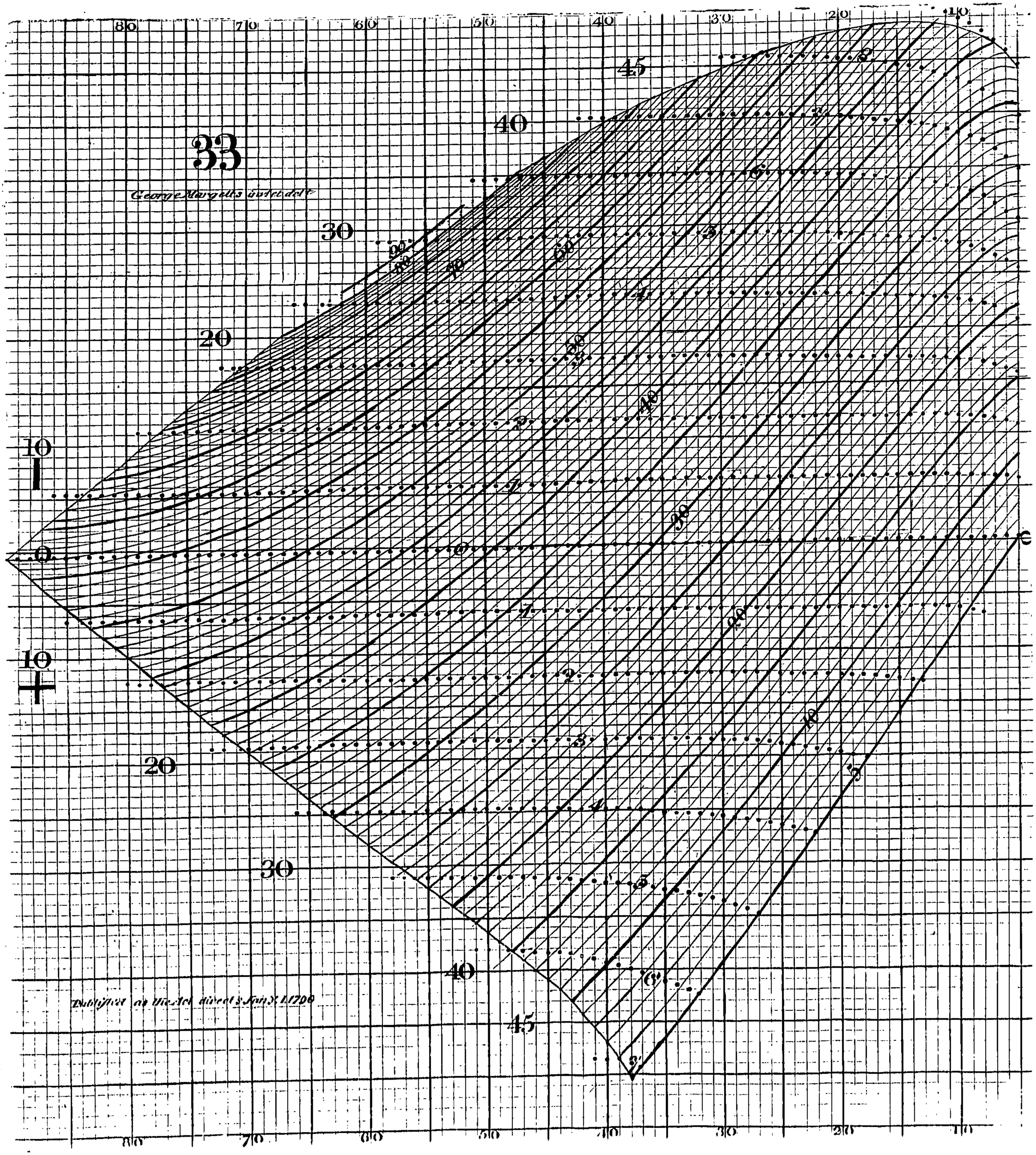
George Burgess inv.t & del.
Published as the Act directs Jan.y 1.1790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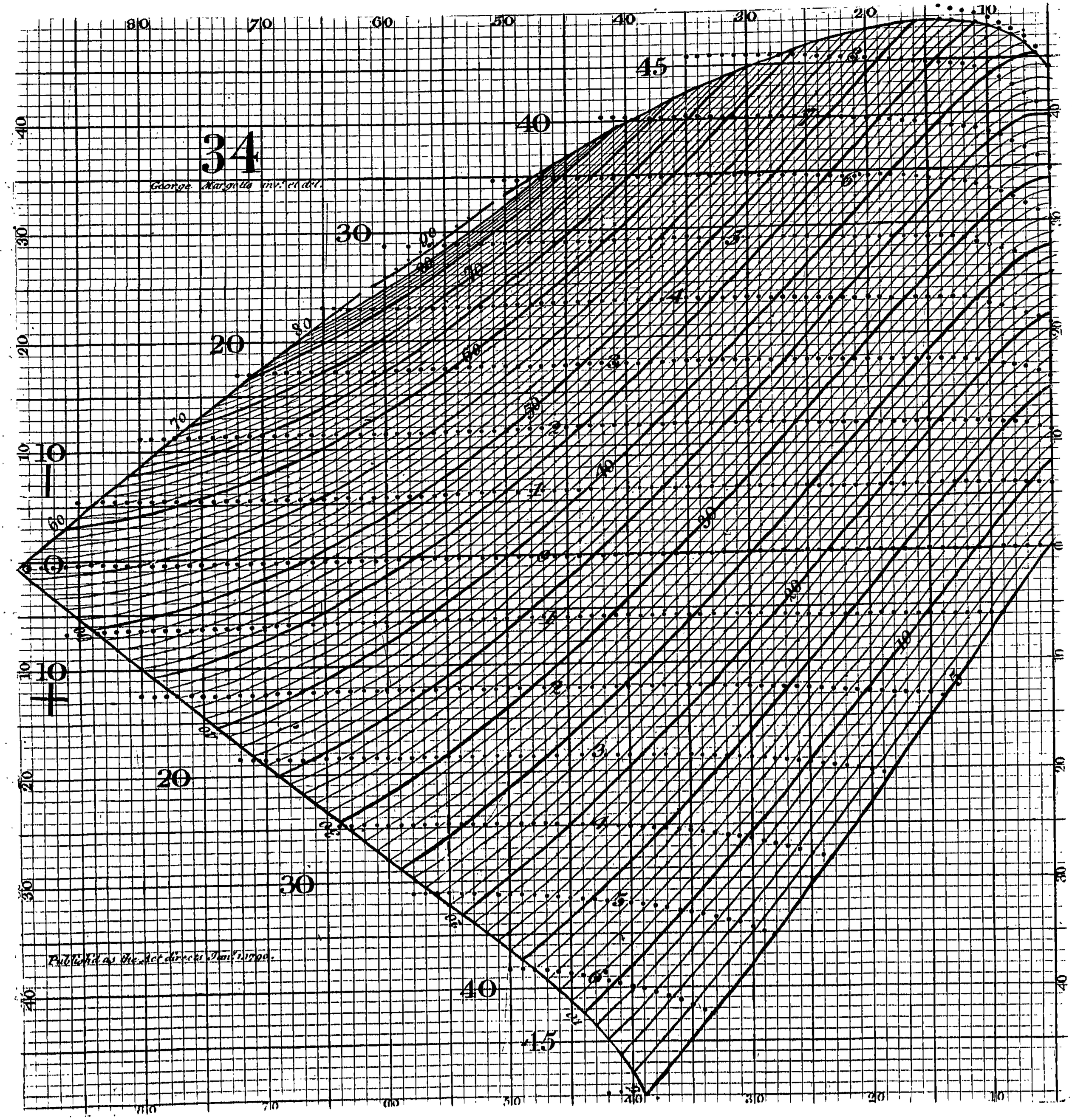
George Hargetts inventor del.
Published as the Act directs Jany 1. 1700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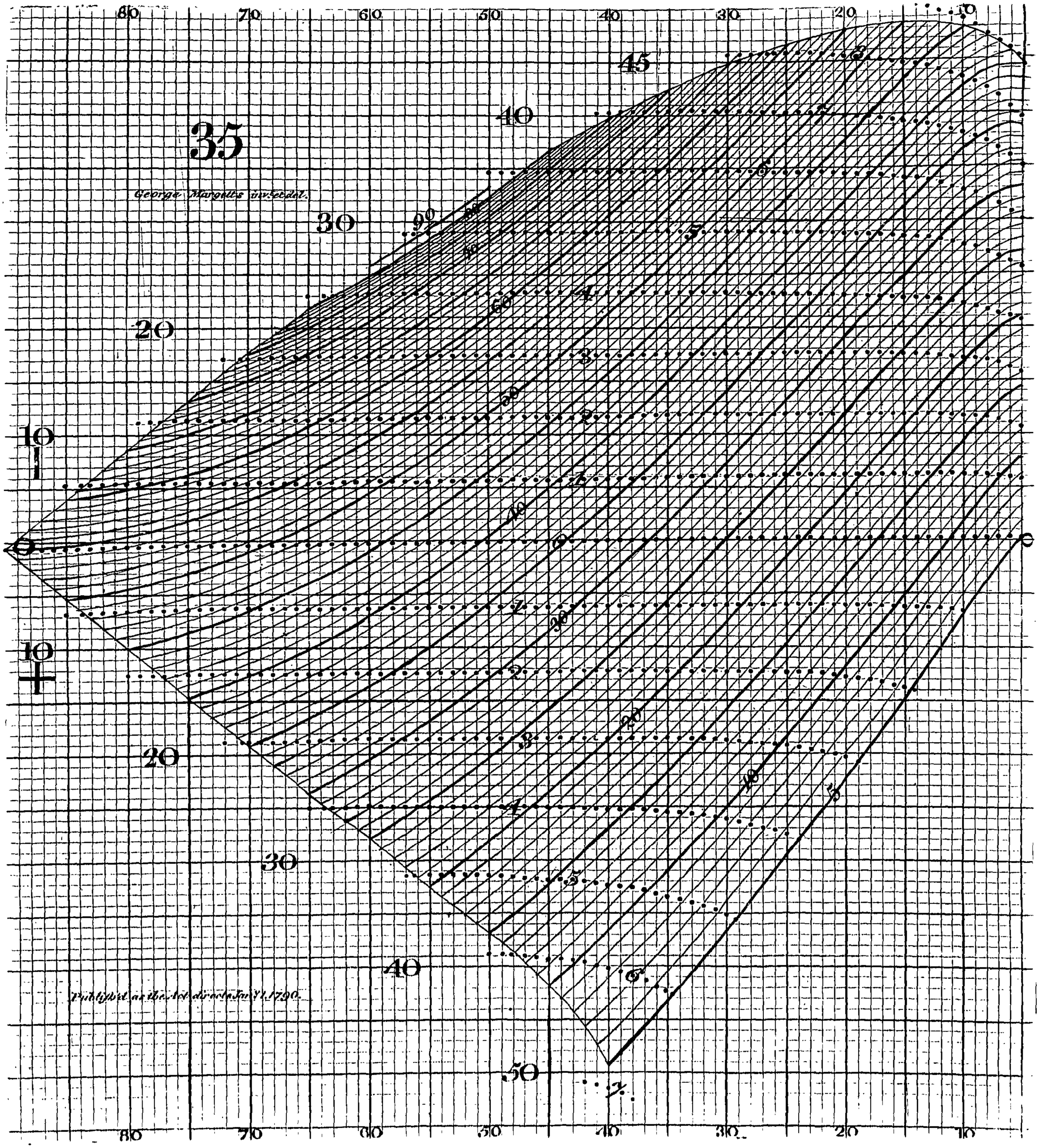
Published as the Act directs Jan.y 1.1790.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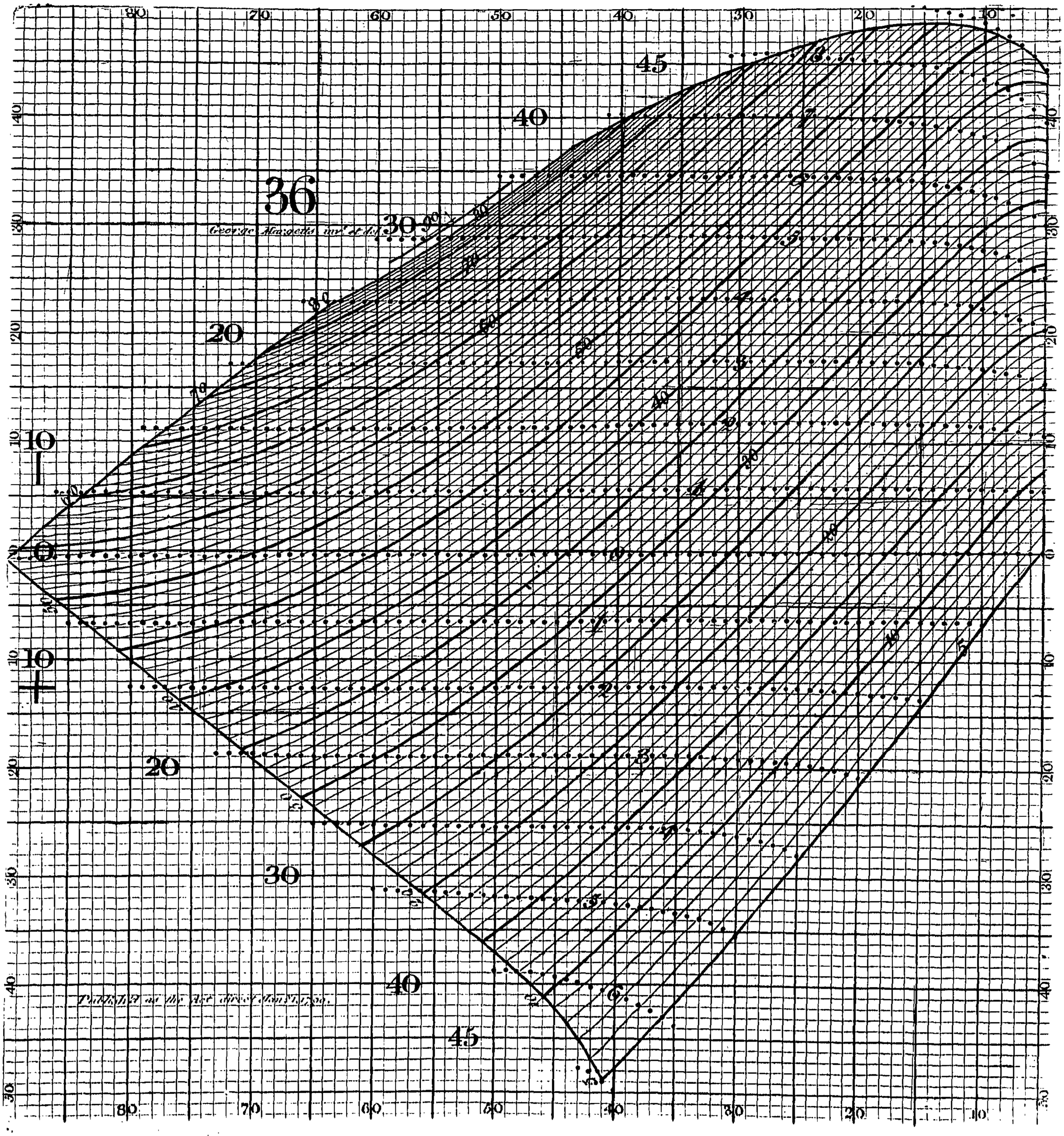
Published as the Act directs Jan.y 1.1790.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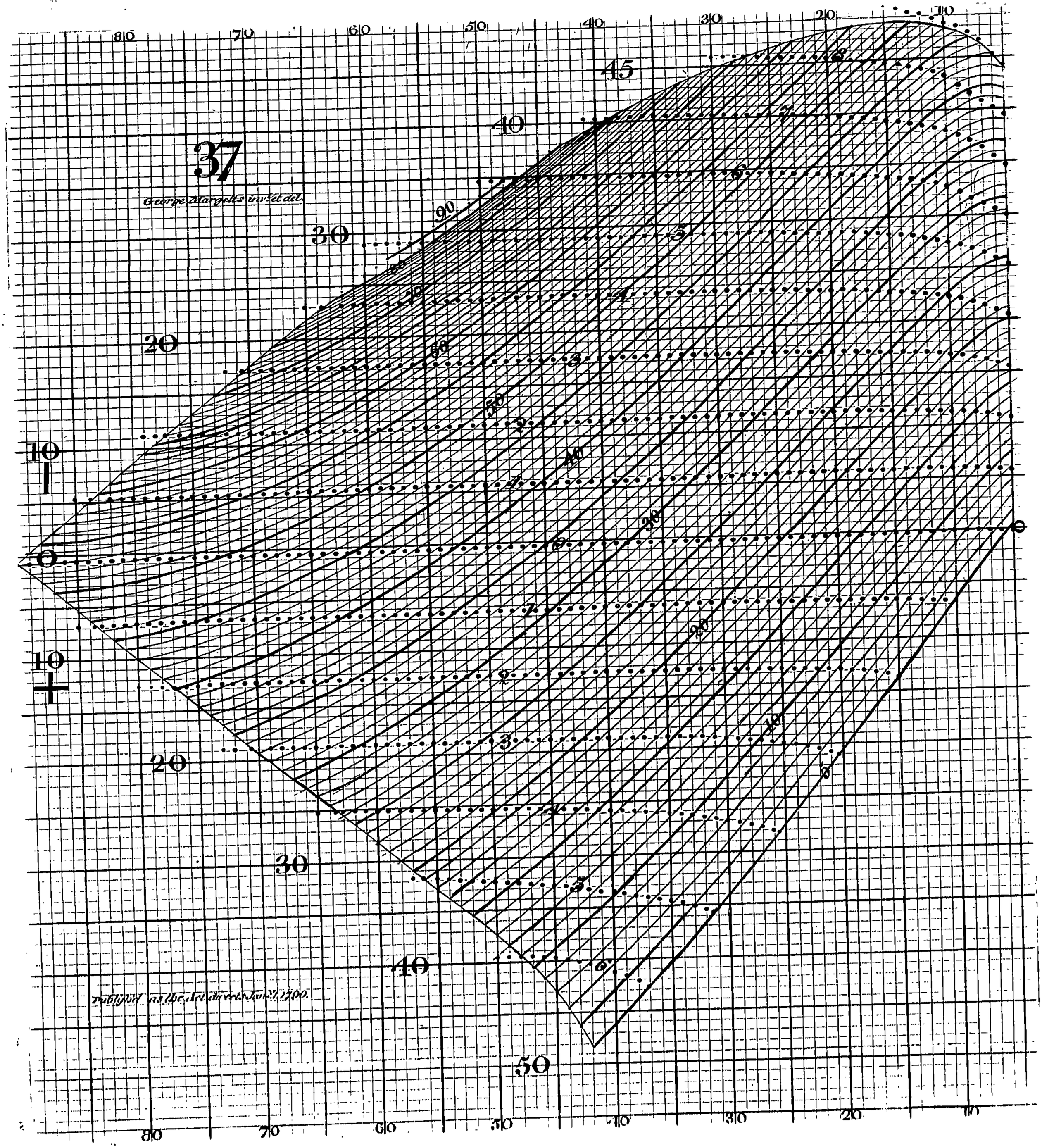
Published at the Act direct. Jan.y 1.st 1820.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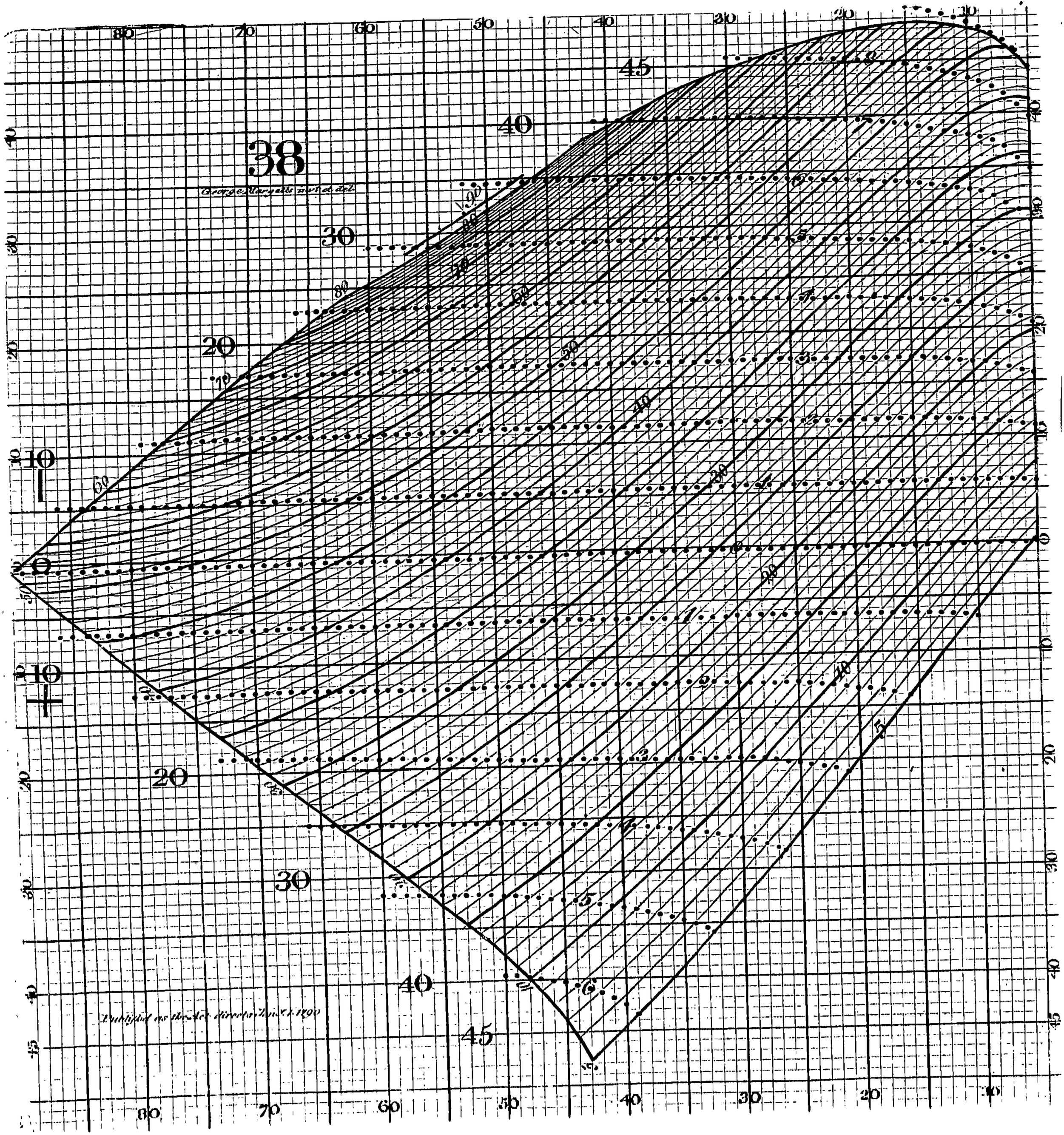
George Margetts inv.t et del.
Published as the Act directs Jun.y 1.1800.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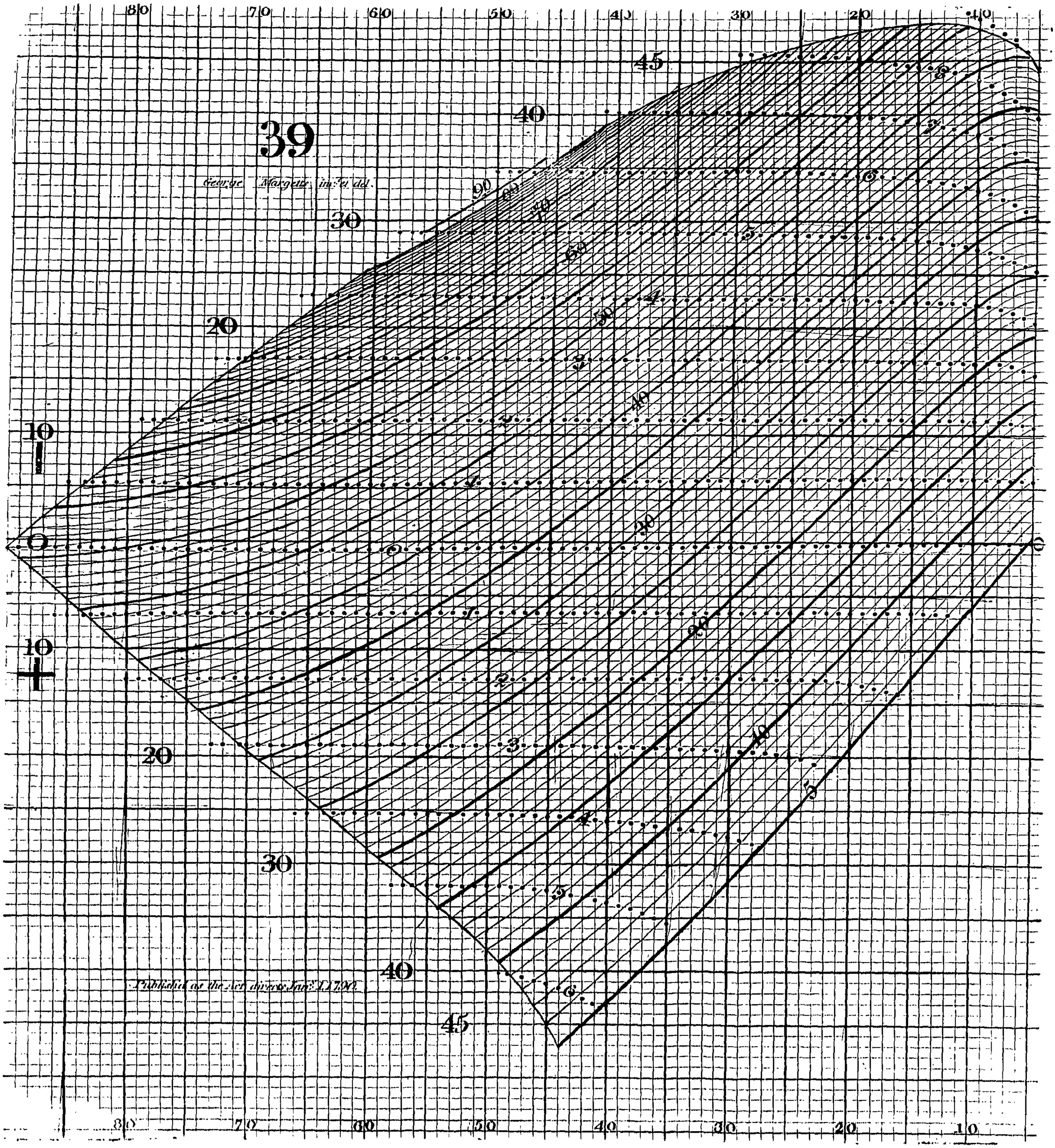
Published as the Act directs Jan. 1. 1790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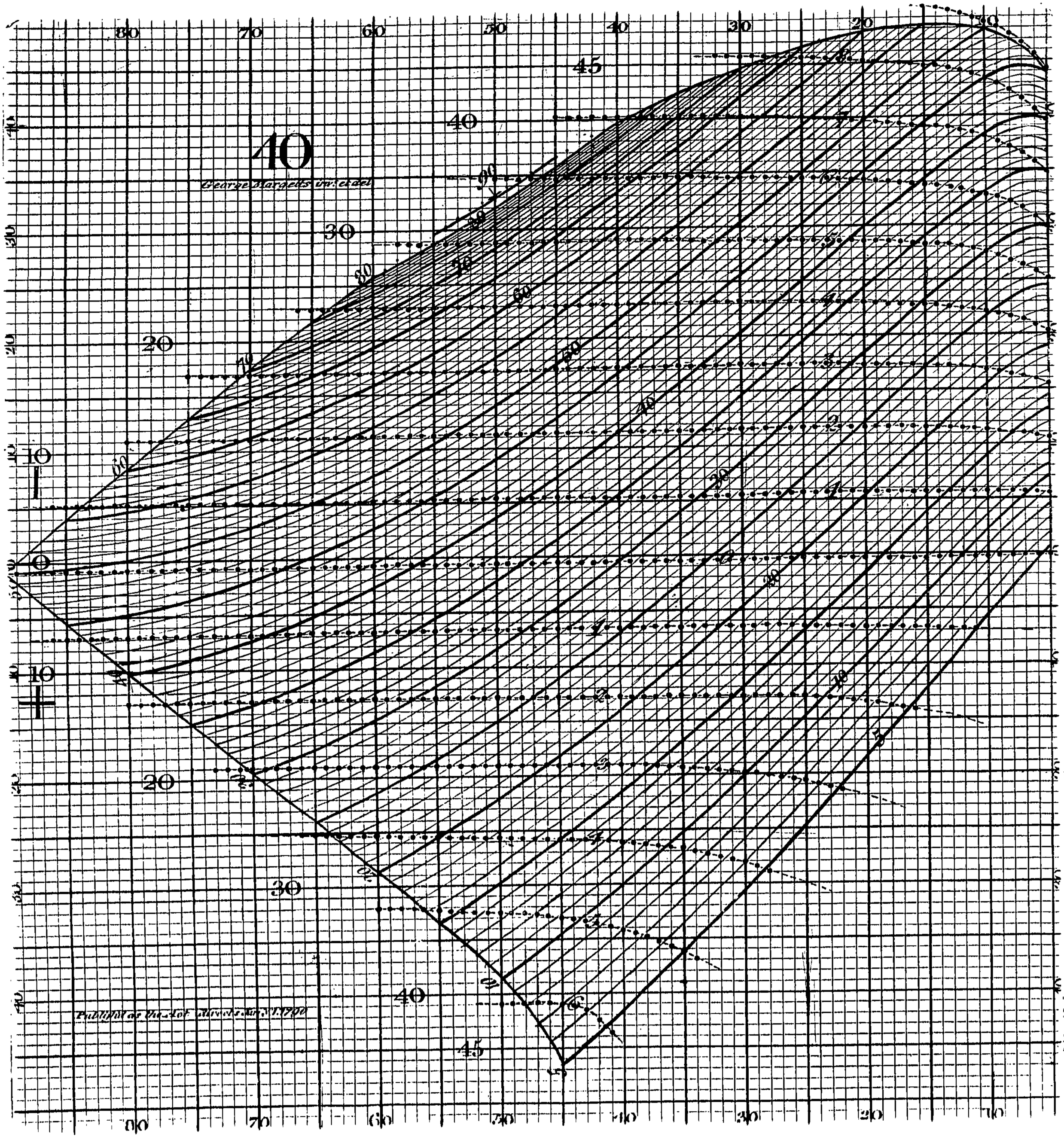
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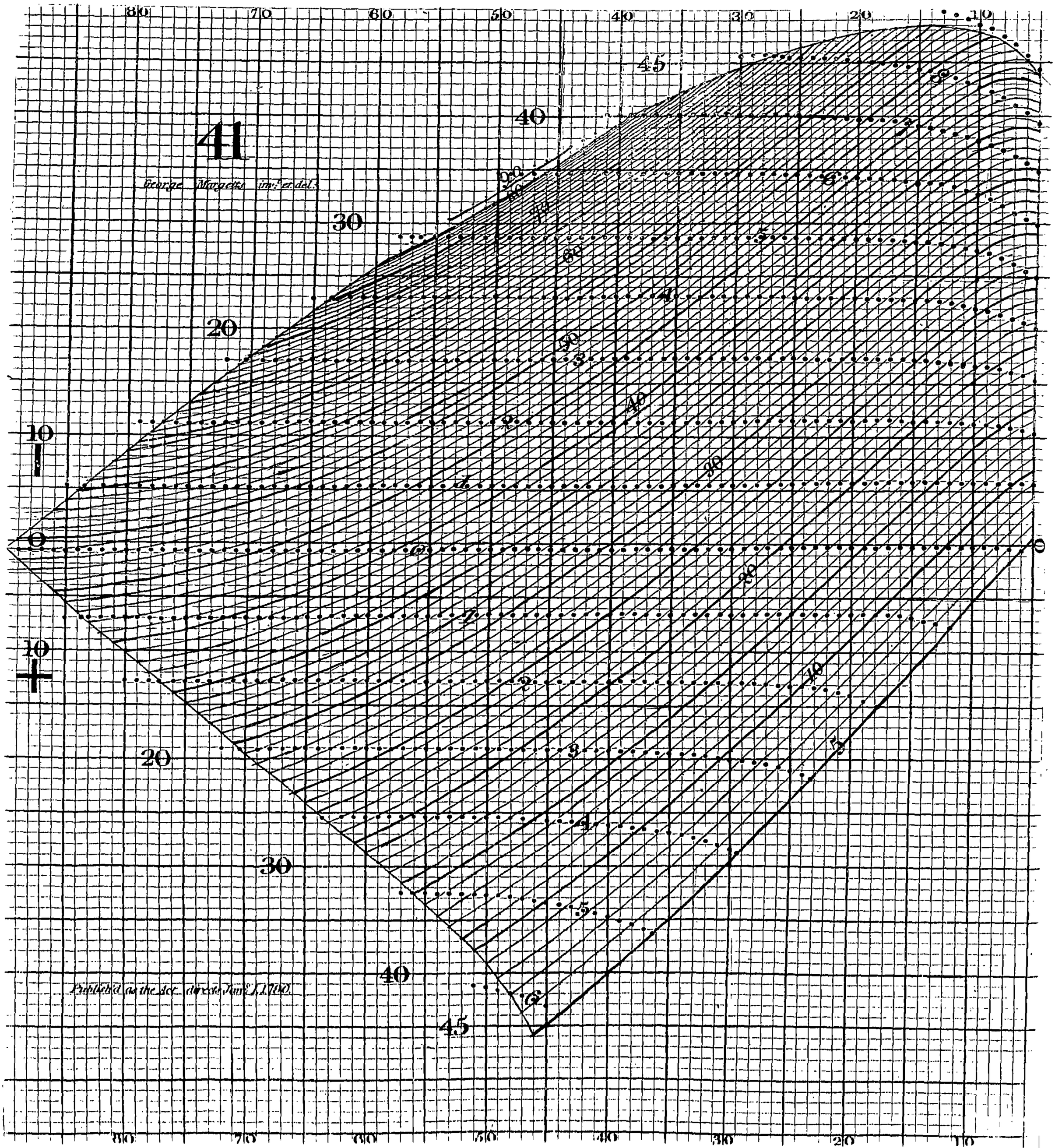
George Margetts inv. et del.
Published as the Act of Parliament directs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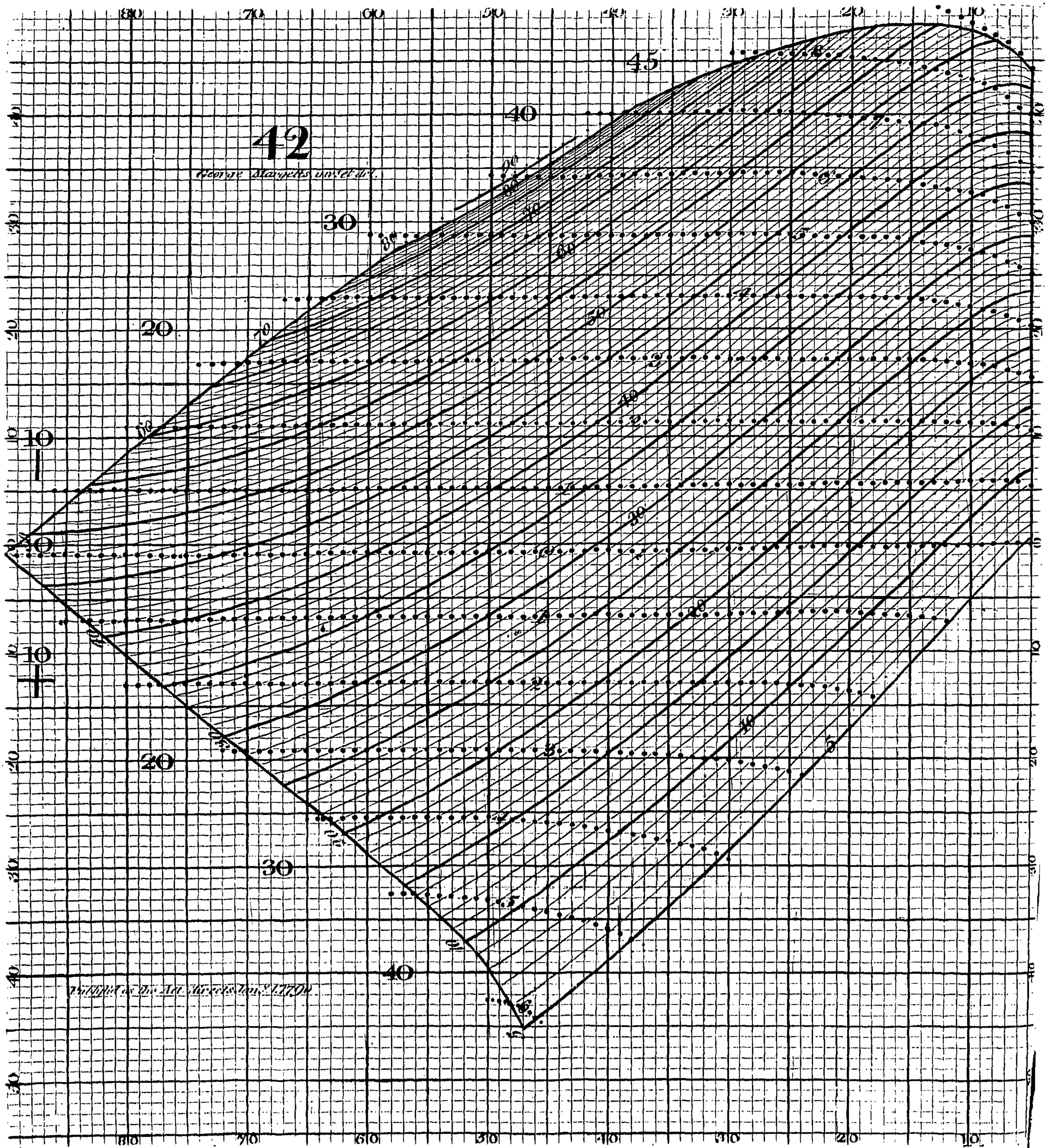
Published as the Act directs Jan.y 1.1700.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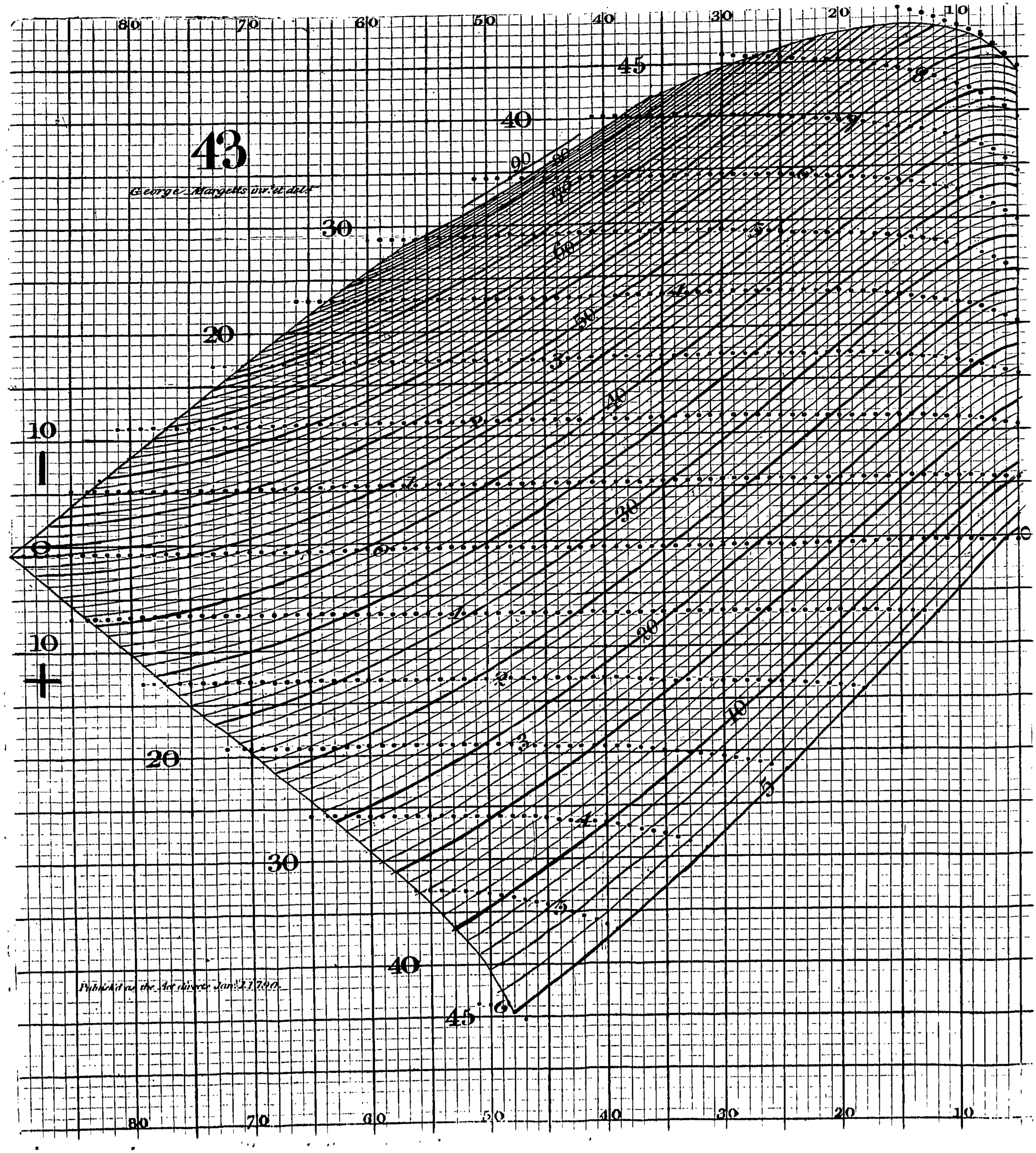
Published as the Act directs Jan.y 1770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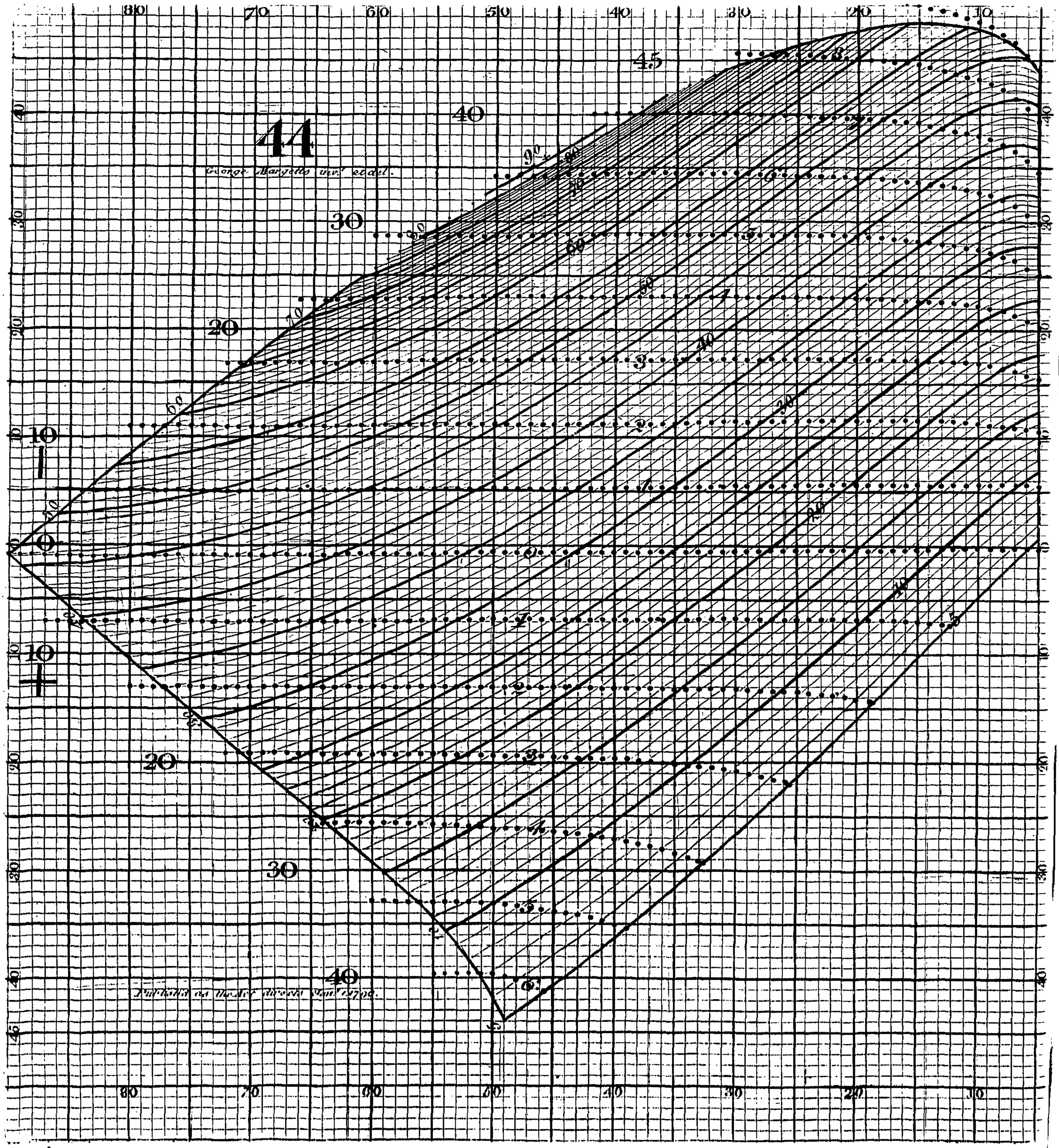
Published as the Act directs Jan.y 1.1790.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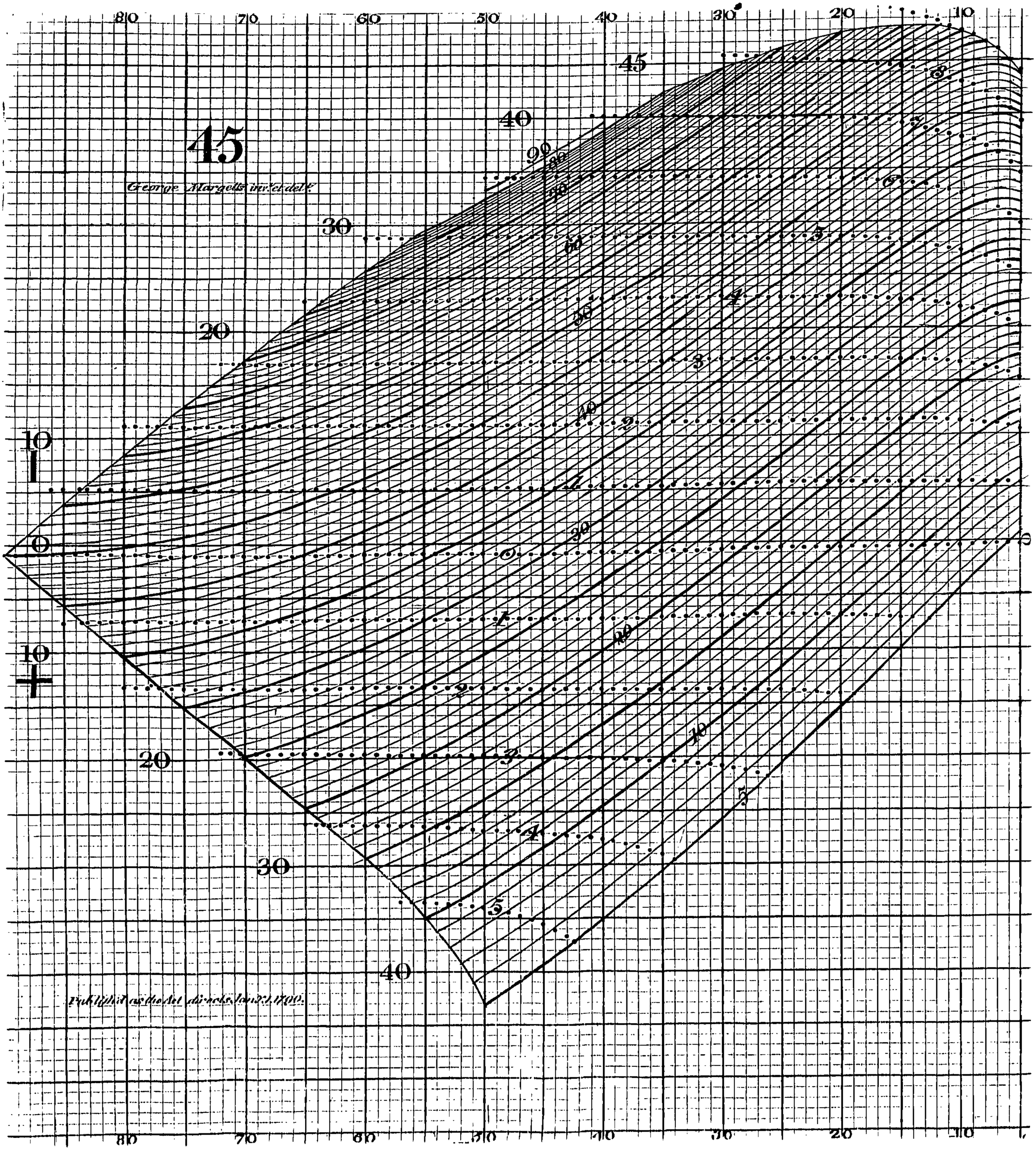
Imprimé au Dépôt général des Cartes.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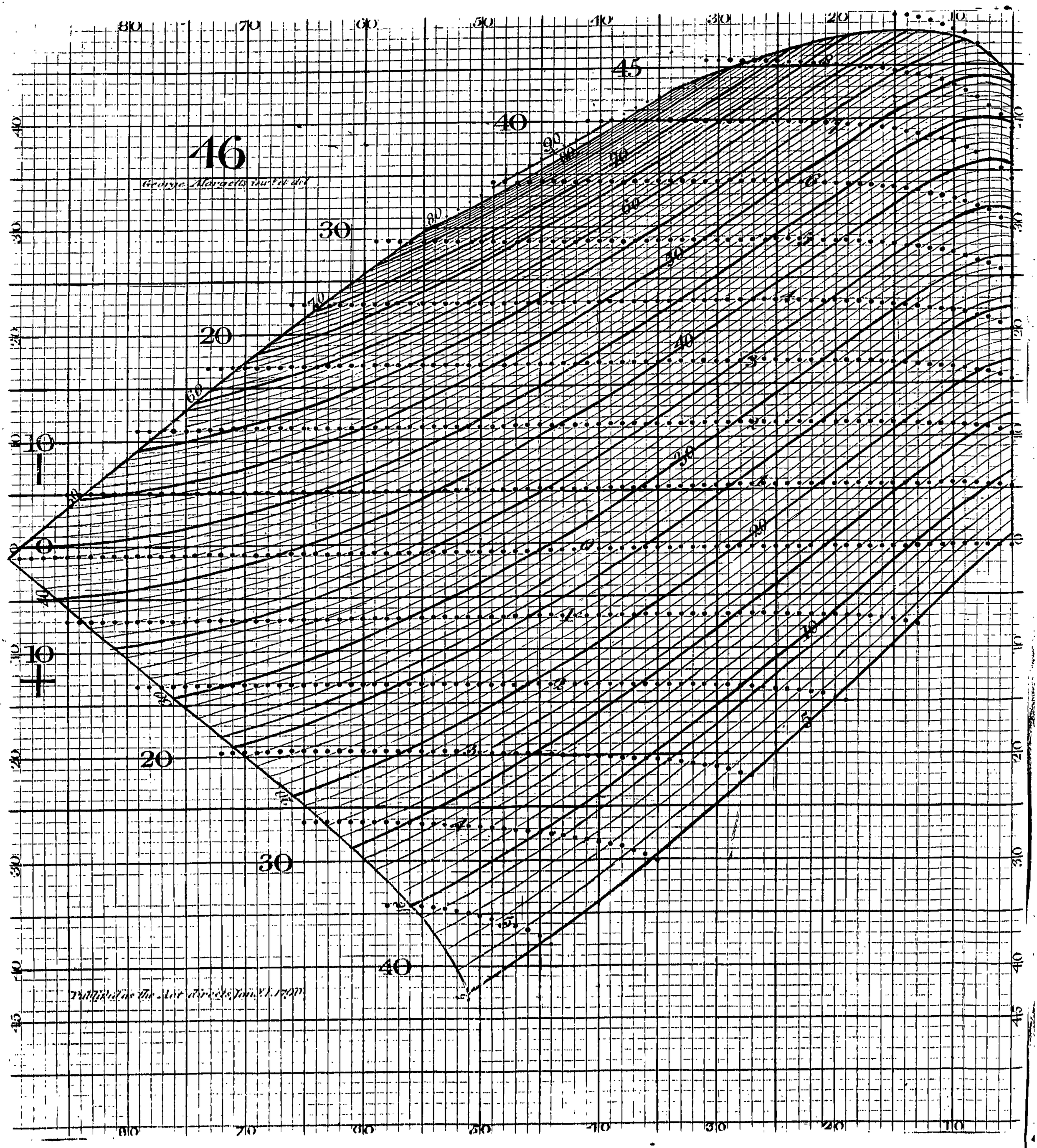
Publiché ce Model à Londres le 21.1700.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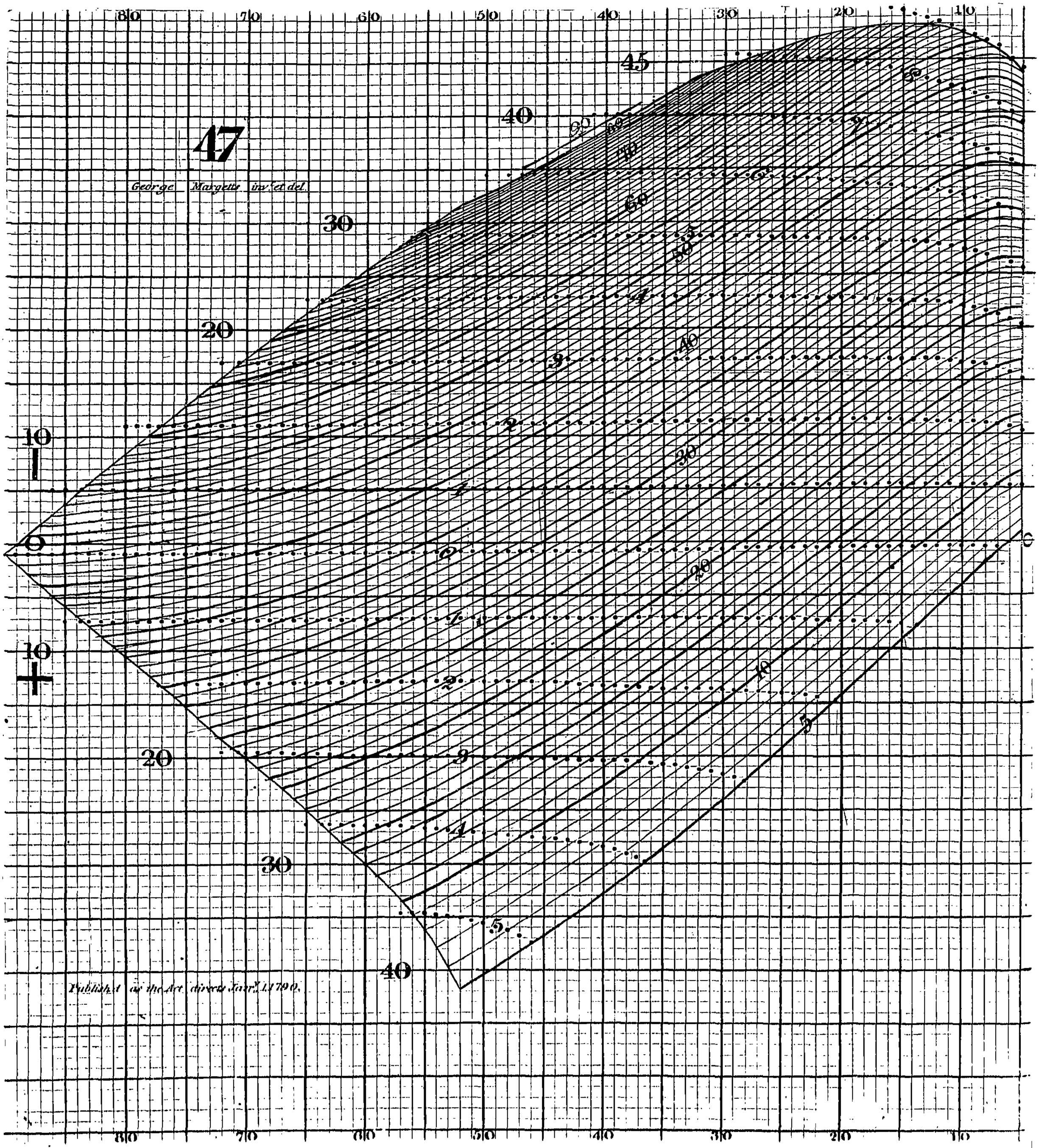
Published as the Act directs Jan.y 1. 1799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George Margetts inv.t et del.
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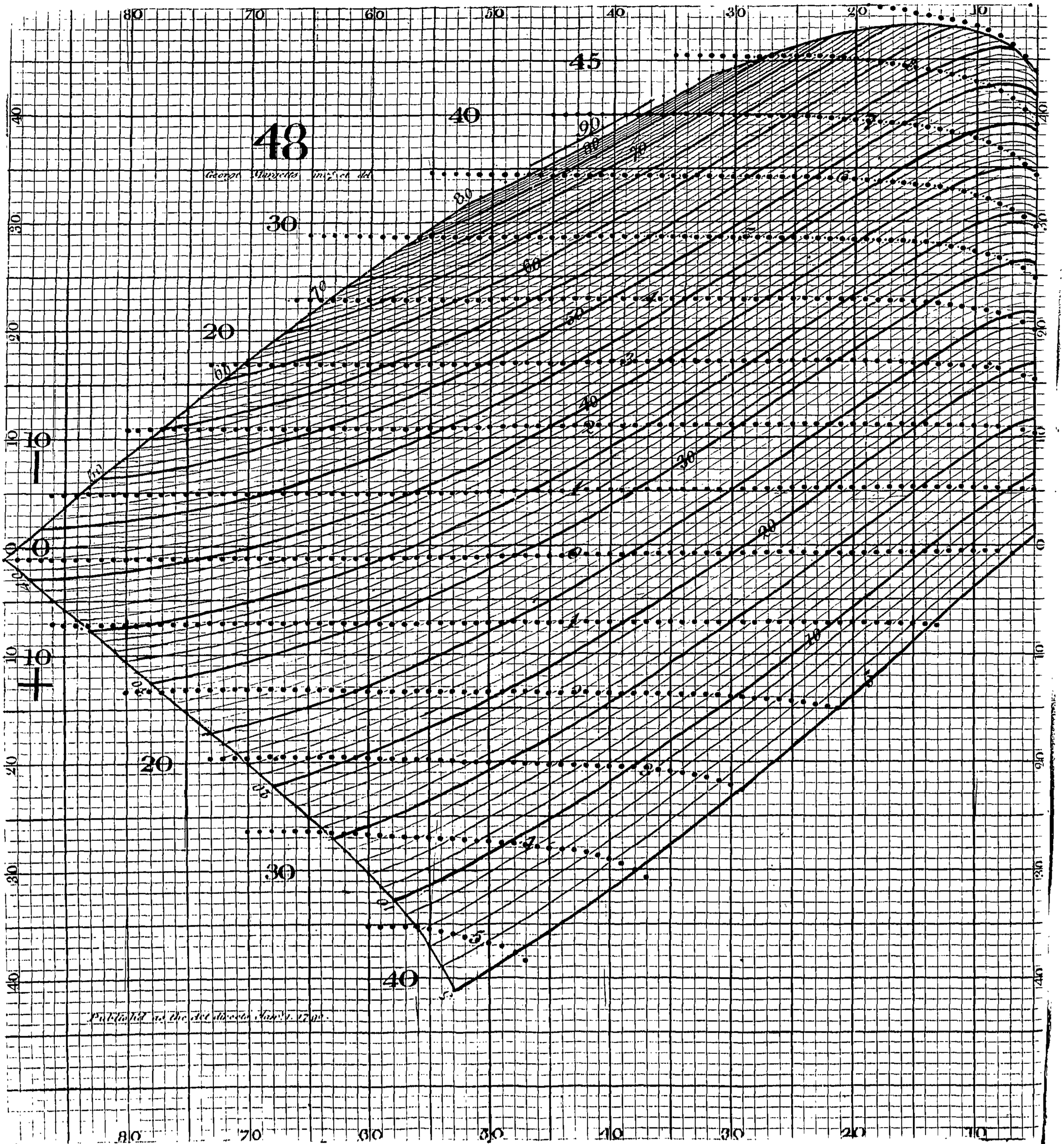
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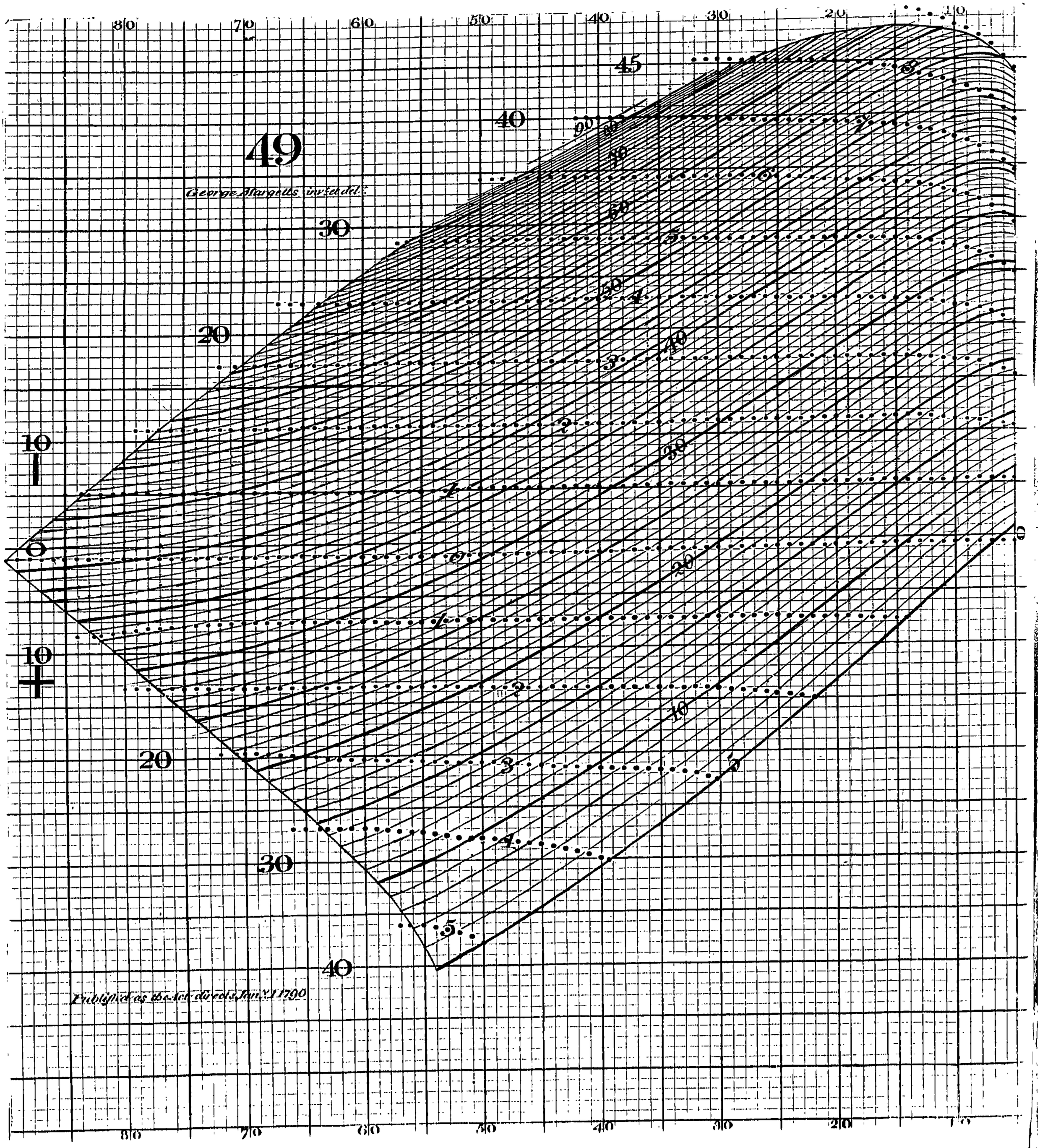
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George Margetts inv. et del.
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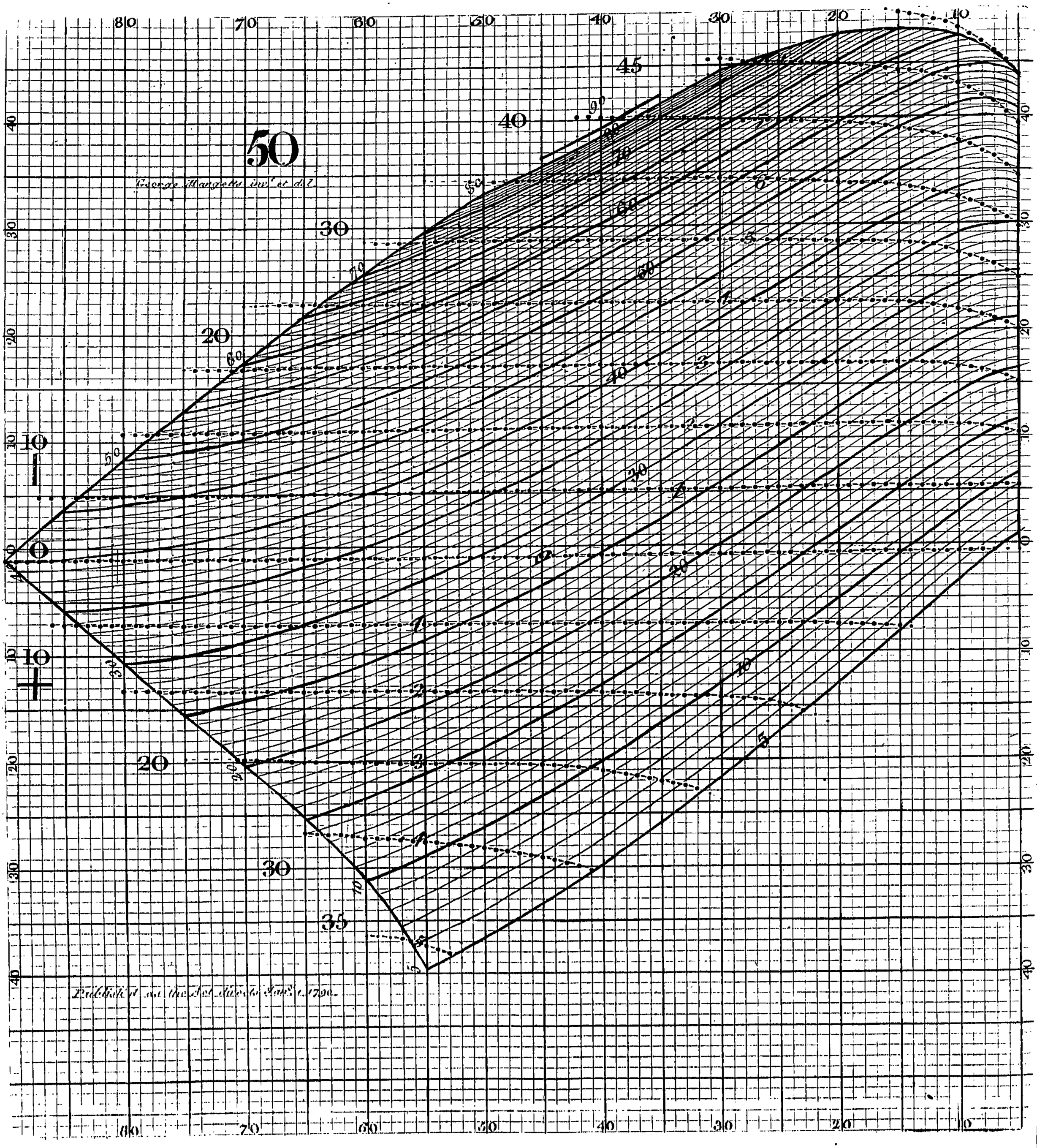
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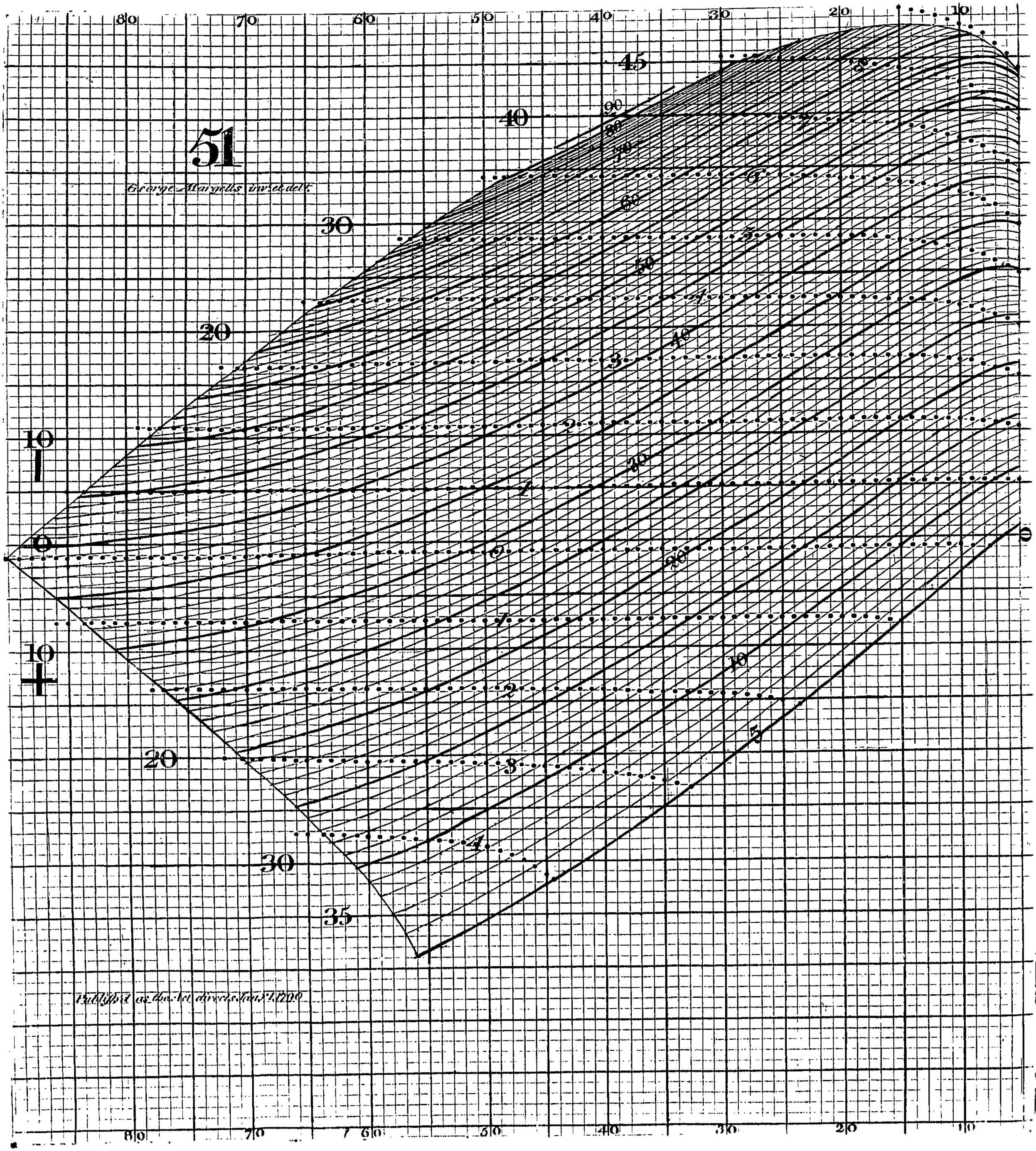
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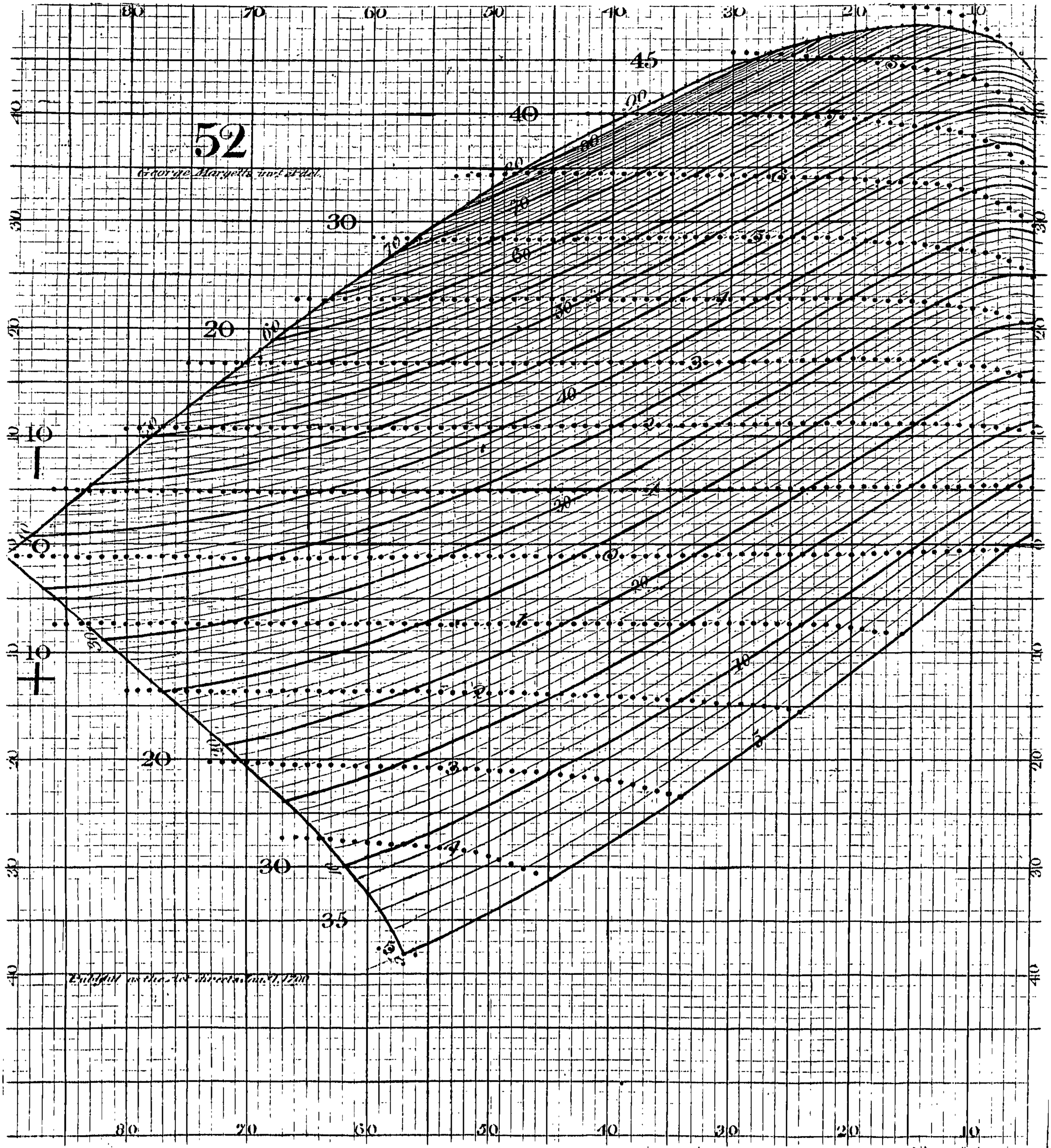
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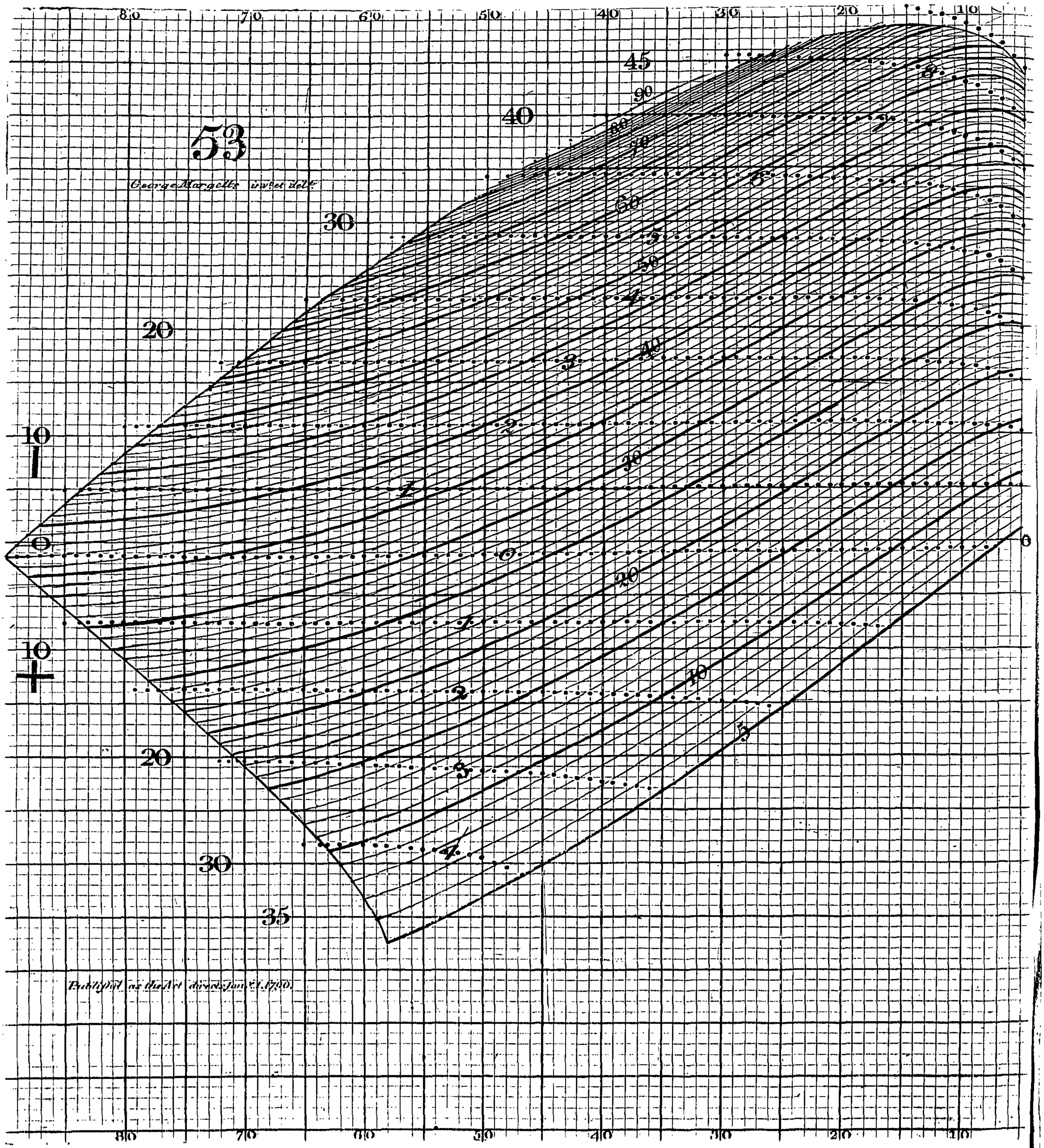
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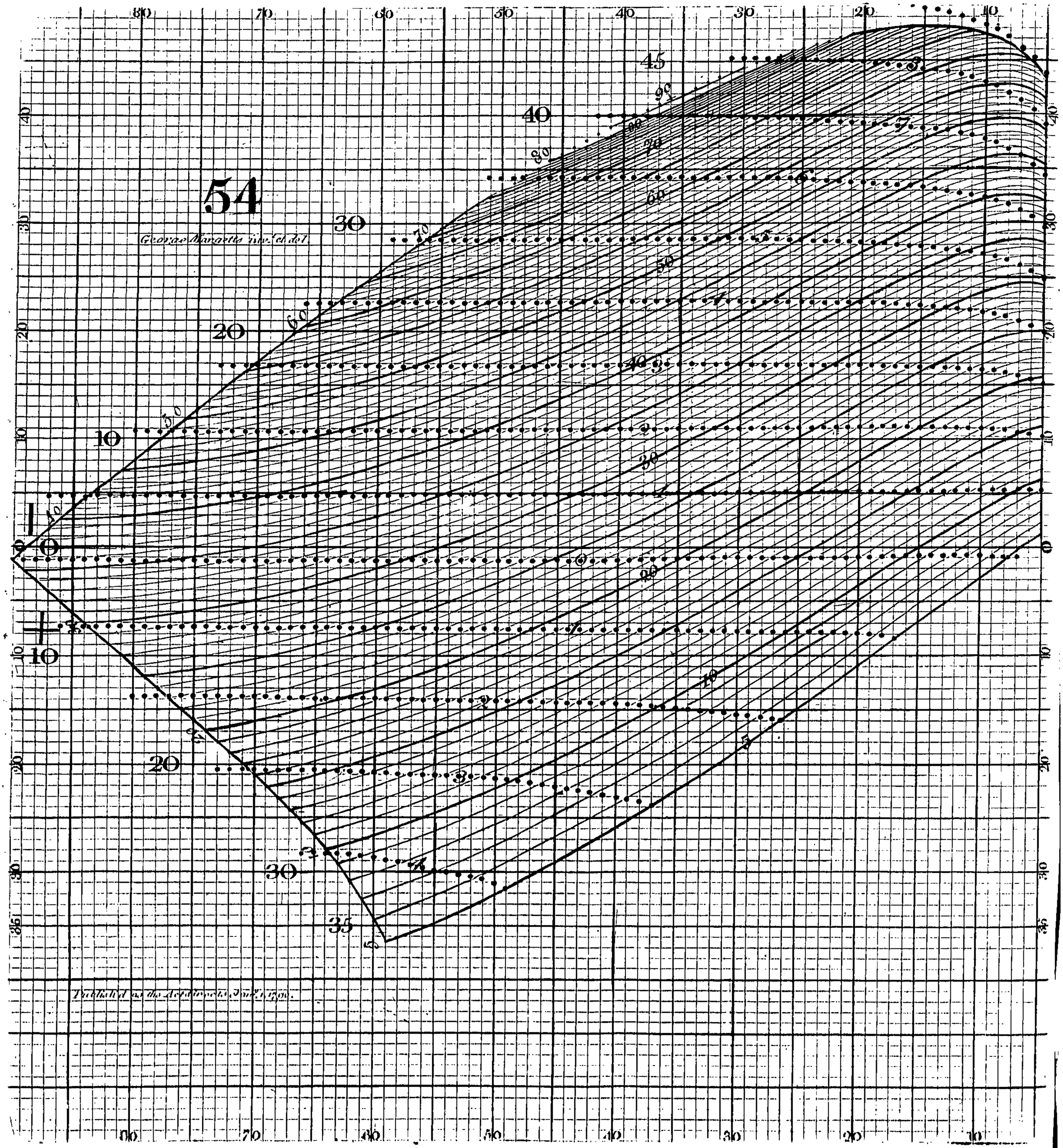
George Margetts invent delt
Published as the Act directs Jan 1. 1790.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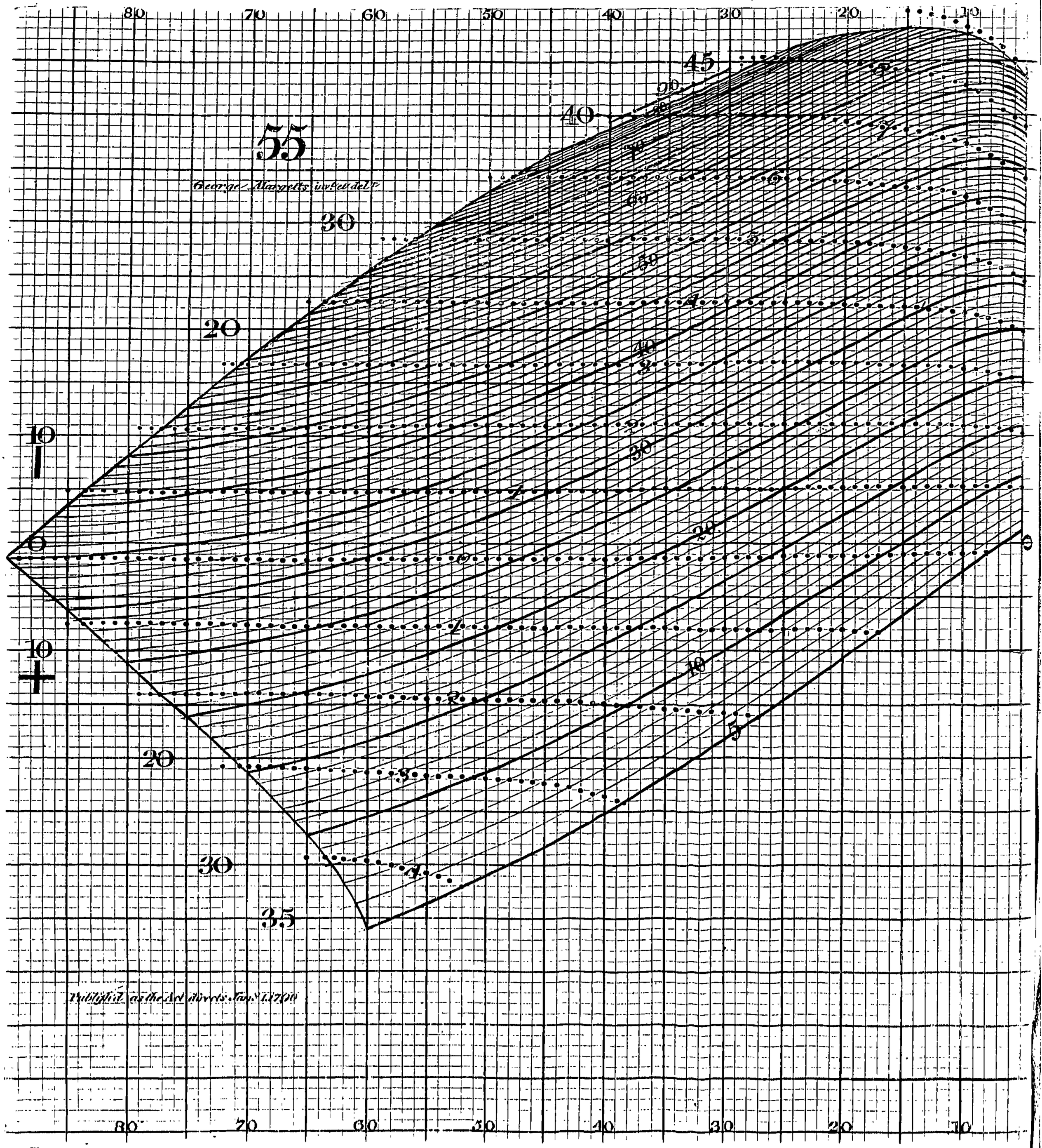
Published as the Act directs Jan.y 1.st 1790.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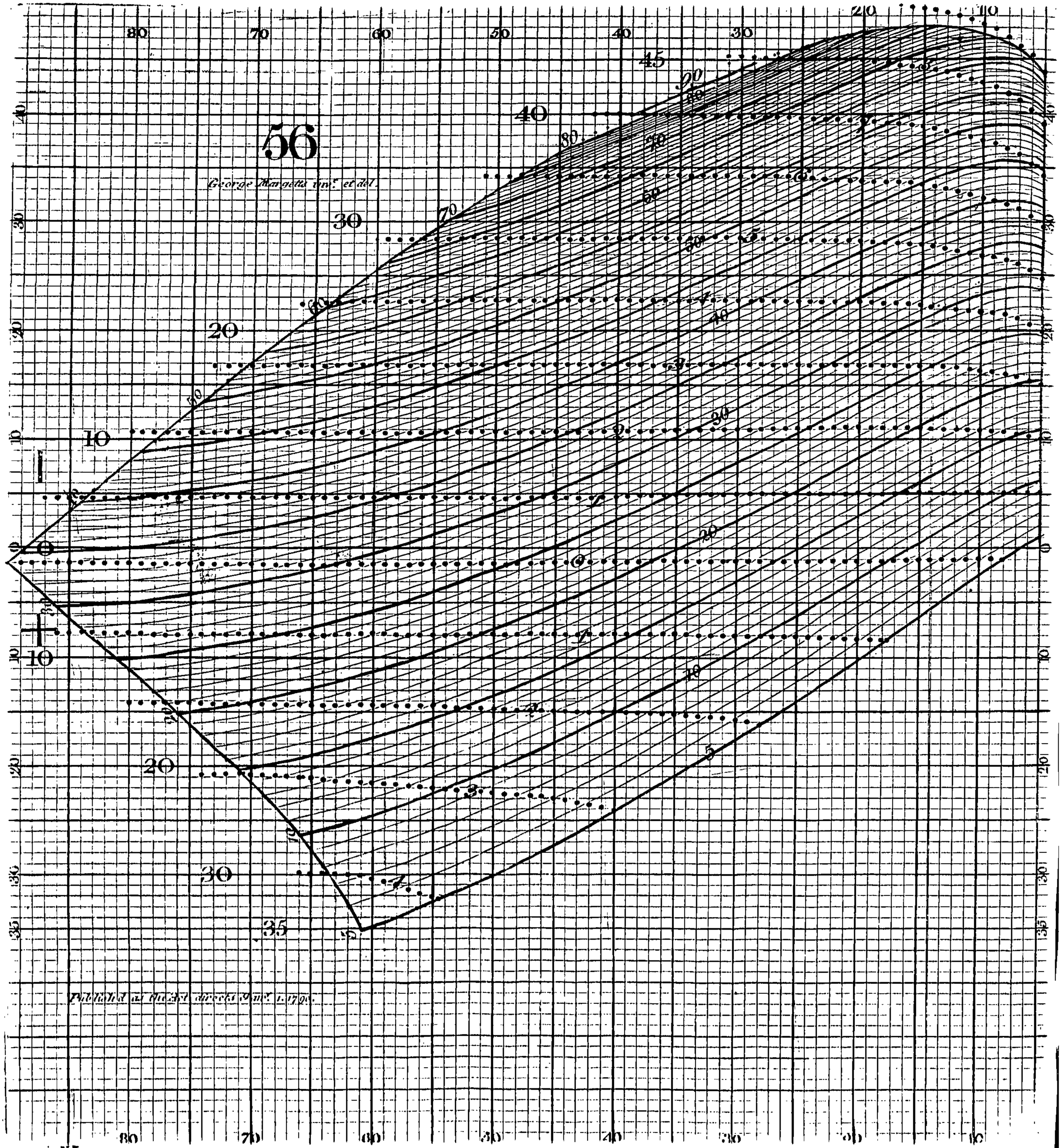
Published as the Act directs Jan.y 1.1790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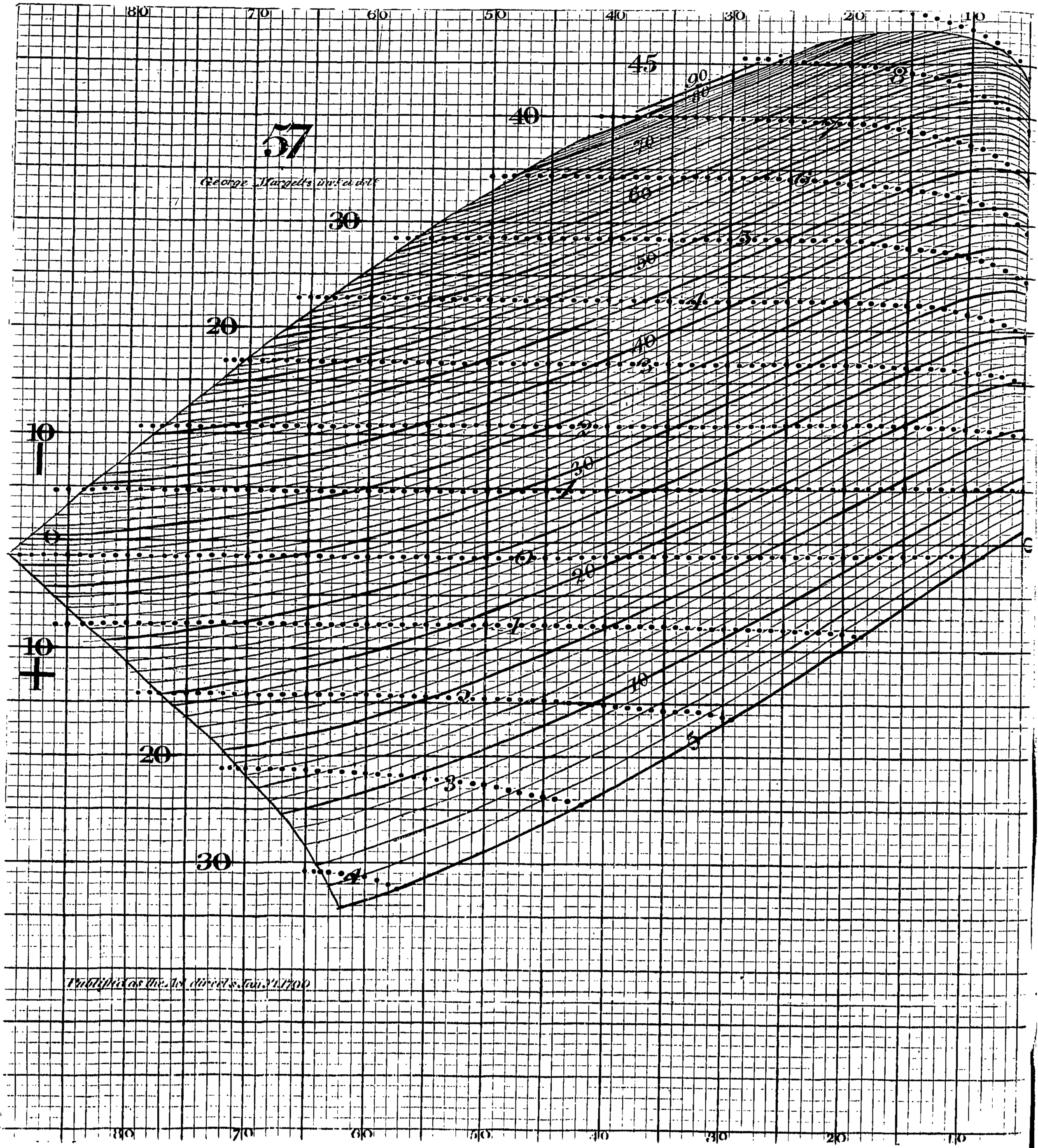
Published as the Act directs Jany. 1. 1799.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Published as the Act directs Jan.1st 1790
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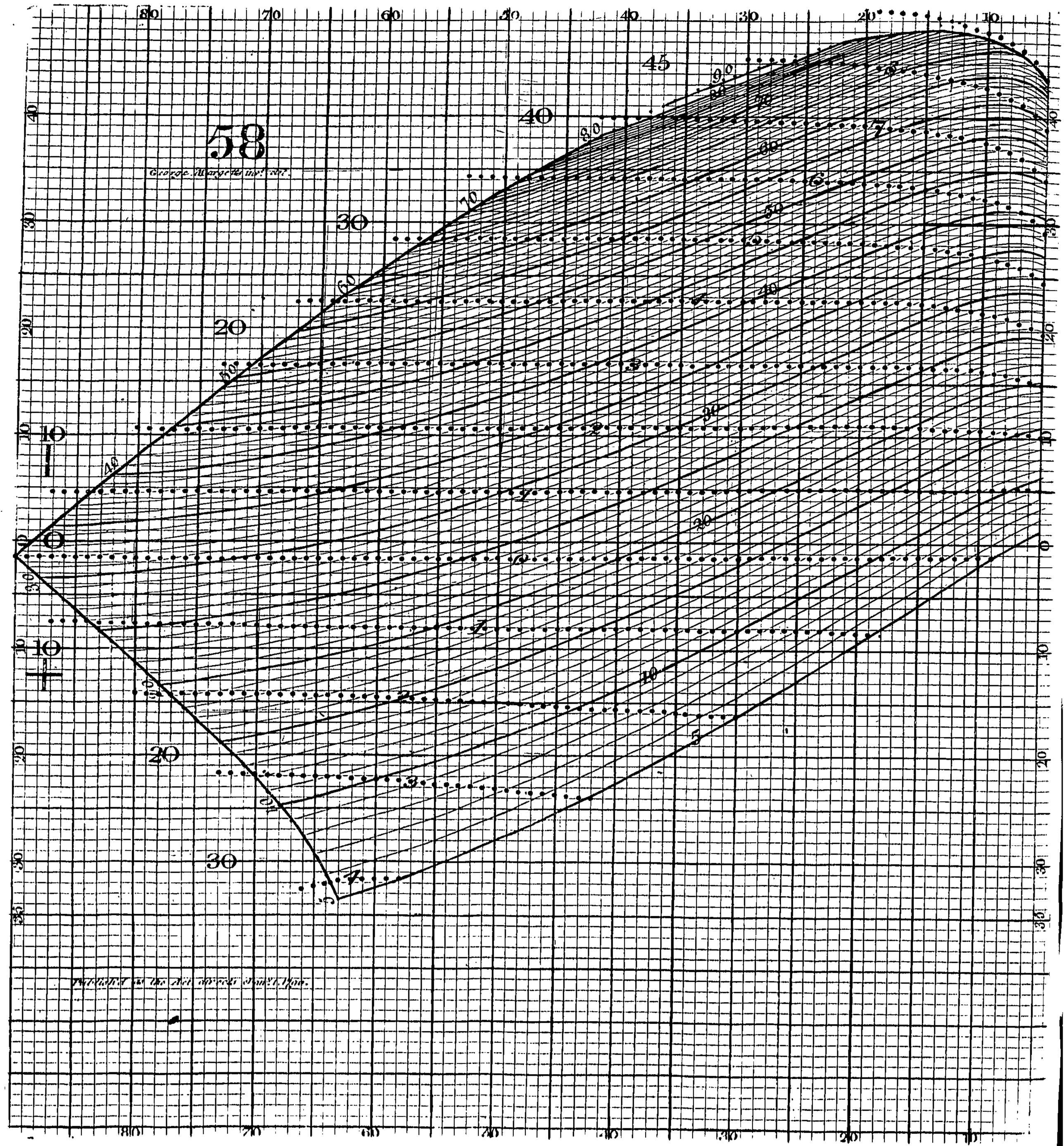
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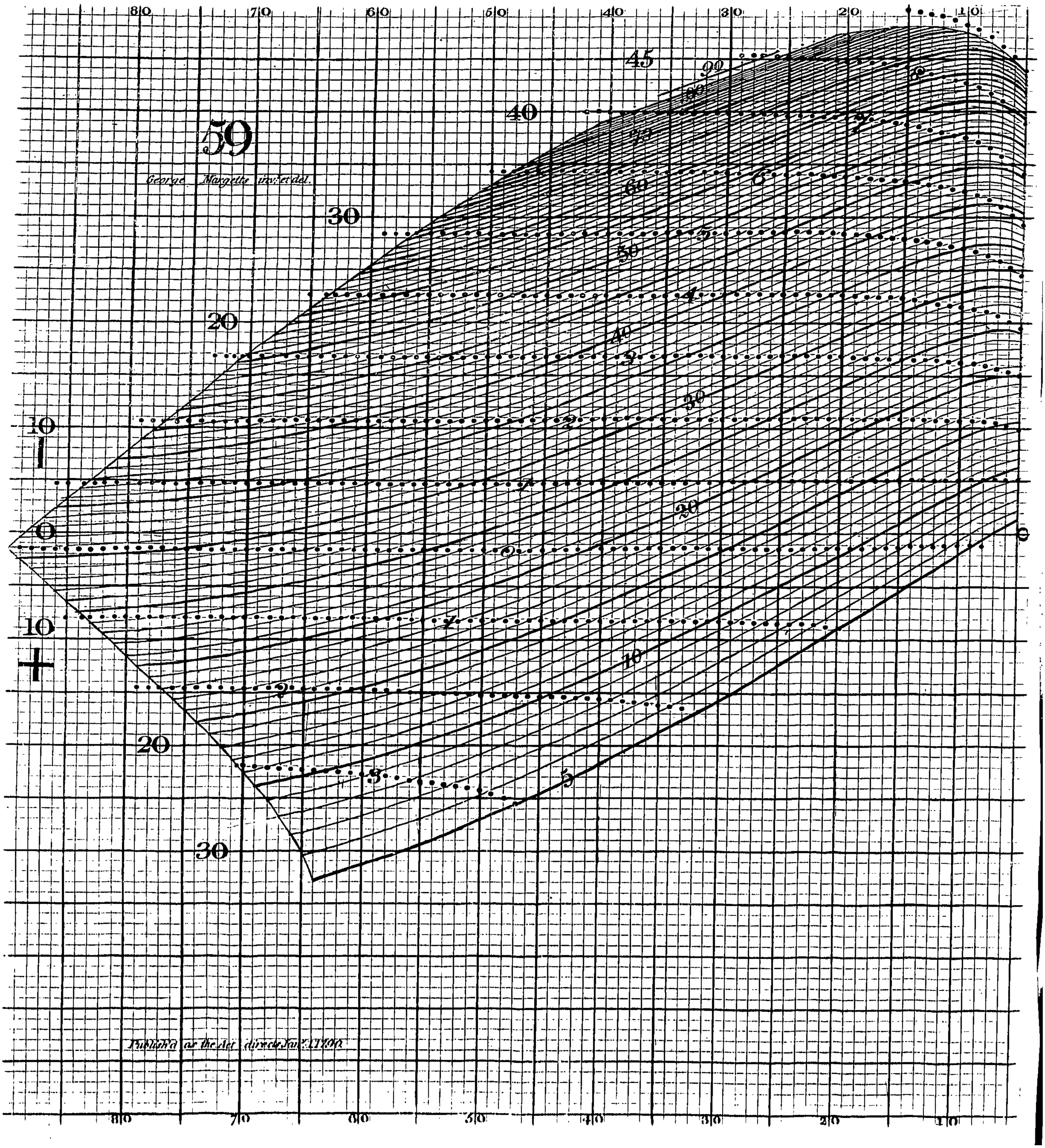
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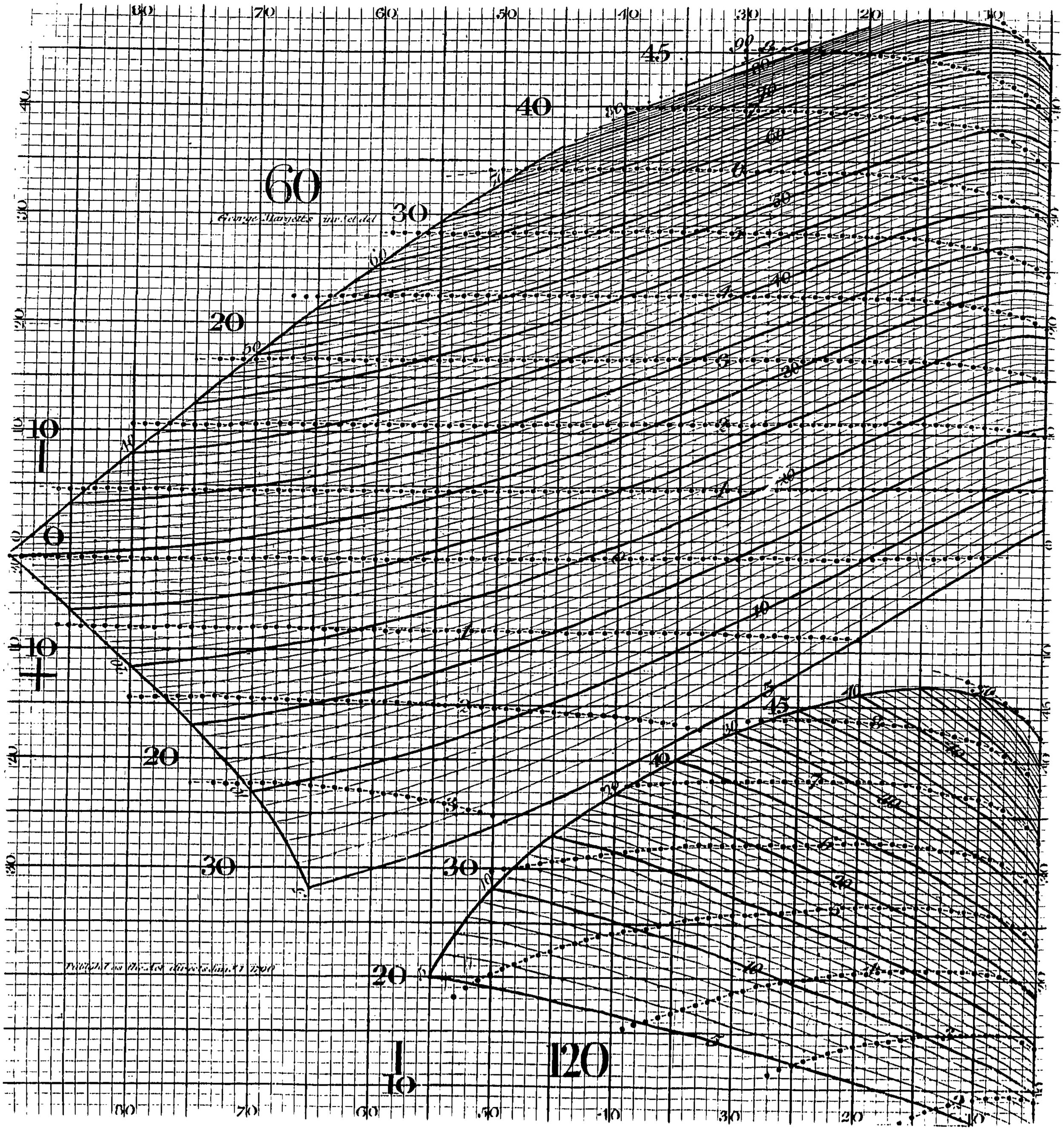
Published as the Act directs Jany 1.1700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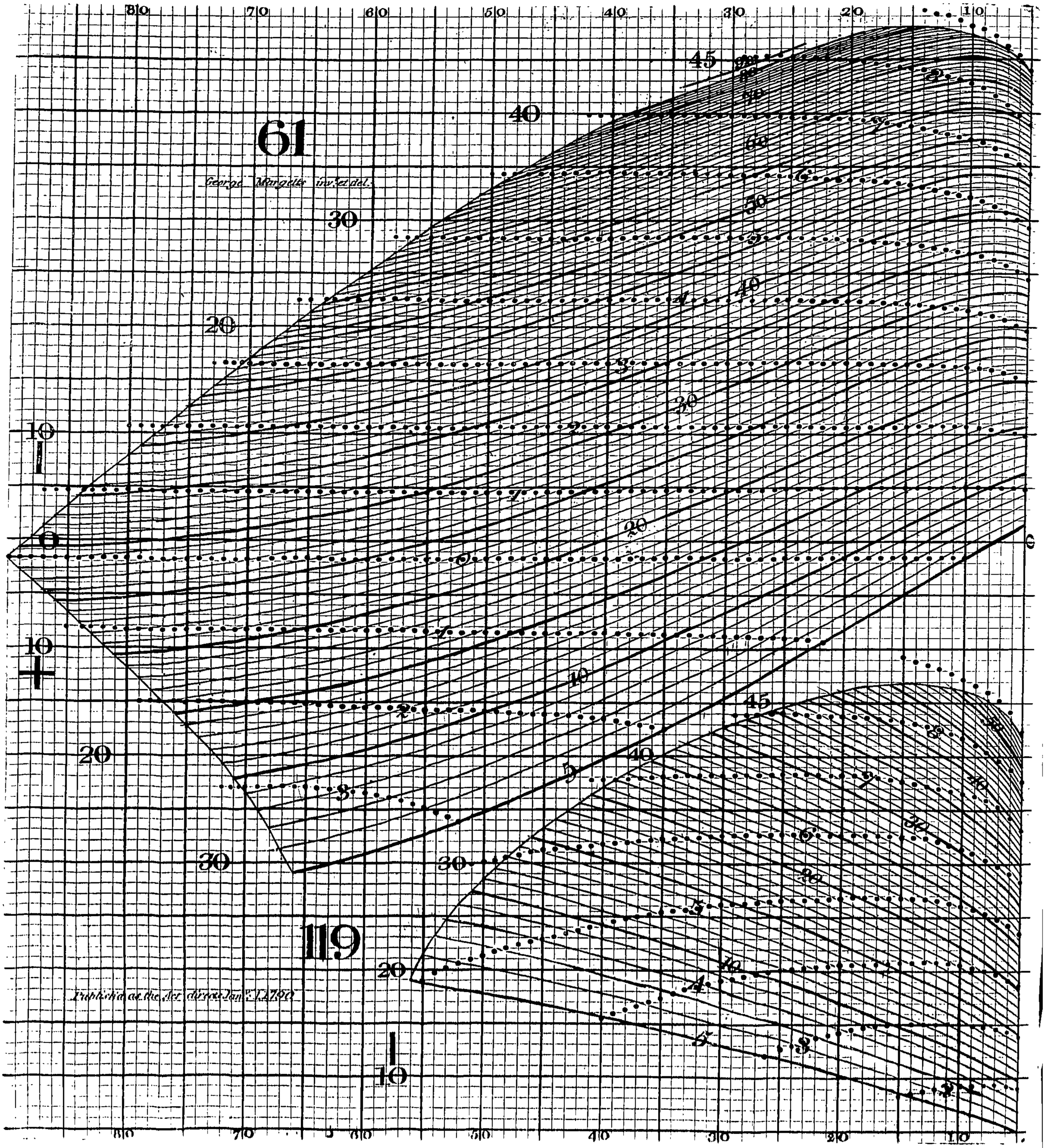
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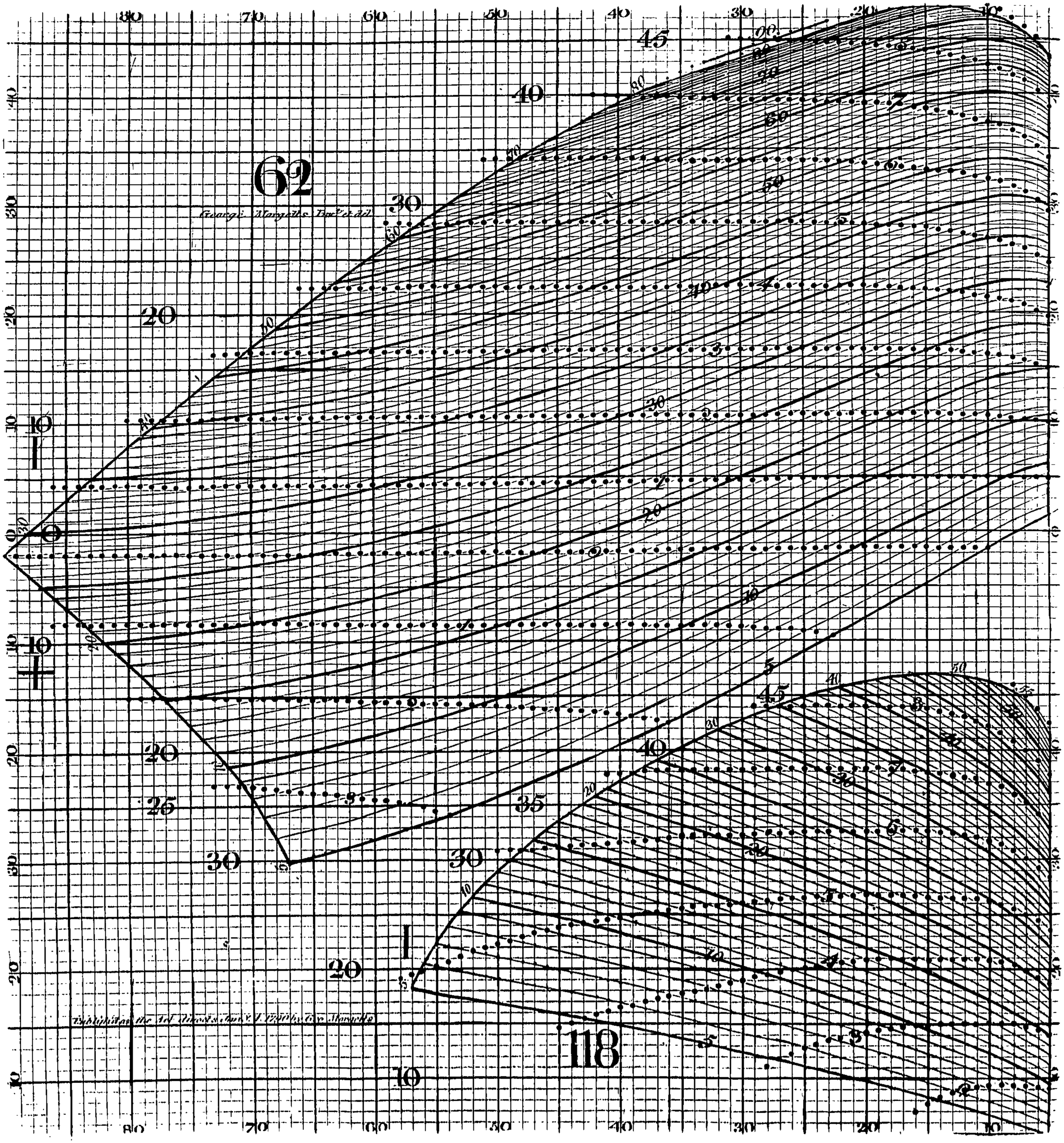
Published as the Act directs Jan.y 1.1790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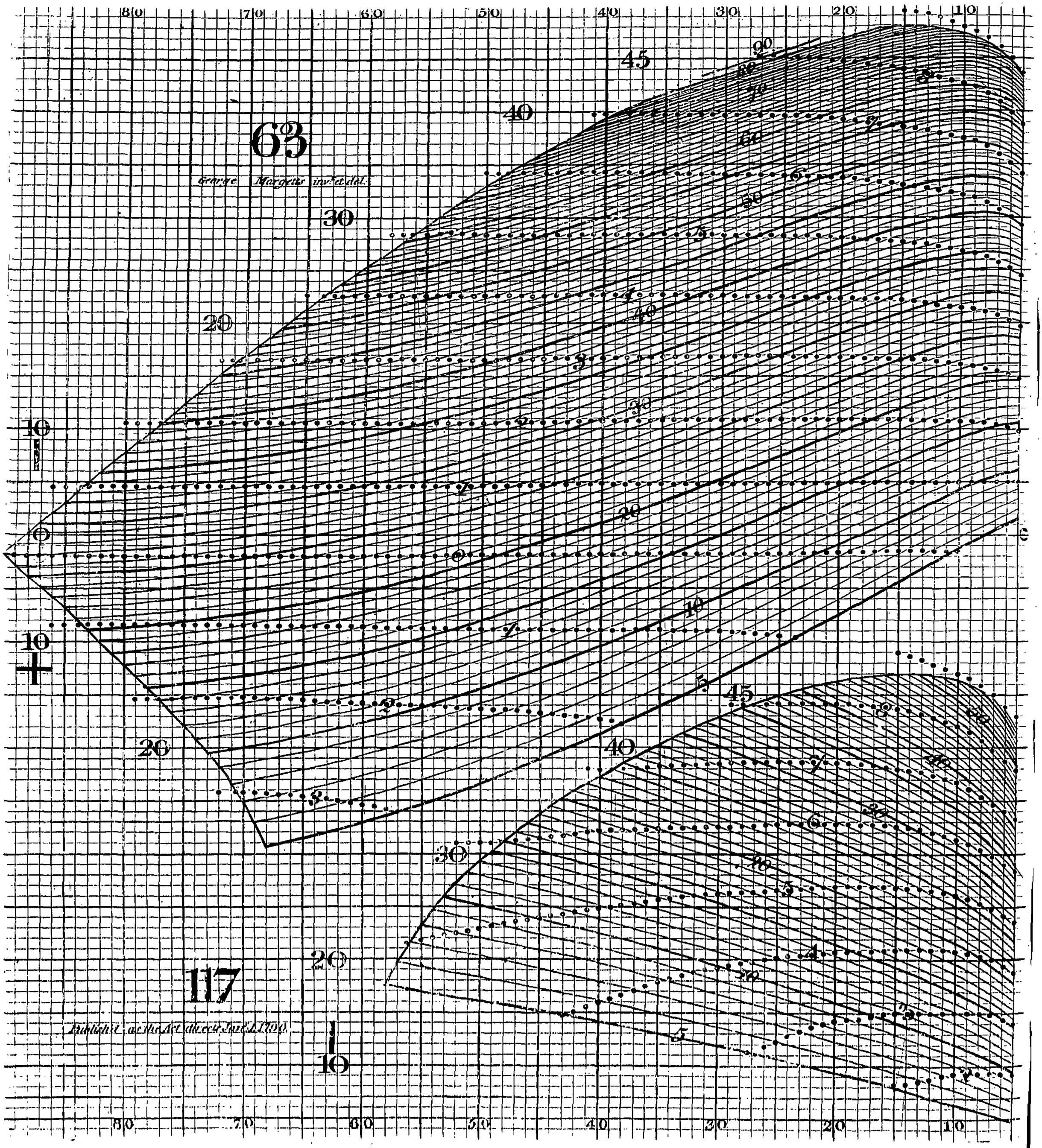
118
George Margetts Del et Sc.
Published as the Act directs by J. Wallis 62 Newgate Street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George Margetts inv. et del.
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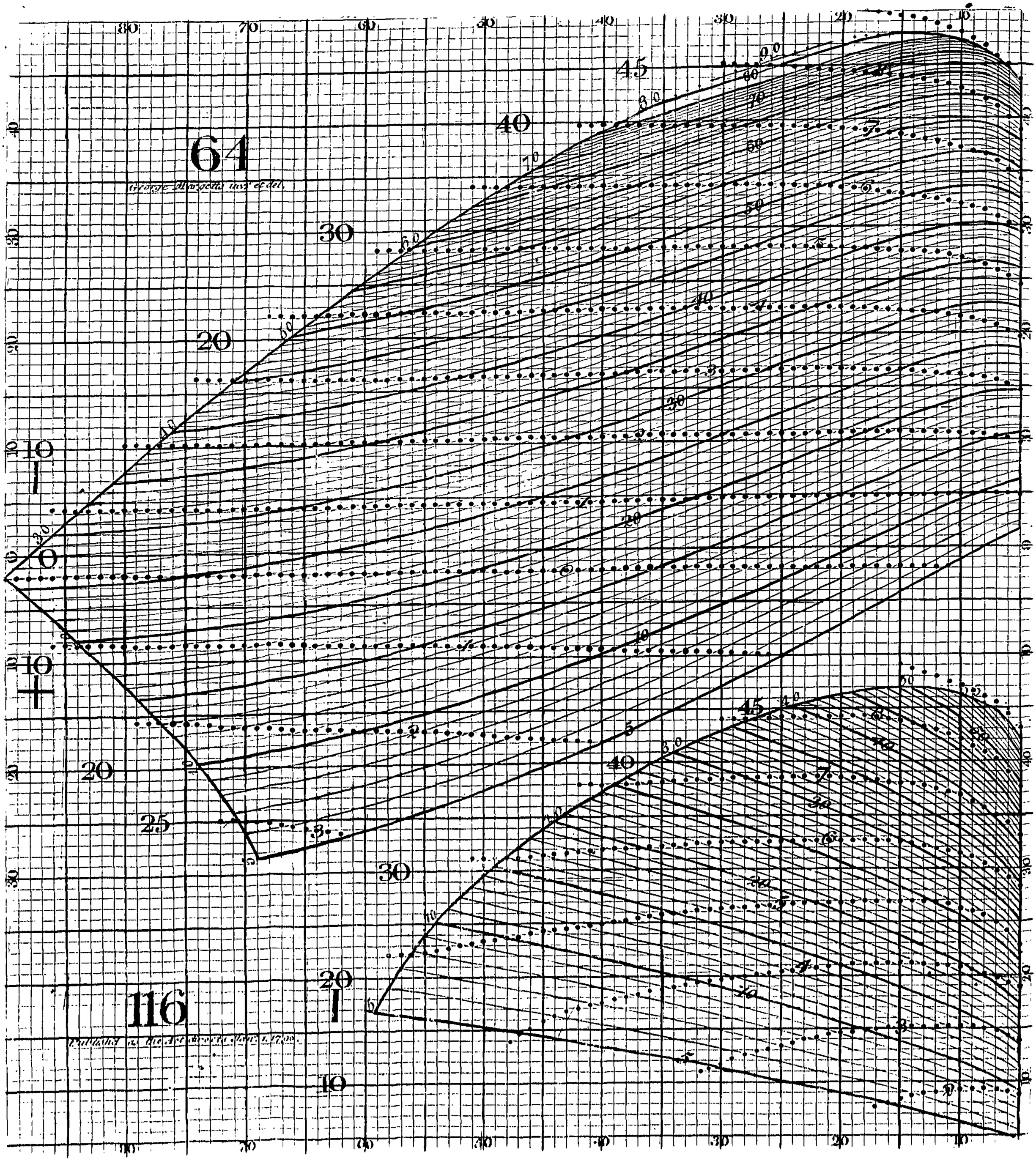
Published according to the Act dated 1st July 1790.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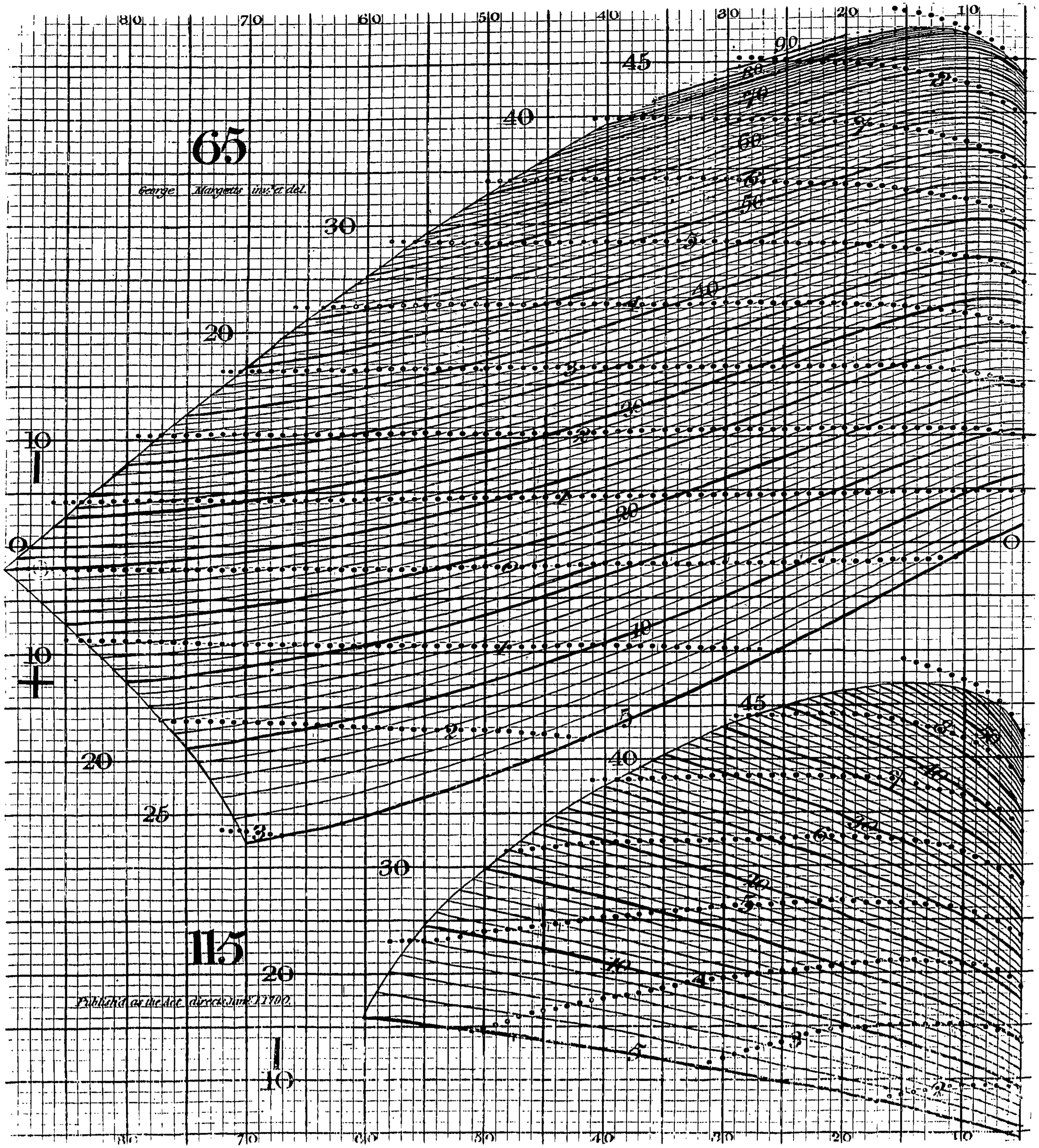
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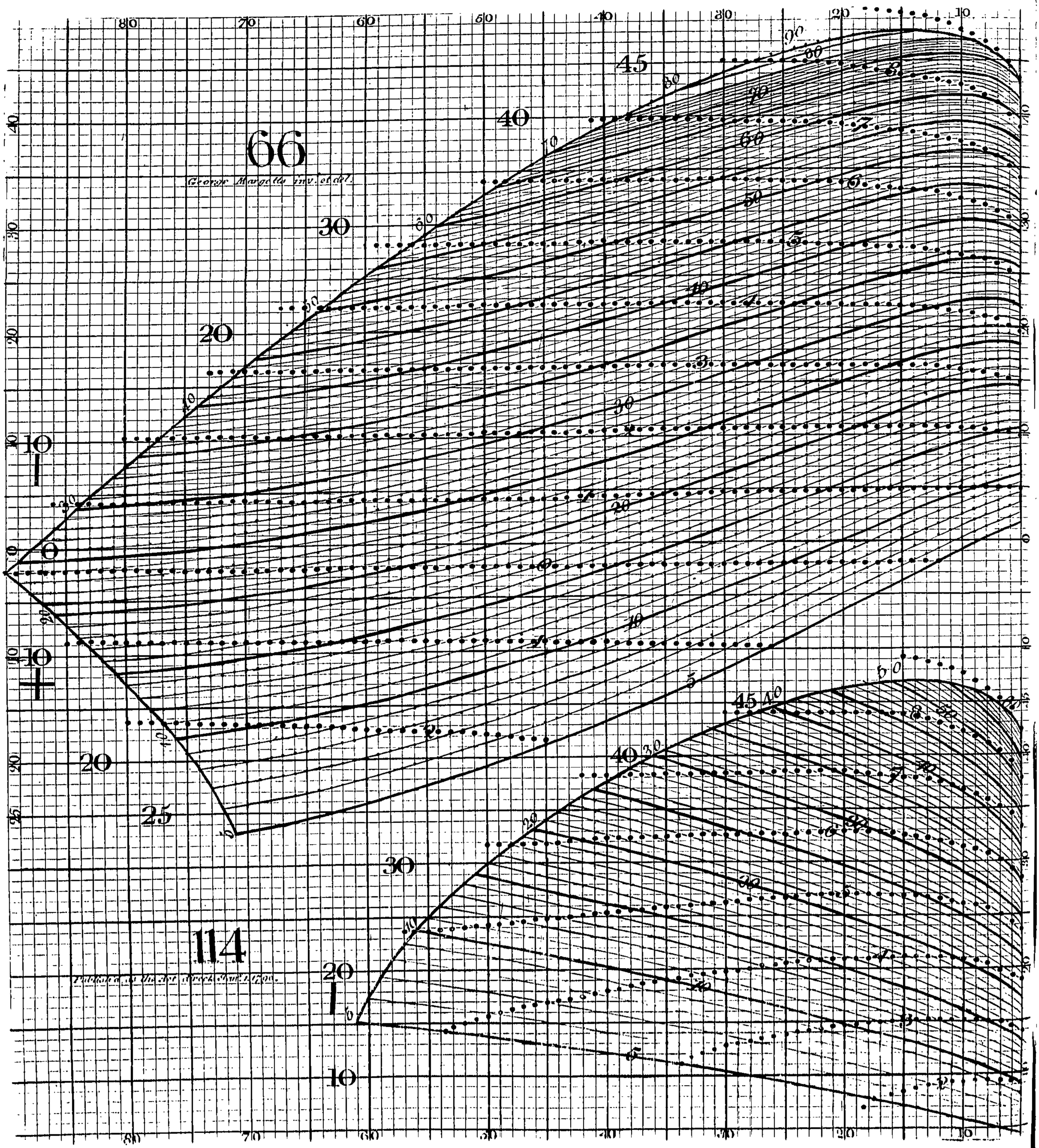
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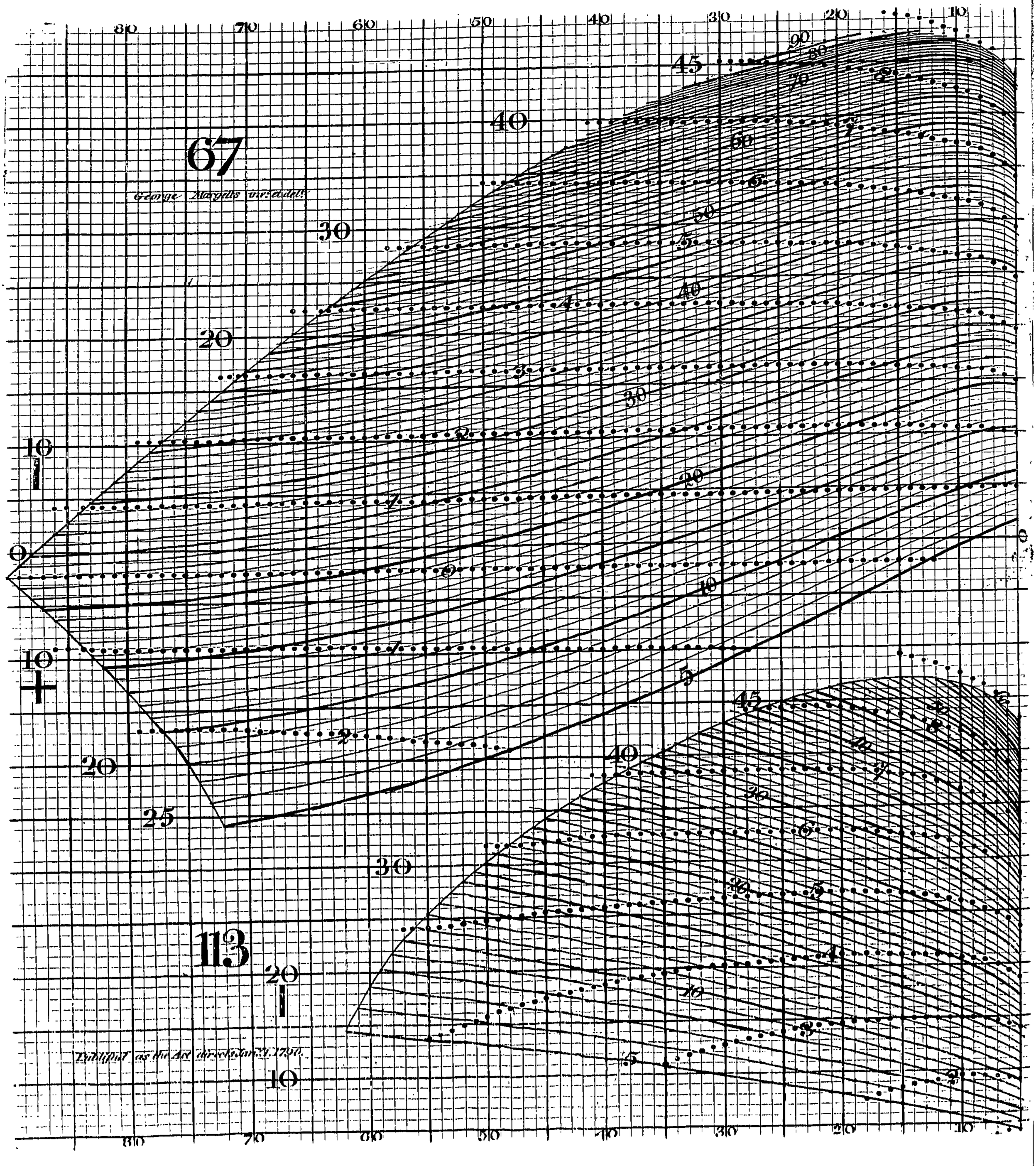
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George Mayalls invt. et delt.
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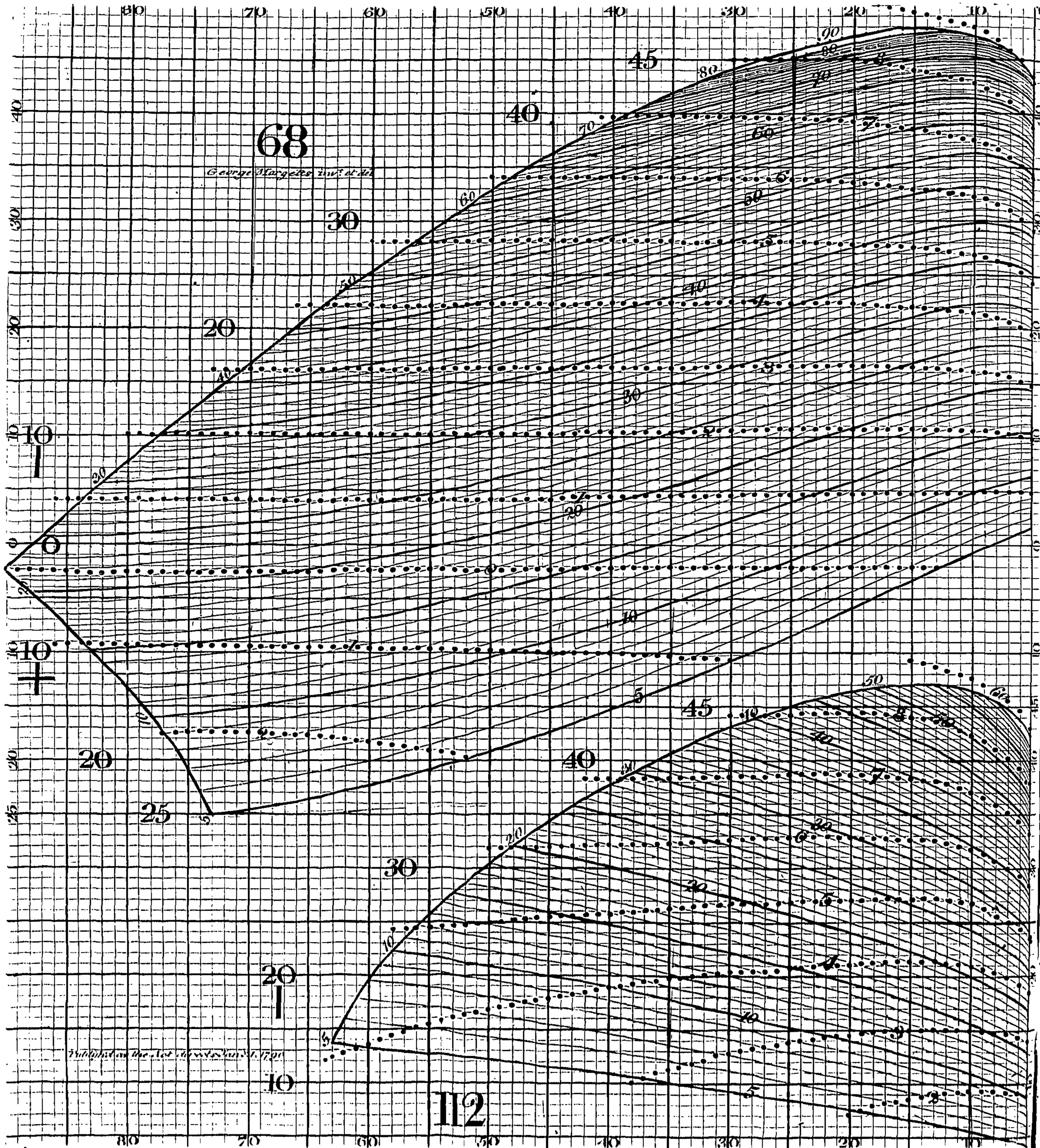
Published as the Act directs Jan.1st 1790.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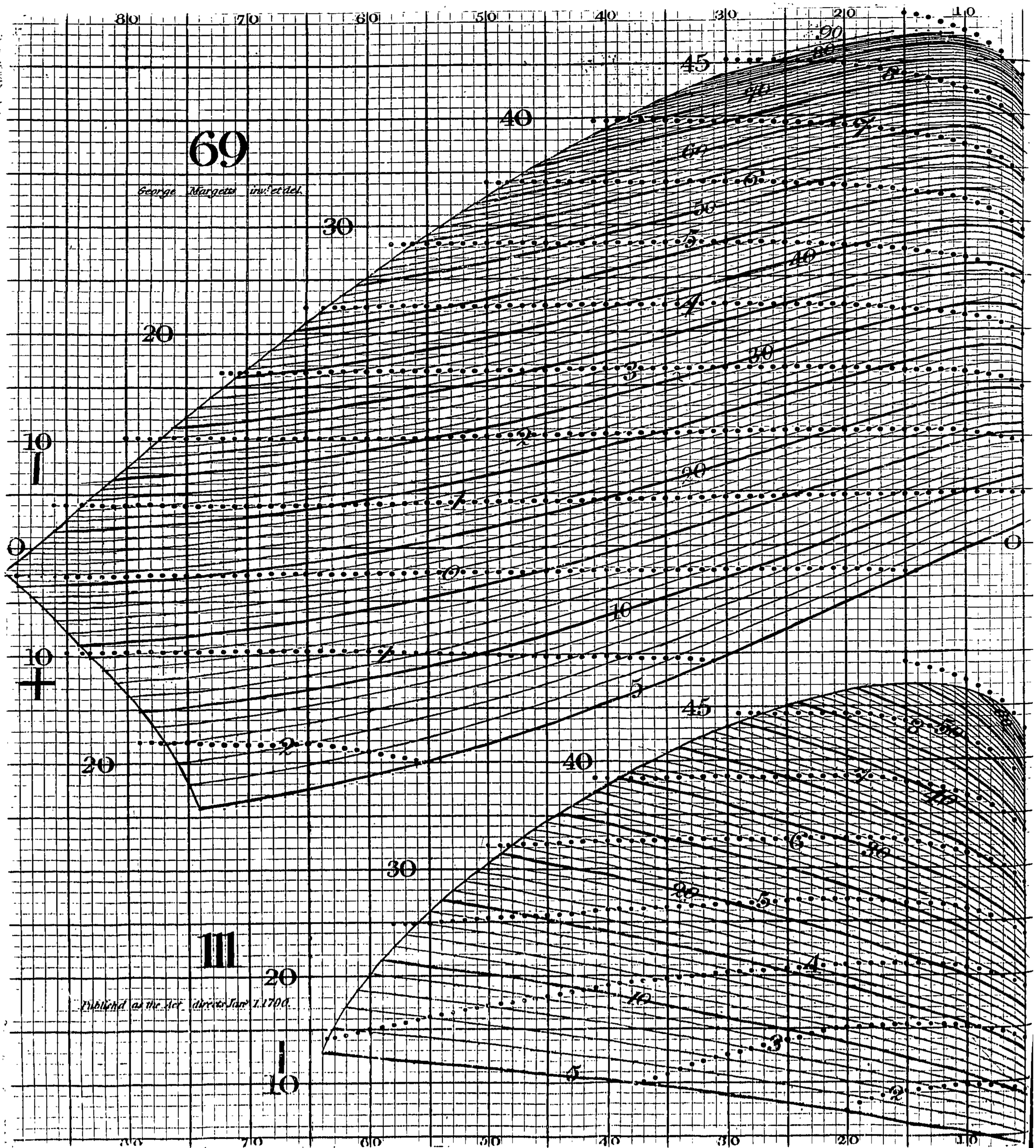
George Margetts Inv.t et del.
112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Published as the Act directs Jan.y 1.1700.
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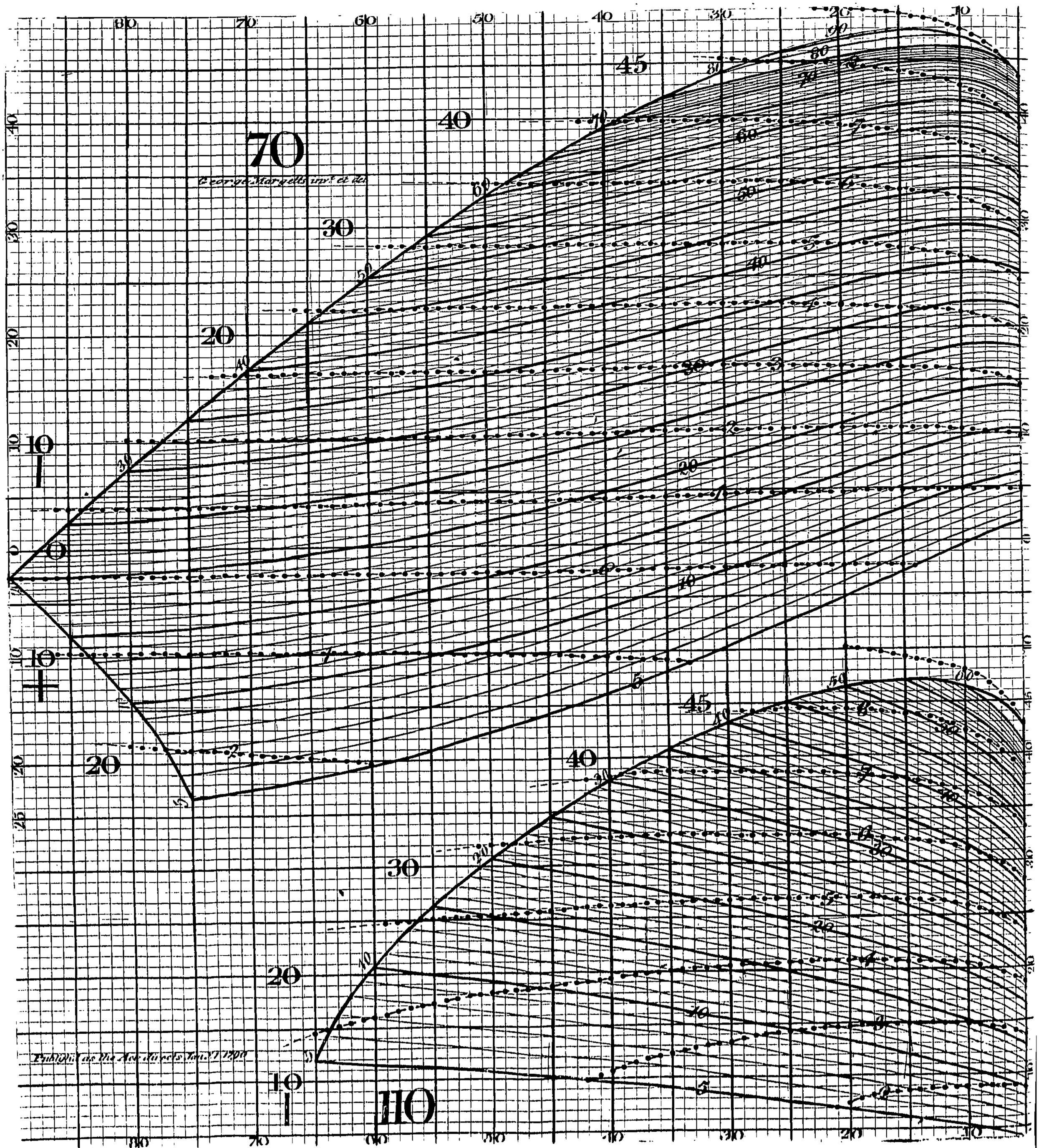
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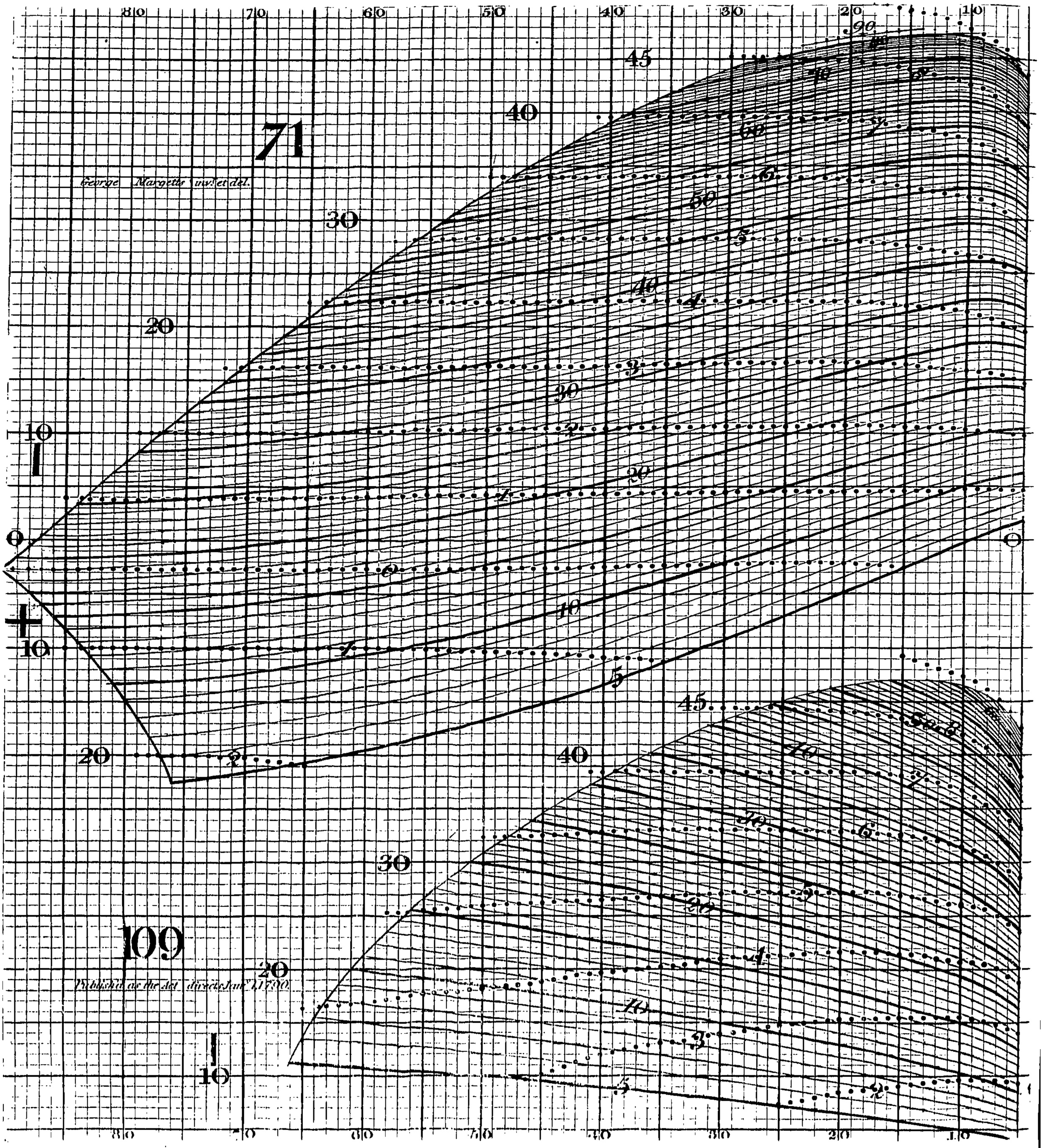
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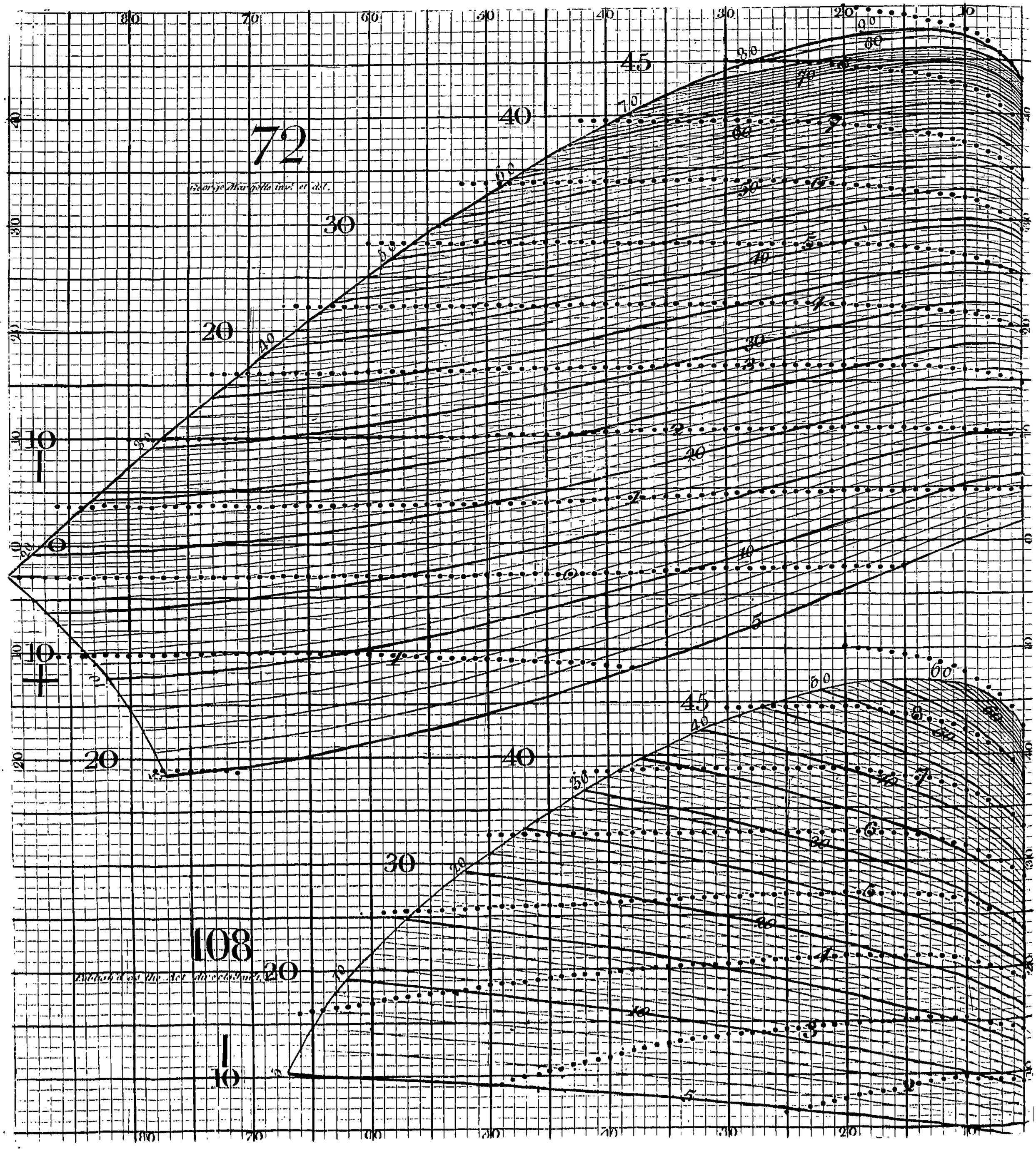
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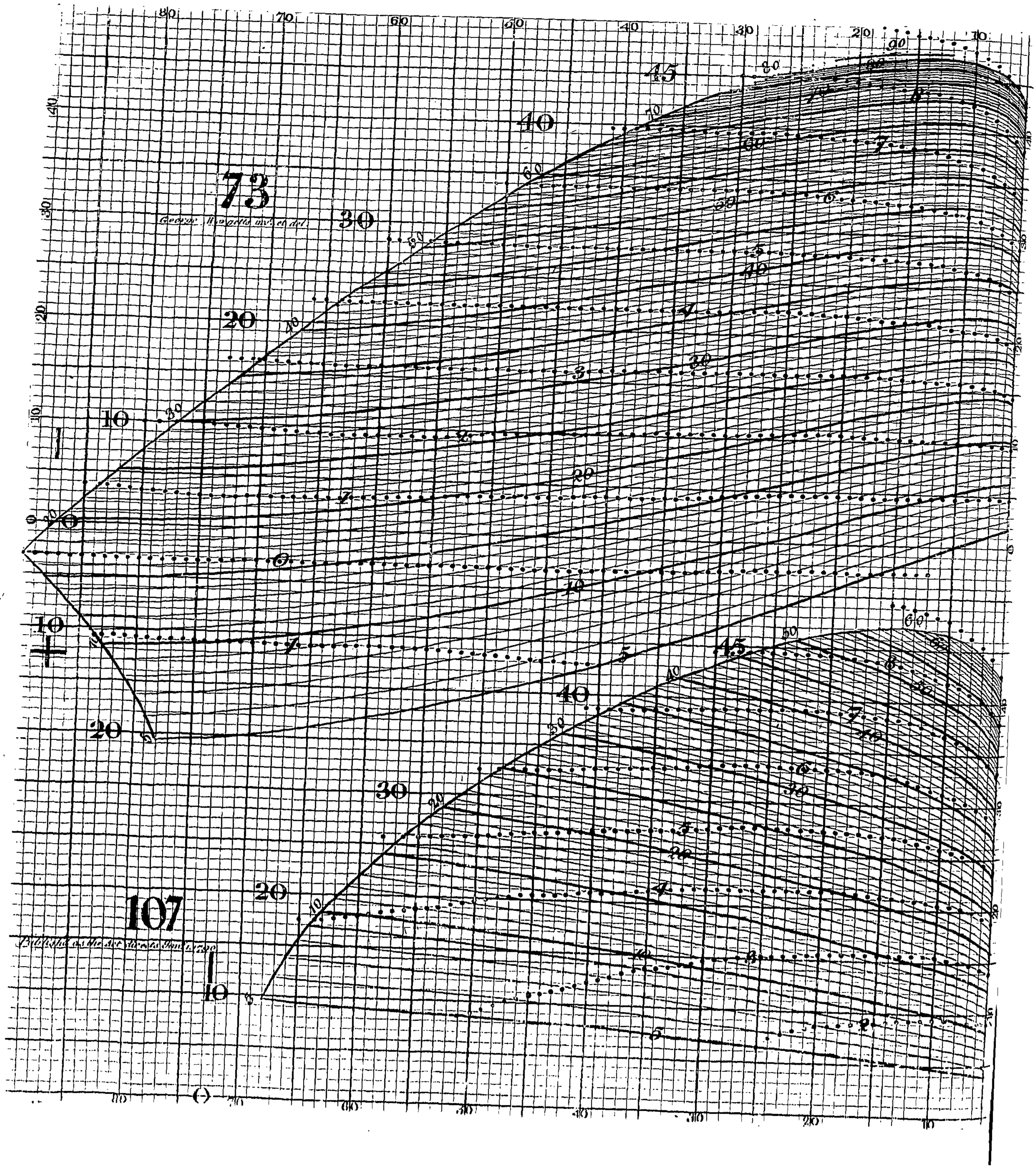
Published as the Act directs 1st Jan.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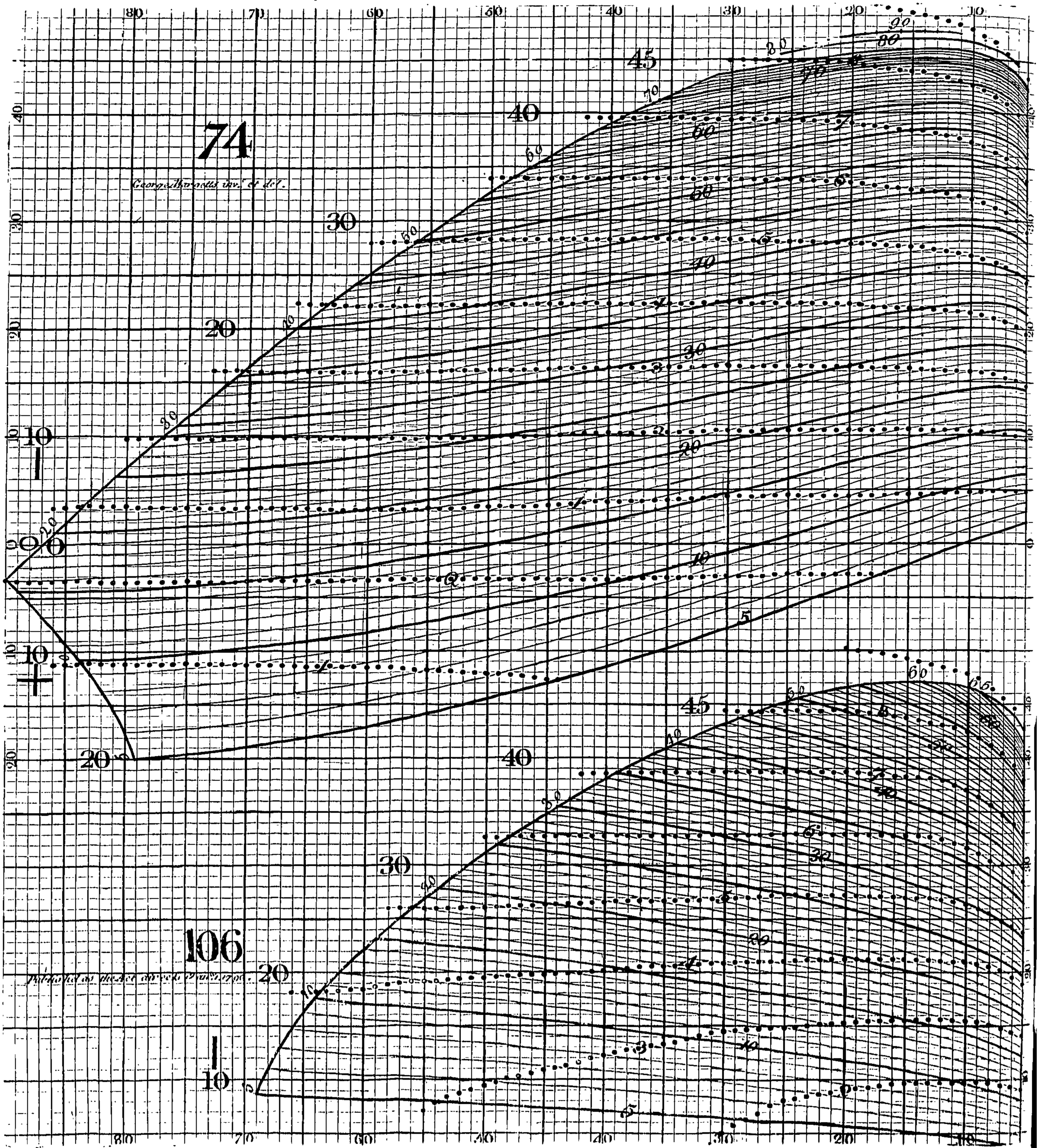
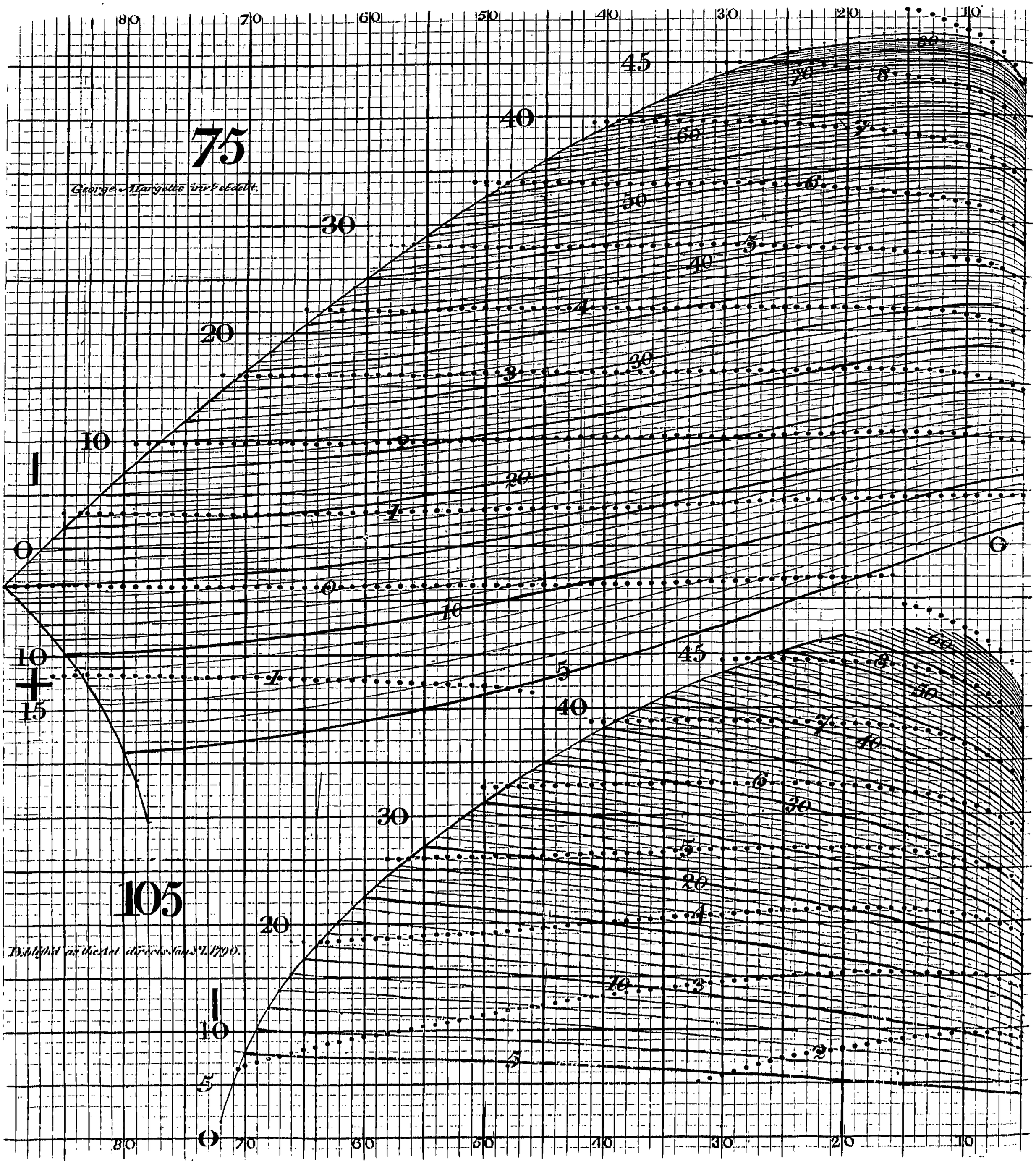
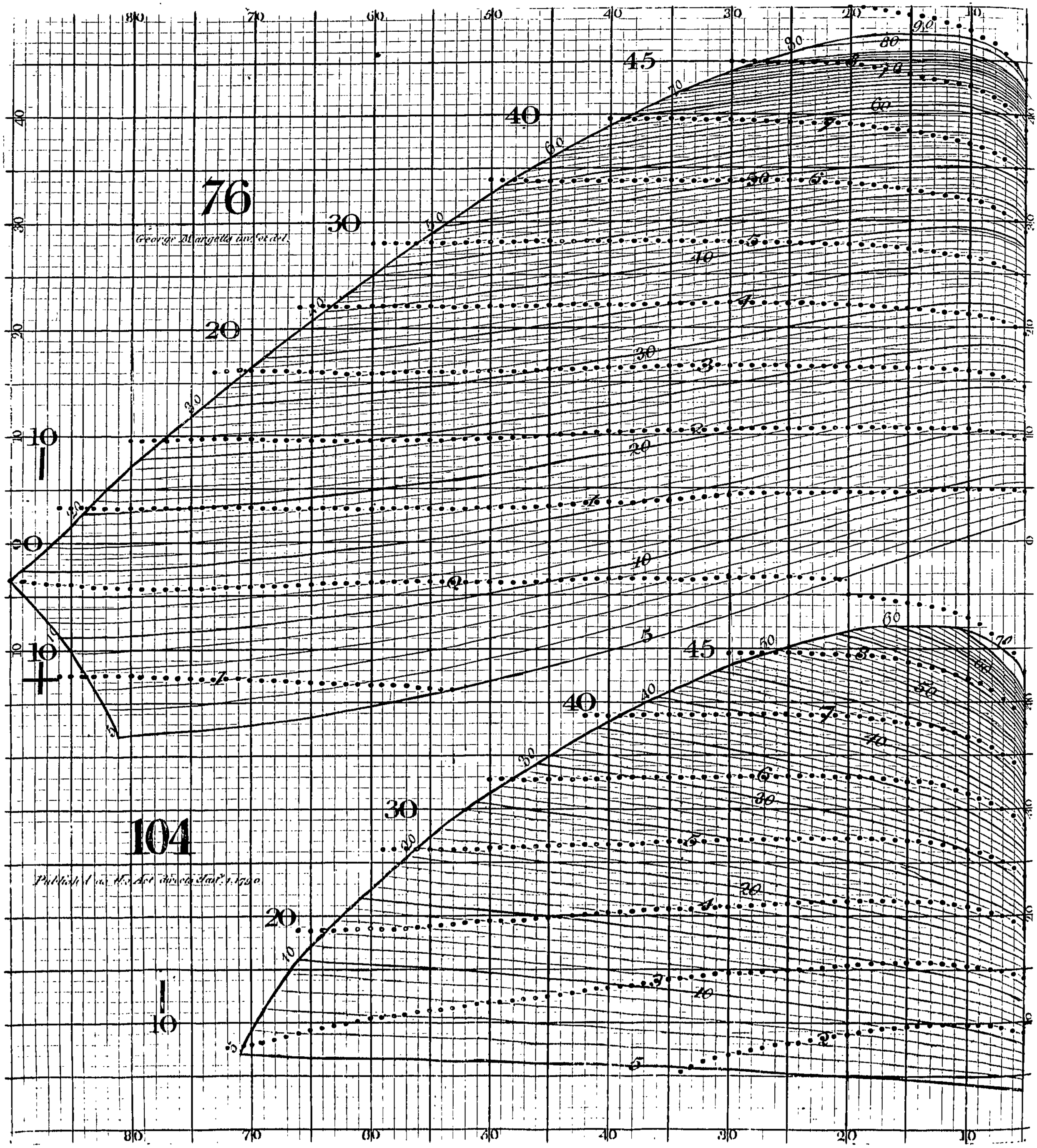
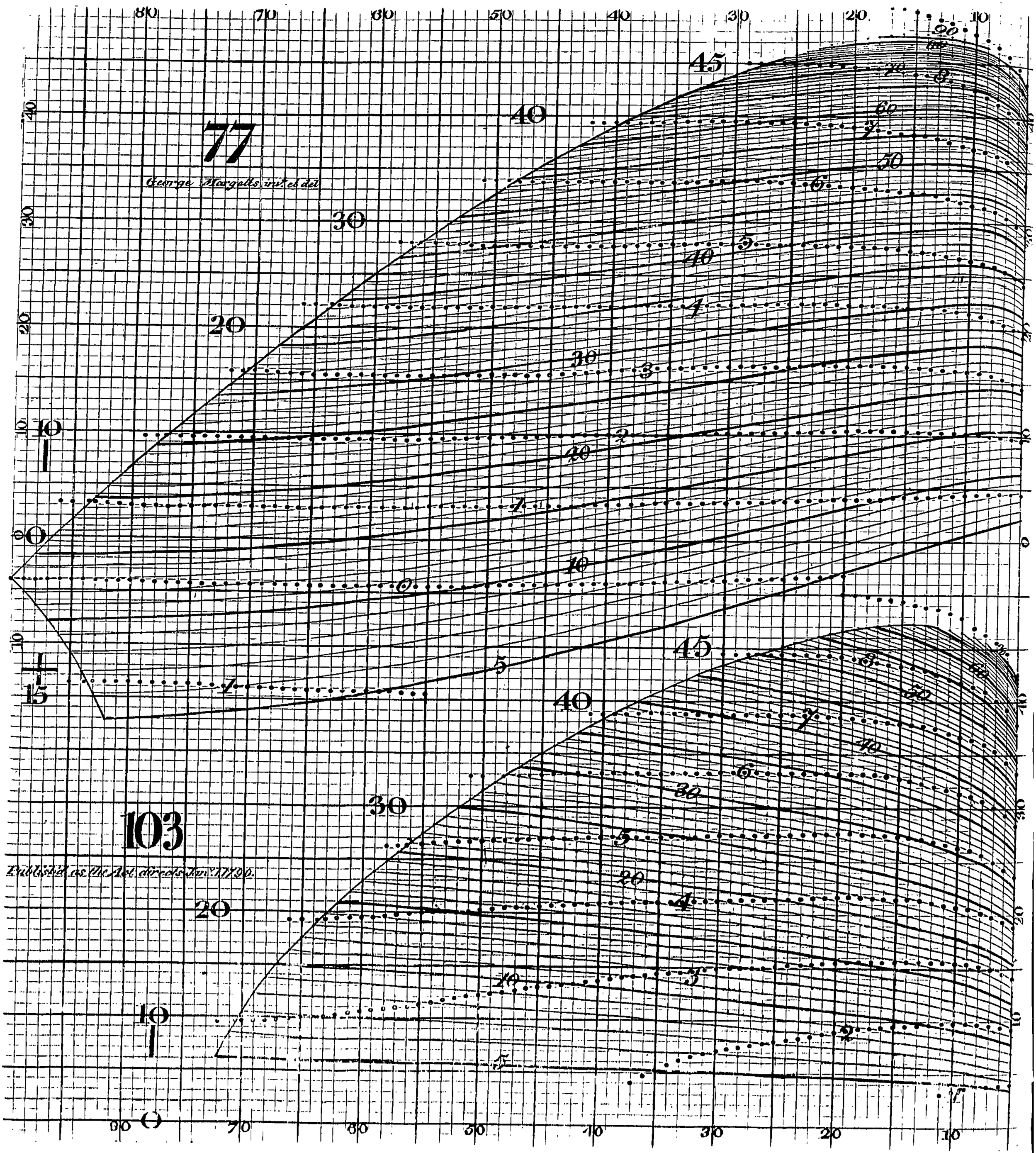
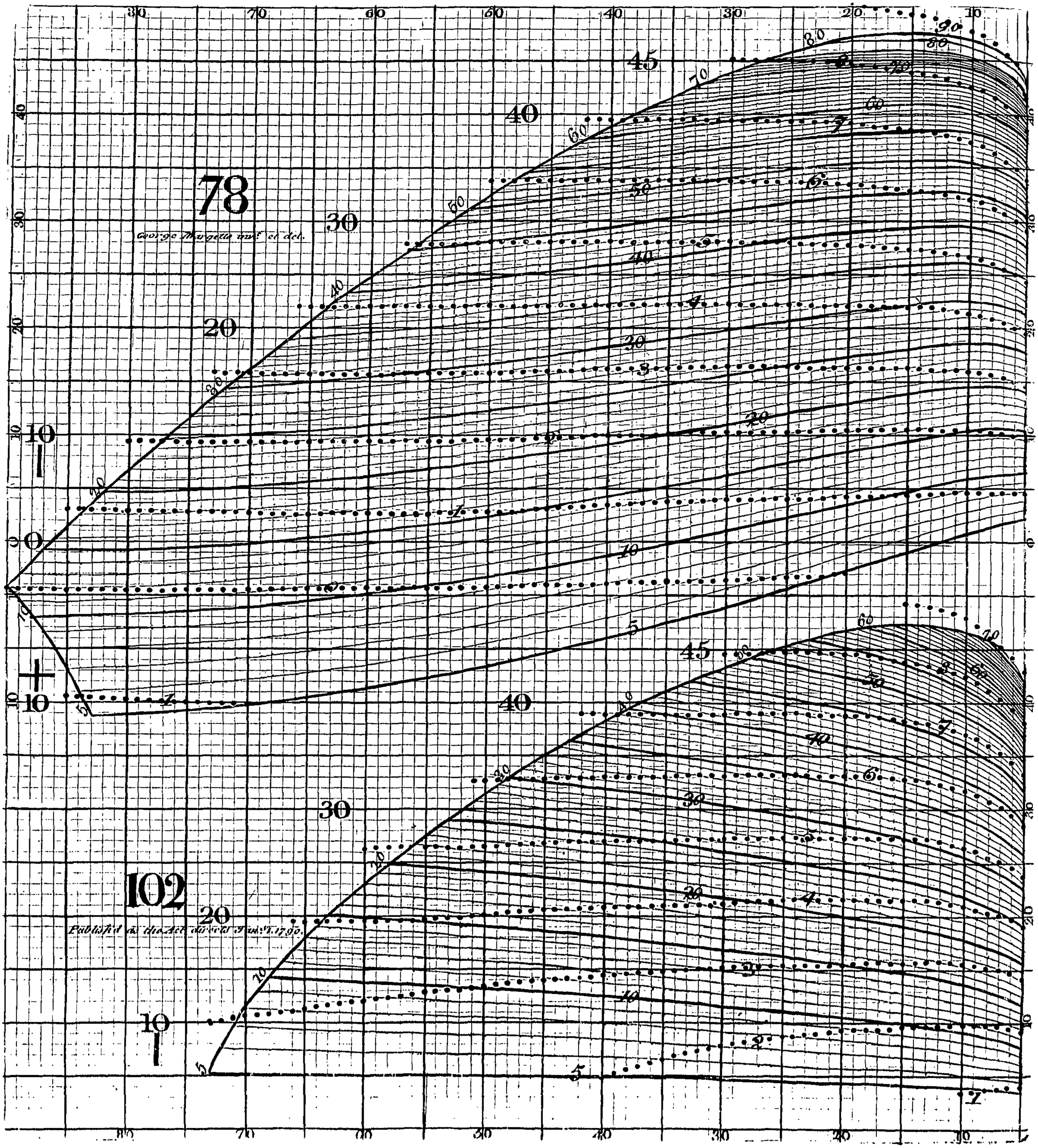
107

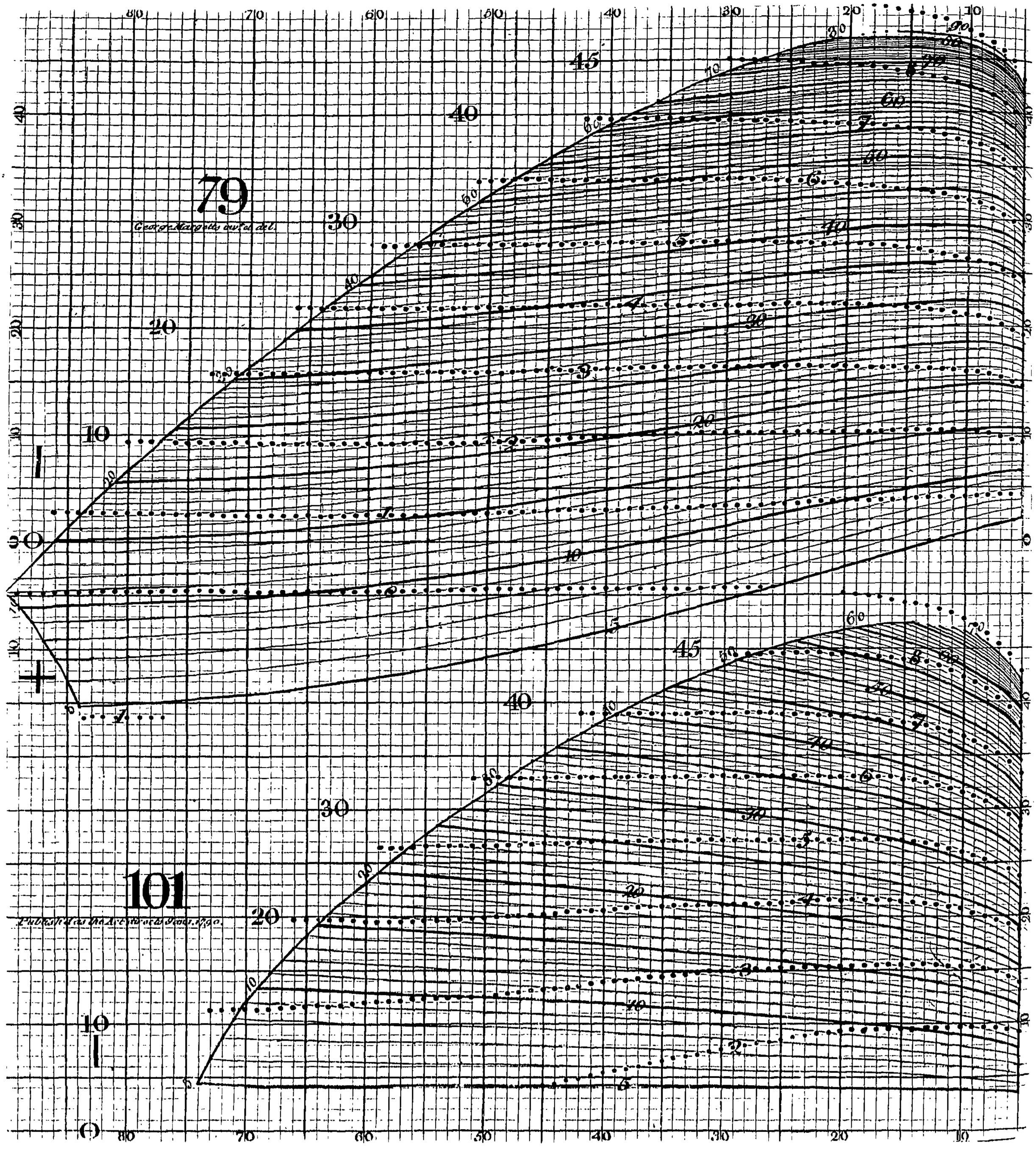

74
Georgethroodts inv.t et del.
106
Published as the Act directs 1st Jan.y 1800.

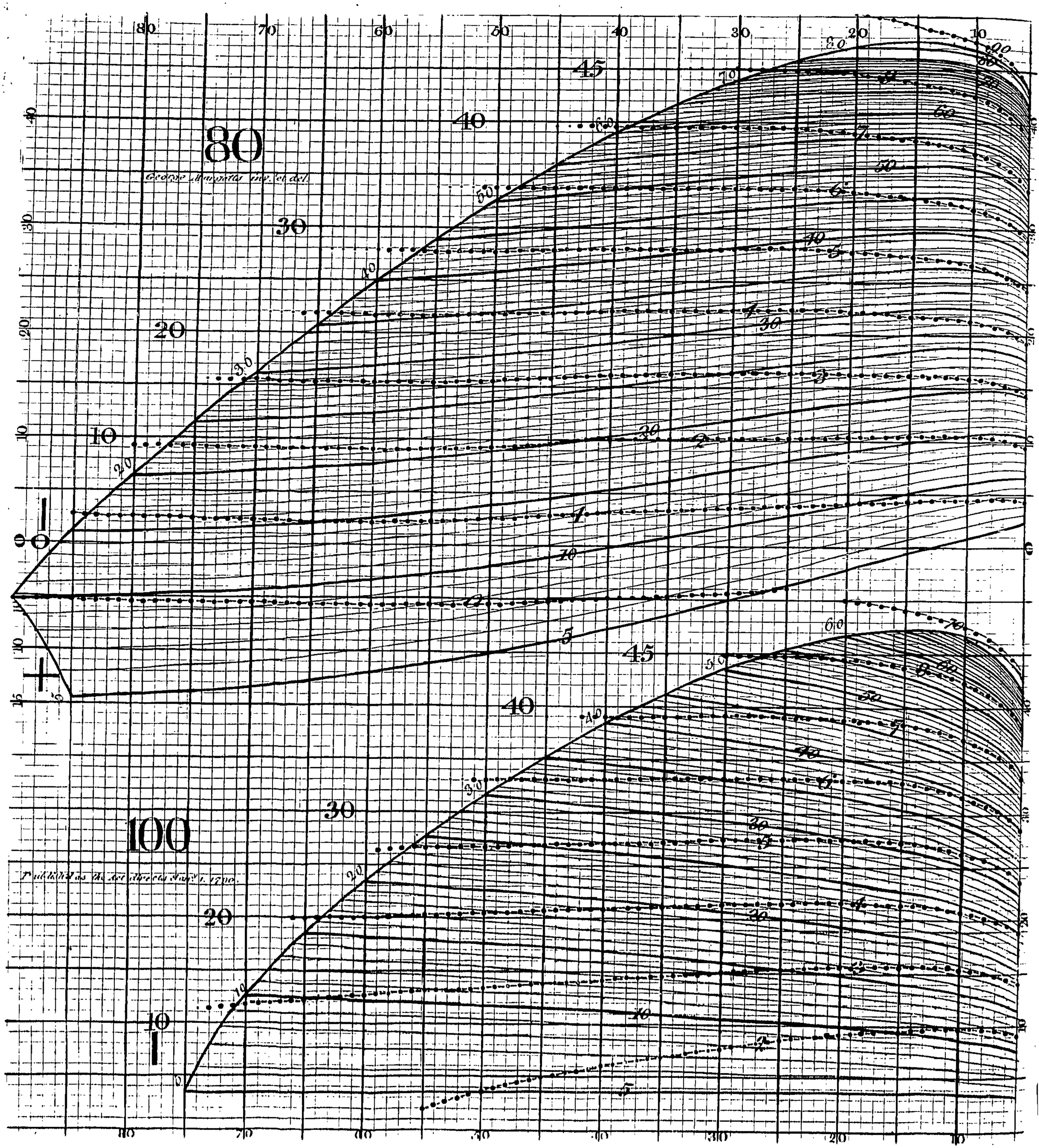

75
George Margetts inv.t et delt.
105
Published as the Act directs Jan.y 1. 1796.

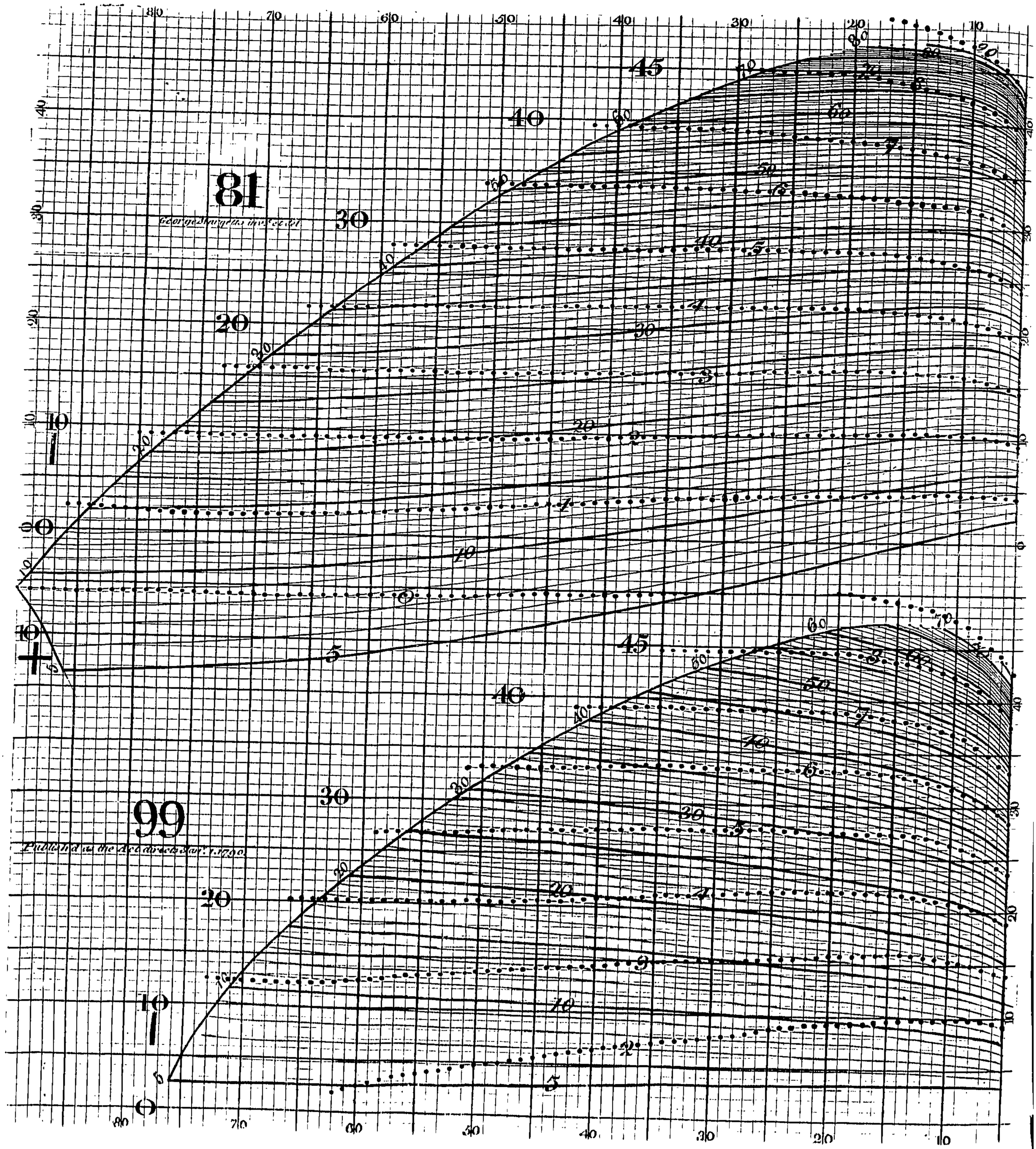

76
George Mangelly an.t et del.
104
Published as the Act directs Jan.y 1.1790

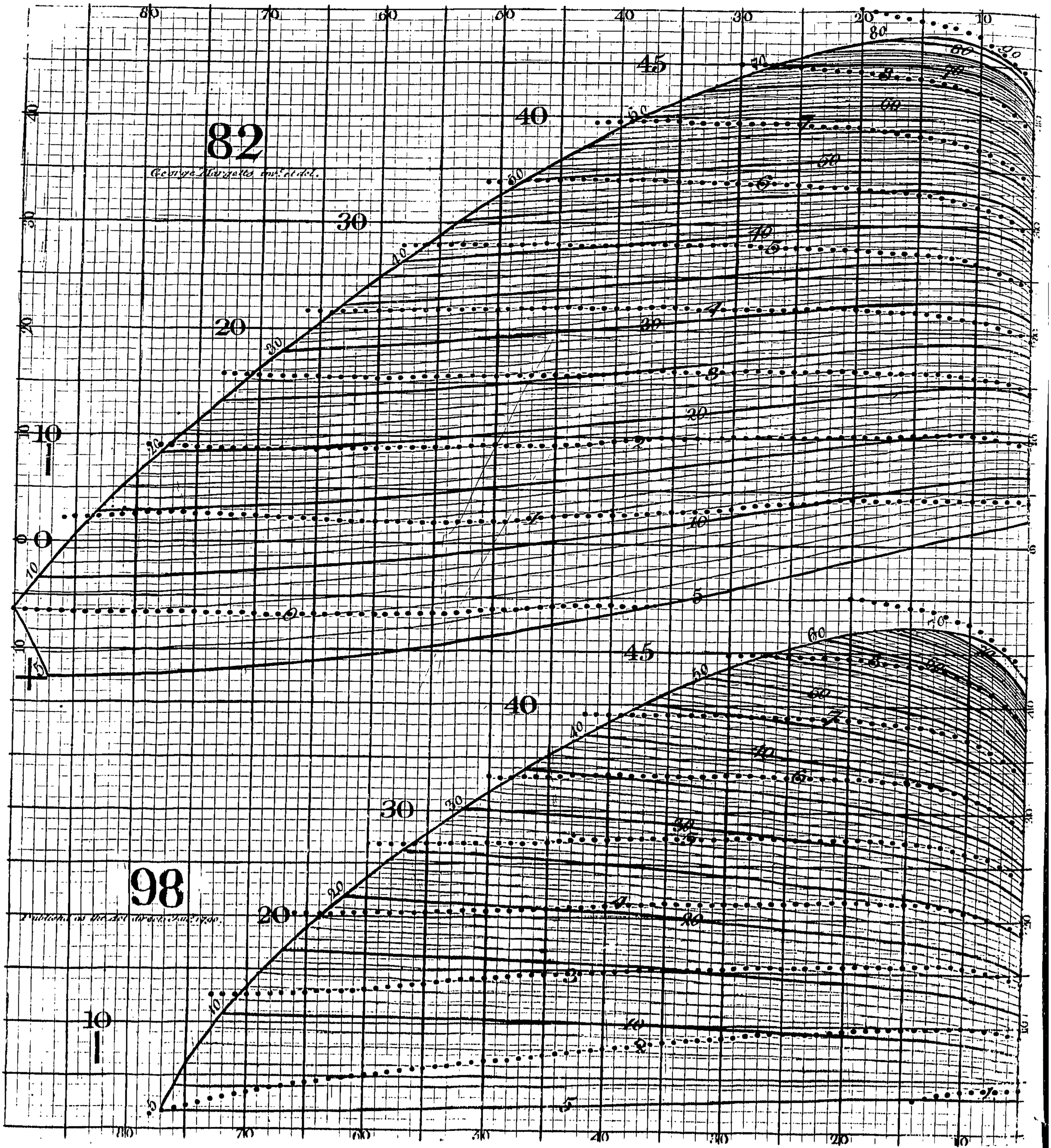

77
George Margetts inv.t et del
103
Published as the Act directs Jan.y 1790.

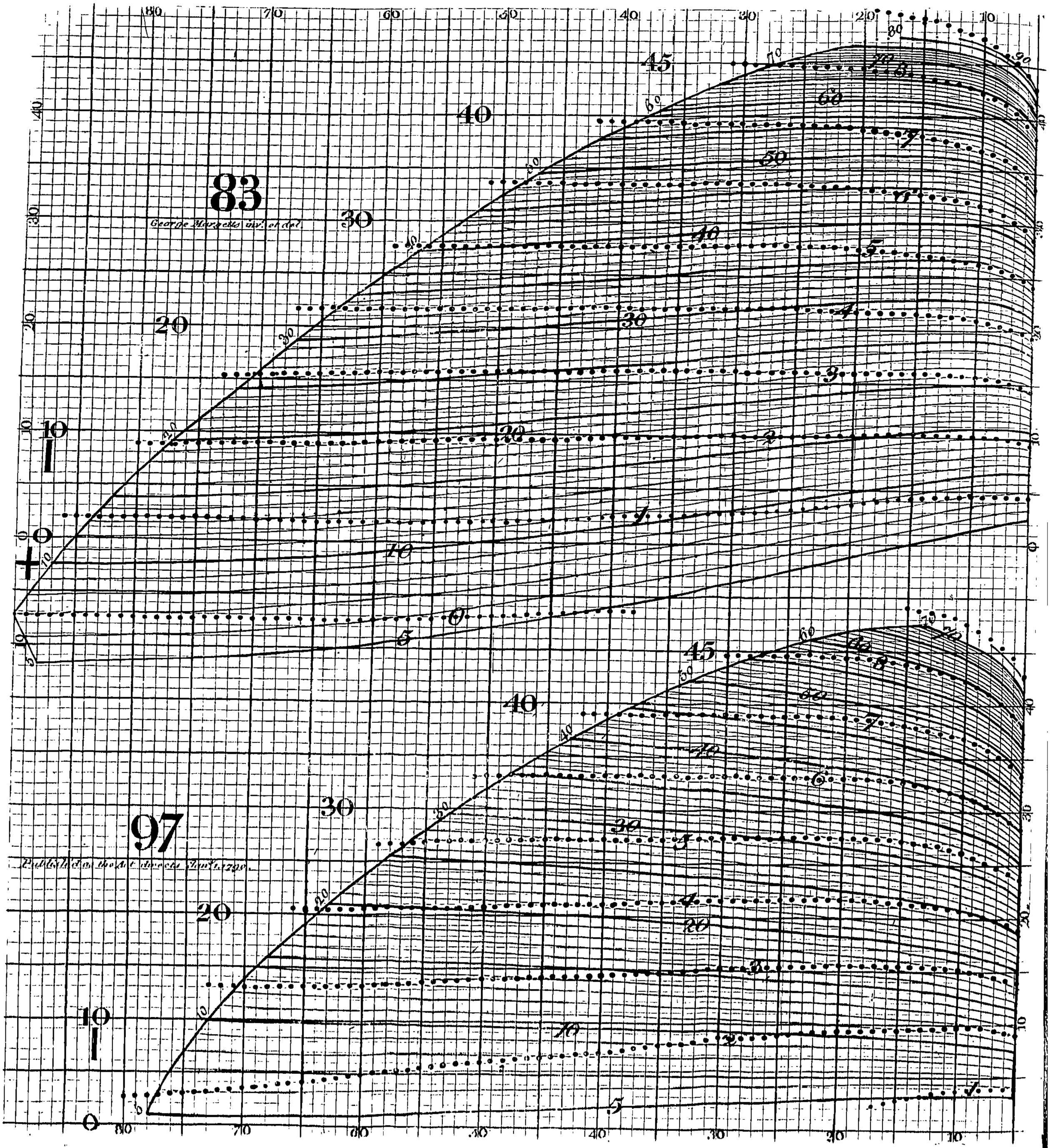

78
George Margetts inv.t et del.
102
Published as the Act directs 1 Jan.y 1790.

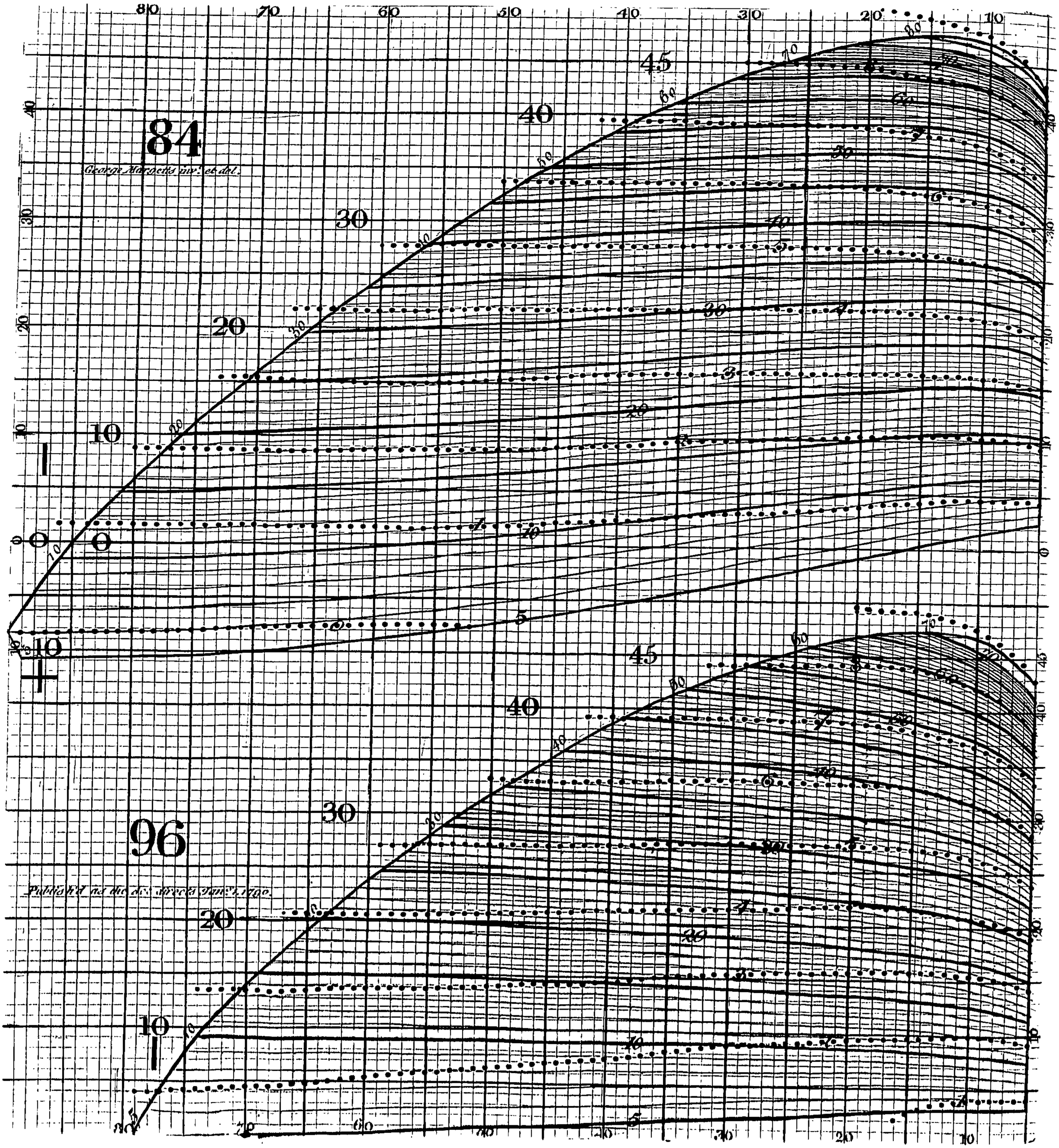

79
George Margetts inv.t et del.
101
Published as the Act directs 1st Jan.y 1790.

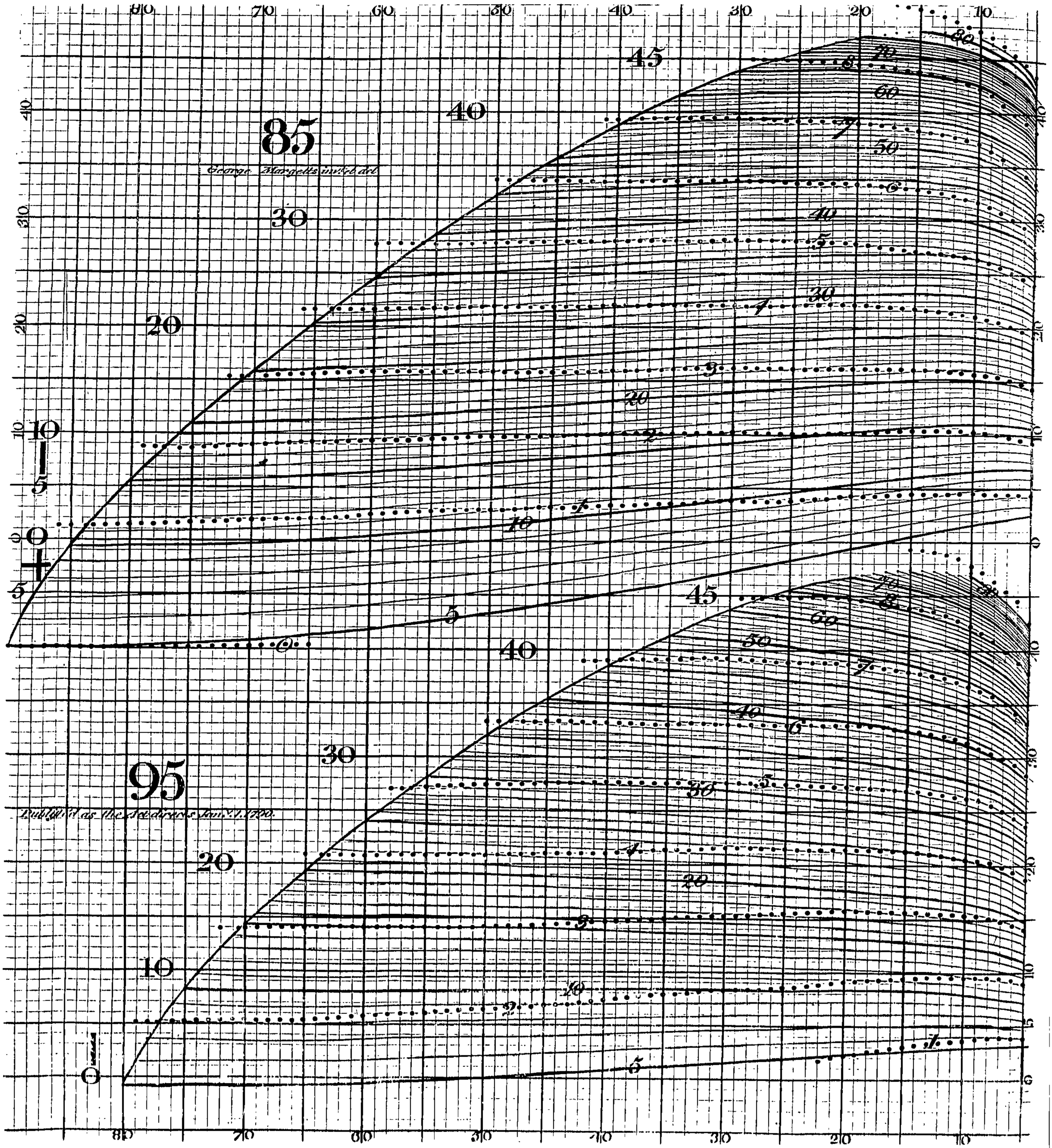

80
George Mannatts inv. et del.
100
Published as the Act directs Nov.r 1. 1790.

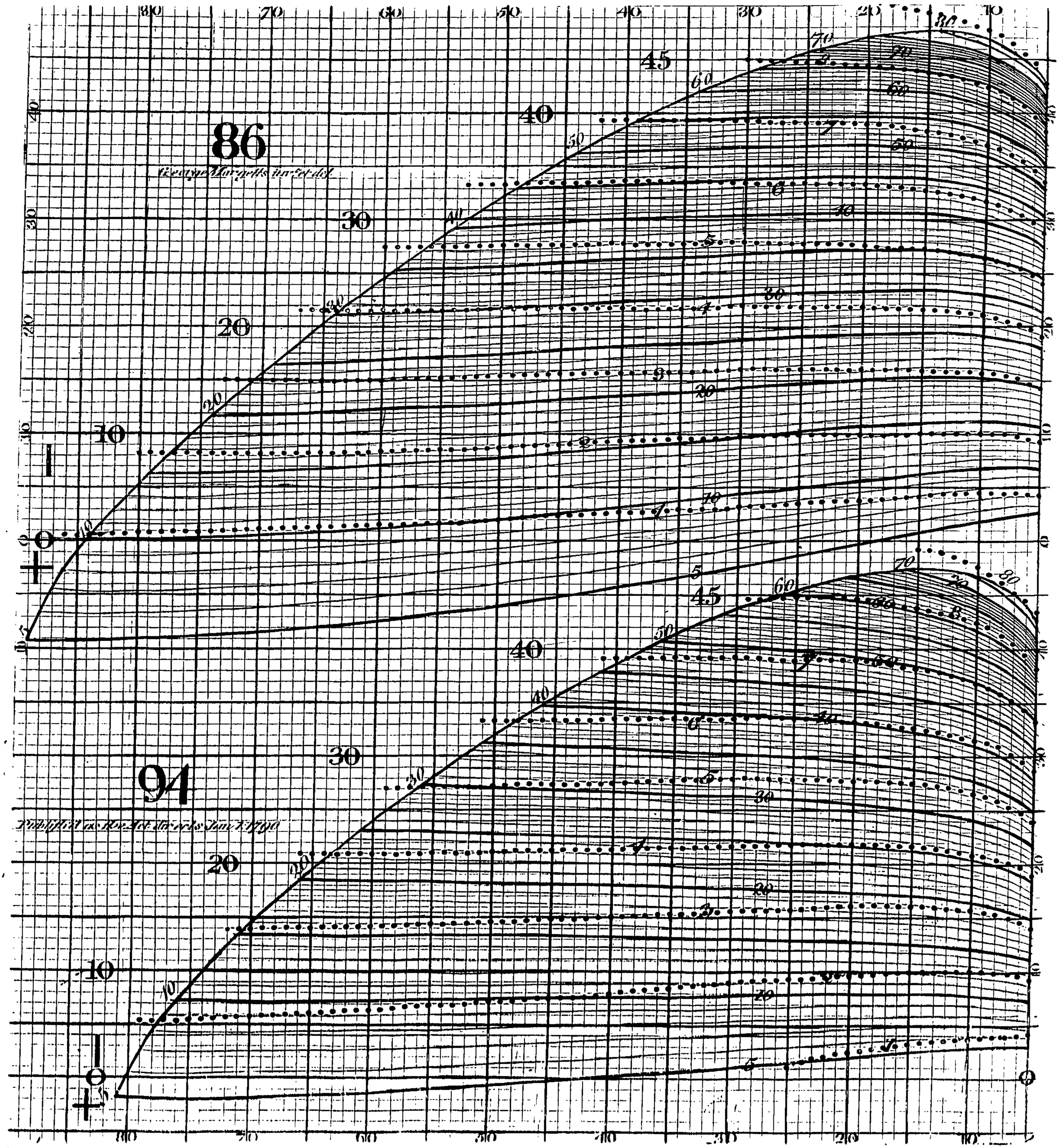

81
George Douglas inv. et sc.
99
Published as the Act directs Jan.y 1.1790

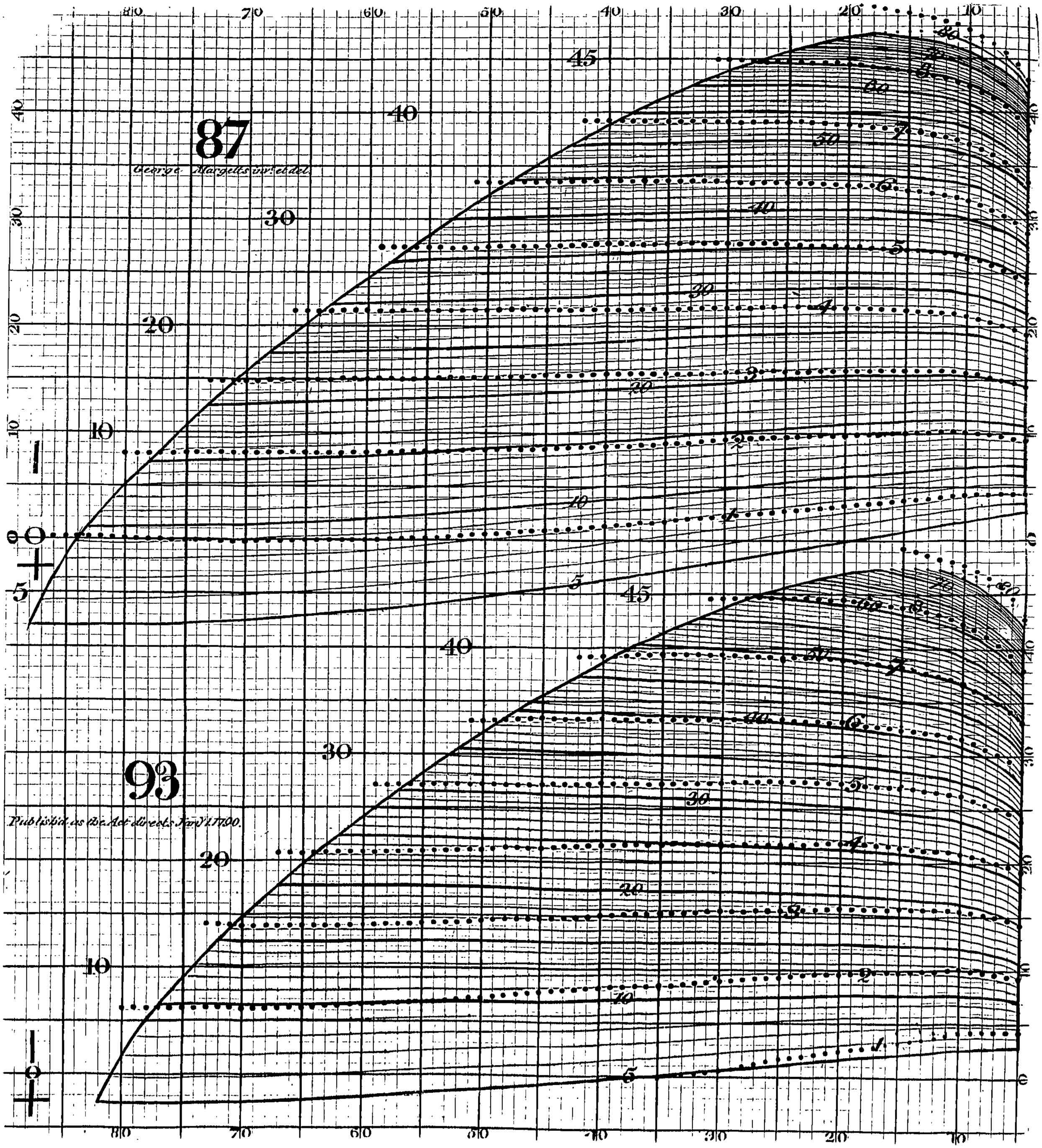

82
George Margetts inv.et del.
98
Published as the Act directs Jan.y 1790.

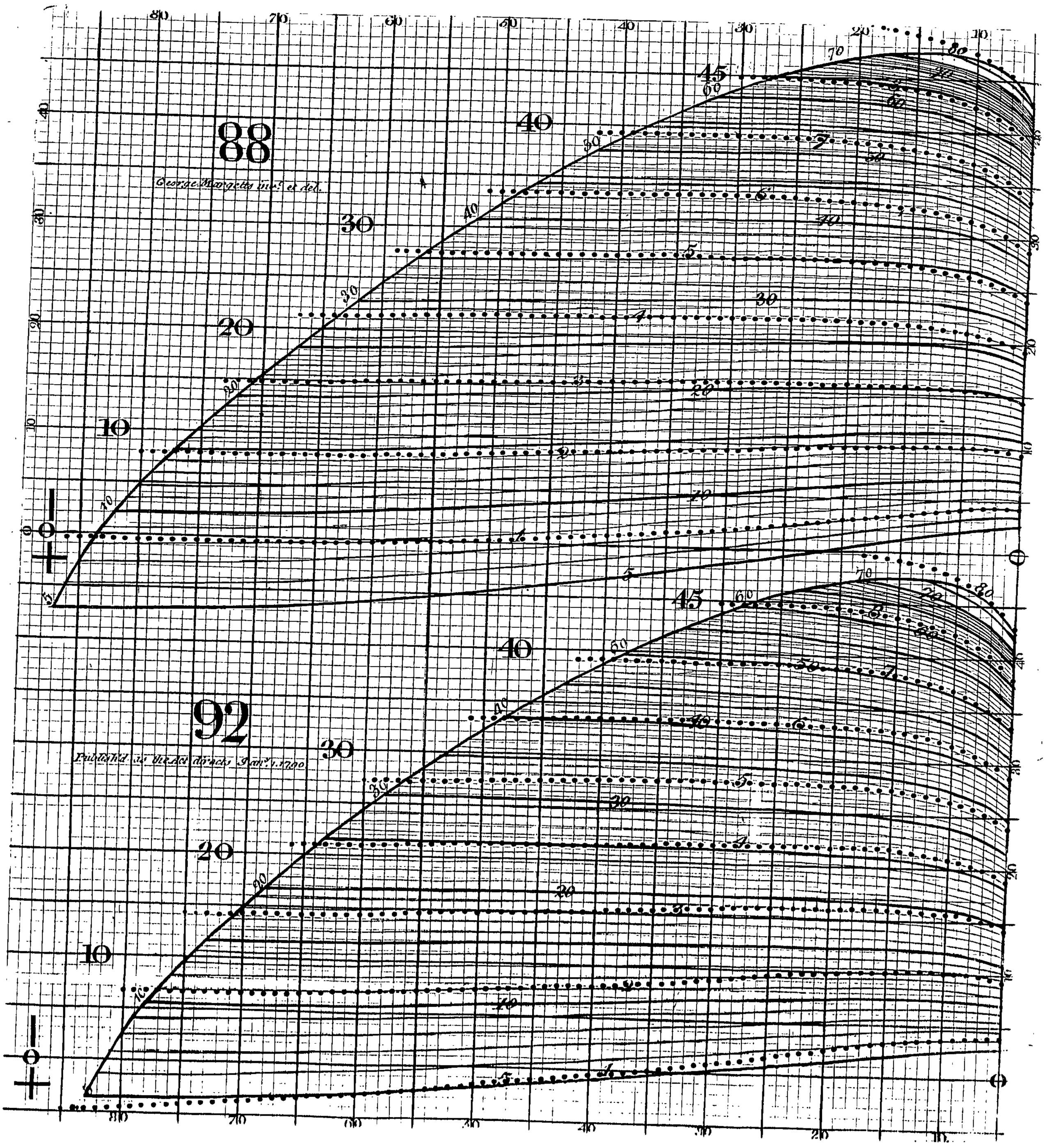

83
George Margetts inv. et del.
97
Published as the Act directs Jan.1.1795

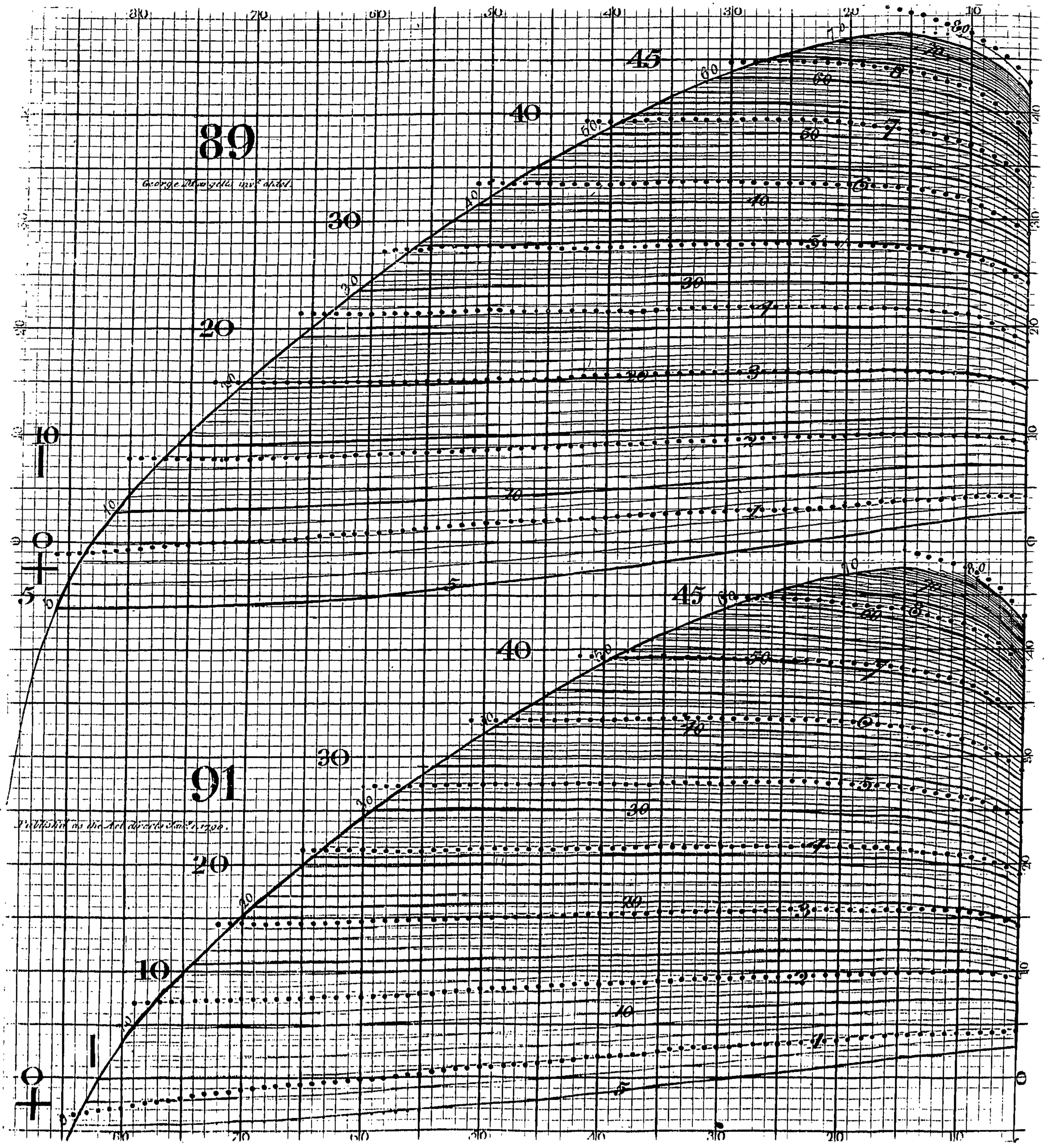

84
George Marsden inv.t et del.
96
Published as the Act directs Jan.y 1.1790.

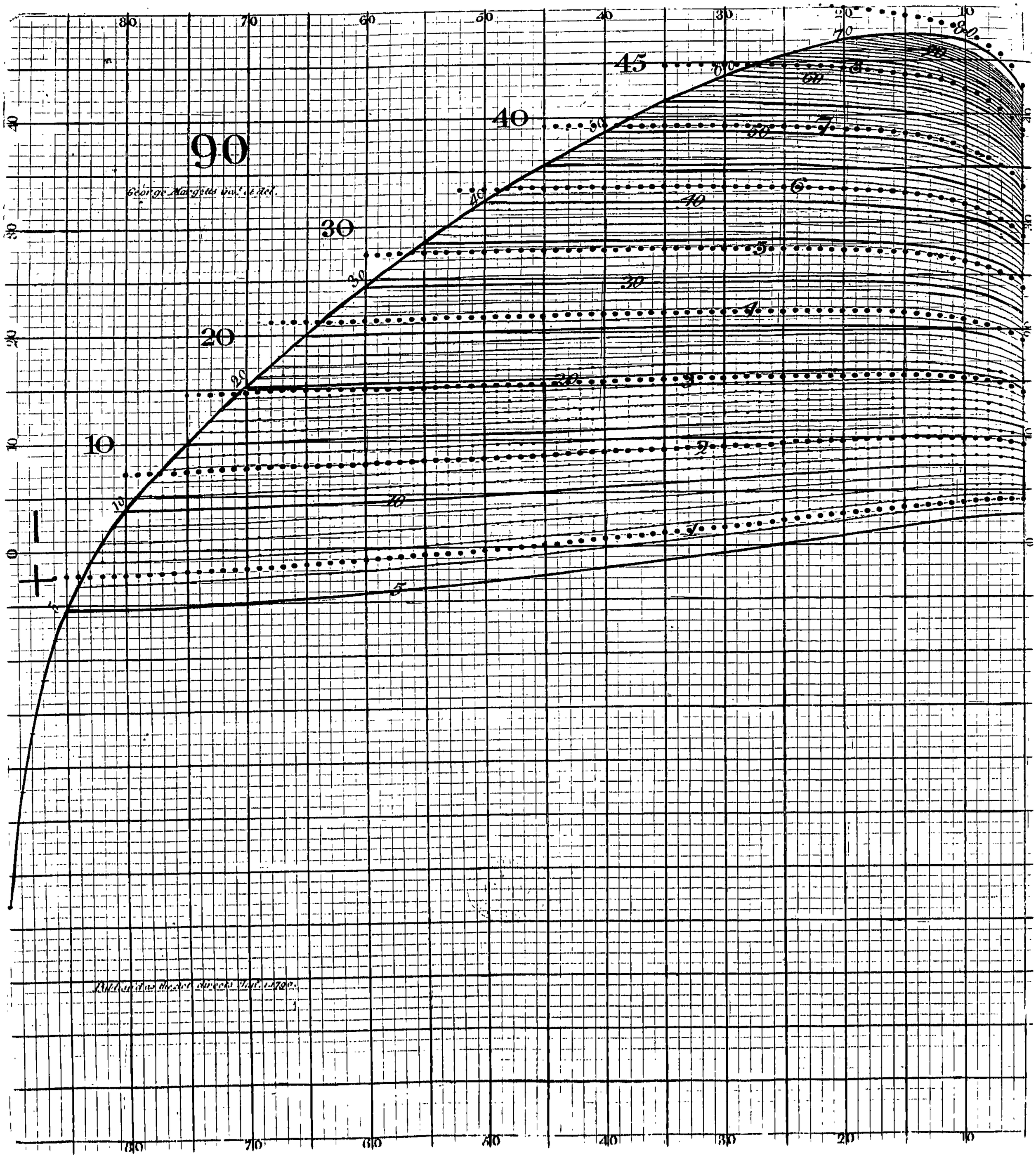

85
95
George Margetts inv.t & del.
Published as the Act directs Jan.y 1. 1790.


86
George Marquetts invented
91
Published as the Act directs Jan. 1 1790


87
George Margetts inv.t et del.
93
Published as the Act directs Nov.r 1.1790.


88
George Margetts inv.t et del.
92
Published as the Act directs 9 mo.t 1.1790


89
George Mowgill inv.t & del.
91
Published as the Act directs 1st Jan.y 1798.


90
George Margetts Sculpt. et del.
Published as the Act directs Jan.1 1790.