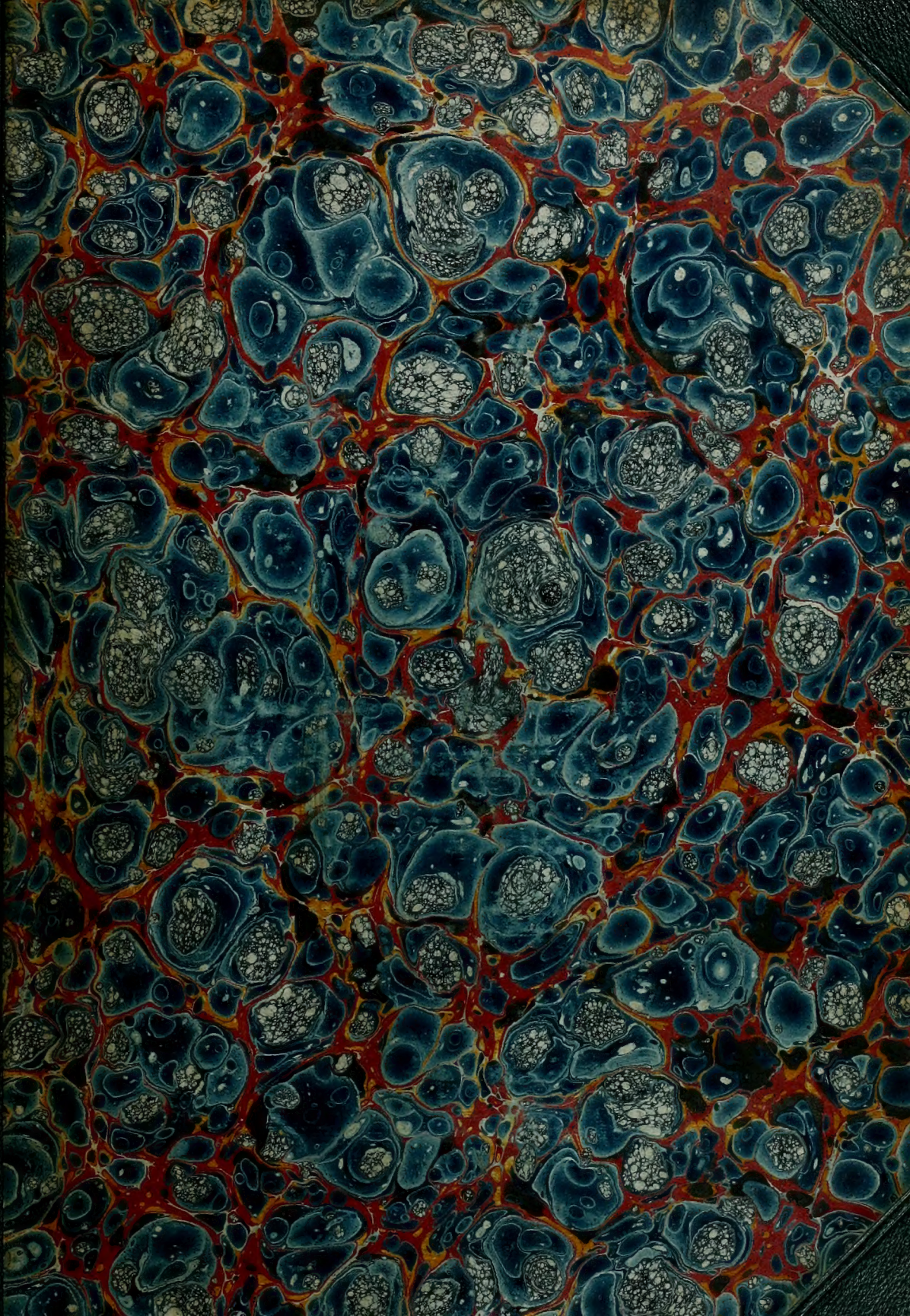
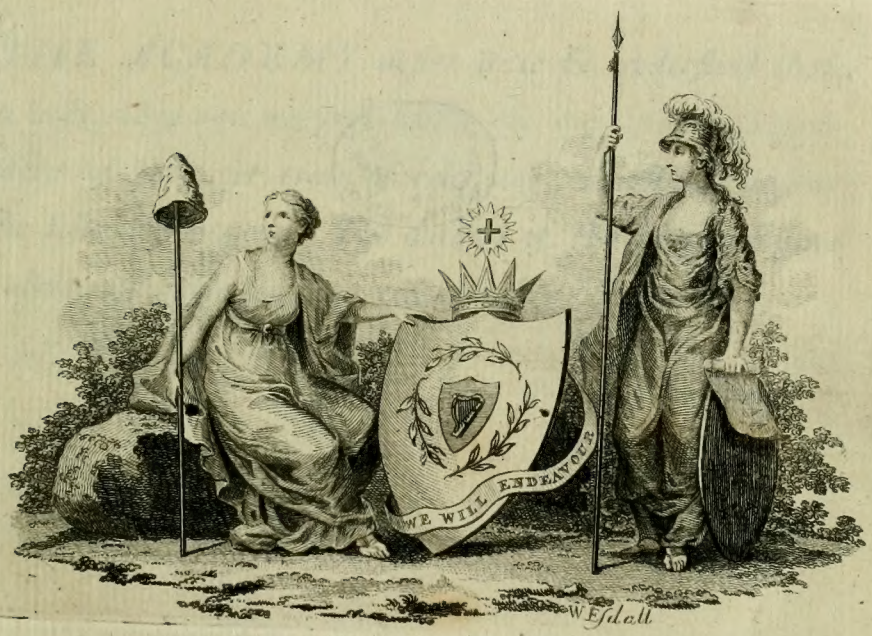


# THE TRANSACTIONS OF THE ROYAL IRISH ACADEMY.

M.DCC.LXXXVIII.




DUBLIN:
GEORGE BONHAM,
PRINTER TO THE ROYAL IRISH ACADEMY.

*THE ACADEMY desire it to be underſtood that, as a body, they are not anſwerable for any opinion, repreſentation of facts, or train of reaſoning, which may appear in the following papers. The authors of the ſeveral Eſſays are alone reſponſible for their contents.*

# E R R A T A.

## Science.

Page 11, Line 3, dele the comma after *screws*.
Page 14, Line 7, for *Plate* iii. read Plate i.
Page 15, Line 19, for *in*, read is.
Page 32, Line 11, for *conclave*, read concave.
Page 33, Line 16, in margin insert Fig. vi.
Page 33, Line 25, for *Fig.* viii. read Fig. vii. N. B. The dotted lines in Fig. vi. represent the radii of the concave, those in Fig. vii. the radii of the convex, surface.
Page 34, Line 3, for *ray*, read rays.
Page 37, Line 12, for *arrive*, read arrived.
Page 40, Line 4, for *confirm*, read confirms.
Page 54, Line 3, for *in*, read on.
Page 76, Line 15, for *brass*, read iron.
Page 85, Line 22, in margin insert Fig. i.
Page 90, Line 19, in margin insert Fig. ii.
Page 91, Line 19, in margin insert Fig. iii.
Page 93, Line 9, in margin insert Fig. iv.
Page 149, Line 23, for *these*, read this.
Page 181, Line 20, for *exilles*, read ex illis.

## Polite Literature.

Page 9, Line 3, } for *rhodomantade*, read rodomontade.
Page 28, Line 5, }
Page 14, Line 19, for *versality*, read versatility.
Page 27, Line 18, for *transactions*, read transaction.
Page 35, Line 18, for *apparancy*, read apparency.
Page 57, Line 7, for *had*, read has.
Page 62, Line 12, for *from*, read form.
Page 62, Line 21, for *seem*, read seems,
Page 71, in note, for *Hayley*, read Hartley.

## Antiquities.

Page 4, Line 24, for *seems*, read seem.
Page 15, Line 3, note (m) for *forgot*, read forgotten.
Page 26, Line 27, for *had*, read has.
Page 53, Line 25, for *tumulii*, read tumuli.
Page 69, Line 7, for *telesmanic*, read talismanic.
Page 84, Line 13, for *proclocutor*, read prolocutor.

# S C I E N C E.

## C O N T E N T S.



VIII. *An*

# POLITE LITERATURE.

## CONTENTS.

# ANTIQUITIES.

## CONTENTS.



V. *An*

# A LIST OF DONATIONS
## MADE TO THE
# ROYAL IRISH ACADEMY,
## PREVIOUS TO THE YEAR 1789.

AN ancient Irifh *Manufcript*, called THE BOOK OF BALLYMOTE. Prefented by Chevalier O'Gorman.

Lettres phyfiques et morales fur l'Hiftoire de la Terre et de l'Homme. Adreffées a la Reine de la Grand Bretagne, par J. A. De Luc. Prefented by the Author.

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A Number of Brazen Inftruments. Prefented by William Carroll, Efq;

Two

Two Drawings of the Sculls of unknown Animals. Prefented by Colonel Vallancey, M. R. I. A.

Hiftorical Memoirs of the Irifh Bards. By Jofeph C. Walker, Efq; M. R. I. A. Prefented by the Author.

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A Catalogue of the Bibliotheca Pinelliana. Preſented by the Right Honorable Lord Viſcount Mountmorres.

# S C I E N C E.

# *An Account of the* MOVING *of a* BOG, *and the* FORMATION *of a* LAKE, *in the County of* GALWAY, IRELAND. *By* RALPH OUSLEY, *Esq*; *M. R. I. A. Communicated by* JOSEPH COOPER WALKER, *Esq*; *M. R. I. A.*

ON Tuesday, March 28, 1745, O. S. a very remarkable and extraordinary event happened at the bog of Addergoole, about a mile and an half from the town of Dunmore, county of Galway. As James Carroll, Esq; * of Killeeny, superintended his men cutting turf, about eleven o'clock in the forenoon, the day being very sultry, he observed a sudden and alarming gathering of the clouds just over his head, and had scarce time to warn his labourers of the approaching storm, when the most violent and surprizing rain, ever remembered, assailed them, accompanied with a dreadful though unknown noise, not so loud, but as tremendous as thunder, a little to the east of where they stood: though the men ran instantly towards an adjacent village, they were wet to the skin before they got half way.

Read Oct. 1, 1787.

* A Brevet Major in Queen Anne's reign.

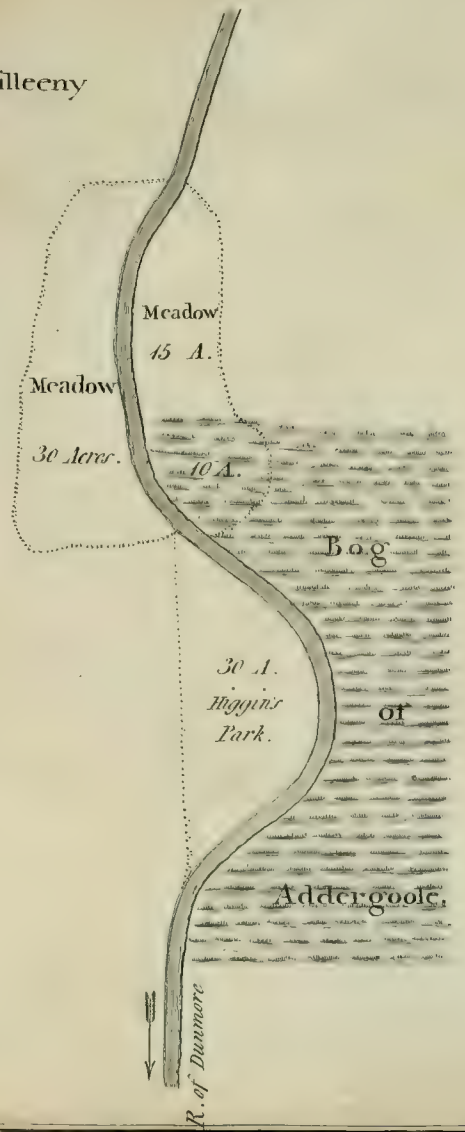
THIS ſhower, or water-ſpout rather, continued little more than an hour, at the concluſion of which the turf-cutters were preſented with a phænomenon much more extraordinary; they ſaw the turbary they had juſt left, containing about ten acres, floating as it were after them, 'till it ſubſided at laſt upon a piece of low paſture of near thirty acres by the river's ſide, called Higgins's Park, where it ſpread and ſettled, covering the whole, to the aſtoniſhment of numbers, and the very great loſs of Major Carroll; as it inſtantly became, and ſtill continues, the wetteſt and moſt unprofitable piece of bog in the whole country.

ANOTHER and more conſiderable injury immediately ſucceeded this; the moving bog completely choaked up the river, which conſequently overflowed the back grounds, and before evening a lough or lake of near fifty-five acres covered the adjacent fields. Major Carroll's fine bottom meadow of thirty acres was in a few hours perfectly transformed into water: Fifteen acres alſo of meadow of the lands of Addergoole, belonging to poor tenants, ſhared the ſame fate, which with the ten acres of bog that moved, make up the number mentioned above; forming a conſiderable lough in half a day's time, to the great prejudice of many, and ſurprize as well as terror of the neighbourhood.

THE lake naturally increaſing every hour, Major Carroll in a few days collected a great number of labourers, and began to make a large drain to carry the water by the ſhorteſt cut to the bed of the river, now dry: but perceiving the new-formed lough

lough forcing itſelf into another line, he aſſiſted its operations, and without much trouble formed the preſent courſe of the river to its junction with the ancient channel, below the late formed bog, as will eaſily appear by the plate annexed. Before the paſſage was finiſhed, and the lake let run, it was ſuppoſed to have covered three hundred acres, but in ſeven or eight days it diminiſhed to fifty or ſixty acres, of which extent it ſtill continues. The river below the new bog was nearly dry for more than a mile, and children of ten or twelve years old deſtroyed all the fiſh, even in the deepeſt holes.

Most of the grounds mentioned here are bounded by the eſtate of the preſent Earl of Louth, who has been often on the premiſes, and is well acquainted with the above particulars.


Killeeny
Meadow
15 A.
Meadow
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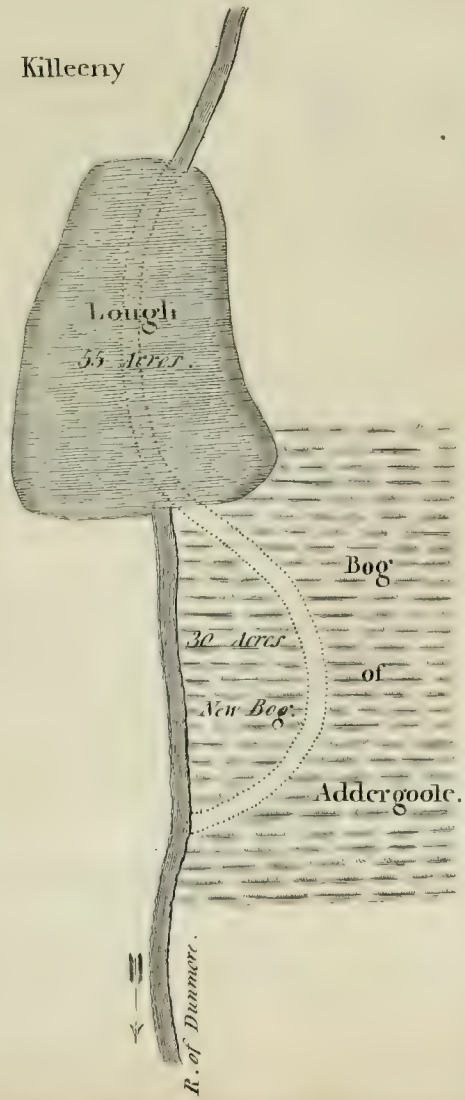
10 A.
Bog
30 A.
Higgins
Park.
of
Addergoole.
R. of Dunmore


Killeeny
Lough
55 Acres.
Bog
30 Acres
of
New Bog.
Addergoole.
R. of Dunmore.

*An Account and Deſcription of three* PENDULUMS *invented and conſtructed by* JOHN CROSTHWAITE, *Watch and Clock Maker, Dublin.*

FIG. I. repreſents a pendulum, with a ſimple mode of compenſation, which has now been going eighteen years, much more accurately than could be expected in ſo very unfavourable a ſituation: the firſt ten years againſt a lath and plaiſter partition, within three feet of the external wall, and the ſame diſtance from a hall-door, the frequent ſhutting of which muſt have very much diſturbed its vibrations; the laſt eight years, againſt an external wall only three feet from the ſtreet; which, though a much better ſituation than the former, yet even here it was liable to have the iſochroniſm diſturbed by the carriages almoſt conſtantly paſſing. Read Nov. 1, 1787.

A and B are two rods of ſteel forged out of the ſame bar, at the ſame time, of the ſame temper, and in every reſpect ſimilar. On the top of B is formed a gibbet C; this rod is firmly ſupported by a ſteel bracket D, fixed on a large piece of marble E, firmly ſet into the wall F, and having liberty to move freely upwards between

between croſs ſtaples of braſs 1, 2, 3, 4, which touch only in a point in front and rere (the ſtaples having been carefully formed for that purpoſe); to the other rod is firmly fixed, by its centre, the lens G, of twenty-four pounds weight, although it ſhould in ſtrictneſs be a little below it. This pendulum is ſuſpended by a ſhort ſteel ſpring on the gibbet at C, all which is intirely independent of the clock. To the back of the clock plate I are firmly ſcrewed two cheeks nearly cycloidal at K, exactly in a line with the centre of the verge L. The maintaining power is applied by a cylindrical ſteel ſtud in the uſual way of regulators, at M. Now, it is very evident that any expanſion or contraction that takes place in either of theſe exactly ſimilar rods, is inſtantly counteracted by the other; whereas in all *compenſation* pendulums compoſed of different materials, however juſt calculation may ſeem to be, that can never be the caſe, as not only different metals, but alſo different bars of the ſame metal that are not manufactured at the ſame time, and exactly in the ſame manner, are found by a good pyrometer to differ materially in their degrees of expanſion and contraction, a very ſmall change affecting one and not the other; this, however, is by their framers always tried by the pyrometer, and any defect experimentally remedied by hammering or filing; but it, notwithſtanding, requires a length of time, much expence, and an inſtrument not always accurate. It is very evident, that whenever diſſimilar rods are introduced to counteract each other, diſorders will take place in the moſt ſuſceptible, ſometime before the remedy is applied by the moſt tardy, and that this remedy or compenſation continues ſometime after the occaſion for it ceaſes; and therefore in this country, where the temperature of the atmoſphere is ſubject to ſuch various and ſudden changes; when compen-

ſations

ſations are uſed, they ſhould be executed with the ſame materials as that of the pendulum rod, and have exactly the ſame expoſure to the air.

A DESCRIPTION of a pendulum, with a diamond ſuſpenſion.—The lens is ſeven inches diameter, made of lead melted into a braſs ſhell, very accurately weighed in all poſitions, turned truly in a very ſteady lathe, firſt flatwiſe, and then on an arbor through its centre, and adjuſted ſo that in all ſituations the centre of gravity of the lens exactly coincides with the axis of the pendulum rod; a piece of braſs, half an inch thick and three and an half long by two broad, is let into the lead ſo as to be even with its ſurface; four holes being tapped in it to receive the ſcrews c c c c, Fig. II. with their heads counterſunk in the braſs ſhell: this piece of braſs is hollowed lengthwiſe on the inſide, ſo as to embrace the pendulum rod, the whole length of itſelf, but moſt ſtraightly at its centre. The lens never to be altered after the clock is brought to time. The rod made of red deal, firſt baked, then boiled in linſeed oil for a conſiderable time, and then well varniſhed. On the top is formed an irregular octagon and an opening cut through, of the ſhape of the letter U; there is drilled in the lathe, exactly through its centre lengthwiſe, a hole to receive the piece of very hard caſt ſteel e, which after being fitted ſquare into a braſs collar f, paſſes through the hole in the upper part of the pendulum rod at 5, and is there firmly ſecured by a ſcrew, the head of which is counterſunk in the top of the rod; at 6 the ſteel piece is wrought to a fine conical point, on which the whole pendulum is ſuſpended on the well-levelled face of a large diamond; this diamond is ſet and

 ſoldered

ſoldered with ſilver into a tempered piece of ſteel g, having three levelling ſcrews h h h, carefully tapped through it. The points of theſe tempered ſcrews are rounded and lie in beds formed for them in I, a piece of ſteel $\frac{7}{10}$ of an inch broad on the upper ſide; the lower part being rounded, this is very firmly leaded into a piece of ſtatuary marble K, about two hundred weight, firmly inſerted in the wall, ſo as juſt to admit the ſteel piece I to paſs through the back of the clock caſe: The pendulum being entirely detached from the clock and ſuſpended on the diamond, and the whole upon the wall. Before the clock was applied, it continued vibrating twenty-ſeven hours in this detached ſtate as a ſimple pendulum. I have applied the maintaining power from the movement by a well-tempered and poliſhed ſteel cylinder $\frac{1}{11}$ of an inch diameter, firmly ſcrewed to the crutch through the opening in the braſs collar L; in this opening I have fixed two pieces of ſapphire, of which this is the ſection ᗡ, the cylindrical ſides which the hard ſteel cylinder above-mentioned acts againſt being well poliſhed, the contact is lineal. To the back of each of thoſe pieces of ſapphire I have fitted two ſcrews o, o, tapped through the braſs collar L, which firmly embraces the pendulum rod. By theſe ſcrews the pieces of ſapphire are accurately adjuſted to the ſteel cylinder, ſo that the power is applied, without the ſmalleſt ſhake or loſs of force, exactly in the line of the centres of oſcillation, gravity and ſuſpenſion.

An account of a clock where the maintaining power is applied immediately from the eſcapement wheel to the axis of the pendulum rod, without verge, crutch, or any other agent.—I cut a notch

notch in the pendulum rod deeper than its axis, (ſee the profile, Fig. III.) and in that opening at k, and in that part on a plate of braſs fixed firmly by ſcrews, two pallets r and s, repreſented larger at Z below, and by the eſcapement wheel P, with pins 1, 2, 3, 4, 5, 6, &c. made of very hard drawn braſs wire inſtead of teeth, I applied the maintaining power exactly in the line of the centres of magnitude, oſcillation, ſuſpenſion, motion and gravity. This appears to me the moſt ſimple and perfect method of applying the maintaining power to pendulums that has hitherto been thought of, and if perfectly executed with ruby or ſapphire pallets, and hard ſteel pins well finiſhed in the wheel, the point of ſuſpenſion made perfectly immoveable, and the maintaining power perfectly uniform, then perhaps the faireſt trial may be given to different pendulums.

On ſhewing my clock made in this way to an ingenious gentleman from London, he told me he ſaw one executed on the ſame principles in England. I went to ſee it, and found it ſomewhat like mine, but the maker had not thoſe matters in view that I had, as he did not communicate the power at the centre of the rod, but on its external part, by which means much of the power was loſt, and the remainder gave the pendulum an undulatory motion which added conſiderably to the friction, and totally deſtroyed the iſochroniſm *.

* Since theſe clocks were made, I conſtructed another very ſimple one, in which I made the pendulum to vibrate at right angles with the plane of the eſcapement wheel: this method promiſes ſome material advantages, particularly in large clocks.

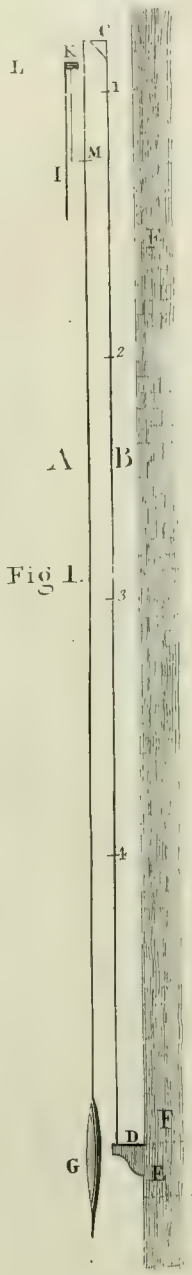
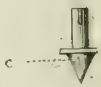
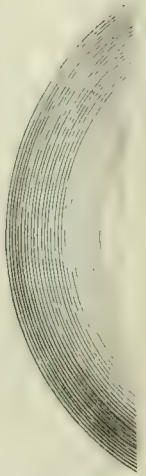


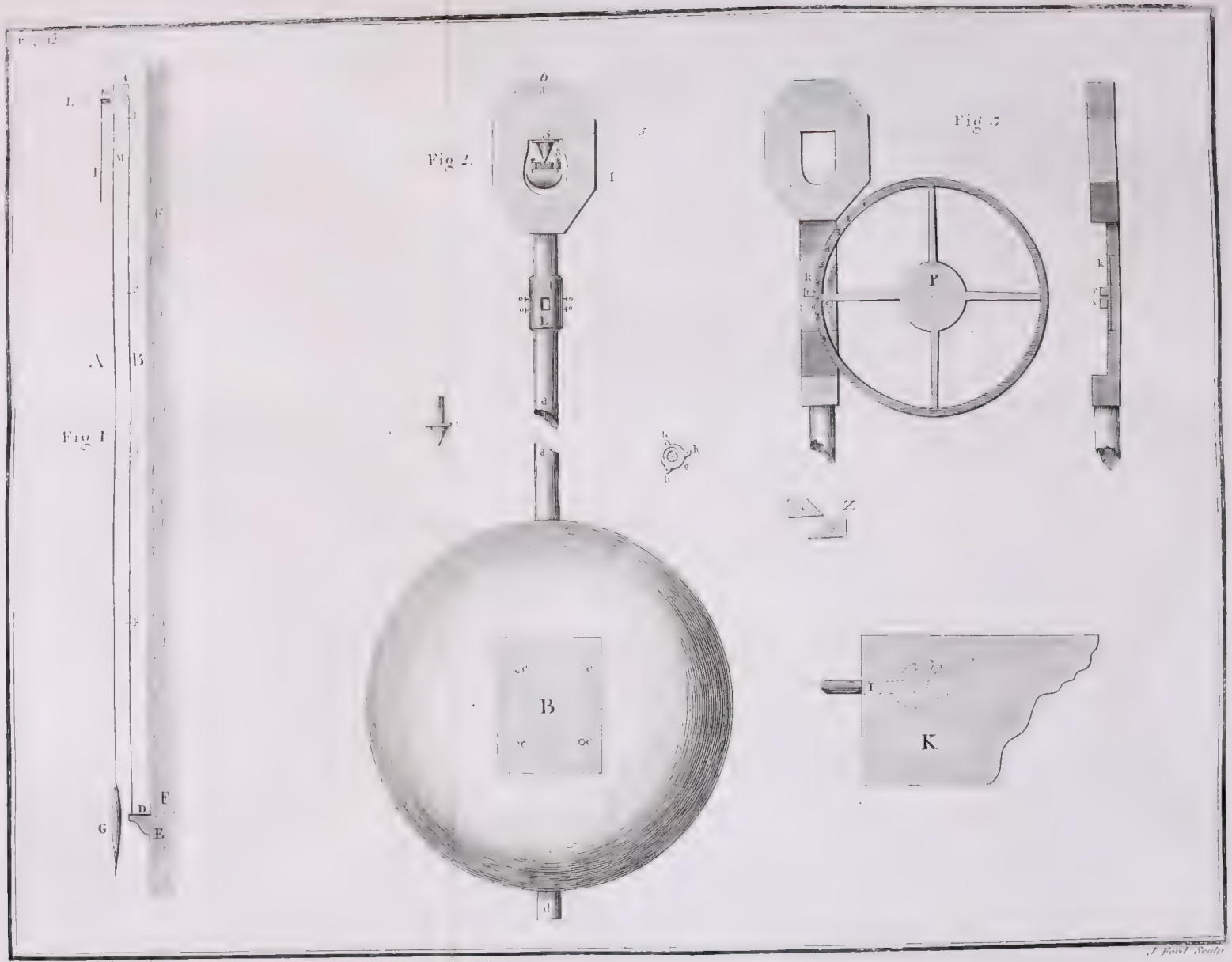

Fig 1.

Fi



John Crosthwaite Inv.t & Del.t




John Greathwaite Inv.t & Del.t

J. Ford Sculp.t

## *An Account of a new Method of* ILLUMINATING *the* WIRES, *and* REGULATING *the* POSITION *of the* TRANSIT INSTRUMENT. *By the Rev.* HENRY USSHER, *D.D. S.F.T.C.D. M.R.I.A. and F.R.S.*

IT is now univerſally allowed that the paſſages of the celeſtial bodies over the meridian are more eaſily, more * abundantly, and more † accurately taken by means of the tranſit inſtrument, than by the method of equal altitudes.

EVERY attempt, therefore, to improve this valuable inſtrument is of importance; and as there are ſome particulars in the tranſit inſtrument of our obſervatory, which appear to me to be advantageous improvements, I conſider it my duty to lay them before the

* On account of the uncertainty of weather, which often prevents the correſpondent obſervation of altitude.

† On account of the variation of refraction at the given altitude, if the ſtate of the barometer or thermometer, or both, ſhould be different at the times of the two obſervations.

Academy:

Academy: and in order to form a more juſt eſtimate of their value, I have given ſome ſketches of this inſtrument, as commonly executed, with a brief deſcription of the uſual modes of illuminating the wires, and ſubjoined the method adopted in that belonging to our obſervatory, with ſome other more important particulars.

Fig. I. Plate III. repreſents the inſtrument as commonly conſtructed, mounted ready for obſervation. The detail of the parts is unneceſſary, the inſtrument being in ſuch general uſe as to be known to every one. The candle or lamp for illuminating the wires by night is here made to deſcribe a circle equal and parallel to that deſcribed by the reflecting ſurface placed before the object glaſs, the centres of both lying in the ſame right line parallel to the horizon. This movement is effected by a ſimple apparatus repreſented in Fig. II.: it conſiſts of a ſtrong ring of wood, which ſurrounds the axis of the inſtrument at a ſmall diſtance, and is made faſt to the pillar; this ring ſupports and confines another, which has a liberty of circular movement, and carries the two arms A. B. one ſuſtaining a lantern, and the other a counterpoiſe; the lantern is loaded at the bottom, and plays freely upon a pin placed above its centre of gravity, and therefore always preſerves a vertical ſituation; it is ſo contrived as to let out the ſmoak at the back part, by which means the obſervations are leſs affected by the tremors ariſing from the vapour of the candle.

There is another method, very convenient for ſmall inſtruments, which I firſt ſaw at St. John's College, Cambridge; it is repreſented

repreſented Fig. III. In this, the centre of motion of the arm which carries the counterpoiſe and lantern does not lie in the axis of the inſtrument, but at ſome diſtance above it, by which means the axis is diſengaged from ſurrounding wood-work, which is an obſtruction to the facility of reverſing the inſtrument for adjuſting or verifying the line of collimation; and that the light in the lantern may move in an arc equal and parallel to that deſcribed by the elliptic illuminator, the light muſt be as far diſtant from the point of ſuſpenſion of the lantern, as in the centre of motion of the arm above the axis; in this method, therefore, a lamp or a candle with a ſpring ſocket muſt be uſed.

In Fig. I. and III. the two ſpecies of elliptic illuminators, uſually applied, are repreſented; that in Fig. III. is an elliptic ring of paſteboard or other proper ſubſtance made white; the leſſer axis of the ellipſe is ſomewhat leſs than the diameter of the object glaſs,—the other ſhown in Fig. I. is a ſmall cylinder of ivory placed oppoſite the centre of the object glaſs: In each the ſurface is ſet in an angle of forty-five degrees to the axis of the teleſcope. Doctor Maſkelyne, whom I believe the inventor of the ſolid illuminator, has improved it lately, by ſubſtituting for the ivory ſurface a ſmall reflecting mirror, by which he obtains a ſufficient quantity of light for the wires, without ſo much loſs of the central rays.

In our tranſit inſtrument the entire light of the object glaſs is preſerved by a moſt ſimple contrivance:—That pivot of the axis which reſts upon the plate that regulates the motion in azimuth,

is

is perforated with a ſmall hole, and in this is inſerted a convex lens; the plate and the pillar are perforated alſo in the direction of the axis; the perforation in the pillar near the back part is three inches in diameter; in this is inſerted a tube carrying another larger convex lens; to this tube is attached the lantern, in which the flame of the candle is kept always oppoſite the axis of the tube by means of a ſpring ſocket.

The rays of light iſſuing from the candle are by theſe lenſes brought to a focus immediately beyond the ſmall lens inſerted in the pivot, and diverging from thence, within the conical axis, are intercepted at the ſquare box in the centre by a diagonal plate of ſilvered braſs, which reflects the light down to the wires; this plate is perforated with an elliptical hole, to let the cone of rays from the object glaſs paſs through undiminiſhed. See Fig. IV.

To temper this light in proportion to the ſtar obſerved, there is a green glaſs increaſing gradually in depth of tint from the top to the bottom: this glaſs is ſet in a braſs frame, which ſlides in a dovetail between the azimuth plate and the pillar; and the elevation or depreſſion of this is regulated by a lever, the arm of which is readily brought to the hand in any poſition; this lever conſiſts of two ſeparate arms, which are preſſed together by ſcrews, and each turn upon one pin inſerted into the pillar: by lightening the ſcrews the friction of the arms againſt each other may be ſo increaſed, that when the longer arm is moved the ſhorter one moves with it, and raiſes or lets down the glaſs-frame; when this is raiſed to the greateſt height,

height, then the ſhort arm preſſes againſt the bottom of the azimuth plate, and any additional force now applied overcomes the friction at the centre; ſhould the motion of the arm be required in the oppoſite direction, this is effected by making the ſhort arm preſs againſt a pin placed below it, with a ſimilar effect to the former, the force applied overcoming the central friction as above; and thus the long arm may be brought parallel to the teleſcope in whatever poſition it is ſet for obſervation.

Fig. V. repreſents the lever and glaſs-frame; the azimuth plate is repreſented by dotted lines. If it be required to move the long arm from the poſition there repreſented to a vertical ſituation for an obſervation in the zenith; then by depreſſing the handle x, the ſhort arm a, a is raiſed and puſhes up the glaſs-frame, until a, a preſſes againſt the bottom of the azimuth plate, where, as it can go no higher, any additional force in that direction overcomes the friction at the central pin (d) and the long arm is readily brought into a vertical poſition, the ſhort one remaining at the azimuth plate; and in this new poſition, the lever has the ſame power of regulating the deſcent of the frame as before: if it be required to put the arm into an horizontal poſition, the preſſure of the ſhort arm againſt the pin (p) inſerted in the pillar below it, overcomes the central friction in this direction; h repreſents the hole in the pillar through which the light comes; n, n the braſs frame; b, b the green glaſs.

In juſtice to Mr. Ramſden I muſt obſerve, that it was not without ſome difficulty that I prevailed upon him to introduce

 this

this mode of illumination in this inſtrument, he being juſtly cautious leſt the heat of the candle might have any effect on the axis; but ſeveral hours carefully employed by him and me in critical experiments, ſatisfied him fully that his fears were groundleſs, and I can now by experience of the inſtrument pronounce them ſo.

This mode of illumination has many advantages. Firſt, the object is not rendered tremulous by the vapor and flame of the candle decompoſing the air at the object glaſs. Secondly, no part of the light afforded by the object glaſs is loſt. Thirdly, you can diminiſh your aperture at pleaſure without the trouble of altering your illuminator; whereas if the annular one be applied a different elliptic ring muſt be provided for every diminution of aperture; if the ſolid illuminator be uſed, you cannot diminiſh the aperture very much, and preſerve the valuable central rays*. Another uſe of this method has occurred to me ſince I began to apply it, which is this—by accurately dividing the ſtem of the glaſs-frame, and removing the green glaſs, we might more certainly determine the different magnitude of the ſtars, by noting the quantity of light neceſſary to efface them.

I now come to the principal improvement in this inſtrument; an invention that does high honour to Mr. Ramſden, and is a moſt valuable acquiſition to all aſtronomical inſtruments where plumb lines are introduced.

* The advantages of a great diminution of aperture on particular occaſions I ſhall mention in a future paper.

*The*

*The Method of adjuſting the horizontal Poſition of the Axis.*

Every one muſt allow, that the adjuſtment by the ſpirit level is of all modes the moſt convenient, but it is not without its defects; there are few levels true to leſs than two ſeconds in winter, when all levels are moſt ſluggiſh; add to this, that the pivots of the axis muſt, for this adjuſtment, be accurately of equal diameters, and perfect cylinders; we muſt alſo take into account the danger of any partial heat reaching the glaſs tube, which will create an enormous error.

To remedy theſe defects, a plumb-line has been ſubſtituted, but generally not well contrived. The uſual adjuſtment by the plumb-line has been, to attach two ſmall pins to the tube of the teleſcope, one near the object glaſs, the other near the eye end of the tube, and to make a plumb-line, ſuſpended from one of theſe, paſs over and biſect two fine points, one near each end of the tube; then, inverting the teleſcope, and ſuſpending the plumb-line from the other pin, to ſee whether it biſect the ſame points again; and if not, to correct half the error in the uſual manner: but this appears to be dangerous to the line of collimation.

My firſt attempt at adjuſtment by the plumb-line in the year 1774, was to ſuſpend a braſs rod by hooks on the pivots, like the horizontal bar of a level, and to the middle of this I attached a vertical bar with two fine points, and a plumb-line; but this was ſubject to inaccuracy, unleſs the pivots were pre-

ciſely of equal diameters. I then contrived that the bar ſhould not hook on the pivots, but be preſſed upwards by a ſpring againſt their under parts. Fig. VI. ſhews the principle of this adjuſtment. A is the extremity of the pivot of the axis; c the ſpring, which is attached to the notched piece n, n, reſting on the pivot, and forcing the piece T, T upwards, which raiſes the whole adjuſting tool, and keeps the notch l, l, bearing againſt the lower part of the pivot; l, l, m, m is a piece ſimilar to the vertical bar of a level ſeen in profile; o, o is the profile of the perpendicular bar which ſtrengthens the horizontal bar; to the middle of this is attached the vertical bar y, y, with two fine points, one being moveable; beſide this hangs the plumb-line x, x, with the plummet P ſwinging in water.

Although this adjuſtment was independent of all inequality in the pivots, yet it was objectionable, becauſe during the adjuſtment there was the weight of the tool on the axis, from which it was diſengaged in the act of obſervation; whence the inſtrument was proved and applied in diſſimilar circumſtances. But whilſt I had this tool actually in hands, the following elegant and unobjectionable mode was deviſed by Mr. Ramſden, which immediately made me lay aſide all thoughts of the former; and in fact I know of no late invention that ſeems to promiſe more towards the improvement of all aſtronomical inſtruments where plumb-lines are applied.

In one ſide of the tube of the teleſcope, and twelve inches from each end of it, he makes a ſmall hole, and inſerts a very thin ſemipellucid bit of ivory, with a black dot in the centre; in

in the other ſide of the tube, oppoſite to each of theſe, he inſerts a convex lens; now it is obvious that an image of each dot will be formed in the conjugate focus of its correſponding lens. The tops of the pillars ſupport a braſs frame, carrying a plumb-line and two microſcopes, placed directly before the images of the dots, to which their foci are adjuſted, ſo that the images are diſtinct and magnified; and the plumb-line being moveable by ſcrews at the ſuſpenſion frame above, is made to ſwing through theſe images. Nothing can be better imagined than this.

In the firſt place, the adjuſtment is applied totally independent of the inſtrument; and ſecondly, the plumb-line hanging in the images themſelves, there cannot poſſibly be any parallax on the wire, nor any corpuſcular attraction exerted on it, as is probably the caſe when a plumb-line is brought very near to a metallic plate; inconveniences to which all plumb-lines have hitherto been in ſome degree ſubject.

The three plates are deſigned to ſhew this valuable adjuſtment more fully.

Plate II. Fig. I. is a bird's-eye view of the top of the eaſtern pillar. Fig. II. of the weſtern.

On the top of each pillar, and in the direction of the meridian, is ſhewn a priſmatic bar of braſs, A, B, ſeen in profile, and of a larger ſize in Fig. III. The horizontal poſition of this bar is obtained by the capſtan headed ſcrew t, and is fixed by the

the other capſtan head T; the application of the other capſtan headed ſcrew D, with its ſetting ſcrew, will be ſhewn in the application of the adjuſting tool.

On the top of each pillar is a braſs cock marked C, and ſeen in profile, and of a larger ſize in Fig. IV.; in this the ſcrew X works vertically, and is ſet by the ſcrew Y.

E G F H I is a frame covered with green ſilk to ſcreen the axis from the ſun *. K, K are holes in the ſilk to let the hooks of the counterpoiſes through, to relieve the Y plates from the entire weight of the inſtrument.

Plate III. Fig. I. ſhews the adjuſting tool, the notches N, N, cut in the end of the horizontal arm, reſt upon the priſmatic bar ſhewn in the former figure, and the extremity Z, of the horizontal bar at right angles to this, reſts upon the point of the vertical ſcrew, which works in the cock C, on the oppoſite pillar. C, P is a fine ſilver wire, ſupporting the plummet P, which ſwings in a glaſs veſſel filled with water, as is uſually done to check the vibration. X, X are the two microſcopes, into the focus of which the wire is brought by the ſcrew C, ſhewn more diſtinctly in Fig. II. in which D is the head of a ſmall ſcrew, which confines the end of the plumb-line under its ſhoulder, the plumb-line hangs through the hole H, and reſts in a fine notch cut in the chamfered edge S, S. The ſcrew B draws the whole ſyſtem L M N R eaſt or weſt, to draw

* The view of the counterpoiſes is here omitted, not to embarraſs the figure.

the

the wire oppoſite the dot; and its poſition is ſecured by a ſpring concealed in the tube A. The ſcrew C, as mentioned before, moves the frame a b c d north or ſouth, and its place is ſecured by a ſpring ſhewn in the figure. W is a pinion which works in a rack that ſupports the glaſs veſſel filled with water; by means of this the veſſel can be raiſed ſo as to relieve the wire from the weight of the plummet when the machine is moved.

Plate IV. Fig. I. ſhews a ſkeleton of the adjuſting tool on its ſupports, and parallel to the teleſcope B B, which during the adjuſtment is always in a vertical poſition.

Fig. II. is the ſame in profile. Q, Q are the dots; o, o the lenſes, by means of which the images of the dots are formed in the conjugate foci at S, S; theſe images are diſtinctly ſhewn by the microſcopes x, z; the plumb-line is made to ſwing through one dot by means of the ſcrews at the top of the adjuſting tool already ſhewn in Plate III. Fig. II.; whilſt the other dot, which is moveable from right to left, has its image brought to the wire by means of a ſcrew S in Fig. III. Plate III. which repreſents the piece which carries the moveable dot. We now ſuppoſe that the plumb-line ſwings through the centre of each image, and the true poſition of the tool is ſo far obtained, provided the plummet hangs freely in the middle of the glaſs veſſel, which will be the caſe when the arm, which reſts upon the priſmatic bar, that is, when the bar itſelf is horizontal; this is obtained by the capſtan headed ſcrews t, T, Fig. III. Plate II. Provided alſo that the other arm C, L, is truly horizontal, which poſition

is

is obtained by the ſcrew, which works vertically in the cock C, Plate IV. Fig. I. and Plate II. Fig. IV.

The juſt diſtance of the tool from the teleſcope is ſhewn by the diſtinct viſion of the images; and in order to obtain the ſame diſtance exactly at all times, the ſcrew D, in Fig. III. Plate II. is moved, 'till its point juſt preſſes againſt the end of the notched piece which reſts on the bar, and is there ſet by the ſcrew S *(ſame figure)*. Let now the ſcrew W at the bottom be turned, ſo as to relieve the plumb-line, and let the tool be removed; then let the teleſcope be inverted, and the tool brought to the other ſide, and placed upon the other bar and cock, let the wire be made to ſwing through and biſect the upper image; if now the teleſcope has turned upon an axis truly horizontal, the plumb-line will alſo biſect the lower image; if not, correct half the error as uſual, and repeat the adjuſtment 'till all error vaniſhes.

Thus we ſhall have the inſtrument proved, without any additional weight on the axis; we have the advantage of a long plumb-line, without parallax, or corpuſcular attraction; and all error of the artiſt in the diameters of the pivots is rendered of no conſequence whatever.

*Apparatus*

*Apparatus for reverſing the Inſtrument.*

As the line of collimation requires conſtant verification, the reverſing of the axis ſhould be rendered as commodious as poſſible; particularly as this is always done to the greateſt nicety by celeſtial obſervations, which will not admit of delay. I always prove it by the polar ſtar*, and this is the method: I obſerve the paſſages over the three firſt wires; I then reverſe the inſtrument, and take the paſſages over the two laſt wires, that is, in fact over the two firſt again. Now it is manifeſt, that if the collimation be perfect, the intervals from the firſt wire to the middle one, and from the middle one to the fifth, will be preciſely equal, as alſo the intervals from the ſecond to the middle, and from the middle to the fourth. The apparatus for this purpoſe, ſhewn in Plate V. Fig. I. is ſo manageable, that I can reverſe this weighty inſtrument without help in the ſhort half paſſage of ß Urſæ minoris, in time to obſerve the paſſage over the laſt wire, having before reverſing obſerved the paſſages over the firſt, ſecond and middle wires. The horns E, E, being placed under the axis: the winch A is turned, which works with a double pinion in the rack B, which is double, having the teeth ſet at alternate intervals, as ſhewn in Fig. II. by which means the ſmootheſt motion poſſible is obtained: this rack elevates the block C, hol-

* The reaſon why I prefer the polar ſtar is, becauſe the ſmalleſt error in the collimation will, on account of the ſlow motion of this ſtar, ſhew a difference which cannot be attributed to the unavoidable error of obſervation, or caſual irregularity of the clock; at leaſt we know the limit by practice.

lowed conically to receive the extremity of the cylinder D, made to fit it; and this raiſing the upper work on which the axis now reſts, lifts the inſtrument off its ſupports, which is then readily turned round on the cylinder D, working in the cone C and female cylinder F, F; and may be then, in its reverſed poſition, ſmoothly and gently lowered down again to its ſupports.

PLATE 1st

See Page 26

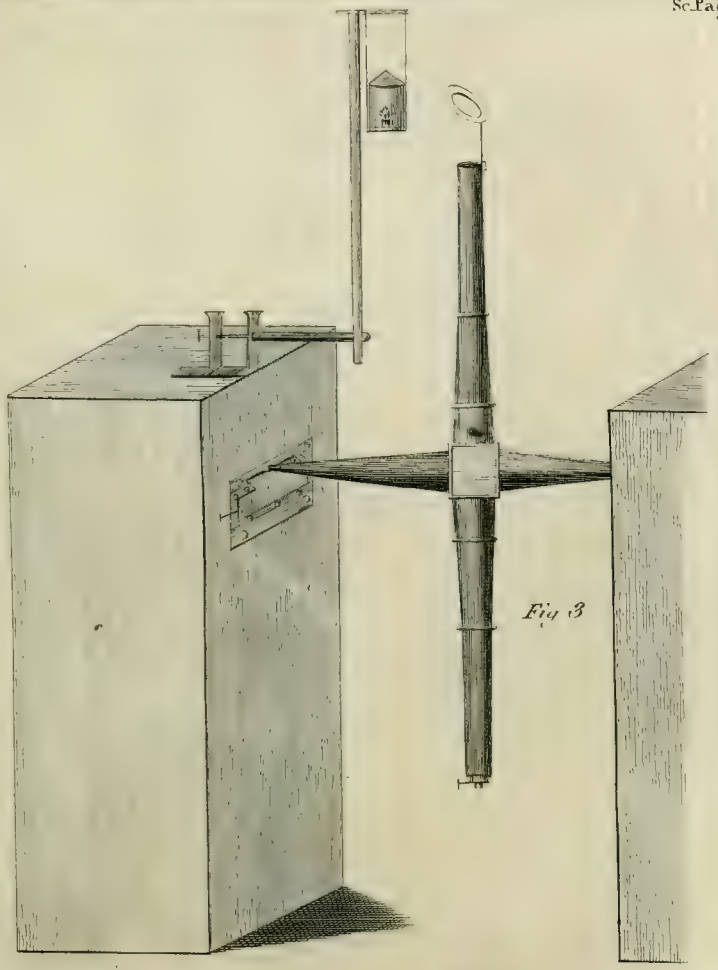


Fig 3

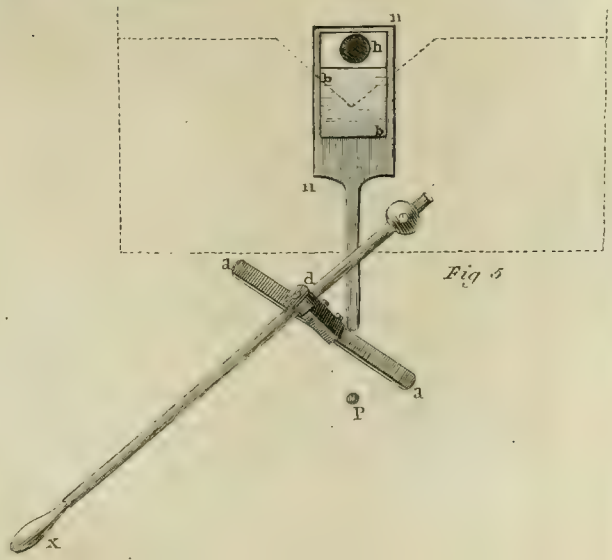



Fig 5

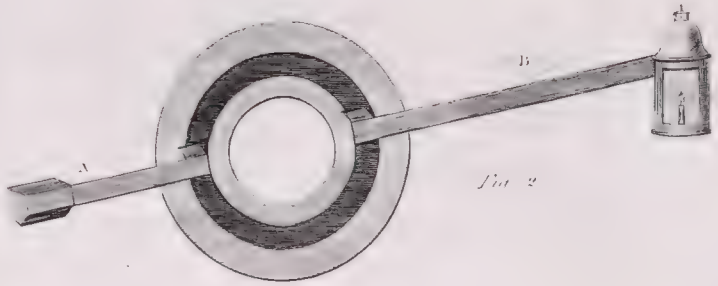



Fig. 2

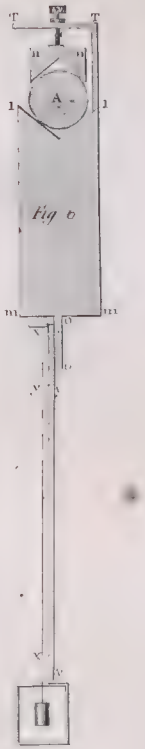



Fig. 6

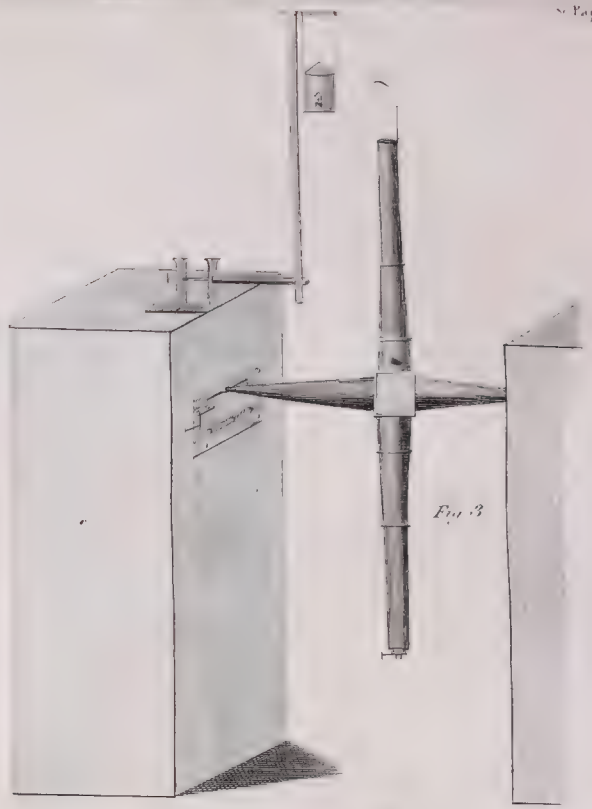


Fig. 3

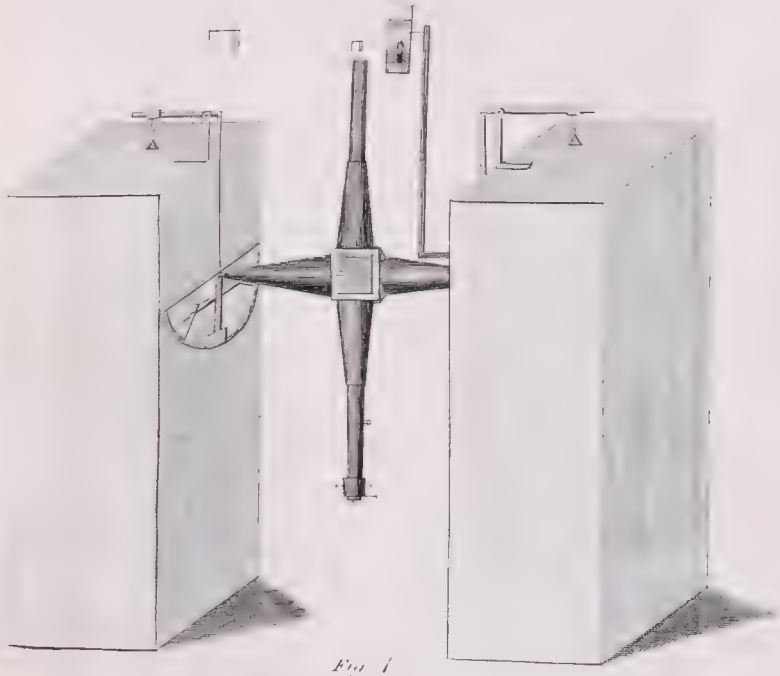


Fig. 1

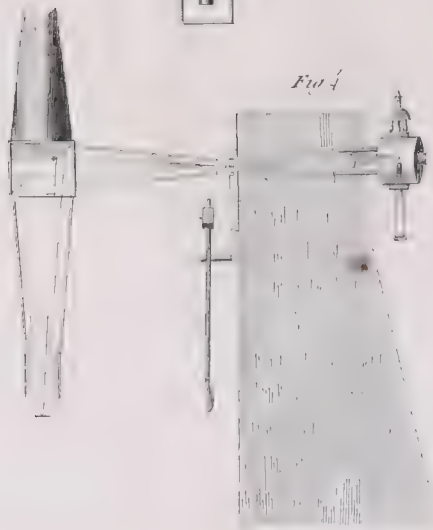


Fig. 4

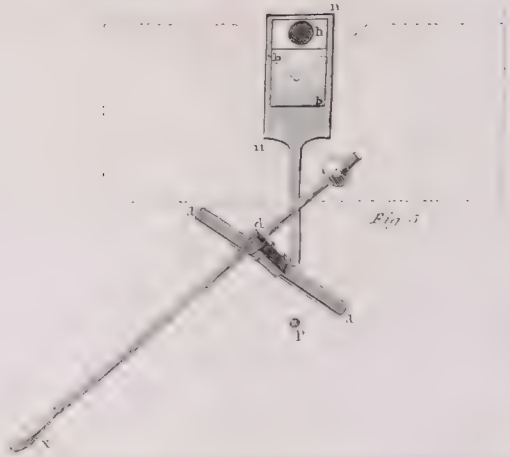



Fig. 5

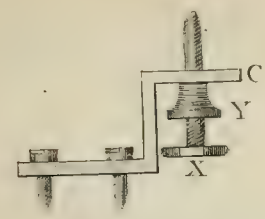
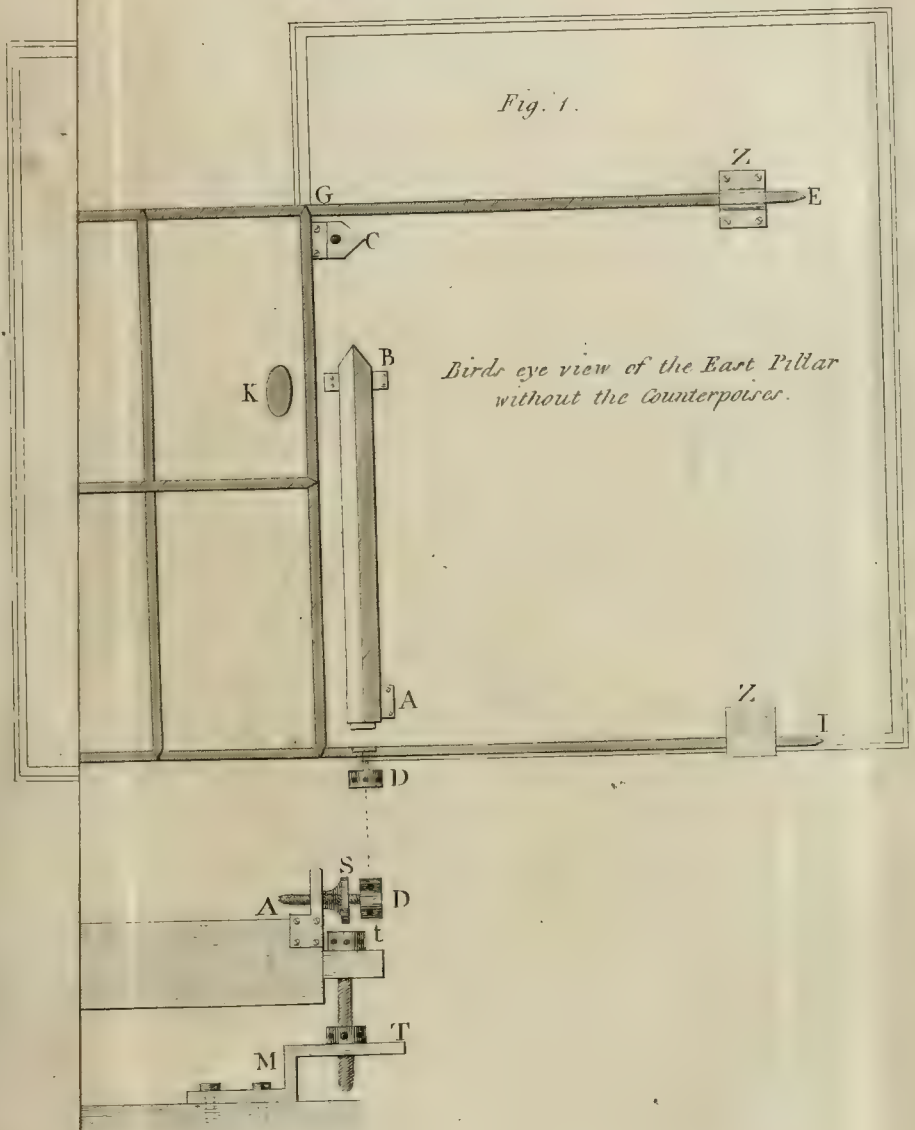


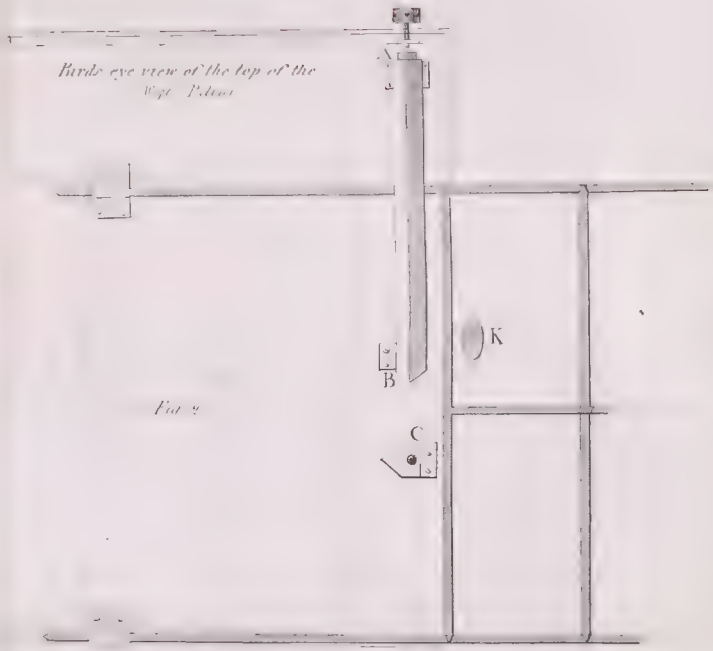

*Fig. 4.*

*Fig. 1.*




*Birds eye view of the East Pillar without the Counterpoises.*


Fig. 4




Bird's eye view of the top of the West Pillar

Fig. 2

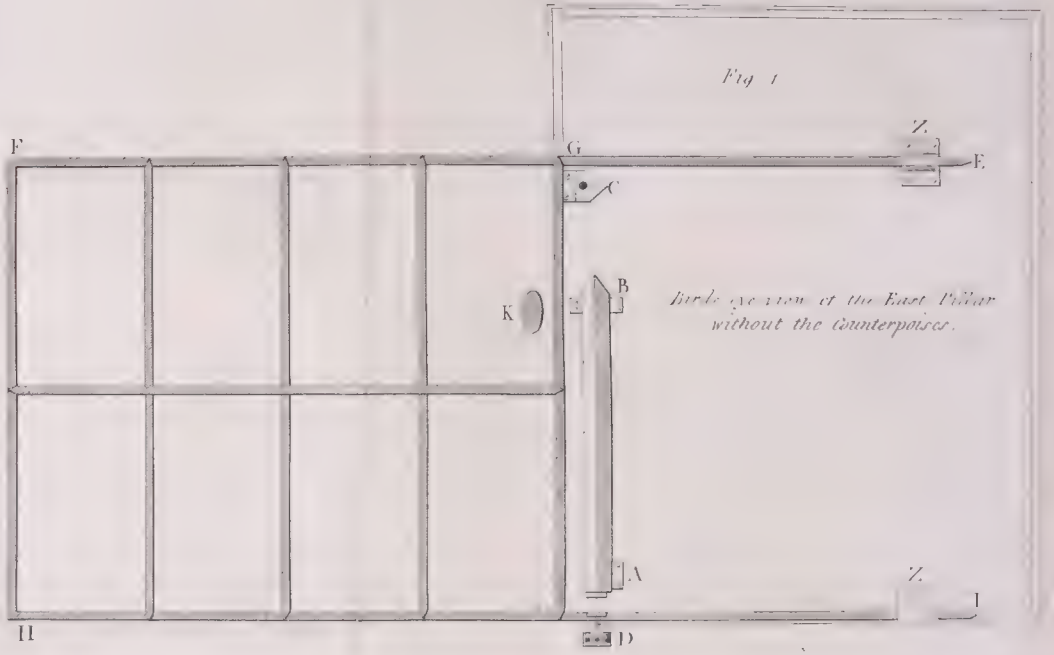



Fig. 1

Bird's eye view of the East Pillar without the Counterpoises.

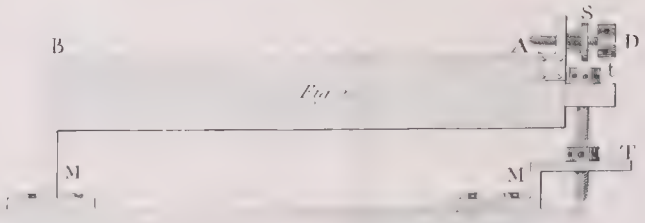



Fig. 3

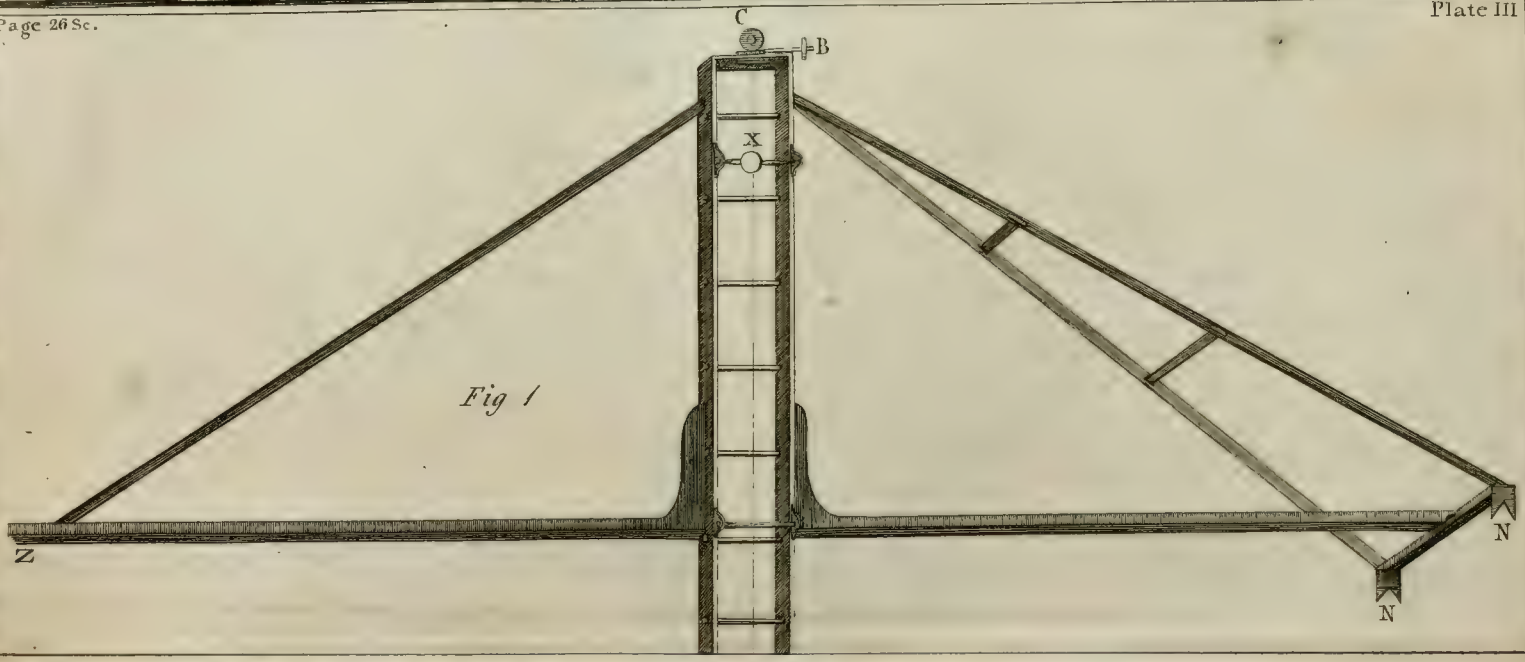
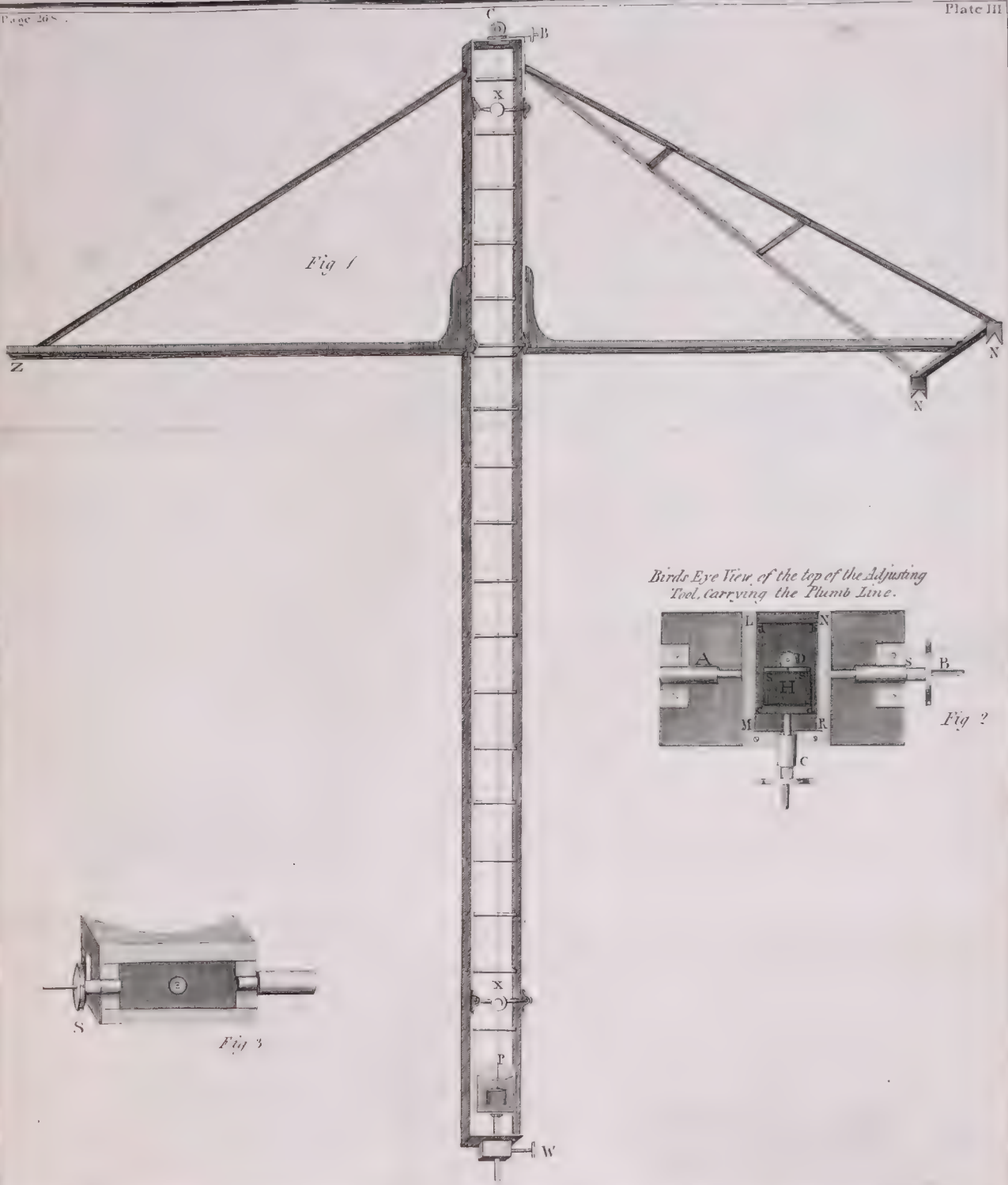



*Fig 1*


C
B
X
Fig 1
Z
N
N
Birds Eye View of the top of the Adjusting Tool, carrying the Plumb Line.
L
N
A
D
S
B
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H
M
R
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Fig 2
X
S
Fig 3
P
W

*Fig 1*

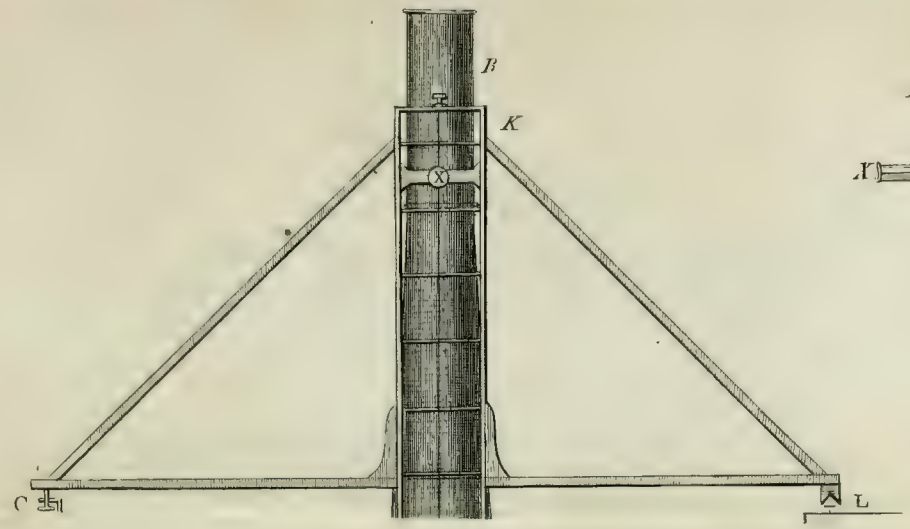



*Fig 2*

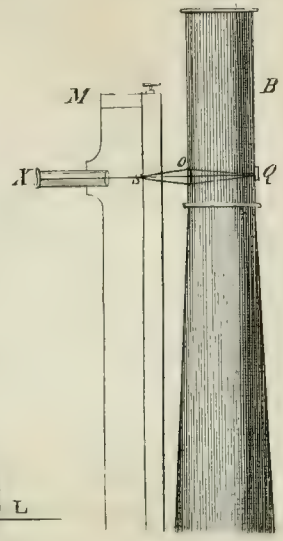


Fig 1

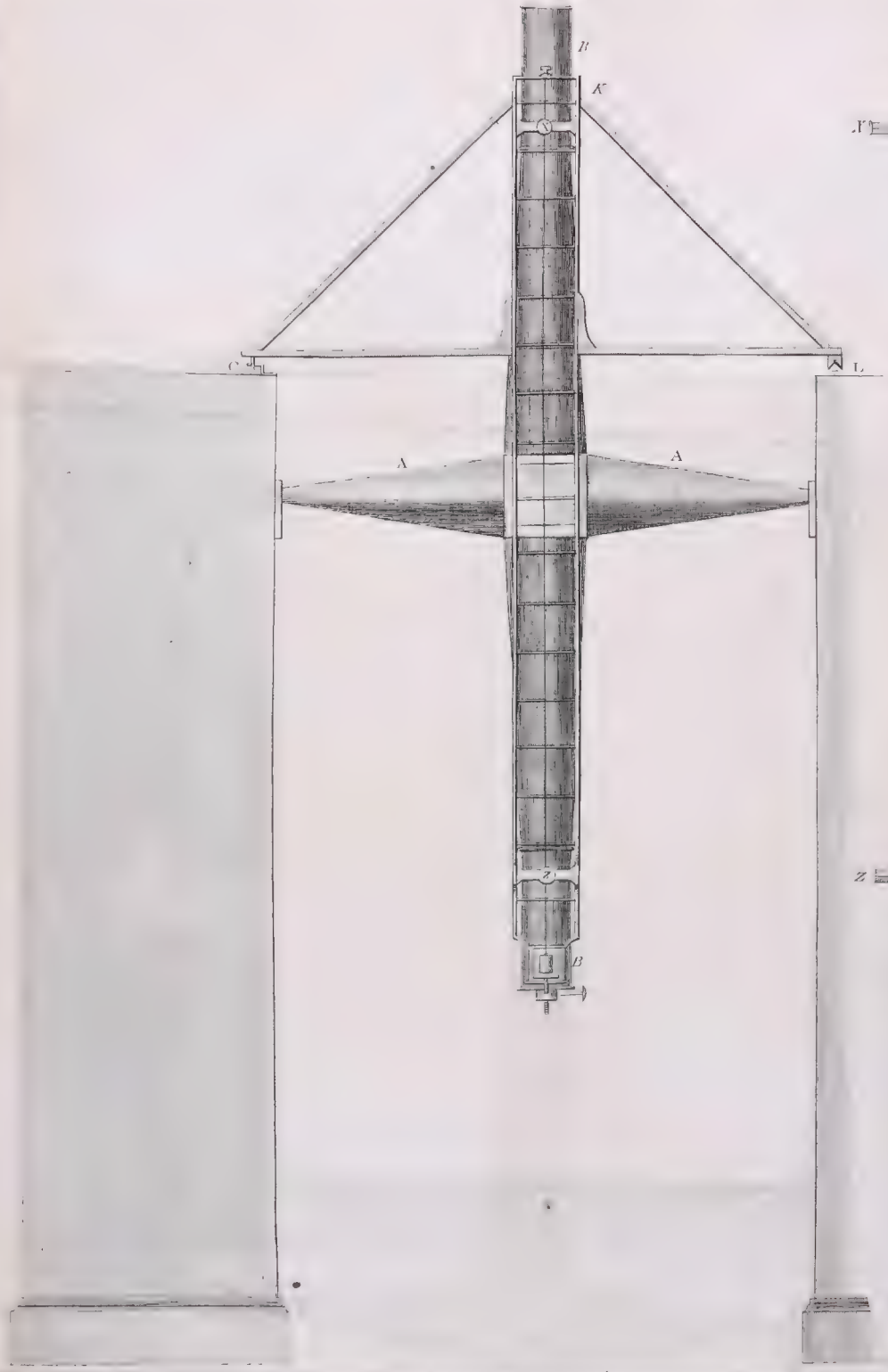
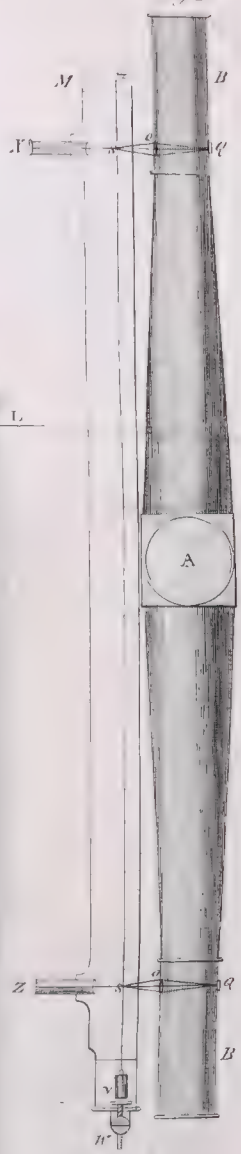
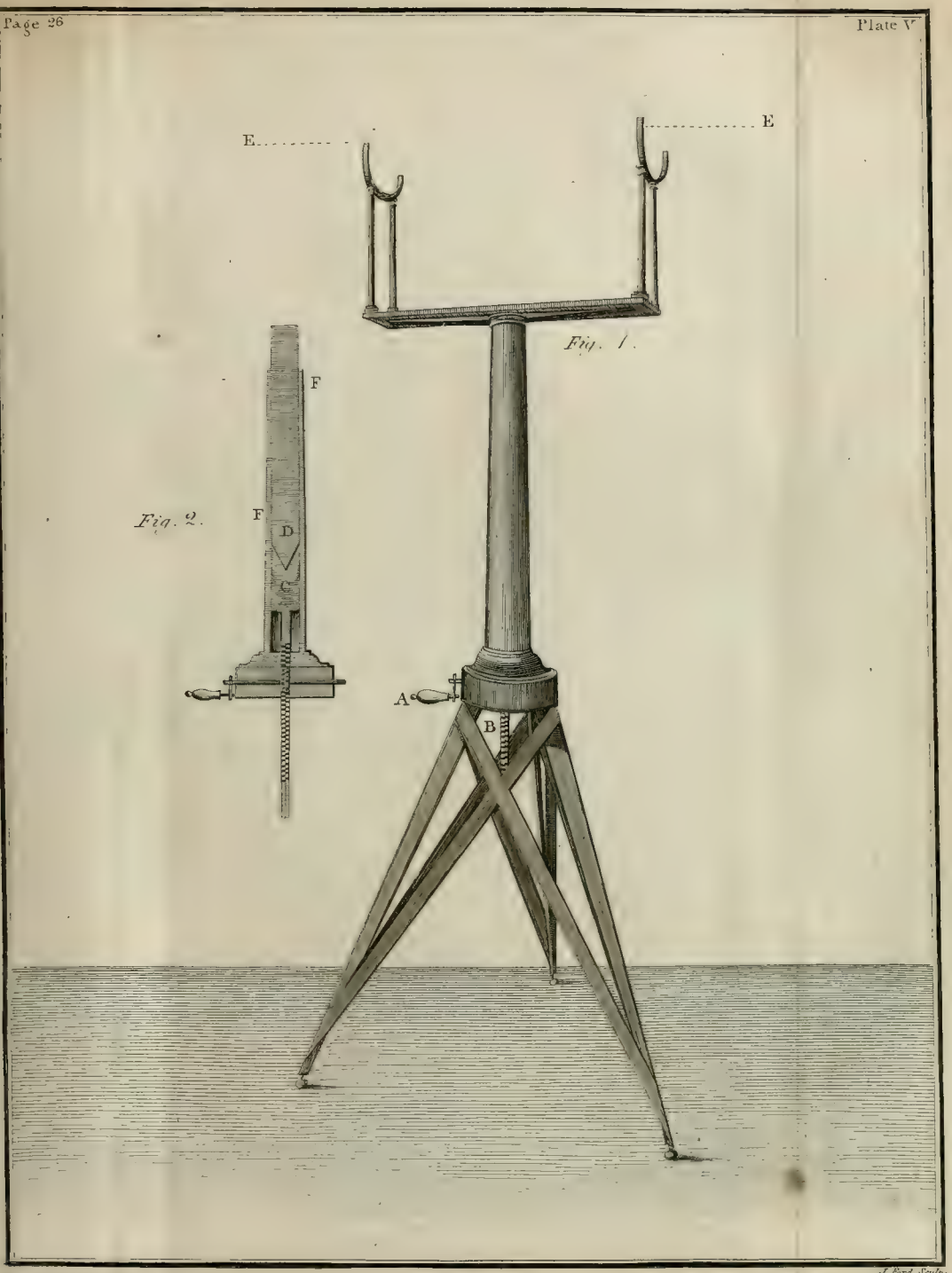



Fig 2






J. Ford Sculp.

# *An* ESSAY *to improve the* THEORY *of* DEFECTIVE SIGHT. *By the Rev.* JOHN STACK, *F. T. C. D. and M. R. I. A.*

THE common theory of defective ſight attributes the confuſion in imperfect viſion to the interſection of the rays of each pencil that enters the eye, in points either *before* or *behind* the retina. It ſtates the former of theſe defects as proceeding from too great a convexity of the cornea, or of the chryſtalline humour, or of both; and the latter from the contrary ſtructure of thoſe parts of the eye. Beſide theſe ſcarce any other cauſes are aſſigned, or any farther explanation of the defects given. Read Jan. 5, 1788.

THIS, however, ſeems inadequate to the ſolution of ſeveral phænomena in caſes of defective ſight that frequently occur; ſuch as the following:

1. I HAVE frequently cauſed ſhort-ſighted perſons to place a printed book a little beyond their limits of diſtinct viſion; then

 applying

applying a card, with a ſmall hole made in it, to the eye, they read at the above-mentioned diſtance with great eaſe.

2. Obſerving the effect of this experiment to be more ſtriking than uſual in a perſon the pupil of whoſe eye was very large, I meaſured the diſtances at which he could read when the pupil was dilated, and when it was contracted, and found the former leſs than the latter by about two inches.

N. B. These caſes are the more remarkable, as the quantity of light incident from the object on the eye is diminiſhed in each of theſe experiments *, and conſequently the vividneſs of the pictures on the retina ; therefore a conſiderable degree of diſtinctneſs muſt have been procured to overbalance the diſadvantage that the loſs of light occaſioned.

3. I have met with caſes, though not frequently, of defective ſighted perſons whoſe ſight was ſuch as to be incapable of being aſſiſted by any double-concave or convex glaſſes. Some of them found viſion a little more diſtinct through a pin-hole *in ſtrong light*, others not.

These caſes do not appear at all explicable on the vague theory of defective ſight generally received ; and perhaps others of a ſimilar deſcription may occur, or have already occured to more accurate and extenſive enquirers.

* Hence the reaſon why theſe experiments are attended with more remarkable effects in ſtrong than in weak light.

That

That ſuch phænomena however may reſult from various defects in the ſtructure of the eye, will be evident to any one who conſiders the exact conformation and adjuſtment of its parts neceſſary to produce perfect viſion. Theſe requiſites indeed are ſo many, and of ſo ſubtile a nature, that it ſeems much more ſurprizing that ſo delicate an organ ſhould not be oftener rendered imperfect by accident or natural infirmity, than that ſo many inſtances of defective ſight ſhould be met with.

A deviation from the juſt form or refractive power of any of the different humours might be ſhown (from optical principles) capable of cauſing the phænomena above-mentioned; but as the chryſtalline humour is the principal inſtrument in viſion, it will be ſufficient to point out the effects ariſing from any deficiency in its ſtructure, eſpecially as the number and minuteneſs of the circumſtances neceſſary to its perfection make this humour more liable to incur the defect than either of the others; and as any remedy applicable to the removal of errors hence ariſing will be found equally ſo to that of errors occaſioned by the imperfection of the aqueous or vitreous humours.

The chryſtalline humour being in the form of a double convex lens, it is evident that when parallel rays are incident on it, thoſe fall more obliquely on its ſurface which are more remote from the vertex or middle point of that ſurface. Now if that humour were of uniform denſity, the refraction of the remote rays would ſo far exceed that of the central ones as to interſect each other nearer to the chryſtalline than the mutual interſection of the more central rays; therefore if one of theſe interſections

(or

(or foci) be at the retina, the other muſt be removed from it, and conſequently a confuſion would enſue in the picture on the retina.

It is however well known that nature has uſed an admirable precaution againſt this imperfection, by gradually diminiſhing the denſity (and therefore the refractive power) of the chryſtalline from the centre toward the edges; ſo that the exceſs of refraction ariſing from obliquity of incidence ſhould ſerve as a compenſation for the defect of it, owing to the diminution of denſity, and thus *in perfect viſion* produces this effect, that both the extreme and central rays of the incident pencil ſhould be brought to a common focus exactly on the retina.

Let us now ſuppoſe a chryſtalline humour of ſuch a form as it uſually has in a perfect eye, and at the central parts of a juſt denſity, but whoſe denſity is not ſufficiently diminiſhed in proceeding from the centre to the edges: From what has been juſt obſerved on the caſe of uniform denſity in the chryſtalline, it is plain that the exterior rays of the incident pencil, and thoſe only, will in the preſent caſe ſuffer too great a refraction, and produce confuſion in the picture on the retina; conſequently if theſe be intercepted, and the central rays alone tranſmitted to the eye (as is done in the firſt experiment by the pin-hole) viſion will be diſtinct, and no obſtacle to its perfection will remain but what ariſes from want of ſufficient light. Vid. Fig. I.

Fig. II. Even though the denſity of the chryſtalline were every where too great as well toward the centre as toward the edges, yet

yet as the diffuſion O S, occaſioned by the central rays, is far leſs than T V, that cauſed by the exterior rays, viſion, though not rendered perfectly diſtinct by the excluſion of the exterior rays, will be made more clear than before, unleſs the denſity be very much greater than it ſhould, in which caſe the diffuſion O S might be ſo great as to impede viſion entirely, as well as the diffuſion T V, which is greater than it.

I HAVE here ſuppoſed the rays parallel, for the purpoſe of conſidering the view of remote objects; but the reaſoning will equally apply to rays ſenſibly diverging, and ſo will illuſtrate as well the view of nearer objects.

THESE obſervations, if juſtly founded, might ſerve to ſhew the reaſon of what occurred in the ſecond experiment, where the confuſion of viſion was ſo much diminiſhed by the contraction of the pupil, the *Iris* in ſuch a caſe intercepting thoſe rays which cauſed a confuſion when the pupil was dilated; in the ſame manner as the card in the firſt experiment intercepted the rays that cauſed confuſion to the naked eye.

IT appears to me that the defect of all ſhort-ſighted perſons who are aſſiſted by concave glaſſes is probably of that kind repreſented in Fig. II. becauſe as the refraction of a lens affects any rays that fall on it (except that in its axis) and as the refraction is conſtantly greater the more remote the incident rays are from the axis, ſo where ſuch a glaſs renders viſion diſtinct, errors of refraction muſt have taken place in the eye, previous to the

the application of the glaſs, equal and contrary to thoſe refractions which have removed them.

If the defect were not of this nature, but that all the rays were brought to a focus in the ſame point before the retina, a
Fig. III. lens, the refraction of whoſe central parts would bring the rays near the axis to a focus at the retina, will, by the greater refraction of its exterior parts, remove the focus of the more remote rays behind the retina. Or even though all the rays did not meet in a point, yet if their interſections were all very
Fig. IV. cloſe to each other, and at a conſiderable diſtance from the retina, the effect of a conclave glaſs would be the ſame as before, and while it deſtroyed the diffuſion of the central rays, would leave a diffuſion of the exterior rays remaining, or vice verſa.

On the other hand, if the foci of the extreme and central
Fig. V. rays within the eye fall before the retina, and are too diſtant from each other, no double concave of the uſual form (i. e. of equal curvature on each ſide) can deſtroy the error of the one kind of rays, without generating or leaving one of the other kind.

Now, if any glaſs can be contrived in which the quantity of refraction of the central rays can be made the ſame as in a double concave, while that of the exterior rays is diminiſhed, it would ſeem that the former error might be avoided; and on the contrary, that the laſt mentioned error might be compenſated, if the glaſs were ſo contrived as to make the exterior rays ſuffer a greater refraction than they do in the double concave, the

the refraction of the central rays remaining the ſame as before. And perhaps it will appear that theſe effects may be produced by a concavo-convex glaſs of greater curvature on the concave ſide than on the convex, eſpecially if the thickneſs of ſuch a lens be made greater than uſual; becauſe the thicker the lens is, the nearer will an exterior ray be brought to the vertex of the ſecond ſurface, and therefore its incidence, and conſequently its refraction by that ſurface, will be the leſs, as in Fig. VI.; vice verſa in Fig. VII.

We ſee that in the double concave the refraction of an exterior ray, by the firſt ſurface, is greater than that of a central ray, and as its effect is to cauſe a divergence, the refraction of the firſt ſurface will add more to the effect of the ſecond ſurface (which is alſo to cauſe divergence) upon the exterior rays than upon the central.

1. In the ſame manner in the concavo-convex (the rays falling on the convex ſide) the refraction of the exterior rays by the firſt ſurface is greater than that of the central rays; but theſe refractions are decrements of the divergence cauſed by the ſecond ſurface; therefore the divergence of the exterior rays is more diminiſhed than that of the central rays, and therefore may be made leſs than that of the exterior rays made by a double concave, while the divergence of the central rays cauſed by both is the ſame.

2. Let the rays fall on the concave ſide, Fig. VIII. In this caſe the divergence of the exterior rays by the concave is greater than

 that

that of the central rays; hence the incidence of the exterior rays on the ſecond ſurface may be made leſs than that of the central rays, and therefore the refraction of the former ray into air may be leſs than that of the latter; that is (ſince theſe refractions cauſe a convergence) the divergence of the exterior rays is leſs diminiſhed than that of the central, therefore the exterior rays will for both reaſons diverge more than the central.

This, it will be ſaid, is equally effected by a double concave; but if the curvature of the firſt ſurface in the concavo-convex be conſiderable in reſpect of that of the ſecond ſurface, it may be brought to paſs that the incidence of the exterior rays on the ſecond ſurface ſhall be of a different affection from that of the central rays, and therefore that the refraction of the ſecond ſurface may augment the divergence of the former, while it diminiſhes the divergence of the latter, and thus cauſe a greater divergence of the exterior rays than can be effected by the double concave, while the divergence of the central rays cauſed by both is the ſame.

These expedients ſeem capable of correcting the unuſual errors of ſhort ſight, that cannot be removed by any double-concave glaſs, if they ſhould be occaſioned by the cauſes that I have ſuppoſed, i. e. by conſiderable errors of ſphericity.

And it ſeems probable, from what has been ſaid, that ſuch defect is occaſioned by thoſe cauſes, where perſons of the above deſcription are aſſiſted in viſion by looking through a pin-hole, and

and that they may try the effect of the concavo-convex poſſibly with advantage.

And if any chromatic errors ſhould accompany theſe errors of ſphericity, as probably there would, they will be diminiſhed or removed by the diſperſion that attends the refraction of the glaſs.

But where the application of a pin-hole to the eye does not render viſion more diſtinct, the defect probably does not ariſe from ſuch imperfect ſtructure * of the eye as has been ſuppoſed, but from ſome other cauſe, as turbid humours, calloſity of the retina, or reflexion of the oblique rays from the ſides of the eye, by which the pictures on the back part of the retina would be confuſed.

Dr. Porterfield and others account for the diſtinctneſs afforded to ſhort-ſighted perſons by looking through a pin-hole, by the diminution of the breadth of the pencil incident upon the retina, ſuppoſing ſtill that all the rays *interſect in one point within the eye*; but beſide that the breadth is not ſo much leſſened on that hypotheſis as on the hypotheſis here given, and therefore the phænomenon not ſo adequately accounted for, it alſo ſeems a very extraordinary and improbable ſuppoſition, that while all the nume-

* It is poſſible that the ſtructure of the eye might be ſuch as that the foci of the exterior and central rays would fall at different ſides of the retina, which defect would not be eaſily remedied; but even this I conceive might be accompliſhed by combinations of different lenſes, like the compound object-glaſſes of Dolland.

rous parts of ſo delicate an organ as the eye are diſordered or deranged, yet that ſo exact a *harmony in error* ſhould be obſerved among them, as to bring the rays of every different poſition to one common interſection at an improper place.

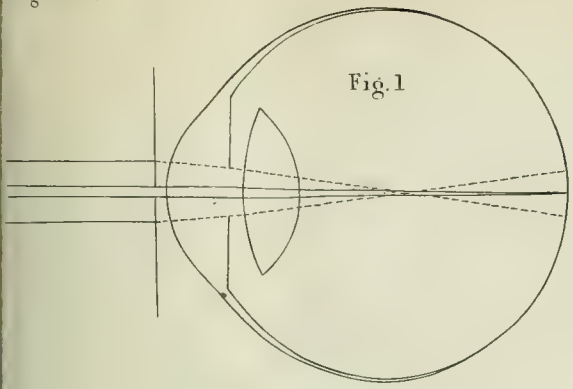
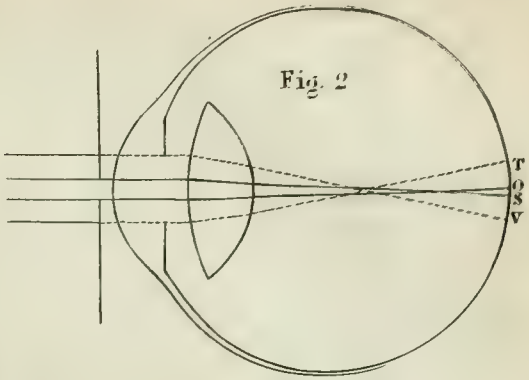


Fig. 1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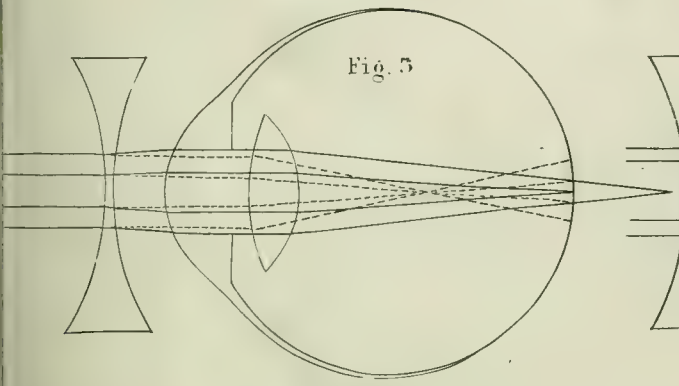
Fig. 3

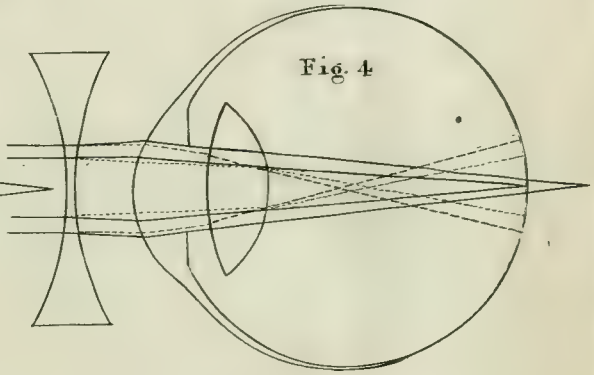
Fig. 4

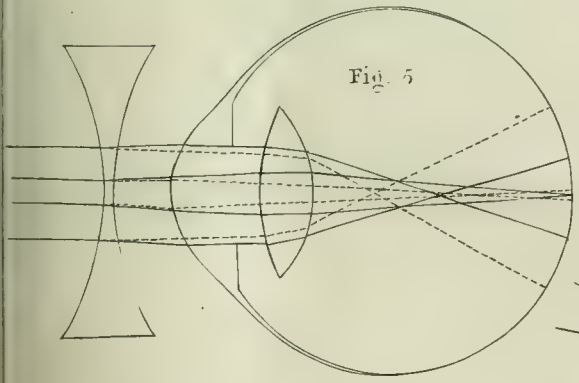
Fig. 5

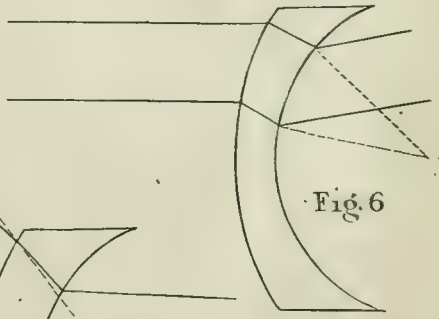
Fig. 6

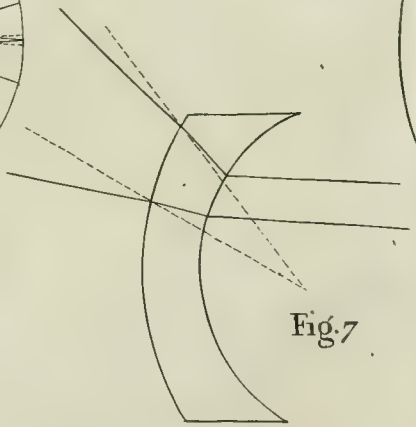
Fig. 7

# *An Account of ſome* OBSERVATIONS *made with a view to aſcertain whether* MAGNIFYING POWER *or* APERTURE *contributes moſt to the diſcerning ſmall Stars in the Day. By the Rev.* HENRY USSHER, *D. D. M. R. I. A. and F. R. S.*

IT has long been a diſputed point amongſt aſtronomers, nor is it, I believe, yet decided, whether aperture or magnifying power contributes moſt to the diſcerning ſmall ſtars in the day. Read Feb. 2, 1788.

THE following experiments and obſervations, made with the tranſit inſtrument of our obſervatory, may perhaps tend to throw ſome light on the ſubject: they were made with care, and are certainly related without prejudice, for the concluſion I arrive at, is contrary to what I ſuppoſed previous to experiment.

THE tranſit inſtrument of the obſervatory is furniſhed with three different ſyſtems of eye-glaſſes, making the magnifying powers of the inſtrument about 200, 400 and 600. Theſe ſyſtems being conſtructed by Mr. Ramſden upon the principle indicated

indicated by him in a paper publiſhed in the Tranſactions of the Royal Society, may be changed at pleaſure, without diſturbing the line of collimation, or altering the quantity of the celeſtial ſpaces, ſubtended by the intervals of the wires; this inſtrument, therefore, ſeems very proper for the purpoſe.

I SHALL ſet down the obſervations juſt as I made them, although the firſt ſet is not concluſive, as they compare magnified areas with lineal apertures.

THE diameter of the object-glaſs is $4\frac{2}{10}$ inches. I made three diaphragms of paſteboard, with apertures whoſe diameters were inverſely proportional to the ſquare roots of the magnifying powers; and by means of theſe I could compare ſeverally 600 and 200, 400 and 200, and 600 and 400; although, as remarked above, theſe compariſons are not exactly juſt.

THINGS being in readineſs, I began my experiments on December 2d; and in theſe I did not depend ſolely on my own eye; I thought it better to put them to the teſt of eyes leſs uſed to aſtronomical obſervation, yet ſufficiently acquainted with the practice, to find ſmall ſtars in the field of view.

θ BOOTIS of the fourth magnitude paſſed 2H. 12′ before the ſun: this ſtar was viſible with 200, but incomparably better with 600 with the diminiſhed aperture; it appeared with a planetary roundneſs. This trial was made by me.

β URSÆ

β URSÆ minoris, to an unpracticed eye, appeared confeſſedly better with 600 than 200

SECOND γ Urſæ minoris paſſed 1 H. 7' before the ſun. The ſame eye gave the ſame concluſion.

γ SERPENTIS 3d magnitude paſſed 52' before the ſun: not viſible to me with 200 and whole aperture; ſeen with 600, and the proportional diminution of aperture; and ſhewn to another perſon; ſought for again with 200, but in vain *.

θ and η DRACONIS, both of 3—4 magnitude; the latter paſſed 12' 32" before the ſun; viſible with both powers, but far better with 600 to an eye that had ſome practice, and alſo to me.

DECEMBER 4, ſecond γ Urſæ minoris, not diſcoverable with 200, plainly ſeen with 600 by an eye totally unuſed to obſervation.

δ DRACONIS, not viſible to the ſame with 200, ſeen plainly with 600; afterwards diſcovered with 200, but with difficulty.

N. B. THIS day was a little hazy, with thin clouds, through which both by night and day the 600 had the advantage, and ſhewed to my eye many ſtars that were inviſible with 200. I mention this, becauſe I at firſt ſuſpected, that although the great power had the advantage in the clear blue ſky of December 2d,

* This ſtar was very near the ſun, and its being viſible is a ſtrong proof of the excellence of this inſtrument

yet

yet perhaps it might be inferior in another ſtate of the air, by magnifying the haze and vapors; but the obſervation of $\gamma$ Serpentis in the glare of the ſun on the 2d, and many ſtars both by night and day on the 4th, confirm the ſuperiority of 600.

I NEXT prepared a ſet of diaphragms whoſe areas of aperture were inverſely proportional to the magnified area of the object.

DECEMBER 12th, $\beta$ Urſæ minoris diſtinct and magnified with 600; diſtinct alſo but not magnified with 200: this ſtar is too bright for any concluſion to be drawn.

1ſt $\gamma$ Urſæ minoris, a very ſmall ſtar, viſible with 600, with its proportional aperture; inviſible with 400.

MANY other trials proved the ſuperiority of the great magnifying power with diminiſhed aperture: I cannot omit mentioning one more.

DECEMBER 29th, $\beta$ Lyræ paſſed 7' after the ſun; this ſtar, of the 3d magnitude, and ſo near the ſun, I had little expectation of ſeeing. I ſought it in vain with 200 and 400, but ſaw it plainly and obſerved its paſſage with 600, having an aperture rather ſmaller than juſt proportion demanded. I ſhewed the ſtar to another perſon before it quitted the field of view.

FOR the ſuperiority of magnifying power the following cauſes may be aſſigned:

THE

The principal one, perhaps, is the quickneſs of the ſtar's motion in the field of view. That this contributes to perception I collect from hence; that when a ſtar, although within the field, does not immediately preſent itſelf to the eye, as is ſometimes the caſe with Jupiter near the ſun, if the teleſcope be gently moved, the apparent motion of the ſtar immediately diſcovers its place.

Another reaſon may perhaps be the magnified image of the ſtar which thus becomes a more perceptible object, even though its light is diminiſhed; this amplification, as far as I can perceive, is nearly in the inverſe proportion of the aperture; in very conſiderable diminutions at leaſt, it ſeems to follow this proportion: thus with an aperture $\frac{3}{10}$ of an inch the polar ſtar took 64" to paſs the wire: with one of $\frac{6}{10}$ 32",5: but with $\frac{9}{10}$ 30", and with 2,8 inches 19".

I at firſt ſuſpected that this amplification aroſe from ſome unavoidable error in the object-glaſs, which created a circle of diſſipation around the principal image, which circle became viſible in proportion to the darkneſs of the field; but by the following experiment it ſeems to ariſe from the inflexion of light. I made a rectangular aperture $\frac{3}{10}$ of an inch broad, and $\frac{6}{10}$ long; when this aperture was applied vertically, it gave me an elliptical horizontal image; and when applied horizontally, it gave me an elliptical vertical image. Alſo when I applied a triangular aperture, it gave an image nearly the ſhape of a pear; the broad end being formed by the vertex, and the narrow end by the baſe: the triangle was formed with a long baſe and ſmall altitude, ſo

that the effect of the other angles on the image became insensible to the eye.

I SHALL conclude with pointing out an advantage that I reap from this circumstance: By means of a considerable diminution of aperture, I make the polar star so distinctly round and large, that I observe the appulse of its limbs to each edge of the wires, as well as the passage of its centre over them; by which means much greater precision is obtained in proving either the collimation or meridian.

# *An Essay on the* VARIATIONS *of the* BAROMETER.

*By* RICHARD KIRWAN, *Esq; M.R.I.A. and F.R.S.*

Read March 1, 1788.

AMONG the various purſuits which for upwards of a century have engaged the attention, and exerciſed the ingenuity of the philoſophic world, none has the merit of contributing ſo largely to the general ſtock of natural knowledge, nor is there any from which mankind has derived ſuch extenſive and immediate advantage, as from that which has the nature and properties of the atmoſphere for its object. To ſay nothing of the profound reſearches of a Scheele, a Cavendiſh or a Prieſtley, which have ſo happily developed the more ſecret and intimate qualities of this inviſible fluid, it is from the inveſtigation of its more general and obvious properties, its gravitation, denſity and elaſticity, that mechanicks and aſtronomy have received many of their greateſt improvements. The inſtrument which firſt led philoſophers to ſuſpect, and which at laſt fully confirmed the exiſtence, and even defined the extent and limits of theſe properties, was the barometer. Through it the weight of the whole atmoſphere which ſurrounds the earth,

a problem which before its invention muſt have appeared far beyond the reach of human abilities, has been determined. It was this inſtrument, which in the hands of Otto Guericke and our immortal countryman Mr. Boyle, ſuggeſted the invention and improvement of the air-pump, and thus paved the way for the numerous diſcoveries to which this latter gave birth. To this inſtrument we ſtand indebted for our knowledge of the elaſticity, condenſation and rarefaction of the air; properties which have ſince been ſo happily applied to the conſtruction and improvement of hydraulic machines, and the menſuration of heights. To it we owe a more accurate knowledge of the laws of the vibration of pendulums, and of thoſe of the refraction of light; diſcoveries from which aſtronomy, and conſequently navigation, have derived the greateſt advantage. Nay, it may with truth be aſſerted, that it is to this inſtrument that modern philoſophy owes its exiſtence, and modern Europe its ſuperiority over all other regions; for it was the Toricellian experiment that firſt demonſtrated the futility of the antient mode of philoſophiſing, and the advantages of experimental inveſtigation, and thus excited the more civilized nations to thoſe purſuits, which have ſince rendered them as ſuperior both in arts and arms to the more ignorant, as men are to brutes.

Great, however, as has been the ſucceſs attendant on the ſtudy and application of the obſervations made by the help of the barometer, the bulk of mankind have always expected ſtill more from it: Nothing leſs indeed than a prognoſtic of the weather. Nor is this expectation entirely vain; particularly in the circumſtance in which ſuch foreknowledge is of moſt importance.

tance. The marine barometer, if we may credit the moſt reſpectable authorities, that of Doctor Halley *, Captain Middleton †, Lord Mulgrave ‡, and many French navigators §, never fails to indicate a ſtorm ſeveral hours before-hand. But with reſpect to leſs conſiderable changes of weather, it muſt be allowed that its variations afford no indications abſolutely certain, though with certain reſtrictions they afford ſome ground for probable conjecture; and the reaſon of this difference is (as will more plainly appear in the ſequel) becauſe the height of the mercury in the barometer hath no immediate and neceſſary connexion either with rain or fair weather. That its variable height is the immediate conſequence of the variable preſſure of the atmoſphere admits of no doubt, but the cauſe or cauſes of this variable preſſure have not yet been fully aſcertained; many indeed have been ſuggeſted, but none that reached the full extent of the phænomena. This acknowledged want of ſucceſs of my predeceſſors in this enquiry, at the ſame time that it entitles me to make further reſearches in this intricate ſubject, will, I hope, plead my apology in caſe they prove equally unſucceſsful. In order to lay the whole matter fully before the Academy, I ſhall firſt ſtate the principal obſervations made on the variations of this inſtrument; ſecondly, the principal cauſes to which theſe variations have hitherto been referred, with a few remarks to ſhew the inſuf-

* IV. Phil. Tranſ. Abr. Part II. p. 6.

† VIII. Phil. Tranſ. Abr. p. 468.

‡ Phipps's Voyage, p. 74.

§ Encyclop. par Ordre des Matieres Navigation, tom. i. p. 112.

ficiency

ficiency of thefe caufes; and laftly, I fhall explain that which to me feems more adequate to the effect.

## FIRST OBSERVATION.

The more confiderable elevations and depreffions of the ☿ in the barometer happen at a very fhort interval of time in places very remote from each other. This correfpondence was obferved by Mr. Derham in 1699 between the heights of the ☿ at Upminfter in Effex and Townley in Lancafhire; and afterwards by Mr. Maraldi, between the variations at Paris and Genoa *, at the diftance of nearly four degrees of latitude. Mr. Derham alfo obferved nearly the fame agreement between barometers at Berlin, lat. 53°, and Pithæa, lat. 65° †; as did Afclepi between thofe at Rome, lat. 42°, and at Padua, lat. 45° ‡. But I have remarked that where there is a confiderable difference of longitude, the like agreement is not found. Thus Mr. Hadley found that at London and Padua the variations are frequently in oppofite directions §; and fo they commonly are at Ponoi, lat. 67°, long. 47° E. and Peterfburgh, lat. 60° long 30° E.; and the difcordance is ftill greater between the variations at Peterfburgh and thofe at Jakutfki, lat. 62°, long. 129° E. ||; Maraldi obferved alfo that different winds prevailed at Paris and Genoa during the corref-

* Mem. Par. 1709.

† VIII. Phil. Tranf. Abr.

‡ La Cotte Metereol. p. 181.

§ VIII. Phil. Tranf. Abr. p. 587.

|| XIV. N. Act. Petrop.

ponding

ponding variations. On the other hand, variations in a contrary ſenſe, but inconſiderable in their extent, are often obſerved in places very near to each other, as Franeker and Lewarden, as Mr. Van Swinden aſſures us *.

## SECOND OBSERVATION.

The deviations of the ☿ from its mean annual altitude are far more frequent and extenſive in the neighbourhood of the poles than in that of the equator. At Peterſburgh, An. 1725, the ☿ once ſtood at the ſtupendous height of 31,59 inches, if we may credit Mr. Conſett; and yet it has been ſeen ſo low as 28,14 inches. In the northern parts of France the variations are greater than in the ſouthern †; at Naples they ſcarcely exceed one inch ‡. In Peru, under the equator, and at the level of the ſea, they amount only to two or three-tenths of an inch; but in other parts, within a few degrees of the line, on the approach of the rainy ſeaſon or of hurricanes, the barometer falls an inch or more §.

## THIRD OBSERVATION.

The variations without the tropics are greater and more frequent in the winter than in the ſummer months. VIII. Phil. Tranſ. Abr. 605. La Cotte, 298.

* Obſervations ſur le froid de L'anneé 1776, p. 55. VIII. Phil. Tranſ. Abr. p. 555.

† La Cotte, p. 186.

‡ VIII. Phil. Tranſ. Abr. p. 566.

§ Boug. Fig. XXXIX. Phil. Tranſ. 1778, p. 182. Hiſt. of Jamaica, Vol. I. p. 372.

FOURTH

## FOURTH OBSERVATION.

The variations are conſiderably ſmaller in very elevated ſituations than on the level of the ſea. Thus Mr. Bouguer obſerved that while on the coaſts of Peru the variations extended to $\frac{1}{4}$ of an inch; at Quito, elevated 9374 feet above the ſea, they reached only to 0,083 of an inch. Mr. Sauſſure made ſimilar obſervations in Savoy, as did Mr. Lambert in Switzerland. II. Sauſſ. Voy. aux Alpes, p. 577.

## FIFTH OBSERVATION.

The mean height of the barometer on the level of the ſea in moſt parts of the globe hitherto examined is about 30 inches. Mr. Bouguer under the line obſerved it at 29,908 inches; but as his barometer was not purged of air by fire, it ſtood lower than it ſhould. Sir George Shuckburgh, on a mean of ſeveral obſervations on the coaſts of Italy and England, found it at 30,04, when the temperature of the ☿ was 55°, and that of the air 62°. In the proximity of the poles the annual mean heights of the barometer differ much more from this ſtandard than in the more ſouthern parts of our hemiſphere.

As to the connection of the variations of the barometer with the weather, the four following obſervations, made by Dr. Halley in England, ſeem to be moſt univerſal, as they were found by Mr. Melander to apply to lat. 39° *, and by Mr. De Luc to lat. 46° †.

* Schwed. Abhand. 1773, S. 255.

† 1 De Luc Modif. p. 77.

SIXTH

## SIXTH OBSERVATION.

" In calm weather, when the air is inclined to rain, the ☿ is " commonly low."

## SEVENTH OBSERVATION.

" Upon very high winds, though not accompanied with rain, " the ☿ ſinks loweſt, having regard to the quarter from whence " the wind blows."

## EIGHTH OBSERVATION.

" In ſerene and ſettled weather the ☿ is generally high, as " alſo in calm and froſty weather."

## NINTH OBSERVATION.

" The greateſt heights of the ☿ are found upon eaſterly and " north eaſterly winds; to which we may add, that under a " ſoutherly wind it is commonly low."

The cauſes to which theſe phænomena have been aſcribed, are, firſt, variations of temperature; ſecondly, the velocity and other qualities of different winds; thirdly, the agency of vapors.

### *Of the Influence of different Temperatures.*

That air is rarified by heat and condenſed by cold is well known; and it is equally ſo, that denſe air is heavier than that

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which is rarer; but then the maſſes muſt be unequal; for while they remain the ſame the weights muſt be equal, and conſequently ſo muſt the heights to which they elevate the mercury. If, therefore, an alteration of temperature alters the height of the barometer, it muſt be by diminiſhing or encreaſing the maſs of the atmoſphere. Now it appears by obſervation, that a variation of the maſs of the atmoſphere is not a neceſſary conſequence of an alteration of the temperature; for the ☿ is often at the ſame height at different ſeaſons, and at different places in the ſame ſeaſon; for inſtance, in winter, at London and Peterſburgh, though the temperatures at thoſe ſeaſons and places be very different; and even when the height of the ☿ changes ſimultaneouſly with the temperature, the change is often directly contrary to that which the change of temperature would lead one to expect. Thus on the 9th of January, 1777, at eight o'clock in the morning, the thermometer at London ſtood at 19° under a N. wind, and the barometer at 29,69; but at two o'clock in the afternoon, the wind being W. by S. the thermometer roſe to 31,5, and the barometer to 29,7, inſtead of falling, as might be expected, from an encreaſe of 12,5 degrees of heat. Phil. Tranſ. 1778, p. 574.

Besides, great changes of temperature take place only in the lower atmoſphere; in the higher regions they are inconſiderable. Now any increment or decrement of the maſs of the lower atmoſphere that can be aſcribed to a change of temperature is too ſmall to produce any conſiderable alteration in the height of the barometer; for in winter the height to which any conſiderable variation of temperature may be ſuppoſed to extend, ſcarcely

ſcarcely exceeds 5000 feet, as we learn from the teſtimony of aeronauts and the height of clouds; and indeed the winds that prevail on the ſurface of the earth, and which are the primary agents of a change of temperature, ſeldom reach higher, and in the more northern regions not ſo high. Thus, on the 1ſt of December, 1783, at Paris, while a S. wind prevailed below, a N. wind prevailed at the height of 1280 feet *; and the ſame oppoſition was found in the currents of air at the ſame height at Piſançon in January, 1784. At Ponoi the clouds are frequently ſeen unmoved during the moſt violent ſtorms †; yet on the 21ſt of December, 1779, the thermometer in the open air being at 49°, and the wind S. S. E. the barometer ſtood at 28,91 inches; but the next day, the wind turning to N. N. W. the thermometer fell to 30°, and the barometer roſe to 29,89 inches. Here the difference of temperature is 19°, and the variation of the barometrical height nearly $\frac{9}{10}$ of an inch. Let us now examine how this fact can be explained on the ſuppoſition that the maſs of the lower atmoſphere is encreaſed in proportion to the condenſation of its volume.

In the firſt place, we may aſſume that heat in its progreſs upwards decreaſes nearly in an arithmetical progreſſion. The barometrical method of meaſuring heights is in a great meaſure founded on this ſuppoſition; and as the errors of this method do not exceed 2 or 3 feet, and ſeldom 1 foot in 1000, it may be looked upon as ſufficiently exact, and conſequently ſo may the

* Mem. Par. 1782, p. 650.

† II. Faujas Balons, p. 274. XVI. N. Act. Petrop. p. 68.

ſuppoſition on which it is grounded. On examining a conſiderable number of obſervations of this ſort, I find that the differences of heat at different elevations are to the differences of the logarithms of the mercurial heights at thoſe elevations, very nearly, as 160 to 1; and the difference of the logarithms may be found ſufficiently near, by dividing the elevation in feet by 60000. If then, in the inſtance above given, the S. wind reached the height of 5000 feet, the difference of the logarithms ſhould be $\frac{5000}{60000}$=,083333, which multiplied into 160, gives 13°,33 for the difference of temperature at the ſurface of the earth and at that height; and the former being 49°, the latter muſt have been 35°,67, and conſequently the mean temperature of the ſouthern air 42,$\dot{3}3$. Again, ſuppoſing the N. wind to have obtained the ſame height, the temperature at the ſurface of the earth being 30°, that at the height of 5000 feet ſhould be 16°,67, and the mean temperature 23,33; or in round numbers, the mean temperature of the ſouthern current was 42°, and that of the northern 23°, and the difference of both temperatures 19°. Now 5000 feet = 60000 inches; and by General Roy's experiments *, it appears that 1000 parts of air at the temperature of 42° loſe about 40 of their bulk by 19° of cold, and conſequently 60000 ſhould loſe 2400. But as in this caſe the height of the column of air is ſuppoſed to be the ſame after condenſation as before it, its maſs or denſity muſt be encreaſed by the addition of 2400 inches, which when the barometer is at 29,89, and the thermometer at 23°, weigh 762,36 grains; and as one-tenth of an inch of ☿, even at the temperature of 62°, weighs 344,32

* Phil. Tranſ. 1777, Part II.

grains,

grains, it appears that the above acceſſion of weight to the column of air that ſupports it can raiſe it little more than $\frac{3}{10}$ of an inch, inſtead of nearly $\frac{9}{10}$, the variation to be accounted for. This cauſe, therefore, though not abſolutely inefficient on the ſuppoſition that the whole maſs of the ſuperincumbent column is encreaſed by the acceſſion of new air in proportion to the condenſation, is notwithſtanding inadequate to the effect produced.

## *Of the Influence of Winds.*

The winds, whoſe efficacy in producing the variations of the barometer I am about to diſcuſs, are thoſe which reign in the lower regions of the atmoſphere, they being principally referred to by thoſe philoſophers who have had recourſe to their agency.

First. Doctor Halley attributes the riſe of the barometer over its mean altitude to the accumulation of air over the place of obſervation, which accumulation he attributes to two contrary winds blowing towards that place; but if this were the cauſe of the elevation of the mercury, we ſhould always have a calm when the ☿ ſtands higheſt; for the accumulation ſhould take place only when the two contrary winds blow with equal force, ſince if one of them prevails it ſhould repel its antagoniſt, and it is only during the prevalence of neither that the air can be accumulated. Now it is notorious that the greateſt mercurial heights are accompanied by an eaſterly or northerly wind, as he himſelf has obſerved. Nor can that equality of barometrical heights

heights which we have mentioned in the firſt obſervation to take place in very diſtant countries, in which very different winds prevail, be explained in this hypotheſis. It is moreover flatly contradicted by the obſervation of Mr. Forth, who, while the mercury all over England ſtood lower than ever it was known to do, found that a N. E. wind prevailed in the northern part of that iſland, and a S. W. in the ſouthern. VIII. Phil. Tranſ. Abridg. p. 497.

Secondly. In this hypotheſis the deſcent of the ☿ beneath its mean altitude is aſcribed to the rarefaction of the atmoſphere over the place of obſervation, owing to its exhauſtion by two contrary currents; for inſtance over England, if it ſhould blow a weſterly wind on the German, and an eaſterly wind on the Iriſh ſea. But a rarefaction in ſuch circumſtances from ſuch a cauſe ſeems to me impoſſible; for if ſuch currents took place, the northern or ſouthern air would flow in to maintain the equilibrium in the ſame proportion; or if this did not happen, and that four contrary currents took place, the higher air ſhould deſcend, and cauſe a ſenſible cold, which yet is ſeldom obſerved in England when the ☿ is low; on the contrary, a warm S. wind commonly prevails, to whoſe temperature nevertheleſs the rarefaction cannot be aſcribed, as we have already ſeen.

Thirdly. The great deſcent of the ☿ on high winds in ſtorms is thus explained by Doctor Halley: "The region of "the earth wherein thoſe winds rage, not extending round the "globe, the ſtagnant air left behind, and that on the ſides, can-"not ruſh in faſt enough to reſtore the evacuation made by ſo

"ſwift

" ſwift a current, ſo that the air muſt be attenuated where the " ſaid winds continue to blow."— " Add that the horizontal " motion, being ſo quick, may take off ſome part of the per- " pendicular preſſure." This laſt reaſon ſeemed to acquire ſome confirmation from an experiment made by Mr. Hawkſby; for having paſſed a ſtream of air through a box in which the lower ſhank of a barometer was inſerted, this ingenious gentleman obſerved the ☿ to fall while the current paſſed through the box, as alſo in another barometer which communicated with the box, but over which the current of air did not flow.

Yet if all this were allowed, ſtill the phænomenon in queſtion would remain unexplained; for not only during the ſtorm, but ſeveral hours, if not days before it, the mercury deſcends conſiderably, as Doctor Halley himſelf and all thoſe who recommend the marine barometer atteſt, otherwiſe this inſtrument would be uſeleſs. Mr. Caſwell ſays that two days before the great ſtorm of January, 1734-5, the ☿ fell $\frac{1}{10}$ of an inch below 28 inches *. But even if the fall were barely concomitant with the ſtorm, Doctor Halley's reaſons would not prove their connexion. That a body ſhould move through air with ſuch velocity as to leave a vacuum behind it, there is a neceſſity that it ſhould move at the rate of 11 or 1200 feet per ſecond, as Mr. Robins has ſhewn; now the ſwifteſt wind moves only at the rate of 92 or 93 feet per ſecond, as appears by the obſervations of Mr. Brice and many others †.

* VIII. Phil. Tranſ. Abr. p. 458.

† Phil. Tranſ. 1766, p. 266.

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The insufficiency of the second reason alledged by Doctor Halley has been clearly shewn by Mr. De Luc; nor is the experiment of Mr. Hawksby conclusive, as it appears that part of the air already confined in the boxes was forced out by the blast of air; and to remove all doubt of the insufficiency of this explanation, I need only mention the observation of Mr. Derham, that during the greatest vehemence of storm the ☿ rises instead of falling lower. IV. Phil. Transf. Abridg. Part II. p. 77. And I have had occasion to make the same observation on the 28th of February, 1785, in London.

*Of the Influence of Vapors.*

The influence of vapors was never totally overlooked by any of the philosophers who undertook to explain the variations of the barometer, though the part they really act was little understood by any except Mr. De Luc. However, within these few years the greatest light has been thrown on this subject by Mr. De Saussure, in his incomparable treatise on hygrometry. He very justly distinguishes two sorts of vapors; the *invisible*, to which the name of vapor is most properly applicable, and the *visible*; of this last there are two sorts, the *vesicular* and the *concrete*. The invisible are specifically lighter than air of the same temperature, as Mr. De Luc has shewn by numerous observations, and Mr. De Saussure by direct experiments; but the *vesicular* are of the same specific gravity as the air in which they subsist. To understand the influence of both species of vapors on the barometer, it is necessary to enumerate some of their principal properties, and shew how air is affected by them.

First.

First. Mr. De Sauſſure and General Roy have proved that water in its ſolid ſtate evaporates in every degree of cold between 0 and 32°, as it is well known to do in its liquid ſtate, and in far greater proportion in all degrees ſuperior to 32°.

Secondly. Though water evaporates more quickly and in greater quantity *in vacuo* than in open air (and conſequently its evaporation cannot be attributed to its affinity to air) yet it would ſpeedily be condenſed back again into water by contact with colder bodies if it did not adhere to air, which therefore chiefly ſupports it in a vaporous ſtate, and thus the different opinions of philoſophers on this ſubject may be reconciled. Mr. Sauſſure has ſhewn that the power of air to ſupport vapor diminiſhes with its denſity, but not in the ſame ratio, even though the heat ſhould continue unaltered. This power, therefore, depends partly on its temperature, and partly on its denſity; and hence inviſible vapor abounds more in the lower than in the middle ſtrata of the atmoſphere. Mr. Lambert, in the memoirs of Berlin for the year 1772, has ſhewn that the quantity of vapor at different elevations in the atmoſphere is generally as the ſquares of the mercurial altitudes at thoſe elevations, which I believe to be true in all heights to us acceſſible; but in the very higheſt regions, which are occupied chiefly by inflammable air, I am inclined to think that vapor is more abundant than in the middle ſtrata, as water adheres more ſtrongly to this air than to reſpirable air, and it is probably this circumſtance that gave riſe to the great miſt obſerved in 1783.

Thirdly. To the delicate experiments of Mr. Sauſſure we are alſo indebted for the intereſting diſcovery that a cubic foot

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of air, when ſaturated with vapor in the temperature of 32°, contains about 4 grains of water, and gains 0,1109 of a grain by ſaturation at every degree between 32° and 80°, the barometer being at 28,77; ſo that at 66° it contains when ſaturated 7,7 grains of moiſture, and about 8,7 if the barometer be at 30 inches*. I have often indeed found a greater proportion of moiſture in a cubic foot of air than is here mentioned, but then it was on dark days, in which the air was not perfectly tranſparent, and conſequently abounded in veſicular vapor.

Fourthly. The ſame excellent philoſopher has diſcovered that in the temperature of 65°, the elaſticity of air which paſſes from a ſtate of abſolute dryneſs to that of ſaturation with moiſture, is encreaſed $\frac{1}{54}$, or as I compute $\frac{1}{51}$; and hence he infers that the weight of vapor is to that of air of the ſame temperature as 10 to 14; however, as the weight of common air appears by my own experiments to be much lower than he ſuppoſes it, I conclude the weight of vapor to be to that of common air as 10 to 12. Mr. De Luc, reaſoning from Mr. Watts's experiments, makes the ratio much greater; but as thoſe experiments were made on vapor in a boiling heat, they do not appear to me to warrant that concluſion. The elaſticity of vapors differs much from that of air in this reſpect, that any conſiderable acceſſion of preſſion will reduce them in ſome degree to the ſtate of veſicular vapor, particularly if they are nearly in a ſtate of ſaturation in the compreſſed air.

* The weights and meaſures are reduced to the Engliſh ſtandard.

Fifthly.

Fifthly. Veſicular vapor conſiſts of a number of hollow viſible globules, highly electrified *, and devoid of elaſticity. It forms a ſort of middle ſtate between water and inviſible vapor, and when in large quantity forms *miſts* and *clouds*; when in ſmall quantity it barely diminiſhes the tranſparency of air. It cannot ſubſiſt for any time but in air ſaturated with inviſible vapor, from whoſe decompoſition it ariſes.

Sixthly. The condenſation of vapor ariſes not merely from cold, but from cold and contiguity, otherwiſe vapor could not be formed in a temperature below the freezing point.

From this view of the nature of vapors, and the change they produce in the weight and elaſticity of the atmoſphere, it is plain that their preſence or abſence cannot fully account for the variations of the barometer. For if we ſuppoſe the atmoſphere perfectly dry, the barometer at 30 inches, and the thermometer at 65°, and then a column thereof to be ſaturated with moiſture, its elaſticity being encreaſed $\frac{1}{51}$, it will contain $\frac{1}{51}$ of its volume leſs air than before ſaturation, ſince the encreaſe of its elaſticity ariſes from the introduction of a new elaſtic fluid amounting to $\frac{1}{51}$ of its bulk: And ſince the weight of the whole volume was at firſt equal to that of 30 inches of ☿, its weight will now be leſſened by $\frac{1}{51}$ of 30 inches, that is nearly 0,59 of an inch. But on the other hand it gained $\frac{1}{51}$ of its volume of vapor, therefore its real loſs of weight will be the difference of the weight of $\frac{1}{51}$ of air, and $\frac{1}{51}$ of vapor; but the weight of air is to that of

* II. Sauſſ. Voy. aux Alpes, p. 259.

vapor as 12 to 10, therefore the gain here is 0,49 of an inch, which deducted from 0,59 the loſs, leaves the loſs $\frac{1}{10}$ of an inch. This, therefore, is the variation the barometer ſhould undergo by the paſſage of a column of air from abſolute dryneſs to complete ſaturation, a circumſtance which perhaps never takes place, as the atmoſphere is never abſolutely dry; and yet previous to heavy rains we often obſerve the barometer to fall 3, 4 or 5-tenths of an inch, a fall which we ſee cannot originate from the ſaturation of the atmoſphere with vapor. Nor is there any proportion between the aſcent of ☿ after heavy rains and the weight of vapor condenſed, for in ſuch caſes the ☿ frequently riſes 3 or 4-tenths of an inch; and yet the heavieſt rain ſeldom produces one cubic inch of water, and the weight of a cubic inch of water is not equal to that of even $\frac{1}{10}$ of a cubic inch of ☿.

*Of the unequal Diffuſion of the higher Atmoſphere.*

Having thus ſhewn the inſufficiency of thoſe cauſes to which the variable weight of the atmoſphere and height of the barometer have been uſually referred, I now proceed to explain that which alone ſeems to me adequate to the effects produced; namely, the accumulation of air over thoſe parts of the globe in which the mercury exceeds its mean height, that is the height ſuited to its ſituation, and the diminution or ſubtraction of the natural quantity of air over thoſe regions in which the ☿ falls beneath its mean height. To trace the origin of this accumulation and diminution we muſt conſider what may be called the natural ſtate of the atmoſphere, and how this ſtate is diſturbed.

I call

I call that ſtate the natural ſtate of the atmoſphere in which the barometer on the level of the ſea would ſtand at 30 inches in ſerene weather, conformably to the fifth obſervation. To produce this ſtate, the weight of the atmoſphere muſt be every where equal at the ſurface of the ſea. The weight of the atmoſphere proceeds from its denſity and height; therefore, to produce this equality of weight, it ſhould be loweſt where its denſity is greateſt, and higheſt where its denſity is leaſt. Theſe extremes of denſity take place in the æquatorial and polar regions. Under the æquator, the centrifugal force, the diſtance from the centre of the earth, and the heat, are all at their *maximum*; in the vicinity of the poles, on the contrary, they are at their *minimum*. Therefore, if the height of the ☿ be 30 inches under the æquator and under the poles, the atmoſphere muſt be higheſt under the æquator, and loweſt under the poles, with ſeveral intermediate gradations.

But though the æquatorial air be leſs denſe to a certain height than the polar, yet at certain greater heights it muſt be more denſe; for the mercurial heights at the level of the ſea being equal, the maſſes of the correſponding atmoſpheric columns muſt be equal; but the lower part of the æquatorial column being more expanded by heat, &c. than the correſponding ſection of the polar column, its maſs muſt alſo be ſmaller than that of the correſponding ſection of the polar column; therefore a proportionably greater part of its maſs is found in its ſuperior ſection than is found in the ſuperior ſection of the polar column; therefore the lower extremity of the ſuperior ſection of the æquatorial column is more compreſſed, and conſequently denſer than

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the lower extremity of the ſuperior ſection of the polar column. What is here ſaid of the æquatorial and polar columns muſt be underſtood alſo of the extratropical columns with reſpect to each other, where great differences of heat prevail.

Hence, in the higheſt regions of the atmoſphere, the denſer æquatorial air not being ſupported by the collateral extratropical columns, gradually flows over, and rolls down to the north and ſouth.

These ſuperior tides conſiſt chiefly of inflammable air, as it is much lighter than any other, and is generated in great plenty between the tropics; it furniſhes the matter of the *Aurora Borealis* and *Auſtralis*, by whoſe combuſtion it is deſtroyed, elſe its quantity would in time become too great, and the weight of the atmoſphere annually encreaſed; but its combuſtion is the primary ſource of the greateſt perturbations of the atmoſphere, as will preſently be ſhewn.

If the affluence of the northern and ſouthern air to the æquator by the trade winds kept pace with the effluence of the ſuperior air, an æquilibrium might ſtill in ſome meaſure be maintained. But the trade winds move only at the rate of twelve feet per ſecond, or about eight miles an hour *; whereas, without the tropics, or at leaſt beyond latitude 30°, the currents of the upper atmoſphere are incomparably more rapid †. For as the

* II. Bergm. Erdeklatet, p. 116.

† Sauſſ. Hygr. 300. I. Gentil. Voy. aux Indes, p. 486.

mean

mean heat of the whole ſpace between lat. 0 and lat. 30° is only ſeven degrees leſs than the mean heat under the æquator, the difference of denſity is not ſo great as to cauſe any rapid collapſion of the ſuperior columns within that ſpace; but from lat. 30 to lat. 60° (a much ſmaller ſpace) the mean annual heat over the ocean differs from that of lat. 30° by nearly fourteen degrees *; therefore the rapidity of the upper current towards the polar regions is much greater, and frequent interruptions muſt take place, during which the weight of the atmoſphere will be diminiſhed. And hence, notwithſtanding the high winds that frequently prevail between the tropics, the barometer varies inconſiderably and but ſeldom, whereas without them the variations are frequent and conſiderable, nearly in proportion to the diſtance from the æquator; and thus the ſecond obſervation is ſufficiently explained.

As the tides of the ſuperior atmoſphere flow in greater quantity where they meet with leaſt reſiſtance, the direction of this *maximum* of quantity is different in different ſeaſons of the year, and on different places.

During the ſummer of the northern hemiſphere, as winter then prevails in the ſouthern, the denſity of the æquatorial air becomes ſuperior to that of the ſouthern air at a much lower height than that at which it becomes ſuperior to the northern, which is itſelf expanded by the preſence of the ſun in the northern tropic; therefore the ſuperior exuberance is chiefly

* Eſtimate of the Temperature of different Latitudes, p. 17.

poured

poured on the ſouthern regions, and a comparatively ſmaller quantity flows over the northern; therefore the variations of the barometer are ſmaller with us in the ſummer ſeaſon, according to the third obſervation, and fewer auroras are formed.

As the tops of the higheſt mountains are covered with ſnow even in ſummer, the air over them will remain colder than that over plains, and its columns ſhorter; and hence the ſuperior air in its paſſage to the poles will linger and accumulate over them, until the difference of denſity becomes ſo great as to enable this air to burſt through the hot air that ſurrounds it, and form cold winds that raiſe the barometer in this ſeaſon.

In winter, on the contrary, the ſuperior current is chiefly directed to the northern hemiſphere, and hence the greateſt mercurial heights are found in this ſeaſon. It accumulates where the columns of the inferior air are coldeſt, and conſequently ſhorteſt; that is to ſay, over all that part of Aſia beyond lat. 35, and E. of the Caſpian Sea to the Frozen Ocean, and over the continent of North America, which I have elſewhere ſhewn to be colder than the old continent, and over the polar regions. Hence the barometer uſually ſtands higher in North America, and varies leſs than with us* even in Hudſon's Bay, lat. 59, where the weather is ſo turbulent the barometer varies but 1,37 inches, whereas in Peterſburgh it varies above two†.

* II. Phil. Tranſ. Philad. p. 142.

† Phil. Tranſ. 1770, p. 148.

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The denſer air of the North American continent preſſing on the rarer incumbent on the Atlantic, produces the almoſt conſtant weſterly winds which prevail on the eaſtern coaſts of America *, and in the weſtern parts of Europe below lat. 70°; but above that parallel the ſuperior European current paſſes by a ſhorter way into America, where the cold is greater.

Accumulations are alſo formed in the ſouthern parts of the old continent; for inſtance, over the mountainous tracts of Thibet, Tartary, Turkey in Europe, Africa, and even in ſome degree on the Pyrenees and Alps; when the rarefaction in the northern parts of Europe is frequent and conſiderable, either from the paſſage of the northern air to America, or from frequent and conſiderable auroræ borealis, the ſouthern air flows from theſe tracts to reſtore the æquilibrium; and while this current laſts, and until the æquilibrium is reſtored, the barometer muſt fall in the intermediate regions; ſo that the deſcent of the ☿ is never the effect of a ſoutherly wind, but both it and this wind are concomitant effects of a rarefaction in the northern parts, proceeding from the cauſes already mentioned.

On the other hand the ☿ generally riſes under a northerly or eaſterly wind, becauſe, as I have already ſaid, the ſuperior atmoſphere is accumulated chiefly in thoſe parts of our hemiſphere from whence theſe winds iſſue, and this accumulated air paſſes with them to the ſouthern regions. A certain proof that this accumulation is the true cauſe of their ſuperior denſity is, that

* II. Phil. Tranſ. Philad. p. 99.

when this northerly wind is ſurmounted by a S. W. the ☿ falls; as the ſoutherly wind in the ſuperior regions procures a rarefaction in the ſuperior or northern tracts. See Mr. Derham's obſervations, IV. Phil. Tranſ. Abr. Part II. p. 71; and that mere cold is no way concerned in the variation cauſed by this wind appears in various inſtances, to which I refer in the notes *.

In the ſame manner when the ☿ falls previous to a ſtorm, both the ſtorm and this fall proceed from a great rarefaction in the air in the quarter towards which the ſtorm blows; which rarefaction proceeds from the diminution or deſtruction of the ſuperior atmoſphere.

As the ſuperior accumulation is derived to us chiefly from North America, where it moſt frequently arrives at its *maximum*, hence it is, that the variations of the barometer generally begin to the weſtward with us in Europe, and are thence gradually propagated eaſtward (as Mr. Planer obſerved on comparing thoſe of London and Vienna †) and comprehend nearly at the ſame time diſtant degrees of latitude, but not of longitude, according to the firſt obſervation; as the appulſe of the ſuperior accumulation to the European ſhores may be extenſive, but its propagation eaſtward muſt be progreſſive. In ſpring the current of ſuperior air begins to flow to the ſouth, and in autumn to return

* II. Phil. Tranſ. Abr. p. 4, 61, 62. VIII. Ditto, p. 614. Phil. Tranſ. 1778, p. 574. Mem. Par. 1709, p. 302, in 8vo.

† II. Ephem. Palat.

from

from it; hence the equinoctial ſtorms and frequent variations of the barometer in thoſe ſeaſons.

The quantity of æquatorial air devolved on our hemiſphere in different years is variable, and ſo is the quantity conſumed in the northern regions; hence the mean barometrical height is different in different years. A ſet of obſervations on the changes that take place between the tropics in different years, compared with thoſe that happen in northern and intermediate regions, would remove all the obſcurities that attend a minute conſideration of this ſubject. Barometers in the middle latitudes might appriſe us of the quantity of air derived to our hemiſphere, and thoſe in polar regions might inform us of the quantity conſumed; but as theſe obſervations have not been yet made, we muſt content ourſelves with a general view of what appears to be the principal cauſe of theſe different annual variations.

In ſome years the accumulation reſting on the mountainous countries of the ſouth of Aſia and Europe, and the northern part of Africa, is greater than in other years, owing perhaps to a greater or earlier fall of ſnow; when this happens the northern air is lighter and the ſouthern colder than uſual, and ſouth winds principally prevail, which, in the northern parts (uſually ſubject to far greater cold) muſt appear comparatively warm; hence, when the winter is remarkably ſevere in the ſouth of Europe and Aſia, it is often as remarkably mild in the northern parts, and the barometer low.

Though clouds and a diſpoſition to rain frequently follow the deſcent of the ☿, yet this deſcent is not the immediate conſequence of either clouds or rain; on the contrary the ☿ frequently riſes during rain. But the rarefaction of the atmoſphere which produces the deſcent of the ☿, and which ariſes from the removal of the ſuperior accumulation, is favourable to the production of clouds, as a heavy atmoſphere, though it ſupports vapors once formed, obſtructs evaporation; when, therefore, its weight is diminiſhed, and evaporation encreaſed, it ſoon becomes ſaturated in the higher regions, and clouds are formed. But rain ſeems to ariſe from a ſubtraction of the electrical fluid, which, when the air abounds with vapors, is eaſily conducted to the earth. In ſerene and ſettled weather the ☿ is generally high, becauſe the greateſt diſturbances of the atmoſphere are connected with its rarefied ſtate, which is commonly pretty diſtant when the ſuperior accumulation is conſiderable.

That the variations of the mercurial heights ſhould be greater at the level of the ſea than at great elevations above that level is very natural. For ſuppoſing the ☿ at the level of the ſea to ſtand at 30 inches, and at a certain elevation above that level at 25 inches, then if the weight of the atmoſphere be diminiſhed $\frac{1}{100}$ part, the ☿ at the level of the ſea ſhould fall $\frac{1}{100}$ part of 30 inches $= 0,3$ of an inch, but that on the elevation ſhould fall $\frac{1}{100}$ of 25 inches $= 0,25$ of an inch; but it has been obſerved that the variation on high mountains is beyond all proportion ſmaller than on the level of the ſea, which proceeds from a cauſe hitherto unnoticed, yet deſerving the greateſt attention; namely, a property which they ſeem to poſſeſs of condenſing and accumulating

accumulating the air incumbent on them in a greater degree than the air incumbent over plains is condenſed at equal heights; and hence when the barometer on the plains falls, and that on the mountain alſo, it will be found, after making allowance for the difference of temperature, that the fall is proportionably greater in the inferior than in the ſuperior barometer; and on the contrary, if the ☿ aſcends both in the inferior and ſuperior barometer, the aſcent will be proportionably greater in the ſuperior than in the inferior.

Thus General Roy on the 7th of Auguſt, 1775, at nine o'clock, found the *correct* height of a barometer on Carnarvon quay 30,075, and on the peak of Snowden 26,418 inches. At twelve o'clock that on the quay fell to 30,043, and that on the peak to 26,405; the fall of the ☿ on the plain was therefore $\frac{1}{1002}$ of the whole, and the fall on the mountain was only $\frac{1}{2032}$ of its original height. On the other hand, at two o'clock, the barometer on the quay roſe to 30,045, while that on the peak roſe to 26,415 inches correct height; therefore that on the quay aſcended only $\frac{1}{15021}$ of the whole, whereas that on the peak aſcended $\frac{1}{2640}$ part of its height. Yet as the deſcents of the ☿ beneath its moſt uſual mean height are much more frequent and conſiderable than its aſcents above it, the variations on mountains are upon the whole proportionably ſmaller than at the ſurface of the ſea. I am ſenſible that ſome obſervations occur in which the ☿ has been found to fall on mountains while it aſcended on the plains; but in all thoſe I have met, this happened in warm ſunny weather, on rocky ſummits which were heated in far greater proportion than their height demanded,

demanded, and thus rarefied the air in contact with them; or on windy days, which did not permit the air to ſtagnate; or when a ſoutherly wind prevailed above and not below. It was from a condenſation of this ſort, apparent in the menſuration of Hackluyt-hill in Spitſbergen, that General Roy inferred that the polar air, though affected with the ſame temperature and preſſure, was ſpecifically heavier than in the middle zones, which cannot be ſtrictly true, as certainly the polar air muſt by the many ſtorms that have blown to and from it, be long ago mixed with the common maſs of the atmoſphere.

I MUST admit that the juſtly celebrated Bouguer was of a contrary opinion; for, from ſome experiments made with a pendulum, he concluded that air on the higheſt mountains was proportionably more elaſtic and leſs denſe than that on the ſurface of the earth; but one of his comparative experiments on which he reſted this concluſion, was made in the moiſt air of Popayan, with a pendulum made of the fibres of the aloe leaf; and I have been aſſured by a very competent judge both of hygrometers and pendulums*, that this vegetable ſenſibly attracts moiſture; ſo that its weight being encreaſed, it is not ſurpriſing that its vibrations were retarded in greater proportion than they otherwiſe would be.

As I have all along ſuppoſed the rarefaction of the atmoſphere in the polar regions to proceed from the auroræ borealis and auſtralis, which I take to be a combuſtion of inflammable

* Mr. Whitehurſt. See alſo Herbert de Igne, p. 18.

air

air caufed by electricity, I fhall conclude by ftating the facts on which this fuppofition is founded.

First. It is certain that inflammable air is produced, particularly between the tropics, by many natural operations, fuch as the putrefaction of animal and vegetable fubftances, volcanoes, &c. and that this air is lighter than any other, and confequently occupies the higheft regions of the atmofphere; and hence Mr. Sauffure and others have found the air on the higheft mountains lefs pure than that on the plains, and its electricity ftronger.

Secondly. It is allowed by Doctor Halley and others who have treated of the trade winds, that the higheft air between the tropics is thrown off on both fides towards the poles, and of this I think I have given fufficient proof; therefore it is inflammable air that is chiefly thrown off towards the poles.

Thirdly. It is certain that the northern lights are the higheft of all meteors, though they fometimes extend pretty low into the inferior atmofphere; and Doctor Franklin's conjecture, that they proceed from electricity, is at prefent generally followed by all meteorologifts. A detail of their reafons I muft omit, as it would occafion too great a digreffion from the prefent fubject.

Fourthly. It is certain that after the appearance of an aurora borealis the barometer commonly falls. This obfervation was firft made by Mr. Madifon in America *; and I have feen

* II. Phil. Tranf. Philad. p. 142.

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it verified in the diaries of the Berlin Academy for 1783 and 1784, the only ones which I have consulted. These meteors are also generally followed by high winds *, and usually from the south, all which strongly prove a rarefaction in the northern regions. These lights are much more common in the higher latitudes of North America than in the same latitudes in Europe. Captain Middleton remarks that they appear almost every night in Hudson's Bay, lat 59, whereas at Petersburgh they are seen much more rarely; which confirms my opinion that the superior effluence is more copiously distributed over North America than over the old continent.

* VIII. Phil. Trans. Abr. p. 463.

# *An Account of ſome Experiments on* WHEEL CARRIAGES. *In a Letter from* RICHARD LOVEL EDGWORTH, *Eſq; M.R.I.A. and F.R.S. to the Rev. Doctor* HENRY USSHER, *M.R.I.A. and F.R.S.*

DEAR SIR,

YOU may, perhaps, have experienced what I now feel in ſitting down to write upon a ſubject that is not likely to be intereſting to many readers, and that is of ſuch familiar uſe as to promiſe neither novelty nor material information. People imagine that they are intimately acquainted with what they have been long accuſtomed to ſee; and the mind feels averſe to that retrograde motion which leads it back to firſt principles, when it neither fears error nor expects diſcovery. Read March 1, 1788.

THE notes from which the following paper is compoſed have lain by me for ſome years, and the conſiderations which I have juſt mentioned have continually prevented me from drawing them into a connected form for publication; but what

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appears to me a duty, as a member of a literary academy, overcomes my reluctance, and calls upon me to contribute ſomething, though I may be aſhamed of the inſignificance of my contribution.

I WAS preſent, in 1773, at a ſet of experiments that were tried in London to determine the relative advantage of high and low wheels for carriages. Diſputes had ariſen upon this ſubject between mechanics of no ſmall eminence, and to determine them an apparatus was provided, conſiſting of a very long and ſmooth table, upon which the carriages to be compared were to be drawn by a ſtring and a deſcending weight. The carriages were conſtructed by ſome of the beſt workmen in London; the ſtrings were made of plaited ſilk of ſmall diameters, paſſing over a pulley nicely turned, and mounted in ſuch a manner as to have ſcarcely any friction. The experiments, however, were undeciſive, each party claiming their evidence in favour of their own opinion; very little difference was perceptible between the carriages when they ran upon the ſmooth table; and when they were drawn over obſtacles, ſometimes the high and at other times the low wheels had the advantage, according to the different heights and ſhapes of the obſtacles. It appears upon a firſt view that the force which drew theſe carriages was employed only in overcoming the friction of the axle-tree, or in lifting the weight over the obſtacle. But I ſuſpected at the time, and have been ſince convinced, that an obſtruction of another ſort exiſted, which was more conſiderable than either of thoſe which I have mentioned, and which has not to my knowledge been taken notice of by any writer upon mechanics.

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The load upon a carriage in paſſing over an obſtacle reſiſts the power which draws it, not only by its weight, but by its vis-inertiæ; after a carriage has been once ſet in motion upon a ſmooth road with any given velocity, its motion, ſo long as that velocity is continued, is neither retarded nor promoted by its vis-inertiæ; but whenever it paſſes over any height, not only the weight of the carriage muſt be lifted up, but the vis-inertiæ of that weight muſt be overcome in a new direction, and as much velocity muſt be communicated to it in that new direction as will enable it to riſe to the height of the obſtacle whilſt it paſſes over its baſe. When an obſtacle is of ſuch a ſize and ſhape that a wheel of ſix feet diameter muſt ſtrike the top of it at once, and not roll from the bottom upwards, and when its ſhape will permit a ſmaller wheel to touch it during its whole aſcent, as there is more time allowed for overcoming the vis-inertiæ of its weight in the latter caſe than in the former, the ſmaller wheel may be drawn forward by a leſs power than the larger, notwithſtanding the advantage of lever, which is in favour of the larger wheel.

To determine theſe circumſtances by experiment, it was neceſſary to conſtruct an apparatus different from that which I have deſcribed. I at firſt made uſe of an inclined plane of five or ſix feet long, and one foot high, placed upon a ſmooth horizontal floor. The diſtance to which the carriage was driven upon the floor by the velocity which it acquired in its deſcent down this inclined plane, I aſſumed as the meaſure of its acquired force, and the reſiſtance of any obſtacle which I placed in its way I determined by the diminution of this diſtance. But

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though I was well ſatisfied with the accuracy of this mode of trial, I conſtructed another that might appear to others leſs liable to objection.

I SCREWED a circle of iron three feet three inches diameter upon a ſolid floor; in the centre of this circle I erected an upright axis or roller upon two pivots, one reſting in a ſocket of braſs upon the floor, the other in a bridge which was raiſed acroſs the machine. This axis or roller had a ſmall ſilk cord wound round its circumference, which paſſing into an adjoining ſtaircaſe, had a ſcale and weights tied to it, which turned the roller with the required velocity. From the roller a horizontal arm of wood extended to the circumference of this iron circle, and to its extremity was faſtened a piece of ſteel in the form of an axle-tree of a carriage, and upon this was placed a wheel, which by theſe means was carried round upon the braſs circle, as the ſtone of tanners bark-mill moves round the trough which belongs to it. This arm was permitted to move up and down by means of a hinge, ſo as to let the wheel riſe over any obſtacle which was placed in its way. Beſides this another arm was placed above that which carried the wheel, at the extremity of which was faſtened a piece of tin, forming a vane, which, by its reſiſtance to the air, regulated the motion of the machine. The roller was now made to turn by putting weights into the ſcale, and it was let to revolve until its motion became uniform. After eight or ten turns it revolved with an equable velocity; and during every ſet of experiments the ſame velocity was preſerved, and whatever reſiſtance the carriage was expoſed to was overcome by the addition of weight. The additional weight

became

became therefore, in all caſes, the meaſure of the additional reſiſtance, and determined with the greateſt accuracy the reſult of every experiment which I wiſhed to try.

Having found that nearly five pounds and a half was ſufficient to give the wheel, when loaded ſo as to weigh about four pounds, a velocity of nearly ten feet in a ſecond, I placed an obſtacle of a quarter of an inch high upon the plane, and it required no leſs than ſix pounds and a half to overcome its reſiſtance. Two ſuch obſtacles required fourteen pounds and a half. Two obſtacles of the ſame height, but of a different ſhape, each making an inclined plane of three quarters of an inch long and a quarter of an inch high, were ſubſtituted in the place of the former, and it required but two pounds to overcome their reſiſtance. The difference, therefore, between two and fourteen muſt be attributed to vis-inertiæ; for the velocities of the carriage and the heights of the obſtacles remaining the ſame, the only difference that exiſts is, that in the one caſe the wheel has much more time to ſurmount the obſtacle than in the other, and conſequently had much leſs vis-inertiæ to overcome.

From this conſideration it appears that whatever permits the load to riſe gradually over an obſtacle, without obſtructing the velocity of the carriage, will tend to facilitate its draught; and the application of ſprings has this effect to a very conſiderable degree. The ſame weight of four pounds being drawn over the ſame obſtacles, when ſprings were put between the load and the carriage, by four pounds inſtead of fourteen.

This

This remarkable difference points out the great advantage of ſprings in rough roads; an advantage which might be obtained for heavy waggons as well as for other carriages by a judicious application of the ſame means.

It has but ſeldom happened that the modeſty of theory has promiſed leſs than what has been verified by experiment; but it appears from the Memoirs of the French Academy that the idea of applying ſprings to carriages had occurred to Monſieur Thomas in the year 1703, who has given a drawing of a carriage conſtructed upon this principle many years before it was attempted to be put into execution. So little hope had he entertained of ſucceſs, that he expreſsly mentions it as a theory which could not be reduced to practice; he had, however, no notion of applying ſprings to facilitate the draught, but merely for the convenience of the rider; and I apprehend that it is not at preſent commonly imagined that ſprings are advantageous for this purpoſe; nor would it at firſt ſight appear credible, that upon a rough paved road, ſuch as are common in Cheſhire and other parts of England, a pair of horſes could draw a carriage mounted upon ſprings with greater eaſe and expedition than four could draw the ſame carriage, if the ſprings and braces were removed, and the carriage bolted faſt down to the perch. I tried ſome other experiments with the ſame apparatus to compare long and ſhort, high and low carriages. I have loſt the particular reſults of each experiment, but I am well aſſured that the preference which has lately been given in England to high carriages is ill-founded; that upon ſmooth roads the height of the carriage is a matter of indifference as to the draught, and that in rough roads it is

conſiderably

conſiderably diſadvantageous; that the length of carriages, if their weight be not encreaſed, is alſo a matter of indifference, except in very uneven roads, and where there are deep ruts; in the former long carriages are preferable, in the latter ſhort ones.

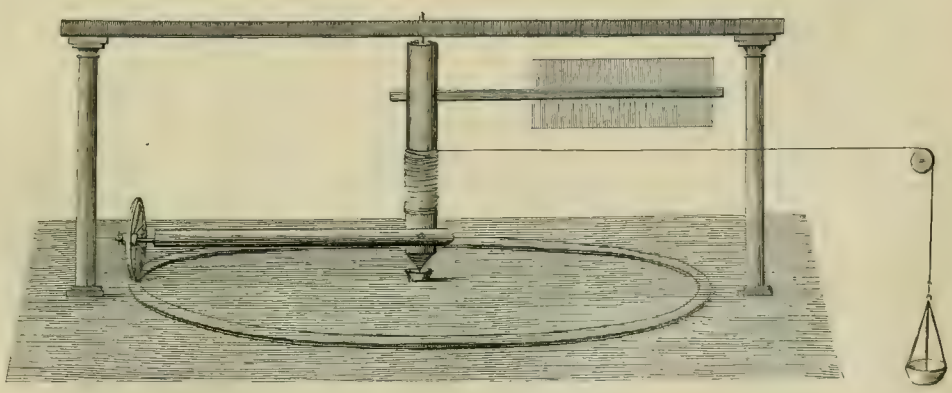
I SUBJOIN a drawing of the apparatus which I made uſe of in theſe experiments, and a table of the experiments, from which the mechanic may draw many uſeful obſervations, and which may ſupply the mathematician with many curious and elegant ſubjects of inveſtigation.

Your's, &c.

R. L. E.

TABLE.

Machine for trying Experiments upon Wheel Carriages.



The weight of the load 3 lb. The weight of the load, wheel and car
The ſcale and weight deſcended ſix inches and two-tenths every revol
The diameter of the wheel was two inches nine-tenths, and the circu

| | EXPERIMENTS. | Tu |
|---|---|---|
| 1 | A vane of tin, 11 inches long, and 5 and $\frac{1}{4}$ broad, faſtened to an arm, projecting from the roller, to regulate the motion of the machine by its reſiſtance againſt the air; the extremity of the vane 21 inches from the centre of the roller, made - | 2 |
| 2 | The ſame as No. 1, with the wheel running upon the iron circle - - - - - - - - - - | 2 |
| 3 | The ſame as No. 2, but with an obſtacle of $\frac{1}{4}$ inch high, placed on the road - - - - - - - - | 2 |
| 4 | The ſame as No. 2, but with two obſtacles - - | 2 |
| 5 | Ditto, with two inclined planes, $\frac{1}{4}$ inch high, $\frac{3}{4}$ inch long, inſtead of the obſtacles - - - - - - | 2 |
| 6 | Springs placed between the weight and the wheel, two obſtacles $\frac{1}{4}$ inch high, placed on the road - - - - | 2 |
| 7 | Same as No. 1, with half the velocity - - - | 1 |
| 8 | Same as No. 4, with half the velocity - - - | 1 |
| 9 | Same as No. 6, with half the velocity - - - - | 1 |

# T A B L E.

The weight of the load 3 lb. The weight of the load, wheel and carriage, &c. 4 lb.
The fcale and weight defcended fix inches and two-tenths every revolution of the roller.
The diameter of the wheel was two inches nine-tenths, and the circumference of the circle upon which the wheel ran was ten feet three inches and a quarter.

| | EXPERIMENTS. | Turns. | Time. | Weight. | | | | OBSERVATIONS. | lb. | oz. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Seconds. | lb. | oz. | | | | | |
| 1 | A vane of tin, 11 inches long, and 5 and ¼ broad, faftened to an arm, projecting from the roller, to regulate the motion of the machine by its refiftance againft the air; the extremity of the vane 21 inches from the centre of the roller, made - | 20 | 20 | 4 | 10 | 1 | | The refiftance of the air againft the vane, and againft all the moving parts of the machine, was equal to - - - This weight muft therefore be deducted from the weights ufed in the fubfequent experiments. | 4 | 10 |
| 2 | The fame as No. 1, with the wheel running upon the iron circle - - - - - - - - - - | 20 | 20 | 5 | 10 | 2 | | 4 lb. 10 oz. being deducted for the refiftance of the air from 5 lb. 10 oz. the remainder was the refiftance occafioned by the motion of the wheel on the fmooth board - - | 1 | 0 |
| 3 | The fame as No. 2, but with an obftacle of ¼ inch high, placed on the road - - - - - - - - - | 20 | 20 | 12 | 0 | 3 | | The refiftance of an obftacle of ¼ inch high - - | 6 | 6 |
| 4 | The fame as No. 2, but with two obftacles - - | 20 | 20 | 20 | 0 | 4 | | The refiftance of two obftacles of ¼ inch high - - | 14 | 6 |
| 5 | Ditto, with two inclined planes, ¼ inch high, ¾ inch long, inftead of the obftacles - - - - - - | 20 | 20 | 7 | 8 | 5 | | The refiftance of inclined planes inftead of abrupt obftacles - | 1 | 14 |
| 6 | Springs placed between the weight and the wheel, two obftacles ¼ inch high, placed on the road - - - - | 20 | 20 | 9 | 8 | 6 | | The refiftance of two obftacles ¼ inch high when fprings were ufed, only - - - - - - | 3 | 14 |
| 7 | Same as No. 1, with half the velocity - - - | 10 | 20 | 1 | 6 | 7 | | Refiftance of the air to half the former velocity - - | 1 | 6 |
| 8 | Same as No. 4, with half the velocity - - - | 10 | 20 | 7 | 8 | 8 | | Refiftance of two obftacles with half the former velocity - | 6 | 2 |
| 9 | Same as No. 6, with half the velocity - - - - | 10 | 20 | 3 | 8 | 9 | | Refiftance of ditto with fprings - - - - | 2 | 2 |

# *An Enquiry into the different* MODES *of* DEMONSTRATION, *by which the* VELOCITY *of* SPOUTING FLUIDS *has been investigated* a priori. *By the Rev.* M. YOUNG, *D. D. F. T. C. D. and M. R. I. A.*

Read March 1, 1788.

THE antients, as Doctor Jurin informs us, had no knowledge of any measure of the flux of water, except that fallacious and uncertain measure derived from a perpendicular section of the stream alone, without any regard to the velocity with which it flows. Benedict Castelli, an Italian, and friend of Gallileo, was the first who opened the way to a true measure. The necessity of guarding continually against the damages from the overflowings of the rivers in Italy, induced Urban the Eighth, who had invited him to Rome as a teacher of mathematics, to request he would apply himself to this subject. The result of his enquiries is contained in his treatise entitled *Della mesura dell' acque correnti*; which measure he found to depend on the area of the section and the velocity of the water conjointly. The fundamental principle of this and other questions in hydraulics is the determination of the actual velocity with which water spouts

 from

from an aperture in the bottom or ſide of a veſſel; but there is none which ſeems to have produced greater perplexity.

Scarcely can one writer be found who acquieſces in the ſolution of another. Even the great Newton, who paid particular attention to this ſubject, is not very conſiſtent with himſelf. In the firſt edition of his Principia he endeavours to prove, that the velocity of the ſpouting water is equal to that which a heavy body would acquire in falling through half the height of the water above the aperture; in his ſecond and third editions he relinquiſhes this calculation, and demonſtrates that the velocity is that which would be acquired in falling through the entire altitude. Yet he immediately ſubjoins an account of experiments which he made with a view to aſcertain this point, and which ſeem inconſiſtent with the demonſtration he adheres to, though very conſonant to that which he rejects.

The demonſtration which he gives in the firſt edition appears at firſt ſight to be unexceptionable, and has accordingly been received by the learned Emerſon, Whiſton, Mr. Wildbore in Hutton's *Miſcellanea Mathem.* and other good philoſophers. It is to this effect:

If a veſſel be filled with water, and perforated in the bottom ſo as that the water may flow through the aperture, it is manifeſt that the bottom will ſuſtain the weight of all the water except the weight of that part perpendicularly incumbent over the orifice. For if the orifice be cloſed by any obſtacle, that obſtacle will ſuſtain the weight of the water perpendicularly incumbent on it, and the bottom

bottom of the veſſel will ſuſtain the reſt. But on removing the obſtacle, the bottom of the veſſel will be preſſed in the ſame manner as before, and the weight which was ſuſtained by the obſtacle being now no longer ſupported, will produce an efflux of the water through the orifice. Whence it follows, that the motion of the whole effluent water is ſuch as can be produced by the weight of the column of water incumbent over the orifice. For every particle of water deſcends by its own weight, as far as it is not impeded, with a uniformly accelerated motion, and as far as it is impeded it will preſs the obſtacle; that obſtacle is either the bottom of the veſſel or the inferior deſcending water, and therefore that part of the weight which the bottom of the veſſel does not ſuſtain will preſs the effluent water, and generate a motion proportional to it.

Let F denote the area of the orifice, A the altitude of the column of water over the orifice, V the velocity which a heavy body would acquire in falling through the height A in the time T, and $x$ the velocity of the effluent water. Since in the time T, a ſpace equal to 2 A would be deſcribed with the velocity V, a ſpace equal to $\frac{2Ax}{V}$ will be the ſpace deſcribed in the ſame time with the velocity $x$. This, therefore, will be the length of the column diſcharged in the time T, and the magnitude of this cylinder will be $\frac{2AxF}{V}$, and its quantity of motion $= \frac{2Ax^2F}{V}$. But the quantity of motion, which, in the ſame time, would be generated in the column of water incumbent on the orifice, if it were to fall freely as an heavy body through a ſpace equal to

 its

its altitude, would be A F V. And theſe quantities of motion are equal, being both generated in equal times, by the ſame generating force; that is, $AFV = \frac{2Ax^2F}{V}$, whence $V^2 = 2x^2$, and $V : x :: \sqrt{2} : 1$. Conſequently ſince V is the velocity which a heavy body would acquire in falling through the entire altitude A, one half of A will be the ſpace through which a body deſcending will acquire that velocity $x$ with which the water flows from the orifice.

The latent fallacy of this argument conſiſts in this, that each plate of water is ſuppoſed to be ſucceſſively diſcharged with a uniform velocity, and the quantity of motion generated in every little portion of time in which each plate is diſcharged is meaſured by the plate drawn into the uniform velocity of the efflux. But this, on a little conſideration, will be found not to be a true ſtatement of the caſe; for every plate of water is diſcharged in time, and its velocity is uniformly encreaſed from nothing, during the deſcent of the plate through its own altitude, at the end of which little portion of time it attains that ultimate velocity with which it afterwards continues to move uniformly. Hence, therefore, it follows that the quantity of motion really generated during the time of the diſcharge of each plate of water is but half that which is determined by ſuppoſing the water to be diſcharged at once with its full velocity. The correction of this error will lead us to a true ſolution of the queſtion. Let the time of a body's fall through the height A be divided into an indefinite number of little portions, each equal to the time in which a plate of water is diſcharged by deſcending through its

own

own altitude. The quantity of motion generated in the cylinder in the time of the fall is equal to the ſum of the quantities of motion generated in that cylinder in all the little portions of time into which the whole time is divided, taken ſeparately; that is, equal to the ſum of the quantities of motion generated by the preſſure of that cylinder, in the ſame little portions of time, in the ſucceſſive plates of water (becauſe equal forces generate equal quantities of motion in the ſame time); that is, equal to half the quantity of motion in theſe plates as meaſured by the ultimate velocity continued uniform for theſe portions of time. Whence it follows, that the quantity of motion generated in the incumbent cylinder, if it were ſuppoſed to fall freely through its height, is equal to half the quantity of motion of the cylinder ſuppoſed to be diſcharged in the ſame time with a uniform velocity. That is, $AFV = \frac{Ax^2F}{V}$, whence $V^2 = x^2$, and $V = x$; that is, the ultimate velocity with which the water is diſcharged is equal to that which a heavy body would acquire in falling through the entire height of the water above the orifice.

The mode of demonſtration which Sir Iſaac purſues in the ſecond and third editions of his Principia, and which has been admitted and diſcuſſed at large by Jurin, Maclaurin, Robinſon, and other mathematicians, is this: Let M N C D be a cylindric veſſel filled with water to the height A B; C D its bottom parallel to the horizon; E F a circular hole in the bottom, and I G a perpendicular to the horizon paſſing through the centre of the hole. Newton then ſuppoſes water to be poured in at the upper ſurface A B as faſt as it ſubſides by the efflux of the water through the

aperture

aperture E F; and ſince the water is continually accelerated from the upper ſurface to the bottom, where it is diſcharged, by the action of gravity, the body of deſcending water will contract in breadth according as the velocity encreaſes, ſo as to move in a regular curve A K E, which he calls the cataract of deſcending water. And becauſe the water, in its deſcent, ſuffers no other reſiſtance than what ariſes from the friction or mutual adheſion of the particles, which in the preſent caſe is ſuppoſed evaneſcent, it follows, that the particles will deſcend to the hole with a velocity uniformly accelerated, and conſequently that their velocity in the aperture will be the ſame as if they had deſcended in the vertical line H G. Now becauſe at the very inſtant that the water flows from the aperture the ſurface A B ſubſides, and the water is ſupplied as faſt at that ſurface as it iſſues from the orifice, it follows, that by diſcovering the velocity with which the water is poured in at A B to ſupply the waſte, the velocity with which it iſſues from the orifice will be alſo aſcertained. For ſuppoſe I H to be the height from which a body muſt fall in order to acquire the velocity with which the water is poured in, ſince it is uniformly accelerated from thence to the orifice by the action of gravity, it follows, that the velocity of the effluent water will be that which a heavy body would acquire in falling down the height I G.

He then proceeds to calculate the height I G; and if S denote the ſurface of the water at A B, A the orifice, and H the height of the water, he ſhews that I G will be equal to the quantity $HG \times \frac{S^2}{S^2 - A^2}$.

But

But many reaſons concur to render us ſuſpicious of the truth of this reaſoning: In the firſt place, it is extremely improbable that the water ſhould deſcend in this regular cataract, leaving the fluid in the ambient ſpace at reſt; and it appears to be falſe in fact, by obſerving the motion of light particles ſuſpended in the water, whoſe motion does not appear to be confined within the bounds of the cataract, or to be performed in that regular curve which the reaſoning requires. Secondly, Newton ſuppoſes that the water which iſſues with this velocity deſcends from the upper ſurface; if this were ſo, the ſpouting fluid could not attain its full velocity till a cylinder of it had been diſcharged, whoſe baſe is equal to the area of the orifice, and height equal to that of the fluid; but this is not the caſe, for the loweſt plate or ſmalleſt quantity of the fluid will be diſcharged with its full velocity. Thirdly, ſince the orifice is leſs than the upper ſurface of the water, it would follow that the altitude I G would be greater than H G; that is, the velocity of the ſpouting fluid would be greater than that which a heavy body would acquire in falling through the height of the veſſel; and that exceſs would be greater the larger the aperture; ſo that by encreaſing the aperture we might encreaſe the velocity of the ſpouting fluid at pleaſure. But this appears not by any means to be true in fact; for we can never produce, by any variation of the orifice, a velocity greater than that which a heavy body would acquire in falling through the height of the fluid.

Doctor Helsham's demonſtration of this propoſition is to the following effect: If we ſuppoſe the column of water which ſtands directly over the orifice to be divided into an indefinite number of plates of an equal, but exceedingly ſmall thickneſs,

we

we muſt allow that whatever be the force of gravity wherewith the uppermoſt plate preſſes upon the ſecond, the ſecond preſſes on the third with a double force, and the third upon the fourth with a triple force, and ſo on; ſo that the plate which is next the orifice is preſſed downward by the joint gravities of the ſeveral plates which lie above it, and likewiſe by the force of its own gravity, inaſmuch as there is no other plate beneath it whereon to reſt; conſequently from its own gravity, and that of the ſeveral plates above it, it does all at once receive as many equal impreſſions from gravity, as it would ſucceſſively in falling down the height of the water; and of courſe muſt paſs through the orifice with the ſame velocity that it would acquire in falling down that height.

This demonſtration appears to be defective in this reſpect, that it does not take into account the time in which the force accelerating the diſcharge of the water acts; for it is evident, that the greater the velocity with which the loweſt plate of water is diſcharged through the orifice the ſhorter will be the time during which it is accelerated by the preſſure of the incumbent fluid. By neglecting this circumſtance, it would follow, from Doctor Helſham's reaſoning, that the velocity ſhould be in the direct ſimple, not ſubduplicate ratio of the height of the fluid, the velocity generated being, *ceteris paribus*, as the accelerating force, that is, as the height of the column of water ſtanding directly above the orifice. If, indeed, this time be taken into conſideration, the inference will be legitimate. Thus the velocity generated in the iſſuing plate of water will be as the accelerating force and the time of its action conjointly, the plate, that is, the quantity of matter moved, being given; but the time

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in which the accelerating force acts on the plate, is inverſely as the velocity with which the plate iſſues; therefore the ſquare of the velocity is directly as the force, and the velocity as the ſquare root of the force, that is, as the ſquare root of the height of the water above the orifice. But the actual velocity of the effluent water would not even thus be aſcertained.

The Abbè Winkler's demonſtration is built on the ſame foundation with Helſham's.

Musschenbroeck's demonſtration of this principle is liable to a three-fold objection: Firſt, it is founded on a falſe meaſure of the force of bodies in motion, to wit, the quantity of matter and the ſquare of the velocity. Secondly, it involves a confuſion of what is an equal ratio with a ratio of equality. Thirdly, it implies that equal forces generate equal velocities, without any regard to the times in which they act, or the quantities of matter which they move.

Varignon proves only, that the velocities of ſpouting fluids are in the ſubduplicate ratios of the heights of the fluids above the apertures, but does not aſcertain the actual velocity, which is the principal object of enquiry. See Acad. Science. An. 1703.

Belidor's demonſtration is ſubject to the ſecond imperfection of Muſſchenbrœck's. For from proving, after Varignon, that the velocity of the effluent water is proportional to the ſquare root of the height of the water, and therefore follows the ſame law of acceleration with that of falling bodies, he concludes, that the velocity of the ſpouting water is actually the ſame which a

heavy body would acquire in falling through the height of the fluid.

Professor Gravesende, who has considered this subject with particular attention, has also given us a demonstration, that the velocity of the effluent water is equal to that which a body would acquire in falling through the entire height of the fluid. But it appears liable to the following objections: First, it supposes, that the velocities communicated to equal quantities of matter, in moving through equal spaces, are directly as the generating forces, without any regard to the time in which these spaces are run over by the bodies moved. And secondly, it supposes that the forces acquired by the falling bodies are equal when the heights are inversely as the masses; whereas they are equal only when the masses are in the inverse subduplicate of the heights.

I have already shewn how the demonstration given in the first edition of the Principia, when duly corrected, affords a legitimate solution of this problem; and the same conclusion may, I think, be thus otherwise made out in an unexceptionable manner.

Let MNOP represent a vessel of water filled to the level GH; MP the bottom, in which is the aperture CD; CIKD the column of water standing directly above the orifice, and CABD the lowest plate of water immediately contiguous to the aperture. Also let $v$ denote the velocity which a heavy body would acquire in falling freely through the height BD of the plate, and $x$ the velocity acquired by the same plate during its descent through the same space until it is discharged by the pressure of the column CIKD.

Suppose

Suppose the loweſt plate of water ACBD to fall as a heavy body through the height BD, its moving force will be its own weight. Again, ſuppoſe it to be accelerated by its own weight and that of the incumbent water, that is, by the weight of the column CIKD through the ſame ſpace, that is, while it is accelerated from quieſcence until it is actually diſcharged. The velocity in the former caſe will be to that in the latter as the moving forces and the times in which they act directly, and the quantities of matter moved inverſely. But the moving forces are to each other as the heights BD and KD; the times in which they act are inverſely as the velocities, the ſpace through which the body is accelerated being given; and the quantities of matter moved are equal; therefore $v : x :: \frac{BD}{v} : \frac{KD}{x}$; conſequently $v^2 : x^2 :: BD : KD$. But $v$ is the velocity which a heavy body would acquire in falling through the ſpace BD; therefore $x$, the velocity of the ſpouting fluid, is that which a heavy body would acquire in falling through KD, the height of the fluid above the orifice.

In the ſame manner it may be ſhewn, that if a pipe be inſerted horizontally in the veſſel NOMP, the plate of water ACBD will be diſcharged with the ſame velocity as before, whatever be the thickneſs of the plate; this velocity not depending on a continual acceleration through the length of the tube, otherwiſe the effluent water could not attain its full velocity, until a column had been diſcharged whoſe baſe is equal to the orifice and height equal to the length of the tube: whereas we find by experience, that this full velocity can be attained by the thinneſt plate which we can let eſcape from the aperture.

What is here ſaid of the velocity of the effluent water is true only of the middle filament of particles which iſſue through the centre of the aperture, and which ſuffer no other retardation than what ariſes from the reſiſtance of the air, and their mutual adheſion and attrition againſt each other. But thoſe which iſſue near the edges of the aperture undergo a greater attrition, and therefore ſuffer a greater retardation. Hence it follows, that the mean velocity of the whole column of effluent water will be conſiderably leſs than according to theory.

Sir Iſaac Newton, who examined every ſubject that came before him with peculiar accuracy, firſt diſcovered a contraction in the vein of effluent water; and he found, that at the diſtance of about a diameter of the orifice, the ſection of the vein contracted nearly in the ſubduplicate ratio of 2 to 1. Hence he concluded that the velocity of the water, after its exit from the aperture, was encreaſed in this proportion, the ſame quantity paſſing in the ſame time through a narrower ſpace. Now, from the quantity of water diſcharged in a given time through that narrow ſection, he found that its velocity there was that which a heavy body would acquire in falling through the height of the water above the orifice; and ſince the velocity there was greater than immediately in the orifice in the ſubduplicate ratio of 2 to 1, he concluded that the velocity of the effluent water in the orifice was equal to that which a heavy body would acquire in falling through half the altitude. But all this is true only of the mean velocity; for there is no cauſe which can actually accelerate the water after its exit from the orifice, whatever cauſes may contribute to its retardation. The manner in which the mean velo-

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city of the water is encreaſed after its diſcharge, though the actual velocity of the ſeveral particles continues unvaried, may be thus explained: the particles which iſſue near the ſides of the orifice proceed converging towards the axis of the vein, and with a retarded motion, upon account of their attrition againſt the ſides of the orifice; and as the central particles move faſter than thoſe which are farther from the axis, each plate of water after leaving the orifice, will aſſume a curved form, the concavity of which will reſpect the orifice. Let E F be the diameter of the vein where narroweſt, and A B the diameter of the orifice; the line of particles A B, which leave the orifice at the ſame inſtant, will aſſume a curvilineal poſition E G F, the central particles at G moving faſter than the extreme ones at E and F; the particles, therefore, in the diameter of the vein between E and F are ſupplied from the plates of water which iſſued ſucceſſively after EGF; and theſe extreme particles being thus diminiſhed in number, the central particles continuing nearly the ſame, the mean velocity muſt be encreaſed, becauſe that velocity is found by dividing the ſum of the velocities of all the particles by their number, and the number of particles which move with the greateſt velocity bears a greater proportion to the whole number in the narrow ſection of the vein at E F than in the orifice. In ſhort, to expreſs myſelf perhaps more clearly, the particles in the diameter A B, without being accelerated after their exit from the orifice, paſs through a leſs ſpace, becauſe they arrive at that ſpace in different times. It appears, therefore, that the actual velocity of the effluent water is not encreaſed after its diſcharge from the orifice, the contraction of the vein not inferring any ſuch augmentation, and there being no cauſe by which it could be produced.

duced. That the velocity with which the water is difcharged is really fuch as the theory gives, is fufficiently confirmed by the well-known experiment that water fpouts to the level of the refervoir, except fo far as it is impeded by external caufes. But though the velocity with which water, unrefifted in its paffage, iffues through the aperture may be thus afcertained by the height or diftance to which it fpouts, yet the mean velocity of the whole body of effluent water, taking in all caufes obftructing its difcharge which feem to lie beyond the reach of calculation, will be confiderably lefs than this, and can be eftimated in general by the analogy of experiment only.

The manner of making this eftimate is to find by experiment the quantity difcharged, in a given time, in any particular cafe, and reducing it to a column whofe bafe is equal to the aperture, the height of that column will be the fpace which would be defcribed in the propofed time by all the particles moving with a common velocity. The height of a column difcharged in any number of feconds $t$ is equal to $2\,t\,F\sqrt{l\,D}$, F denoting the area of the aperture in fquare inches, $l$ the fpace which a body defcribes in one fecond, falling freely from a ftate of reft, and D the height from which a heavy body muft fall in order to acquire the velocity of the effluent fluid. A cubic inch of water weighs ,52746 parts of a troy ounce; therefore $\left(\frac{W}{14{,}65\,t\,F}\right)^2 = D$, the height from which a body muft fall to acquire the mean velocity with which the water fpouts out, W denoting the weight of the water in troy ounces. Thus fuppofe a cylinder 20 inches high, kept conftantly filled with water, is found to difcharge 20 ounces troy through a circular aperture of

of $\frac{1}{5}$ of an inch diameter in 15 ſeconds; by the foregoing formula the height from which a body muſt fall to acquire the velocity with which the water is diſcharged will be 8,35 inches; that, is a ſpace which is to the whole height of the water above the orifice as 10 to 24 nearly. But as it is a difficult matter to keep the fluid always at the ſame height, without encreaſing the preſſure by pouring it in, it may perhaps be conſidered a more exact method to calculate *a priori* the time in which the veſſel ought to diſcharge itſelf, and noting the actual time of the diſcharge by experiment, to diminiſh the velocity of the efflux determined according to theory in the ſame ratio in which the time of the diſcharge has been encreaſed.

Now as the baſe of the veſſel is to the orifice, ſo is the time in which the veſſel would empty itſelf to that in which a body would fall freely through the height of the water in the veſſel: let therefore B denote the baſe of a cylindrical or priſmatic veſſel, in which is an orifice whoſe area is O; the time in which a body falls through A, the altitude of the fluid, is equal to $\sqrt{\frac{A}{l}}$ in ſeconds; therefore $\frac{B}{O} \times \sqrt{\frac{A}{l}}$ is the time required in ſeconds.

Let A the altitude of a veſſel filled with mercury be 9 inches, $l$ 193 inches, the diameter of the cylindrical veſſel 1 inch, and the diameter of the circular aperture $\frac{1}{20}$ of an inch. The time of the diſcharge by theory, according to the foregoing formula, will be 86,4 ſeconds; but by experiment it is found to be 140 ſeconds nearly; therefore the velocity of the efflux by theory is to be diminiſhed

diminiſhed in the ratio of 140 to 86,4; that is, in a ratio between the ratios of the ſquare root of 2 and the ſquare root of 3 to 1.

But this method alſo is ſubject to inaccuracy; for the motion of the fluid is found not to be very regular towards the end of the flux; it will therefore be better to calculate the time in which the veſſel ſhould empty itſelf to a certain depth, which is done in the following manner: The times in which the whole and part would be evacuated are reſpectively $\frac{B}{O} \times \sqrt{\frac{A}{l}}$, and $\frac{B}{O} \times \sqrt{\frac{P}{l}}$, P denoting the height of the part. Therefore the difference is $\frac{B}{O\sqrt{l}} \times \overline{\sqrt{A} - \sqrt{P}}$, in ſeconds.

Thus let the altitude of water in a veſſel wholly and in part filled with water be 16 and 12 inches, the diameter of the cylindric veſſel 5,74, and the diameter of the circular aperture ,2. Then, by the foregoing formula, the time in which the water ſhould ſubſide, according to theory, from the height of 16 to 12 inches, would be 33 ſeconds. But the time actually found by experiment is 53 ſeconds; therefore the velocity determined by theory is to be diminiſhed in the ratio of 53 to 33, or 1,6 to 1, *i. e.* very nearly in the ſame ratio as determined by a former experiment, in which the ſpouting fluid was mercury.

Page 96 Sc.

*Fig. 1.*

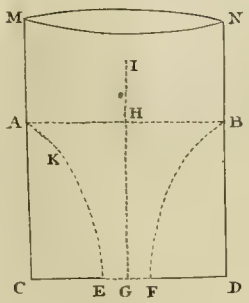



*Fig. 2.*

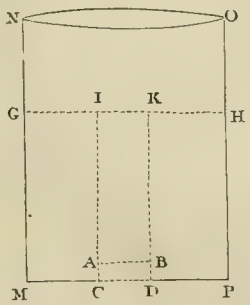



*Fig. 3.*

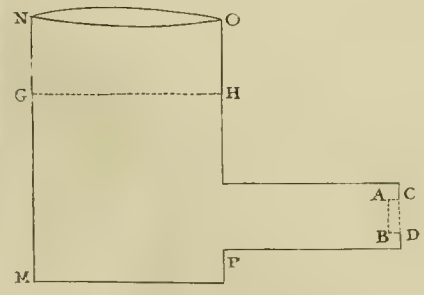
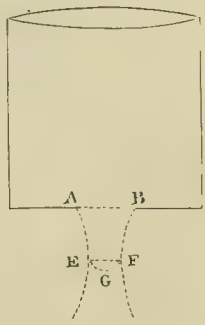



*Fig. 4.*



# OBSERVATIONS *on* GUN-POWDER. *By the Honourable* GEORGE NAPIER, *M.R.I.A. Communicated by the Earl of* CHARLEMONT, *P.R.I.A.*

FEBRUARY 1, 1788.

MY LORD,

IN compliance with your requeſt, I ſend you the following obſervations on gun-powder, deduced from a ſeries of experiments, in the conducting of which I was ably aſſiſted when ſuperintending the Royal Laboratory at Woolwich. Read Oct. 25, 1788.

As I do not mean to fatigue your lordſhip's attention by an elaborate pyrotechnical eſſay, I ſhall confine myſelf to ſuch facts as appeared new or intereſting in the courſe of my inveſtigation; only introducing thoſe parts of the common proceſs which may tend to elucidate an experiment, or ſerve to eſtabliſh the expediency of an alteration: To effect this with ſome degree of accuracy, I ſhall arrange my remarks under the following heads:

First. The ſelection of the materials which compoſe gun-powder.

Secondly. The ſtrongeſt and moſt durable proportion of thoſe materials.

Thirdly. The beſt mode of intermixing and combining them.

Lastly, I ſhall add ſome general obſervations.

The qualities of nitre are not eaſily aſcertained by thoſe rules which chymiſts have preſcribed for determining its purity; their deviations are frequent and ſometimes material in the compoſition of gun-powder, whoſe baſis this ſalt conſtitutes. The method I have generally adopted for detecting the impurity of nitre, is to drop a ſtrong ſolution of Sacch. Sat. into a phial of diſtilled water, ſaturated with ſalt-petre; which, if it retained any conſiderable portion of marine ſalt or magneſia, aſſumed a turbid milky appearance: The lunar ſolution is too powerful a teſt for any nitre I have met with: But it does not always follow that the pureſt nitre produces the ſtrongeſt powder: The beſt I have ſeen is the Ruſſian, yet the manufacturers in that country are not very ſolicitous about the magnitude of the cryſtals, the whiteneſs of the ſalt, nor even its freedom from heterogeneous ſubſtances, though with us thoſe qualities are accounted eſſential. In Ruſſia I am informed they ſeldom refine their nitre more than twice; and having analyzed ſome very excellent Ruſſian powder, I found the ſalt-petre contained a conſiderable portion of marine ſalt and magneſia.

magnesia. It is difficult to account for this phenomenon, as marine salt both impedes the ignition and lessens the explosion of gun-powder; and I believe it may be demonstrated that magnesian or calcareous nitre produces at least the last of those effects, if we consider the faintness of its own detonation, when it has any; and that deliquescent quality, which must communicate a degree of humidity to the composition, inimical to a forcible explosion; and (what is in my opinion of much greater consequence) which must be noxious in the extreme to the durability of gun-powder: I have reason to believe (as far as my experience can establish the fact) that powder made with salt-petre, oftener than four times refined, is of inferior strength, though probably more durable, than that which has been only thrice depurated: If the elastic and expansive fluid contained in nitre partakes at all of a spirituous nature, may not repeated evaporation liberate a portion of it? *Stahl* asserts, that the nitrous acid is a combination of the vitriolic acid with the principle of inflammability, effected by the agency of putrefaction; and *Pietch* of the Berlin Academy seems to prove this theory by his experiment of moistening a calcareous stone with vitriolic acid and urine, which being exposed for some time to the action of the atmosphere, was found strongly impregnated with nitre. If the aforesaid experiment be accurate, we must admit that salt-petre is a compound substance; and it may not be a very improbable deduction to suppose that repeated elixation in part deprives this salt of that elastic fluid which constitutes the strength of gun-powder: And this opinion is strongly corroborated by two well-known facts; first, in purifying a large quantity of nitre there is a distinct deficiency of weight after the process, which cannot be accounted for by the weight of the

 residuum;

reſiduum; and ſecondly, as great a proportion of ſalt-petre cannot be extracted from damaged powder as is obtained from ſerviceable, though originally manufactured with the ſame quantum of nitre: Perhaps, in this Ruſſian powder, the noxious qualities of the magneſia and marine ſalt were ſufficiently counteracted by the native excellence of the nitre, aided by ſome unknown ſuperiority in their method of combining and incorporating the materials.

In the choice of ſalt-petre I ſhould prefer that whoſe cryſtals are of a moderate ſize, ſolid, tranſparently white, which do not readily break with a crackling noiſe when gently graſped in the hand, and which when ignited on a red hot ſhovel do not decrepitate, but melt and conſume with an equable and continued inflammation: The firſt of thoſe ſymptoms is produced by haſty and imperfect deſiccation, and the laſt is a proof that the marine ſalt has not been entirely ſeparated from the nitre: I muſt obſerve that however carefully the proceſs of deſiccation is performed, the cryſtals will retain a certain portion of humidity (beſides their eſſential waters) which when rarefied by the heat of the hand produces a crackling noiſe; this proof of the quality of nitre muſt therefore depend on the degree of decrepitation. It may be aſked, why take ſuch pains to avoid moiſture in nitre, when its combination with the other materials of gun-powder is effected by water? I anſwer, it is this particular ſpecies of moiſture I object to, known to ſalt-petre refiners by the name of mother-waters, which taken up in the act of cryſtallization is replete with a greaſy magneſia and common ſalt. If the powder-maker refines his nitre himſelf, I adviſe him to boil it thrice, carefully ſkimming off the fœculent matter which floats on the ſurface, and

and abſtracting the marine ſalt, which being cryſtallized by evaporation during the proceſs, falls to the bottom; let him filter it through canvas made in the form of a jelly-bag, leaving it to cryſtallize (after each elixation) in leaden or copper veſſels, expoſed to a free circulation of air in a dry ſituation, and not in a cold cellar, which is frequently, though erroneouſly, practiſed, with this palpable diſadvantage, that ſudden refrigeration forming the nitrous cryſtals before all the common ſalt has been precipitated, a part of it enters into their compoſition; they are alſo of a leſs ſize, and not ſo compact as when the ſolution is gradually cooled. It is cuſtomary with powder-makers to prefer the cakes depoſited towards the bottom of the pans in which the ſolution of ſalt-petre is ſet to cryſtallize; theſe are formed by a congeries of minute cryſtals, and are conſiderably leſs pure than the larger ſhoots, being intimately mixed with whatever heterogeneous matter the ſolution may retain, which is generally precipitated towards the commencement of cryſtallization: I ſuſpect the predilection for this kind of nitre has no better foundation than its being more readily pulverized. The mother-water which oozes from the pans is commonly ſprinkled on earth intended for generating ſalt-petre; inſtead of this, was the refiner to add to the mixture a ſmall quantity of wood-aſhes, and repeat the operation of extracting, he would find it advantageous: He will alſo ſave conſiderably by ſubſtituting iron boilers and leaden pans to his copper ones.

Charcoal affords few new obſervations. I have tried various kinds, with a ſcarce perceptible difference in their effects, provided they were completely charred and equally well pulverized; however,

however, on chymical principles, we ſhould prefer that made from wood containing the greateſt quantity of fixed ſalts, and whoſe aſhes abound with alkaline ſalts, as ſuch inflames more rapidly and burns with greater vehemence. Dogwood (cornus-fœminea, virga ſanguinea) and alder (alnus nigra, bacciſera) are eſteemed by powder-makers the fitteſt for their charcoal; but I have not been able to diſcover any cogent reaſon for this preference. Green wood being harder when charred than dry, I believe admits of a more complete comminution, and is conſequently better adapted to that intimate combination of the ingredients neceſſary for the ſtrength and durability of gun-powder. I am informed of an improved method lately diſcovered for the preparation of charcoal; it is a kind of oven, which admitting the external application of heat, the wood piled within is more equally charred and its volatile parts more completely evaporated.

Experience has convinced me that it is of the utmoſt importance to give an exact attention to the purity of ſulphur, the third ingredient in the compoſition of gun-powder. On this agent depends that rapidity of inflammation, to which the charcoal contributes intenſe fire, and the nitre its aſtoniſhing elaſticity and expanſion.

A manufacturer of gun-powder ought never to uſe ſulphur which he has not purified and ſublimed himſelf: the beſt method of doing this is by melting it in an iron pot over a gentle coal fire which does not blaze, and ſtraining it through a double linen cloth; the operation muſt be repeated till there appears little or no reſiduum. When ſulphur is bought in a prepared

prepared ſtate, it is (notwithſtanding the low price) frequently adulterated with wheat-flour, which in moiſt or hot climates readily induces fermentation, and irrecoverably decompoſes the powder: I am convinced that inattention to this circumſtance is a principal cauſe of Britiſh gun-powder being leſs durable now than formerly.

The moſt eligible proportion of the three ingredients is next to be conſidered: and here I muſt premiſe, that after an accurate examination of powder manufactured according to the moſt approved practices in Europe and Aſia, together with the numerous variations of the chymiſts, I find it beyond my experience to give a decided preference, as I have ſeen them all ſucceed and fail, changed by the qualities of the materials, or influenced by the temperature of the atmoſphere, either when the powder was manufactured and barrelled, or when it was proved. I would therefore recommend that the proprietors of powder-mills ſhould manufacture a ſmall quantity of powder from each freſh aſſortment of materials. In doing this the following canon, which is borrowed from the French pyrotechniſts, and eſtabliſhed by experiments, may be found uſeful: begin with 3 lbs. of nitre and 9 oz. of charcoal, (this will explode without ſulphur,) increaſe the quantum of charcoal till the moſt forcible combination of thoſe two ingredients is diſcovered, which will commonly happen at between 12 oz. and 1 lb. of charcoal to the 3 lbs. of nitre; to this proceſs let ſulphur be added, beginning with $\frac{1}{2}$ oz. till the ſtrongeſt exploſion is found, which will be when the proportion of this ingredient to the above is from $2\frac{3}{4}$ to $3\frac{1}{4}$ oz. Finally, let the doſe of *charcoal* be diminiſhed, till the

the compoſition no longer gains in the eprouvette; this will commonly happen when the proportions of the three materials ſtand as follows:

| Nitre. | Charcoal. | Sulphur. |
|---|---|---|
| 3 lbs. | $8\frac{1}{2}$ to $9\frac{1}{2}$ oz. | $2\frac{3}{4}$ to $3\frac{1}{4}$ oz. |

The manufacturer may poſſibly diſcover ſtill greater variations than I have ſtated, as they muſt evidently be determined by the comparative excellence of his materials; but by adopting this method of aſcertaining their qualities, (however troubleſome it at firſt appears) I can venture to affirm he will in the end be a conſiderable gainer. There are various opinions reſpecting the liquid moſt eligible to moiſten the ingredients during the proceſs of preparing them for the mill: urine, vinegar, ſpirit of wine and water, plain water, have ſeverally been recommended for this purpoſe: I have tried them all without being able to eſtabliſh any data on which to found a deciſion; yet the volatile nature of ſpirits, and the heterogeneous matter to be met with in urine and vinegar, ſeem to point out a preference due to pure water; but as this is warmly conteſted, and my experiments exhibited no concluſive ſuperiority, I will not hazard a determination on the ſubject. It was my intention, in this place, to have given a formula of the ſeveral proportions in uſe amongſt the different powder-makers of Europe and Aſia, had I not been deterred by the apprehenſion of ſwelling my letter to a volume: I ſhall therefore confine myſelf to China, as that country claims the original invention, with ſome appearance of probability. Having procured ſome powder manufactured at *Canton*, I analyzed two ounces of it, and after repeating the operation ſix times, the mean reſult gave the following proportions:

Nitre.

| | oz. | dwts. | grs. |
|---|---|---|---|
| Nitre, - - - | 1 | 10 | 0 |
| Charcoal, - - - | 0 | 6 | 0 |
| Sulphur, - - - | 0 | 3 | 14 |

You will obſerve a deficiency in weight of 10 grains, probably the conſequence of ſome defect in my proceſs, which was, firſt to weigh the powder, next to ſeparate the nitre by ſolution, evaporation and filtering; I then weighed the reſiduum of charcoal and ſulphur combined; and laſtly, I ſublimed the ſulphur by a degree of heat not ſufficient to inflame the charcoal, which when weighed compleated the operation, producing the aforeſaid reſult; but as M. Beaumè, a French chymiſt, made a variety of experiments to obtain a total ſeparation of the ſulphur from the charcoal, and was never able to effect it, $\frac{1}{14}$ part remaining united, 3 grains muſt be deducted from the charcoal and added to the ſulphur to give the accurate proportion of the ingredients. This powder was unuſually large grained, not ſtrong, but I believe very durable; it had been made many years when I got it, yet there was no viſible ſymptom of decay, the grain being hard, well coloured, and though angular (which form commonly generates duſt) it was even ſized, and in perfect preſervation.

I NEXT proceed to the moſt eſſential and moſt neglected operation in manufacturing gun-powder, the combining and incorporating the ingredients. This, if poſſible, ſhould be performed in clear dry weather; a lowering ſky, and a humid atmoſphere, being found inimical to that thorough blending of the materials which ought to precede their being worked in the mill. Stamp-

ing-mills were formerly ufed for working gun-powder; their conftruction was very fimple, being a large mortar, in which a ponderous wooden peftle moved by men, by horfes, or by water, performed the operation very perfectly, but with obvious danger to the workmen. In Sweden, and I believe in Ruffia, they ftill continue to ftamp the powder during the firft part of the procefs, and afterwards roll it under ftones; by this means leffening the probability of an explofion, as the compofition is lefs inflammable in the beginning than when the materials are more intimately blended. Since government, alarmed by the frequency of accidents, thought proper to prohibit ftamping in the ordnance mills, this part of the procefs has been effected by means of two ftone cylinders applied to the ends of a common axis, and moved in a vertical pofition round a circular trough, either by water or by horfes. The inferiority of the prefent practice is vifible in its operation on the powder, which has certainly degenerated both in ftrength and durability fince the abolition of ftamping-mills. This may be attributed, firft, to neglect in the manufacturer, who is fatisfied with working his powder feven or eight hours inftead of twenty-four, which was the ufual time when ftamping-mills were employed; and, fecondly, to a radical defect in the machine, where the circumferences of two fmooth and ponderous ftones compref the moift pafte into a hard folid cake, over which they make repeated circumvolutions with a very trifling derangement of the indurated furface, and confequently without contributing much to the incorporation of the ingredients. To obviate the firft objection, it is neceffary that government fhould ftimulate the induftry of the merchant, by giving

giving him a more liberal price for his powder, or (what would be of greater national advantage) that the board of ordnance ſhould take the management of this manufacture (as far as is requiſite for the ſupply of the army and navy) into their own hands: Whilſt it is furniſhed by contract, and the proceſs of manufacturing ſubjected to no controul on the part of government, its quality can never be depended on. Towards the cloſe of laſt war the manufacturer was paid thirty ſhillings, excluſive of eighty pounds of ſalt-petre, per barrel of powder, containing one hundred net pounds; which, conſidering the enormous price of nitre at that period, made the full coſt to the nation about five pounds. Extravagant as this may appear, when we combine the high wages of workmen, the danger of exploſion in the mills, the riſk of rejection in the proof, and, above all, the irregular dilatory mode of payment in uſe with the ordnance board, candour muſt oblige us to allow that the merchant's profit was moderate indeed. I have been informed by ſeveral of thoſe gentlemen, that they certainly could encreaſe the ſtrength and durability of their powder by milling it ſome hours longer, but that the price given would not indemnify them for the additional labour. It is ſurely unpardonable to neglect, and an ill-judged œconomy to be parſimonious in an article whoſe quality may determine the event of a conteſt, deciſive of our exiſtence as an independent people! If to this ſerious conſideration we add the expence of re-manufacturing powder, which, defective in its original conſtruction for want of ſufficient working, is returned and condemned ſoon after being iſſued (to the entire loſs of the charcoal and ſulphur) with the ſums paid for ſtore-houſes, work-

men, &c. and we may ſafely conclude that a ſmall additional expenditure in the firſt inſtance, judiciouſly applied, would turn out a very eſſential public advantage.

I WILL next ſuggeſt an alteration in the ſubſtance and conſtruction of the rollers, which may remedy ſome of thoſe defects I noted in the proceſs of *milling:* Inſtead of marble or granite, I propoſe that they ſhall be made of caſt iron, as well as the circular trough in which they move; let the periphery of the cylinder be divided into eight equal parts, alternately *grooved* and *plain*, with two of the fluted diviſions having their grooves tranſverſe, the other two longitudinal, as in the annexed drawing, where A repreſents the perſpective of the roller, and B is a plan of its circumference, ſhowing the diſpoſition of the compartments and the direction of the grooves; theſe grooves ſhould be an inch in breadth and a quarter of an inch in depth, with their angles rounded off; the trough muſt continue ſmooth, as in the preſent practice. The effect propoſed from this conſtruction is, that the alternations of the plain and fluted diviſions, when the rollers are in motion, will penetrate the ſubſtance of the paſte, producing a more intimate connexion and intermixture of the component parts than can poſſibly reſult from the equable and ſcarce interrupted progreſſion of one ſmooth ſurface over another; by this operation becoming equivalent to many hours labour. Where the private manufacturer is unwilling or unable to afford new cylinders, he may break the continuity of the paſte, by affixing a ſmall but *weighty* harrow, with copper teeth, to the axis of the roller, and following its direction in the trough. Should

iron

iron cylinders be objected to as dangerous, they may be ſhod with braſs, which will be found ſufficiently hard for this purpoſe. I muſt, however, obſerve, that the former are already uſed in ſeveral mills; and intelligent powder-makers allow, that accidental exploſions are moſt frequently produced by the colliſion of chips which break from the edges of ſtone rollers. I am aware of one plauſible objection to fluted cylinders; the paſte, if very moiſt, may adhere to the grooves; but this I think will be prevented by the application of oil to the fluted ſurfaces in ſuch ſmall quantities as ſhall not injure the compoſition.

Before I diſmiſs this part of my ſubject I will hazard propoſing another alteration in the conſtruction of powder-mills; it is ſimply working four rollers in the *ſame* trough inſtead of two. Where water is the moving power, the coſt of additional mechaniſm will appear trifling, if oppoſed to the time and labour obviouſly ſaved by the adoption of this idea.

I will not prolong a tedious, and I fear a tireſome diſſertation, by introducing a minute detail of the proceſſes of granulating and drying powder, but content myſelf with obſerving that the firſt is performed by a horizontal wheel, on which are fixed circular ſieves, with parchment bottoms, perforated to the largeſt intended ſize of the grain; in thoſe ſieves the paſte is depoſited, and with it (in each of them) a ſmall oblate ſpherical piece of lignum-vitæ, which being moved about the ſieve by the action of the wheel, breaks the compoſition, and forces it through the parchment bottom into veſſels placed for its reception;

tion; but as this operation leaves the powder in grains of various dimenſions, it is ſorted by being paſſed through wire ſcreens of progreſſive reticulations. Powder is commonly dried in an apartment, three ſides of which are furniſhed with ledged ſhelves containing the compoſition, and the fourth is occupied by a large iron ſtove, which projects into the room, but is heated from without. This apparatus is very faulty in many reſpects, but more particularly in not diffuſing an equal heat; an amendment has been attempted, by carrying flues round the drying room, filled with heated ſteam; however the change has been little, if at all, for the better. Perhaps a circular room, with a ſpherical ſtove in the centre, might communicate a more equal degree of ſiccity to the compoſition.

I WILL next ſubmit to your lordſhip's examination ſome general obſervations, ſelected from thoſe which occurred during the courſe of my experiments on gun-powder. The powder returned by the navy and garriſons as unſerviceable was depoſited in the magazine at Purfleet, where that which ſtill retained its grain was ſeparated from the duſt; and if two drachms of it, when tried in the vertical eprouvette, had ſufficient ſtrength to project a ſuperincumbent weight of twenty-two pounds to the height of three inches and five-tenths, it was again iſſued for ſervice; but this happening very rarely, ſuggeſted a doubt, that by abſtracting the duſt, our powder was deprived of its principal ingredient; this conjecture I eſtabliſhed by repeated experiments in the vertical and mortar eprouvettes, as the duſt (though varying in degree) almoſt always exhibited ſuperior ſtrength to the granulated

lated powder from which it had been ſeparated. The phænomenon remained to be accounted for; this was effected by an accurate examination of powder in its damaged ſtate, when with the aſſiſtance of a convex-lens I diſcovered a new cryſtallization of the nitre (called by powder-makers the ſtarting of the petre) which having been partially diſſolved, ſhot its minute ſalts to the ſurface of the grain, where they appeared like the ſpiculæ of hoar-froſt, 'till broken and detached by the attrition produced in moving the powder, they were converted into that duſt, which conſequently contained the eſſence of the compoſition. The eprouvette experiments were corroborated by the leſs fallacious teſtimony of analyzation, and this erroneous practice corrected. The foregoing obſervations muſt, however, be applied to ſuch powder only as though injured, in part retains its grain. When it is ſo far damaged as to cake, the cryſtallization of the nitre being more compleat, and its ſhootings larger, they adhere more tenaciouſly to the lumps, or when broken off are prevented by their magnitude from that intimate admixture with the ſulphur and charcoal duſt which is eſſential to forcible exploſion; all attempts to renovate powder, when thus far decompoſed, are nugatory, and can only be dictated by ignorance or fraud; it ſhould be immediately transferred to the extracting houſe. The ſtrength of new powder is not diminiſhed by reducing it to duſt, but rather increaſed, a ſecret well underſtood by powder merchants, who mix duſt in ſmall quantities with that powder they apprehend will not riſe to proof. It was formerly the practice of government to manufacture their powder as ſmall in the grain as that made at *Dantzick* or *Battle* is at preſent; whether the

large

large corned powder now uſed merits a preference, appears to me problematical; the grain of the Chineſe powder I beforementioned was as large as ſmall pepper-corns; and in 1782 I diſcovered at Purfleet ſome barrels of very ſmall-grained powder, manufactured by Sir Polycarpus Wharton, ſurveyor of the ordnance in Charles the Second's reign; a part of this powder was above proof, and none of it much under; the whole retained its grain, and was in compleat preſervation. It may not be improper to remark, that during the aforeſaid reign, and for ſome time after, moſt of the nitre uſed in England was collected in the country; and, if I am not miſtaken, there ſtill exiſt acts of parliament, granting the crown the ſoil of ſhambles and ſlaughter-houſes, and the earth under the flooring of ſtables, bullock-hovels, &c. and alſo directing the magiſtrates to have tubs placed in the ſtreets of populous towns, for the collection of urine: From thoſe materials there was a ſufficiency of nitre extracted to ſupply the ordinary conſumption of government. I cannot in this place omit noting the paradoxical peculiarities of this extraordinary foſſil, which, generated by a combination of animal and vegetable putrefaction, exhibits the moſt energetic antiputreſcent principles; and, though claſſed amongſt the coldeſt of the ſaline genus, is replete with vehement and irreſiſtible fire!

Formerly government manufactured three ſorts of powder, viz. mortar, cannon and muſquet. I am of opinion the practice ſhould be revived in part, for the following reaſon: Sulphur, by its proneneſs to fermentation, is probably the ingredient which contributes

contributes moſt to the decompoſition of powder. Believing this poſition, but retaining ſome doubts of its being practicable to produce forcible powder from nitre and charcoal only, I directed a ſmall quantity to be made, and was agreeably ſurprized to find that fifteen pounds of it projected a thirteen inch ſhell as far as the beſt powder compoſed in the uſual manner; from hence I conclude that a powder might be made ſufficiently ſtrong (when uſed in quantities *above ten pounds)* with a much leſs proportion of ſulphur than the preſent practice admits of. In caſes where a ſmaller *charge* is uſed, or where a rapid inflammation is required, the uſual doſe of ſulphur is indiſpenſably neceſſary.

The proceſs of glazing powder is effected by attaching caſks, ſomething more than half full, to the axis of a water wheel, which turning with velocity, the operation is compleated in a ſhort time by the friction of the grains againſt each other. I found, from a mean of near *ſix hundred* experiments, that glazing powder reduces its ſtrength about one-fifth if the powder is good, and nearly a fourth if of an inferior quality; this proceſs being more noxious to the force of bad powder than of good, is accounted for, in my opinion, by the greater proportion of duſt ſeparated during the operation from the former than from the latter, as this reſiduum is invariably ſtronger than the glazed powder from which it has been ſcreened. I am confident, however, that it would be a wiſe meaſure was government to adopt the practice of glazing all high proof powder, and reſerving it for the garriſons abroad, where it muſt remain long in the maga-

 zine,

zine, as powder of this deſcription retains its grain better, and is conſequently more durable, than when unglazed.

Government powder, manufactured at Feverſham, when received from the mills, is conſiderably ſtronger than either Dantzick or Battle ſhooting powder; and I believe it would continue ſo, was it ſecluded from the action of the atmoſphere, which might be effected by lining the barrels with the thin lead uſed for the preſervation of tea; or was it expoſed to a free circulation of dry air, according to the practice in Dutch men of war, which have an ingenious and ſafe mechaniſm for ventilating their magazines, worthy the imitation of the Britiſh navy. Frequently reverſing the barrels contributes to the preſervation of powder from that ſpecies of decompoſition induced by the different gravitation of the ingredients. In barrelling powder it is of the utmoſt importance to ſelect dry clear weather; the conſequences of inattention to this material point, have, I fear, been oftener *felt* than *ſuſpected* by our fleets and armies.

The ſize, ſhape, and colour of the grain in powder are conſidered as indications of its quality; and though I have met with good and bad of all forms and colours, yet I am clearly of opinion that the general preference is due to powder of a moderate ſized and ſomewhat ſpherical grain, as being leaſt apt to generate duſt, which ſhould be carefully avoided, becauſe ſubverſive of that equal ſtrength which ought to be diffuſed through the whole contents of a barrel, and is in all caſes important to the efficacy of artillery, but in mortar practice becomes indiſpenſably neceſſary.

ſary. The colour ſhould be a greyiſh blue, tinged with red, and the texture of the grain firm, but not ſo hard as to reſiſt a very forcible preſſure from the finger againſt a board. I am aware that my opinion diſagrees with the general ideas of Britiſh powder-makers, who prefer a dark blue colour, and an angular grain, thinking that hue and form ſuſceptible of the readieſt inflammation; but a general deduction from numerous experiments has convinced me of their miſtake.

The ſtrength of powder is frequently impaired by being too precipitately dried; this I diſcovered on examining ſome of the rooms appropriated to that operation, where finding the heat intenſe, I ſuſpected its being ſufficiently powerful to evaporate the ſulphur, which a cloſer inſpection proved to be the caſe, as the crevices of the walls and ſhelves were filled with flour of brimſtone ſublimed by the action of the fire, from the ſurface of the grains, preciſely where the greateſt proportion of this inflammable principle is required. The acceleration of the drying proceſs has this farther diſadvantage, that it leaves the powder moiſt in the centre of the grain: I fear this practice, though every way pernicious, is become ſo general as to demand the interference of government; the detection of ſuch powder is eaſy; for when freſh from the drying-houſe it will riſe to high proof, but being left in the magazine for a month will lower its ſtrength at leaſt a fourth: And here I muſt obſerve, that in times of peace, when the demand cannot be very preſſing, powder ſhould not be proved ſooner than two months after being manufactured.

It was formerly the practice to load with large quantities of powder; and the abuſe extended ſo far, that in ordnance of a higher calibre than twelve-pounders, the charge of powder amounted to half the weight of the ſhot; the conſequence of this was, that about a fourth of the powder remained uninflamed, which added to the weight of the ball gave a reſiſtance of 27 lbs. to be overcome by 9 lbs. of powder, inſtead of 24 by 12, the ſuppoſed *reſiſtance* and *power*. To demonſtrate more accurately the abſurdity of this practice (which had been already reprobated by the beſt artillery officers) I encloſed the vertical eprouvette ſo as to prevent the eſcape of uninflamed powder, and after fifty diſcharges, in each of which 2 drachms were compreſſed by a weight of 22 lbs. I collected above a thirtieth part, or $3\frac{1}{2}$ drachms of ſtrong and highly inflammable powder. The preſent charge is a third of the ſhot's weight for heavy, and a fourth for light artillery; it would ſtill admit of reduction.

Salt of Tartar may be introduced as an auxiliary in the compoſition of gun-powder; it encreaſes the report aſtoniſhingly, but is noxious to ſtrength and durability: Government ſhould, however, give ſome attention to this matter, as a powder might be manufactured, a ſmall portion of which would produce a tremendous report, and prevent the unneceſſary expenditure of that which is ſerviceable, in the parade of war where noiſe only is required. The ſtrength of powder is by no means eſtabliſhed by the proof of the vertical eprouvette, unleſs corroborated by the braſs mortar, which I am informed is conſtantly uſed by the

gentleman

gentleman who at preſent ſuperintends the manufactory and proof of government powder, from whoſe acknowledged abilities I prognoſticate conſiderable improvement in this valuable compoſition, which, though become eſſential in war, and of conſequent importance in commerce, affords ample room for melioration.

I WILL no longer treſpaſs on your lordſhip's attention, but ſubmit this paper to your entire diſpoſal, conſcious that it has more to hope from the partiality of friendſhip, than to claim from the juſtice of ſcience.

I have the honour, &c.

## *Obſervations on the* MAGNETIC FLUID. *By Captain* O'BRIEN DRURY, *of the Royal Navy. Communicated by Colonel* VALLANCEY, *M. R. I. A.*

THE magnetic fluid and its phænomena are not leſs ſingular than obſcure, and have too long engaged the attention of philoſophers for me to offer an hypotheſis on the ſubject; I mean only to ſpeak to a matter of fact, which I am led to believe may be ſerviceable to *navigation*, eſpecially ſhould the variation of the compaſs ever be made uſe of as a method for aſcertaining the longitude. Read Nov. 29, 1788.

IT is not neceſſary to enter into a detail of experiments to prove the exiſtence of the *magnetic fluid*, which circulates continually around and through a *magnet*, as it is fully demonſtrated by the arrangement of iron filings thrown on glaſs, placed over a magnet.

EXPERIENCE ſhews us that the needle of a compaſs, as well as all other magnets, whether artificial or real, perpetually loſes ſomething of its magnetic power, which often produces a difference exceeding a *point*; and I am well convinced that the *great errors in ſhip-reckonings* proceed more frequently from the incorrectneſs of the compaſs than from any other cauſe.

STEEL

STEEL cannot be too highly tempered for the needle of a ſea-compaſs, as the more it is hardened the more permanent is the *magnetiſm* it receives; but, to preſerve the magnetiſm and conſequently the *polarity* of the needle, I recommend to have the needle caſed with thin, well-polished, ſoft iron, or elſe to have it armed at the poles with a bit of ſoft iron.

I HAVE found, from many experiments, that the *caſed needle* preſerved its magnetiſm in a much more perfect degree than the needle not caſed; and I have ſometimes thought that the magnetic power of the caſed needle had encreaſed, and the magnetic power of the uncaſed and unarmed needle always loſes of its polarity.

SOME time ago I placed a *caſed needle*, an *armed needle*, and one *without* either caſe or armour, in a room, for three months, having at that time preciſely the ſame direction, and nearly the ſame degree of force. At the expiration of the three months I found that the caſed needle and the armed needle had not in the leaſt changed their direction; but the other had changed *two degrees*, and had loſt very conſiderably of its magnetic power: If there were any changes in the other needles, it was too inconſiderable to be perceived.

THESE obſervations appear to me to be new, and may tend to great improvement in our ſea-compaſs: They are here ſubmitted to the conſideration of philoſophers.

*Cove of Cork*, 14*th April*, 1788.

# *A critical and anatomical Examination of the Parts immediately interested in the Operation for a* CATARACT; *with an Attempt to render the Operation itself, whether by Depression or Extraction, more certain and successful.* By SILVESTER O'HALLORAN, *Esq; M.R.I.A. Honorary Member of the Royal College of Surgeons in Ireland, and Surgeon to the County of Limerick Hospital. Communicated by the Right Honorable the Earl of* CHARLEMONT, *P.R.I.A.*

*Nullius addictus jurare, in verba magistri.* HOR.

THOUGH it has been unanimously agreed on, by both antients and moderns, that the cataract is *an opaque body immediately behind the pupilla, opposing the passage of the rays of light to the bottom of the eye*; and that the cure of this disorder *consists in removing this opacity*; yet the part immediately diseased has been for about a century the subject of much controversy, whilst the operation itself, *the most essential point of enquiry*, seems as uncertain now as it was a thousand years ago, notwithstanding the boasted improvements of M. Daviel, and other moderns. Read Jan. 3, 1783.

The antients ſuppoſed that the cryſtalline lens was the principal ſeat of viſion, which they agreed to place in the centre of the eye; that the ſpace between it and the bottom of the eye was filled by the vitreous humour, and that the aqueous humour occupied the anterior part of this organ. As the iris interſected this laſt ſpace, they agreed to call *anterior*, or outer chamber of the aqueous humour, the parts between it and the cornea transparens; and *poſterior*, or inner chamber, what remained between the cryſtalline lens and it. The cataract, it was affirmed, was a web or membrane formed immediately behind the pupilla, in this poſterior chamber, and far removed from the cryſtalline, not unlike a ſcum that is ſometimes found on the top of bottled liquors not well corked. But as experience proved that people after the removal of this opaque body by no means ſaw with that diſtinctneſs that might be expected, and that theory and practice might go hand in hand, this phænomenon was accounted for by obſerving—" That in the formation of this ſcum or membrane, " the moſt denſe parts of the aqueous humour were engaged, " the remainder of this liquor was therefore rarer, or leſs enabled " to cauſe a convergence of the rays of light, and ſight muſt of " courſe be proportionably weaker."

Towards the decline of the laſt, but particularly ſince the commencement of the preſent century, repeated diſſections and obſervations made it but too evident that the *cataract was not a membrane, but the cryſtalline lens itſelf, that was rendered opaque.* Numbers of caſes, and many works were publiſhed from time to time to corroborate this fact, which were violently oppoſed by the partizans of the former doctrine; the chief of their arguments,

ments, and for the time the moſt difficult to be anſwered, was this—" It is an acknowledged fact that the cryſtalline is placed in " the centre of the eye; but every oculiſt knows that the opaque " body to be removed lies immediately behind the pupilla, there- " fore it muſt be a membrane between the cryſtalline and iris." This put the advocates for the new doctrine on a cloſer examination of the ſtructure of the eye, in which Briſſeau, Maitre Jean and St. Yves, but more particularly Heiſter, Morgagni, Petel and Winſlow, bore diſtinguiſhed parts. Every new enquiry contributed to advance the ſeat of the cryſtalline more forward, 'till at length, in the year 1729, Doctor Petel publiſhed a letter * in anſwer to ſome remarks of Hequet's, in which he demonſtrated *that the cryſtalline was ſo near the pupilla that it was impoſſible to introduce a cataract needle between it and the iris without wounding it!* And to make clear to every conception this fact, he gave with this letter a figure of the eye, more correct that any that had yet appeared. Still he kept up the diſtinction of the different chambers of the eye, and in this figure determined their limits, which have been carefully noted by all ſubſequent writers. But that moderns ſhould appear no more defective in point of theory and optics than the ancients, the limited ſight that followed the operation was accounted for by obſerving, " that the cryſtalline is " a denſer medium than either the aqueous or vitreous humour, " and of courſe by its removal ſight ſhould be proportionably " weaker."

* Sur la vrai ſituation du Criſtalin.

*Anatomical Obſervations on the Structure of the Iris, Situation of the Cryſtalline, &c.*

AFTER names ſo reſpectable and truly great as thoſe of Heiſter, Petel, Morgagni and Winſlow, one would naturally imagine that nothing with reſpect to the ſtructure of the eye was left unexplored; yet from the following account it will appear that much was ſtill wanting. I ſhall not enter into a general deſcription of the eye, but on the preſent occaſion confine my remarks to the parts immediately intereſted in the operation, and to the *errors committed* in the deſcription of them. And firſt; much confuſion has ariſen on account of the two chambers of the aqueous humour, and very reprehenſible miſtakes in the deſcription and delineation of the iris; the iris is generally ſuppoſed to take its riſe from the ſclerotica, at its junction with the cornea tranſparens; but though this is exactly the caſe *at the middle of the ſuperior and inferior parts of the eye, as it lies in the orbit*, yet the adheſion of the ligamentum ciliare gradually falls back on the ſclerotica, as it advances towards the two canthuſes, inſomuch that HERE the origin of the iris is a mathematical line, poſterior to that of the cornea tranſparens; *a remark of great conſequence to the operation, but particularly to the extraction of the cryſtalline*; to prove this, if you remove the cornea tranſparens, at its junction with the ſclerotica, you will evidently ſee that the cloſe adheſion between this laſt and the choroïdes, called ligamentum ciliare, is exactly as deſcribed The uvea or iris is alſo repreſented as proceeding exactly flat, from the edge of the ſclerotica to its aperture called the

the pupilla; yet if we look into an human eye, or into that of any animal, we will clearly ſee that the iris, ſo far from being flat, is very convex, and that this convexity is greateſt at its ſides. If beſides viewing cloſely the eyes of living animals, we examine through the cornea of inanimate ones, we will perceive the ſame appearance. Certain it is, that after cutting off the cornea lucida, the ſituation in which the eye is placed being moſtly on its poſterior extremity, makes the whole eye, and of courſe the iris, appear flatter than they really are; but a little reflection, and an alteration in the poſition of the parts, will ſoon prove the fallacy of this appearance; for placing the ſides of the eye nearly horizontal (according to their natural ſituation) you will quickly ſee the iris aſſume a much more convex appearance, provided in removing the cornea you have not injured the cryſtalline capſula, even though the loſs of this cornea ſhould have made the parts leſs compact.

Indeed, from the days of Galen, the convexity of the iris was never doubted, 'till Veſalius firſt pretended to controvert this truth; and all the figures given of it by former anatomiſts and opticians have ſo repreſented it, notwithſtanding that they agreed to place the cryſtalline in the centre of the eye. But ſince Monſ. Petel, (already quoted) has affirmed that the iris is flat, and as ſuch has repreſented it, he has been in this error followed by ſubſequent writers: Yet that it is an error, and with reſpect to the *operation of extraction*, a very alarming one, will appear from the following exact deſcription.

The

The vitreous humour occupies all the poſterior and anterior part of the eye as far as the iris, leaving a ſmall ſocket or cavity in its anterior part for the lodgment of the cryſtalline lens. It is ſaid to be covered by a fine membrane, called tunica vitrea; but for my own part, who have diſſected as many eyes, and of different animals, as I believe any man, I confeſs I have never been able to trace any membrane ſurrounding it except in its anterior part, *and there it is covered very ſenſibly and very remarkably.* Leaving then the deſcription of this tunica vitrea to thoſe that can find it, I ſhall obſerve that when the vitreous humour reaches the iris there is a cloſe adheſion between them by the intervention of a firm pellucid membrane ariſing from the inſide of the choroïdes, exactly oppoſite to that part where the adherence between this laſt and the ſclerotica commences, called ligamentum ciliare. This membrane covers all the anterior part of the vitreous humour; but when it reaches the ſocket or cavity in which the cryſtalline is contained it ſeparates; the poſterior, and by much the finer part, lines this ſocket, whilſt its anterior one covers the cryſtalline, ſo that it becomes incloſed in it as a nut is in its ſhell. Thus the cryſtalline is encloſed in a fine pellucid membrane, which capſula is *conſtantly* humected with a tranſparent liquor which prevents any kind of adheſion or connection between it and this interpoſed body. The anterior part of this capſula is ſo denſe as to be ſometimes capable of being ſeparated into two diſtinct coats; the contained liquor is, from its diſcoverer, called *Morgagni's* liquor.

I have

I HAVE ſaid, CONTRARY TO ALL ANATOMISTS, that the inſide of the iris adheres cloſely to the anterior part of the vitreous humour, except where it opens for the lodgment of the cryſtalline; and the better to comprehend this fact, I ſhall give a new deſcription of the iris. With other anatomiſts, I always imagined that this laſt was a real continuation of the choroïdes; I am now ſatisfied that it is not, and that the aſſertion is very nearly as abſurd as to aſſirm that the diaphragm is a continuation of the pleura, though the choroïdes adheres pretty cloſely to the ſclerotica, near the inſertion of the optic nerve; yet from thence to the ligamentum ciliare, the correſpondence is moſtly kept up by blood-veſſels and nerves paſſing from one to the other. HERE a cloſe adheſion of the choroïdes to the ſclerotica commences. At the middle of the ſuperior and inferior parts of the eye, it begins at the very edge of the ſclerotica, bordering on the cornea tranſparens, but from thence to the two canthuſes it gradually retires back on the ſclerotica; the adhering part from the choroïdes, called ligamentum ciliare, is truly tendinous, and forms an expanſion or covering to the iris; within ſide this are groupes of blood veſſels from the arterial circle of the iris, proceeding in nearly ſtraight lines, as well to the pupilla as to the ciliary ligament. To prove that the iris is totally different from the choroïdes and truly muſcular, it is only neceſſary to obſerve that the inſide of the ligamentum ciliare anſwering to its breadth, is fleſhy and thicker than any other part of this body; its fibres proceed radiated or nearly ſo from thence towards the iris. Here the covering of the anterior part of the vitreous membrane commences, and ſo

cloſely

clofely is this attached to thefe radiated fibres that their impreffions are funk deep into it, and may be called the fulci of the proceffus ciliares. This firft range of fibres on the infide of the iris is in a human eye about the breadth of a line; a kind of tendinous narrow and circular band clofes this phalanx, and from thence proceeds a fecond row of radiated fibres thinner than the firft; thefe alfo adhere and leave their impreffions on the vitreous membrane; and that part of the iris which forms the pupilla is ftill finer than the laft-mentioned, refts on the cryftalline, and is quite free from any adherence, by which means it contracts or dilates in proportion to the vicinity or diftance of objects. Thus the convexity of the iris follows nearly that of the cornea tranfparens, and is occafioned by the protuberance of the cryftalline; fo that the idea of a pofterior chamber of the aqueous humour muft be FOR EVER BANISHED; nor is that of circular fibres belonging to the iris better founded in truth and anatomy. Thefe laft we are conftantly told were formed for the purpofe of contracting, as the radial ones were for expanding, the pupilla; but not to advert to a fact, which is, that the ftate of quiefcence in the pupilla is its dilatibility, which is evident, becaufe when afleep or in a ftate of inattention with refpect to objects, we conftantly find it fo; I fhall juft obferve that there are none but radial fibres through the whole internal furface of the iris. That the convexity of the iris may be proved beyond a poffibility of doubt, let the fide of the cornea be pierced at its junction with the fclerotica by a lancet or cataract needle, and paffed in that direction to the oppofite fide of the eye. On examination you will find, that befides the cornea you will have wounded the

iris

iris a line higher than the ligamentum ciliare. If you perforate another eye a line and an half higher up on the cornea, it will juſt glide over the pupilla, and from this to the top of the cornea within is another line. If from the ſummit of the cornea a ſtraight line be drawn, and parallel to one from the riſe of the iris, i. e. the ligamentum ciliare at the ſides of the eye, the diſtance will be found to be three lines and an half. Thus the diſtance between the riſe of the iris and the pupilla or its upper extremity is generally two lines and an half, oftener more, meaſured from either canthus; but from the middle of the ſuperior and inferior parts of the eye, as it lies in the orbit, a line leſs.

*Idea of adherent Cataracts exploded, real Difficulties attendant on depreſſing Cataracts demonſtrated, with the moſt rational Means of overcoming them.*

Brisseau, Maitre Jean, Heiſter, and, in ſhort, all oculiſts, whilſt, as *anatomiſts*, they inform us that the cryſtalline is ſurrounded by a fine pellucid membrane; as *operators*, they are careful to tell us *that the cataract frequently adheres to different parts of the iris*. Heiſter, though his treatiſe *De Cataracta* merits high applauſe, yet ſeems ſo perſuaded of this imaginary adheſion! that, in his ſurgery he directs, when it is found ſo ſtrong as not to be ſeparated by the needle, to perforate the centre of the cryſtalline, in hopes of giving ſome ſmall admiſſion to the rays of light. Warner who, we ſhould ſuppoſe always paid particular attention to this organ, though he tells us that

the cryſtalline is inveſted by a fine membrane from which it readily eſcapes by the leaſt aperture, yet attempts to determine as an *operator*, whether there be an adheſion of the cataract to the iris or not*, nor can his method of performing the operation of depreſſion be approved of, ſeeing that he directs the needle to pierce the ſclerotica at *a very ſmall diſtance* from the cornea, by which means the iris muſt unavoidably be wounded. In a word, the adherence of cataracts has been the language of antiquity, and continues to be that of modern times; but it certainly is not the language of anatomy or reflection, *for it is not the language of common ſenſe:* But before we proceed to explain what has given riſe to this imaginary adheſion, the following practical remarks on the different humours appear very ſeaſonable.

And firſt, as to the aqueous humour, it is a fact long eſtabliſhed, that if, by a wound of the cornea, it eſcapes, it becomes in a very ſhort time repleniſhed, and the proceſs of extracting the cryſtalline proves that this regenerated liquor is as well adapted to all the purpoſes of viſion as the former. The vitreous humour, if partly or totally loſt, never can be reſtored; but a wound of this body does not deſtroy its tranſparency, nor even injure it, as is demonſtrable by the proceſs of couching, which cannot be effected without not only wounding but ſeparating parts of it, and forcing the cryſtalline through them. A wound

* Deſcription of the eye and its diſorders, p. 81, &c.

of

of the cryſtalline is conſtantly followed by its opacity, as numbers of experiments prove, *many of which are within my own knowledge*; and a ſevere compreſſion of it will produce the ſame effect. This lens, when fairly diſcharged from its capſula, and lodged under the vitreous humour, inſenſibly waſtes away*; but *I have had proofs* that when it ſlips into the aqueous liquor this is by no means the caſe. A diſeaſed cryſtalline, whether hard or ſoft, is conſtantly found ſmaller than a ſound one, and its capſula or covering, it may be affirmed, *whilſt entire*, is always tranſparent, let the ſtate of its interpoſed body be what it may. A wound of this membrane ſoon heals, and though by it Morgagni's liquor may eſcape, yet it alſo becomes ſoon recruited. Both theſe INTERESTING FACTS are proved by couching; for if you fail of depreſſing the cataract ever ſo often, yet you may at length ſucceed; and though you ſhould fail in this, yet you are certain to remove the opacity by *extraction*, which could never happen did not the different wounds of this capſula heal, and the encloſed liquor regenerate.

WE will now ſuppoſe a perſon preſents himſelf for the operation; the cataract is of a pearl colour, greyiſh or white; the eye feels plump, the pupilla contracts and dilates, and the patient diſtinguiſhes light and darkneſs; a better conditioned cataract cannot offer, nor a fairer for depreſſion. Let us now ſee what are the *real*, not *imaginary*, obſtacles to the ſucceſs of the

* Philoſophical Tranſactions for 1730, No. 384.

operation; the needle pierces the ſclerotica, we behold it, through the pupilla, lodged in the cryſtalline; the ſurgeon endeavours to diſengage and remove the cataract; it ſeems in part obedient to the needle; as it is preſſed down the iris ſeems to follow it, but lighten the force, and every part aſſumes its former place and appearance; you renew your endeavours, and on preſſing the cataract below the pupilla, and retaining it there awhile with the needle, the diaphanous vitreous humour follows it, and for the inſtant enables the patient to ſee objects; the needle is now carefully withdrawn, and all parties congratulated on the ſucceſs of the operation. It is however but tranſitory, for the parts return to their former ſituation, and any violence done to the vitreous membrane is removed before the eye is again opened. Let us ſuppoſe in the firſt inſtance that the operator ſees the cryſtalline riſing: perſuaded that this is occaſioned by its adherences, he freely pricks and wounds the proceſſus ciliares, which are the internal parts of the iris, to break this coheſion; the hemorrhage diſturbs his plan by deſtroying the tranſparency of the aqueous humour, and he withdraws his needle *re infectâ*; or if he perſeveres, he may have the credit of deſtroying the eye in forming this ſeparation. Here are in one view collected all the proofs, *and melancholy ones they are*, of an adherent cataract; but the deſcription already given will clearly explain them. It is to be remembered, that the opaque cryſtalline has a lodgment formed for itſelf in the anterior part of the vitreous humour; that it is ſurrounded on every ſide by a ſtrong membrane, which is a continuation of that which covers the anterior part of this laſt body; that the proceſſus ciliares being the inſide of the iris

adhere

adhere closely to this membrane in every part, even to the border or edge of the cryſtalline capſula, to which capſula the cataract has not the ſmalleſt adherence; the foſſula or bed alone muſt give ſome degree of ſtability to the cryſtalline; but when to this we add its envelope, the covering of the iris, and its ſtrong adheſion to the vitreous membrane, we muſt be convinced that nature has paid uncommon attention to the ſecurity of this body, and that no ſmall pains and attention are neceſſary to diſplace it. Certain it is, that if a ſufficient opening were made in the capſula the cryſtalline may be thrown out of it by means of its contained liquor: But are the ſmall pointed needles, moſtly uſed, well calculated for this purpoſe? they undoubtedly are not; they perforate this membrane, and ſtick in the cryſtalline, which is of a thickiſh viſcous ſubſtance, often much harder than in its natural ſtate. Pains are taken to remove this opaque body, but the needle does not afford a ſufficient paſſage for its exit; the parts are preſſed down, and the vitreous membrane, and of courſe the iris, muſt yield to this preſſure, from their connections with each other, without the aid of any imaginary adherence of the cryſtalline or its capſula to the iris: but let us ſuppoſe the cataract fairly diſlodged from its bed by a proper opening of its capſula; are there no other obſtacles to its precipitation? there are, and conſiderable ones; the vitreous membrane and its adheſion to the iris oppoſe it, ſo does the denſity of the vitreous humour itſelf. Theſe are NOW the real difficulties, and none other. It is for theſe reaſons that the cataract ſometimes ſlips into the watery chamber of the eye, which from its tenuity gives leſs reſiſtance to it; and it is this circumſtance

circumſtance that gave riſe to Monſ. Daviel's method of extracting the cryſtalline.

To overcome theſe REAL OBSTACLES, care muſt be taken, firſt, by a proper opening of the cryſtalline capſula, to give room to the diſcharge of this body; next, to diſlodge it from its ſocket or bed; and laſtly, to withdraw it to the poſterior and inferior parts of the eye, at leaſt to place it below the pupilla. Inſtead of the needles in uſe, I have mine flat, pointed, and edged like lancets, and like them gradually encreaſing in ſurface. The length of the inciſive part is to its greateſt breadth nearly as three to two; from the broadeſt part it rounds off gradually, and both the handle and blade are ſhorter than thoſe of the common cataract needle. With this knife or lancet moiſtened, the eye (if the left) is to be perforated in the ſclerotica, at about two lines diſtance from the cornea lucida, at the external canthus. If for the right eye, and that the operator is not ambo-dexter, a curvature may be made in the inſtrument, and the lancet ſhould pierce the eye at the internal canthus, and at ſame diſtance from the cornea tranſparens. Let it advance in nearly a ſtraight line *(for it ſhould have a ſmall inclination towards the pupilla)* and it will then enter into the ſide of the capſula. The breadth of the inſtrument alone will give a tolerable opening, which ſhould be encreaſed by a gentle elevation and depreſſion of the ſides (not the point) of the inſtrument. Puſh the point after this to the other ſide of the capſula, which is alſo to be opened, but without injuring the proceſſus ciliares. Sufficient ſpace is now left for diſlodging the cataract from its bed, which the ſurrounding fluid will facilitate; but if we fail in our

our endeavours the capſula will heal, and all will be to do over again. To effect this the cataract ſhould be gradually diſengaged by gentle and nearly rotatory motions, and inſenſibly withdrawing it from before the pupilla, which the breadth of the needle ſeems well calculated for. When you behold it retiring from it, you ſhould gently preſs it (but with the ſides of the inſtrument) to the bottom of the eye, and there detain it for two or three ſeconds, or 'till the vitreous humour fills up the deſerted place. Though a cataract thus depreſſed may riſe a little, yet as it is effectually removed from its original place, it will inſenſibly fall again, and melt away; for I am to repeat it, that the ſucceſs of the operation depends on a ſufficient opening of the membrane, and puſhing the opaque body from its natural reſting place. If the cataract be in a diſſolved ſtate, the firſt perforation will give iſſue to it; and though it may appear to diſturb the other humours, yet in a few days all will inſenſibly ſubſide, and the eye clear up. There are other inſtances where the cryſtalline will be removed with very little trouble to the operator; but this only proves that its membrane is very thin, and the vitreous humour not ſo viſcid as uſual. But notwithſtanding the directions given to remove the cryſtalline, if it ſhould ſtill reſiſt our endeavours, and if, by accidentally wounding the iris, blood ſhould follow; in this caſe, when the operator is ſatisfied that the capſula is ſufficiently dilated, he ſhould immediately withdraw the needle, and preſs with his finger on the ſide of the globe oppoſite the perforation, *and this will effectually diſlodge the cataract, without any injury whatever to the eye, provided the preſſure is not too violent*, which the forcing out the cryſtalline does not ſeem to demand.

HAVING,

HAVING, I think, effectually exploded the erroneous doctrine of *adherent cataracts*, and given a more exact description of the parts interested in the operation, the true causes of the difficulties that occur in it, and the means of overcoming them, than has hitherto appeared; I shall now proceed to treat of the extraction of the crystalline, and propose an operation much more simple than that now in use, and attended with infinitely greater advantages to the patient.

### *Of extracting the Crystalline.*

WOUNDS of the cornea have been long known to be attended with no danger or inconveniency, except from the cicatrice obstructing the rays of light; for the aqueous humour is soon restored. Pieces of the crystalline have been often known to pass into this chamber, and to be sometimes extracted by incising the cornea; instances of which are given by Mery, Petel and St. Yves; and, encouraged by this success, Mery proposed to the academy the extracting the cataract by an incision of the cornea, as a certain cure *. It does not however appear that he ever reduced it to practice; and whatever applause is due to this method, M. Daviel is certainly entitled to it. He pierced the cornea nearly in a line with the pupilla, at the external canthus, with a cataract needle, and continued it in this

* Memoires de l'Academie des Sciences, 1707.

direction

direction 'till it paſſed through the oppoſite ſide of this coat. The ſide of a fine ſciſſars was introduced into the firſt aperture, and the inferior half of the cornea was divided near the ſclerotica; another needle opened the cryſtalline membrane, and by a gentle preſſure on the globe of the eye the cataract ſlipped into the aqueous chamber, and ſo down the cheek. Such in a few words is Monſ. Daviel's account of this operation. Succeeding writers have laboured to reduce the operation to greater ſimplicity; for it was found that, beſides the cicatrice from the wound, the ſqueezing of the blades of the ſciſſars added conſiderably to the opacity. A ſimple inſtrument, ſomething like an iris knife, has been recommended, and is generally uſed, to perform the entire inciſion of the cornea with.

‡ M. La Faye directs the cornea to be pierced at about half a line from the ſclerotica, and to puſh it on in a ſtraight line 'till it paſſes through the oppoſite ſide, when by a ſingle inclination of the inſtrument the inferior half of the cornea is at once divided; nor need you fear, ſays he, to hurt the iris in traverſing the cornea, AS IT IS PLANE OR FLAT IN ITS SURFACE, as Dr. Petel demonſtrated in the Memoirs of the Academy of Sciences for 1728. Mr. Warner * would have the knife to be *ſuddenly and reſolutely* puſhed through the cornea, and paſſed in a ſtraight line

‡ Mem. de l'Academie de Chirurgie, tom. vi. p. 304.

* Deſcription of the Eye, p.101.

to the other ſide. Such are the directions given by Sharp †, Bertrandi §, and all ſubſequent writers.

NEVER was operation received with greater applauſe, or more ſpeedily and univerſally adopted for thirty years paſt, than the preſent. The avidity with which it was embraced proves but too truly the difficulty and uncertainty of that by depreſſion, and *the utility and neceſſity of the preſent memoire.* For, notwithſtanding all that has been ſaid in its favour, I am not afraid to affirm, THAT NEVER WAS OPERATION LESS ENTITLED TO PUBLIC ESTIMATION. This declaration is not the reſult of theory and ſpeculation, but of ſound practice. I have myſelf performed it both with the ſciſſars as Daviel recommends, and with a knife of my own invention, and have frequently ſeen it performed by others, and never with ſucceſs adequate to expectations. For, in the firſt inſtance, the ſemiſection of the cornea leaves a cicatrice, by which nearly half of it becomes opaque, at leaſt the rays of light cannot diſtinctly paſs through it. But beſides this defect, unavoidable by the directions given, there are other ſtill more alarming accidents to be apprehended from the very manner of piercing the cornea. We ſee La Faye recommends the needle to proceed in a ſtraight line from one ſide to the other, without fear of wounding the iris, which he tells you is FLAT. Warner deſires it to be paſſed *ſuddenly and reſolutely*; and ſuch is too much

† Philoſoph. Tranſactions for 1753.

§ Traitè des Operations de Chirurgie, p. 345.

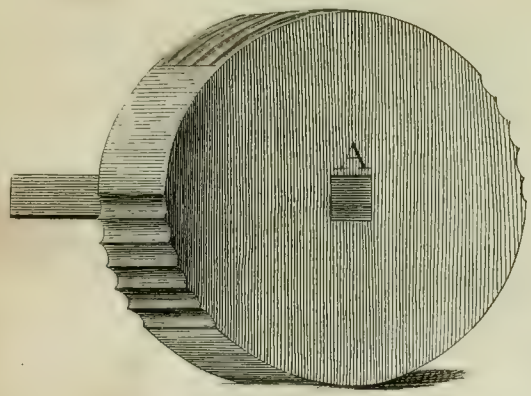
the

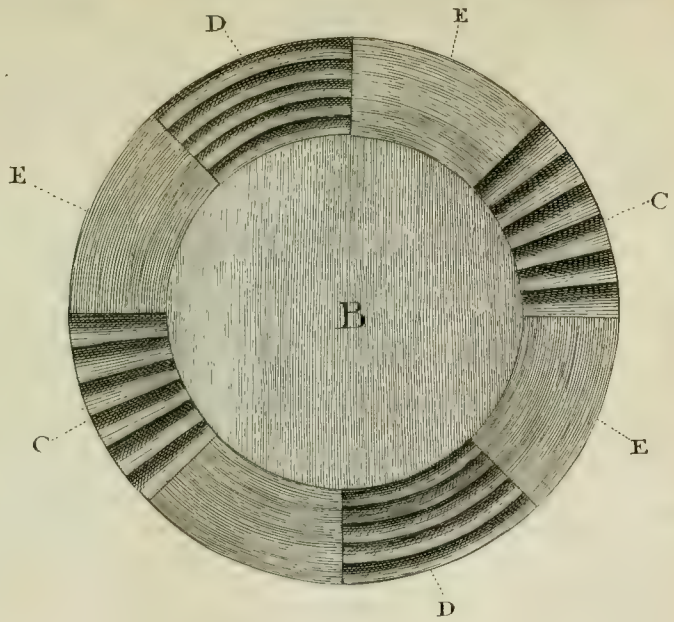
the practice. What are the consequences of this rule? That the iris must infallibly be wounded; and this accounts for the complaints ON ALL SIDES, that a part, sometimes the whole, of the vitreous humour is discharged with the crystalline. Examine the projection of the iris and crystalline in the annexed plates, and you must subscribe to this melancholy truth: But that no doubt should remain, let it be remembered that if the iris be not wounded no particle of the vitreous humour can escape by moderately pressing on the globe, after opening the cornea. We have already noted that the anterior part of this humour is covered by a strong membrane, firmly adhering to the processus ciliares, except where it forms a sheath for the crystalline; what then can pass through the pupilla by pressure but this crystalline? The vitreous membrane, and the adhesion of the iris to it, oppose any other, except the pressure be too strong; but even in this case *the cataract must pass through first.* If then a part of the vitreous humour escape, and a distorted iris follow, we must attribute both to an absolute misconception of the structure of the parts, and to erroneous rules, the consequence of it. Thus we see, besides the unavoidable cicatrice of the cornea, other and more alarming dangers are to be feared, even to the total loss of sight, notwithstanding the cataract is removed.

BUT may not the structure of the parts furnish some hints to render this operation more safe and certain? From a careful perusal of the foregoing very accurate description of them, I think it will; and the following is the modus I would recommend. My knife is of the same size and figure of those used in this operation,

tion, except that it cuts at both ſides from its point, and that the inciſive parts are a little convex, the concave or inſide of which ſhould be marked in the handle. With the concave part next me, I pierce the SCLEROTICA, very near the edge of the CORNEA—ſuppoſe the third of a line—at either the external or internal canthus, according to the eye to be operated on. Inſtead of puſhing it on in a ſtraight line, as recommended, I direct the point rather a little towards the aqueous chamber than the iris, for fear of wounding this laſt, which its riſing convexity expoſes it to. The paſſage of the needle is proved by part of the aqueous humour's eſcape, and by your ſeeing its point, within the cornea, between it and the iris. You now inciſe the inferior ſide of the ſclerotica, advancing the inciſion to the edge of the cornea tranſparens, as the adherence between the iris and ſclerotica approaches cloſer to the cornea, the farther you go from the ſides of the eye. Without withdrawing the inſtrument you cut the upper ſide of the ſclerotica in the ſame manner. The reaſon why the inferior inciſion is firſt performed is, that if you cut the upper ſide firſt a little blood might oppoſe your carrying this inferior opening ſo very accurately afterwards. Thus nearly one ſide of the ſclerotica from top to bottom, at its junction with the cornea, becomes divided; with the point of this very inſtrument you prick the cryſtalline capſula, and the ſmalleſt inclination of it inſide the pupilla will do this, and then gently preſs on the globe of the eye, the cataract will inſtantly ſlip out, and though divided into parts, as it is ſometimes, will with the greateſt facility be extracted through the aperture.

By this ſimple mode of operating very little if any opacity can appear on the cornea; and though ſome may, yet as it is at its very edge from whence the rays of light ſeldom are tranſmitted to the bottom of the eye, no defect can follow; whereas by inciſing half the cornea from ſide to ſide, and not confining the opening to its extremity, a very great opacity remains. I have made no allowance for the eſcape of the vitreous humour, becauſe it cannot poſſibly happen except the iris is wounded, and a very little attention will ever prevent that.




A....Perſpective of the Roller.
B....Plan of the Periphery.
C....Grooves or Flutes croſsing Ditto.
D....Longitudinal Grooves on Ditto.
E....Smooth Surfaces on Ditto.

*Fig. 1*

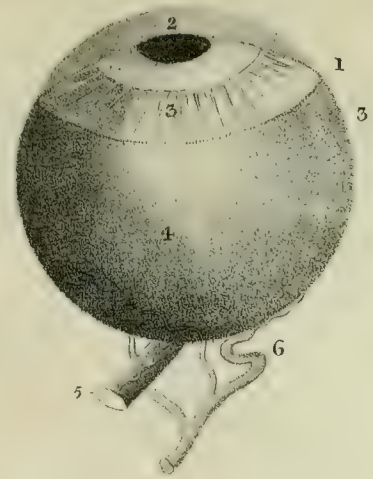
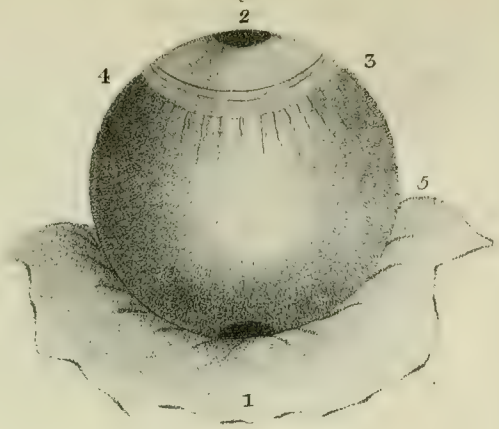



*Fig 2*




1 The Cornea Transparens
2 The Pupilla
3 The Iris, the fold next the Pupilla marks where the Adhesion with the Crystalline Capsula & Iris & Commences
4 The Sclerotica
5 The Optic Nerve
6 The Principal Trunk that Supplies the Eye with Blood

1 The Sclerotica Dissected from the Choroides
2 The Pupilla
3 The Iris
4 The Adhesion of the Iris to the Cornea called Ligamentum Ciliare
5 The Choroides

# *An Account of* EXPERIMENTS *made to determine the* TEMPERATURE *of the* EARTH's SURFACE *in the Kingdom of Ireland in the Year* 1788. *By the Reverend* WILLIAM HAMILTON, *F.T.C.D. and M.R.I.A.*

IT is a queſtion as ancient as the days of the Scythians and Egyptians, whether the temperature of the earth be a permanent or variable quantity*. Unfortunately theſe early nations, deſtitute of proper inſtruments for aſcertaining the temperature of their reſpective kingdoms, have not given us any aſſiſtance in reſolving this curious and intereſting problem, which has been handed down to poſterity with no other attendants than vague and illuſive ſpeculations. Read Dec. 6, 1788.

* See Juſtin, l. 2, c. 1.

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In the preſent age this enquiry has been revived, and purſued with all the fruitleſs enthuſiaſm of antiquity, affording the cleareſt proof that the ſpeculative reaſonings of mankind for three thouſand years, are unequal to the taſk of deciding a queſtion which attentive experiments would probably have reſolved in a much ſhorter period of time.

The Count de Buffon has indeed ventured to aſſert that the temperature of the earth has been for many ages a decreaſing quantity; but a ſlight view of the ſteps by which that gentleman conducted himſelf to this haſty opinion will eaſily ſatisfy one that neither his experiments, nor his reaſonings, are adequate to the concluſions which he has deduced from them; ſince it is obvious that any proofs derived from the cooling of heated bodies on the earth's ſurface, in a medium of known denſity, and a determinate capacity for receiving heat, become extremely deceitful when applied to the diminution of temperature which may take place in a body ſituated, as the earth is, either in vacuo, or in a medium whoſe denſity and capacity for heat is altogether indefinite.

From obſervations on the warmth of the earth itſelf, on the heat of various ſprings of water, and on the eruptions of volcanoes, many philoſophers have been led to conclude the exiſtence of a central fire, by which theſe phænomena might be explained; and, were this concluſion well founded, it might ſeem that the temperature of the earth's ſurface ought to be an encreaſing quantity: but it is certain that the accumulation of heat communicated to the ſurface of the earth in ſummer, will

will ſufficiently account for its relative heat in winter; while the decompoſition of various minerals at conſiderable depths, will afford a reaſonable explanation of the other phænomena: ſo that theſe obſervations do not at all neceſſarily lead us to believe in the exiſtence of a central fire, and experiments made at conſiderable depths within the earth, evidently tend to diſcountenance it.

Whatever be the truth, whether the general temperature of the earth be an encreaſing, a permanent, or decreaſing quantity, it is likely that poſterity will be able to form a probable concluſion on the ſubject, from a compariſon of future experiments with thoſe of the preſent age. But there is another queſtion of ſufficient importance to us, which may poſſibly admit of an earlier anſwer; Whether the temperature of particular countries be ſubject to any conſiderable variations, which, in the courſe of ages may be capable of influencing their vegetable and animal productions, and the affections of their atmoſphere.

We have experience enough, even in our temperate iſland, to ſatisfy us, that the cauſes of heat and cold are not abſolutely uniform; ſince it never happens that two ſucceſſive years are alike throughout, in the temperature of their ſeveral months: Inſtances have even frequently occurred, wherein the temperature of the month of January has rivalled the genial warmth of May.

We often behold a ſucceſſion of years wherein winter ſeems to have entirely loſt its uſual horror, while the arbutus, the laurel, the myrtle, and the rareſt ſpecies of evergreens, ſpring up with the vigour of indigenous plants, almoſt emulating in ſize the trees of the foreſt. Again, periods occur which ſenſibly remind us of our vicinity to the polar ice, periods in which the luxuriant foliage of our more tender plants is entirely withered and deſtroyed, and when even the mountain pine can ſcarcely maintain its hardy ſhoots.

Hence it is plain, that the ſources of heat and cold in our climate are variable in different years; and it is a problem, curious and intereſting in its own nature, to determine what may be the effect on the general temperature of the kingdom, whether it be an encreaſing or decreaſing quantity? whether it be ſubject to periods of encreaſe and of diminution? and whether theſe periods, and the rate of their variations, be uniform or irregular?

For this purpoſe I have endeavoured, by ſuch means as were in my power, to aſcertain the temperature of the ſoil of Ireland, from its ſouthern to its northern coaſt, in the year 1788 and part of 1787, the reſults of which I here offer to the academy.

But firſt, it will be neceſſary to ſtate the methods which have been uſed to procure theſe reſults, that ſhould it be thought worth while to repeat the experiments at any future time, they may be made under circumſtances as nearly ſimilar

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as poſſible to the original ones, which alone can give us reaſonable hope of a right concluſion, where the difference of temperature, even in a great number of years, will probably be exceedingly ſmall.

Experience ſhews us, that the ſurface of the earth enereaſes in its heat during the ſummer, and decreaſes during winter: Of this our ſenſes give us ſufficient notice; and were the greateſt heat in ſummer, and the leaſt in winter obſerved, the mean of theſe would give a reſult ſomewhat approaching to the mean temperature of the ſurface of the earth during that year.

But the quantity thus reſulting, would ſeldom correſpond accurately with the truth; becauſe, the ſurface of the earth being expoſed to the immediate effects of the atmoſphere, to rains and wind, to clouds and ſunſhine, it is evidently ſubject to rapid diurnal variations of heat, which render it an unfit ſtandard from whence to derive the mean temperature of the year, by any induction from a ſmall number of experiments.

At the depth of thirty, forty, or fifty feet beneath the ſurface, theſe diurnal variations ſeem to loſe their influence; while a ſlow and gradual change of temperature takes place, which is not ſenſible except after intervals of many days. At ſuch depths the earth, in our climate, is uſually found at its loweſt degree of cold about one month after the vernal equinox; from that time, it ſlowly and progreſſively acquires heat, until about a month after the autumnal equinox, at which period it commonly poſſeſſes its maximum of temperature. After this, gradually parting with

 heat

heat during the winter, it becomes again cooled to its extreme degree ſoon after the commencement of the following ſpring*; and thus ſuffers as it were an annual tide of temperature, higheſt before the beginning of winter, and loweſt at the commencement of ſpring.

Hence, by proper obſervations, we have an opportunity of diſcovering the proportional increments or decrements of heat communicated to the maſs of earth at certain depths, during the *months* of any one year, for the purpoſe of comparing them with the reſpective increments and decrements of the correſpondent *months* of any other year: and alſo, from an obſervation of the maximum and minimum of heat in different *years*, we are enabled to derive the mean temperature of the outward maſs of earth in ſuch *years*, and thus to make a compariſon between the annual temperatures themſelves at different periods.

At the depth of eighty feet beneath its ſurface (in covered ſituations) the earth is not at all affected, even in many months, by the ſuperficial alterations of heat; and the moſt ſenſible thermometer is ſcarcely competent to diſcover any change through-

* The times of the year at which the maximum and minimum of temperature happen, are different at different depths, earlier at a leſs depth, and later at a greater. Heavy rains about the equinoxes ſeem to expedite the effect: Thus, in the wet autumn of 1787 the temperature began to decreaſe in the beginning of October, in ſituations, where, in the dry ſeaſon of 1788 it did not take place till the month of December. Count Caſſini informed me that the ſame obſervation was uſually made in the cave of the Obſervatory at Paris.

out

out the year. Here then the diurnal and even monthly variations of temperature loſe their influence, and the annual changes alone become perceivable.

Hence it appears that the *diurnal variations* of temperature manifeſt their effects at the ſurface of the earth, where they are beſt to be obſerved. That the *monthly changes* alone, are perceivable at depths of thirty or forty feet; in which ſituations we have the power of comparing correſpondent increments or decrements of heat in different months with each other, or even the medium temperature of different years. It further appears that at the depth of eighty feet and upward, even the monthly variations loſe their influence, while the *annual changes* alone, become perceivable: At ſuch depths, therefore, the acceſs or diminution of heat, in ſucceſſive periods of years, may moſt accurately be obſerved; and attentive experiments, thus made in different climates, may not only throw light on the variations of temperature in ſuch particular climates, but may at length tend to ſolve the problem concerning the general temperature of the earth itſelf, which has in vain been agitated for ſo many ages.

The beſt method of determining the degree of heat, at conſiderable depths, might naturally ſeem to offer itſelf in mines; but experience proves theſe to be extremely fallacious, ſince the decompoſition of mineral ſubſtances often produces caſual varieties which may very much miſlead us. Thus, to give a ſingle inſtance; the ſtreams which run from three of the principal levels of the Ballycaſtle coal pits give a mean degree of heat equal to 51°

of

of Farenheit's ſcale, which is three degrees above the general temperature of the northern coaſt, and equal to that of Cork, though ſituated above three degrees of latitude farther to the ſouth: while the water, iſſuing from a new level opened in the year 1787, produces a mean temperature only equal to 46°, which is two degrees below that of the northern coaſt itſelf; ſo that in theſe pits there is a variation of five degrees of temperature at the leaſt *.

For this reaſon experiments are rather to be derived from covered wells of pure water; and it matters little whether ſuch wells be ſupplied by ſprings, or by a ſlow filtration, ſince the water, long reſting at the bottom of each well, will always give the temperature of the earth at that depth; and conſiſtence, or inconſiſtence, in experiments made at different places not very diſtant from each other, will always enable an attentive obſerver to conjecture concerning the fairneſs of the trial.

The firſt table, which is annexed to this paper, marks the temperature of the coaſt of Ireland in different degrees of latitude. By this it will appear that there is, at preſent, a difference of $3\frac{1}{10}$ degrees of heat, (as marked by Farenheit's ſcale) between our northern and ſouthern coaſt, through a difference of latitude equal to 3° 18′; ſo that the variation of heat, in our iſland, is

* This latter level is opened on a little bay called Port na Graigh, (the Mares Port); and I was conducted to it in conſequence of the complaints of the workmen, who ſuffered very much from the intenſity of the cold. It was then the month of Auguſt, 1787, and yet the temperature of the pit was ſo low as 47, 5.

at

at a rate nearly equal to one degree of temperature for each degree of latitude.

THE ſecond table marks the temperature of places in the kingdom, which are not ſituated on the ſea coaſt. From this we have ſome data for inferring the effects which ariſe in conſequence of diſtance from the ſea, and elevation. Thus it will be found, that the country adjoining to Tullamore in the King's county, near the *centre* of the kingdom, about *fifty miles* diſtant from the Iriſh channel on one ſide, and as much from the weſtern ocean at the bay of Galway on the other ſide of Ireland, *gradually elevated* to the height of *two hundred and ſix feet* above the level of the ſea *, and not very far beneath the higheſt point of the *general* ſurface of our iſland †, poſſeſſes a mean temperature nearly correſponding to a ſituation on the coaſt two degrees more northerly.

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* The elevation of the country at Tullamore is thus proved:

| | Feet. |
|---|---|
| Elevation of the Canal baſon at James's-ſtreet, in Dublin, above the mean height of the tide at the Marine ſchool on the river Liffey, *by obſervations made for the Canal Company*, - - - - | 67½ |
| Elevation of the *ſummit level* of the Canal above the Baſon in James's-ſtreet. *See Brownrigg's Survey*, - - - - | 202½ |
| Total elevation of ſummit level, - - | 270 |
| Depreſſion of Tullamore, below the ſummit level. *See ſtatement laid before Parliament*, - - - - | 64 |
| Hence elevation of Tullamore above the mean height of the tide in the river Liffey - - - - - | 206 |

† It may ſeem ſtrange that a tract of country full of moraſſes, ſhould nevertheleſs, be marked as almoſt the higheſt part of the *general* ſurface of the kingdom; yet there is

In the third table is written the temperature of the ſoil, as obſerved in conſiderable towns; from whence it may be inferred, that there is an artificial encreaſe of heat uſually communicated to the ſurface of the earth in ſuch places, varying conſiderably from the mean temperature of the contiguous country. This is to be eſteemed the reſult of the warmth communicated directly from the quantity of fuel burnt in ſuch towns, and from the heated air and ſmoke which, more or leſs,

is great reaſon to believe that the Bog of Allen, wherein is placed the ſummit level of the Grand Canal, is in reality elevated above a very large portion of the ſurface of Ireland; which may be inferred from the following circumſtances:

From the Bog of Allen the River Barrow derives the greater part of its waters; and at Monaſterevan, (from whence it has yet a courſe of ſixty-eight Iriſh miles to traverſe before it reaches the ſouthern ſea on the coaſt of Waterford;) its depreſſion is eighty feet below the ſummit level of the Grand Canal. *See Brownrigg's ſurvey.*

From the ſame ſource riſes the River Boyne, which, after a north-eaſt courſe of forty miles, diſcharges itſelf into St. George's Channel, on the eaſtern coaſt of the kingdom *(ſee map of Ireland)*; and the elevation of the Bog of Allen is proved to be two hundred and ſeventy feet above the eaſtern coaſt at Dublin. *See preceding note.*

Weſterly, the deſcent is every where toward the Shannon, *(ſee ſurveys before parliament)* even to the ſource of its waters, *(compare Cowen's ſurvey of the Shannon with Brownrigg's ſurvey of the Canal)* ſo that this ſpacious river, which, riſing from the borders of the northern province of Ulſter, waſhes the ſhores of the three remaining provinces of Ireland through a courſe of one hundred and eighteen miles, *(ſee Cowen's ſurvey)* is every where conſiderably depreſſed beneath the Bog of Allen.

Hence it appears, that in a ſoutherly direction as far as Waterford; eaſterly, to Dublin and Drogheda; northerly, as far as Lough Allen; and weſterly, to the ocean at the mouth of the River Shannon; the deſcent of the kingdom is every where from this extenſive moraſs.

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reſts over the ſurface. It is here noticed, to prevent errors in experiments derived from ſuch ſituations; and to ſhew, in general, the unfitneſs of great cities for determining, with accuracy, the true temperature of the year; in which places, nevertheleſs, experiments of this kind have uſually been made, without any correction for ſuch irregularities.

The local diſpoſition of our iſland, conſiderably advanced into the Weſtern Ocean beyond the other ſhores of Europe, and removed from the immediate influence of any great tract of mountainous country, renders it peculiarly fitted for a ſtandard ſituation, to which the obſervations of other countries may be conveniently referred, for which reaſon theſe experiments have been made with attention.

The thermometers uſed were graduated from a common ſtandard; and that ſtandard itſelf carefully made, and compared with many of the beſt thermometers of different countries; yet ſtill I would adviſe that the reſults be not too implicitly confided in, until ſupported by ſucceeding experiments.

# TABLE I.

*Mean Temperature of the* Sea-Coaſt *of Ireland, obſerved in different Latitudes.*

| | | |
|---|---|---|
| Lat. 55° 12′ | Medium temperature of the northern coaſt of Ireland, near the town of Ballycaſtle, obſerved in the year 1788, by means of copious ſprings flowing from a limeſtone ſoil * - - | 48, |
| Lat. 54° 48′ | Medium temperature of the iſland of Eniſcoo, one of the Roſſes iſlands, on the weſtern coaſt of Ireland, obſerved by means of a covered well in a granite rock; the maximum of temperature taken in 1787, the minimum † in 1788 - | 48,6 |
| Lat. 53° 20′ | Medium temperature of the eaſtern coaſt of Ireland, near Dublin, obſerved by means of deep covered wells in ſoils of clay, gravel and limeſtone, 1788 - - - | 49,4 |
| Lat. 51° 54′ | Medium temperature of the ſouth coaſt of Ireland, near the city of Cork, obſerved by means of deep covered wells in limeſtone and other ſoils ‡, 1788 - - - | 51,2 |

* Obſerved by Mr. Edmond Mc. Gildowny.

† Minimum obſerved by Robert Corbet, Eſq;

‡ Obſerved by J. Longfield, Eſq; M. D.

TABLE

## TABLE II.

*Mean Temperatures of Places* diſtant *from the Sea, and* elevated *above its Surface.*

| | | |
|---|---|---|
| Lat. 55° | Medium temperature * in the neighbourhood of Londonderry, diſtant twenty *Iriſh* † miles from the northern ſea, and at a ſuppoſed elevation of one hundred feet above it (1788) - | 46, 9 |
| Lat. 54° 20′ | Medium temperature ‡ in the neighbourhood of Armagh, diſtant twenty-five miles from the Iriſh Channel, and elevated about fifty-eight feet above the coaſt §, by means of a well ſixty feet deep ſunk to the bottom of a gravelly hill, (1788) - - - - - | 47, 5 |

* Obſerved by William Patterſon, Eſq; M. D.

† 54½ Iriſh miles are almoſt equal to a degree of the meridian, that is to 60 geographical miles, or to 69¼ Engliſh miles.

‡ Obſerved by the Rev. Dean Hamilton.

§ This elevation is preſumed from the following circumſtances:

| | Feet. |
|---|---|
| Elevation of Lough Neagh above the ſea, from obſervations *(ſee Whitworth's Reports)* that have lately been found extremely correct - - - | 38 |
| From Lough Neagh to Blackwater town, through a diſtance of ſeven or eight miles, the river Blackwater is navigable, and extremely ſtill, ſo that its fall cannot exceed - - - - - - - | 10 |
| From Blackwater town to the valley of Armagh is a direct diſtance of about four miles; for that ſpace the elevation here marked is only the reſult of conjecture - - - - - - - | 10 |
| Total - - - | 58 |

| | | |
|---|---|---|
| Lat. 53° 12′ | Medium temperature derived from the maximum of 1787, and minimum * of 1788, in the neighbourhood of Tullamore (in the King's county) near the *center* of the kingdom, *diſtant* fifty miles from both the ſeas †, *elevated* two hundred and ſix feet above the coaſt ‡, in a *level country*, which may be counted the higheſt ground of the general ſurface of Ireland § - | 48, |

## T A B L E III.

*Mean Temperature in Cities.*

| | |
|---|---|
| MEDIUM temperature in different parts of the city of Londonderry by maximum of 1787, and minimum of 1788, various from - - - | 47, 6 to 49 |
| MEDIUM temperature in different parts of the city of Dublin in 1788 - - | 50 to 52 |
| MEDIUM temperature in different parts of the city of Cork in the year 1788 - - | 52, 5 to 53, 5 |

* Minimum obſerved by the Rev. Peter Turpin.

† See map of Ireland.

‡ For proof of this, ſee note in page 151.

§ See the ſecond note in page 151.

# OBSERVATIONS *on* COAL-MINES.

*By* RICHARD KIRWAN, *Esq*; *M.R.I.A. and F.R.S.*

IN travelling through different parts of the kingdom laſt ſummer, it was with pleaſure I obſerved the attention of many of the principal landholders awakened to reſearches after minerals, a ſpecies of riches with which I have reaſon to think Ireland is well ſupplied, though few of them have as yet been worked with national advantage. In conſequence of this attention, ores of copper, lead, and iron of the beſt kind, have been already found in different provinces; but the want of fuel has hitherto prevented the proprietors from reaping the full benefit of their diſcoveries, ſuch ores as lie in the interior parts of the kingdom being utterly neglected, and thoſe ſituated near the ſea being generally tranſported to England. It is therefore evident that of all minerals the moſt neceſſary at preſent is pit-coal; its uſes extending not only to the purpoſes of metallurgy, but to thoſe of

Read Jan. 10, 1789.

of many other manufactures, as well as to ſupplying the immenſe conſumption of the capital. It is a happy circumſtance that the obſervations that lead to its inveſtigation are, of all others, the leaſt fallible and ambiguous. To collect theſe, I have peruſed all thoſe hitherto made on coal-mines, and the ſtrata that uſually accompany them. The moſt important, and which may ſerve to guide us in our reſearches, being but few, and perhaps not generally known, at leaſt in this kingdom, I take the liberty of laying before the Academy, to which every attempt to promote the public utility, however deſtitute of merit in other reſpects, cannot fail of being acceptable.

## *General Obſervations.*

When we conſider the interior conſtruction of mountains, hills or plains, and the materials of which they conſiſt, we are eaſily led to acknowledge not only that the greater part were formed in water, but that ſome of them are of later formation than others. Thus ſome are formed of huge ſhapeleſs maſſes, without any regular fiſſures; but if theſe maſſes be attentively inſpected, they will be found to conſiſt of ſmall grains of ſtones, of different ſorts, concreted together, and hence called *granites*; the exact adaption of theſe grains to each other, and the regular cryſtallized ſhape of ſome of them, ſhew that they muſt have been originally in a ſoft or even in a fluid ſtate; their continuity, and want of regular fiſſures, indicate their ſimultaneous concretion; the ſuperior difficulty of their ſolution at preſent, and the immenſe ſpace they occupy in the globe, of which they conſtitute

conſtitute as if it were the kernel, and the total abſence of all organic remains, induce us to think that of all others they are the moſt antient. Other hills or mountains conſiſt of ſtony maſſes, apparently homogeneous, at leaſt for the greater part, but ſeparated from each other by fiſſures parallel to each other; theſe are moſtly of an argillaceous or calcareous nature, and appear to have been formed by a gradual ſubſidence from water, in which they were originally ſuſpended. As no organic remains are found in them, they alſo ſeem to date their origin from the formation of the globe.

From the decompoſition of theſe primæval maſſes, their attrition againſt each other, the eroſion of water, and various other accidents, clays, ſands, marles, and the component particles of freeſtone, ſandſtone, limeſtone, ſlate, and various other ſpecies of ſtone, have ariſen. Theſe are placed over each other in alternate and regular beds, parallel to each other, and being commonly mixed with marine exuviæ or other animal or vegetable remains, the hills formed of them are evidently of a date poſterior to thoſe already mentioned. In theſe, and in theſe only (or in plains formed of the ſame materials) coal is found, and there are ſcarcely any of them that do not contain it.

Hills of this ſort are frequently interpoſed between the primæval mountains and the adjacent plains; ſometimes alſo they ſtand ſingle, and frequently they form the eminences that border rivers. It is to hills of this ſort, therefore, that we muſt direct our reſearches after coal. The thicker beds of it lie pretty deep,

generally

generally from twenty-five to forty fathom, or more; and the ſureſt means of diſcovering them is to penetrate into theſe hills with an earth-borer, examining the ſtrata every two or three feet; if alternate ſtrata of indurated clay, ſand, ſlate, or ſand-ſtone occur, with iron ore or mica, we may be certain that coal will be found at a greater depth. The beds neareſt to the ſurface are generally either earthy, ſlaty or ſulphureous, and commonly thin and ſcanty, but under theſe, different beds of greater thickneſs and of a better ſort are found. Coals have alſo been ſometimes diſcovered by collecting the reddiſh or yellowiſh muddy water that runs down the ſides of hills after heavy rains; this water is collected in a pan ſuffered to ſubſide, and gently evaporated; if the ſediment appears covered with a black ſcum, the hills may be preſumed to contain coal.

Veins of coal are often mentioned, yet in reality coal is ſcarcely ever found in *veins*, but rather in *beds* or in *heaps*; though theſe beds, from a derangement cauſed by the occurrence of ſtone or matter of a different kind from that which forms the ſtrata, are ſometimes thrown into the form of a horſe-ſhoe, with the curvature downwards, and thus aſſume the appearance of a vein.

When a coal-mine is diſcovered, its *direction*, that is, its extent in the ſame horizontal line, and its *inclination*, that is, its fall beneath that line, are next to be traced; as it ſhould always be worked at right angles with its direction, and the ſhaft to drain off the water ſhould be ſunk in the loweſt part.

To

To find the inclination, three holes, each reaching to the bed of coal, are bored at the diſtance of ſix hundred feet from each other, forming an equilateral triangle, and the level and depth of each are taken. The higheſt is the ſtandard to which the diſtance downwards of the bed of coal under each hole is referred, that which is moſt diſtant in depth from the ſtandard being the loweſt. It is almoſt needleſs to add, that the boring ſhould be ſkilfully conducted, in order that the holes be perfectly perpendicular. A deſcription of the moſt improved earth-borer has lately been tranſlated from the German, and publiſhed by Doctor Mc. Nevin of this city *.

In England beds of coal of leſs than two feet and an half in thickneſs are judged not worth working, but in Germany none exceeding ſix inches are neglected.

To convey a fuller idea of the ſtrata of earth or ſtone that generally accompany coal-mines, I ſhall here add an account of thoſe that are found in the principal coal-mines of Europe.

* The price of boring in England is five ſhillings per fathom for the firſt ten fathoms, ten ſhillings per fathom for the next five fathoms, fifteen ſhillings per fathom for the next five, &c.

## ENGLAND.

The moſt conſiderable coal-mines in England are found in the counties of Northumberland and Durham on the eaſt, and thoſe of Lancaſhire and Cumberland on the weſt; they ſeem to extend acroſs the kingdom, or at leaſt to the mountains of Cumberland and Weſtmoreland. On the eaſtern coaſt, towards Newcaſtle, the land gently deſcends towards the ſea, but is here and there interſected with deep vallies, in the declivities of which the coaly ſtrata appear to have been firſt diſcovered. The ſtrata here lie in the following order*:

| | | Fathoms. | Feet. |
|---|---|---|---|
| 1. | Mould or clay - - - - | 4 | — |
| 2. | Brown ferruginous clay and mica - | 3 | — |
| 3. | Whitiſh ſandſtone, intermixed with mica - | 4 | — |
| 4. | Bituminous clay, mixed with pyrites and mica | 8 | — |
| 5. | Coal - - - - | — | —½ |
| 6. | Stony clay, with ſand and mica - | 4 | — |
| 7. | Coal - - - - - | — | 1 |
| 8. | Martial indurated clay, mixed with mica - | 8 | — |
| 9. | Bituminous clay, like No. 4. - - | 4 | 5 |
| 10. | The principal bed of coal, - - from | — | 4 to 8. |

The principal bed is therefore about thirty-ſeven fathoms deep, but other beds are found ſtill lower.

* Schwed. Abhandl. 1776.

WHITEHAVEN.

WHITEHAVEN.

| | Fathoms. | Feet. |
|---|---|---|
| 1. Clay - - - - | 8 | $1\frac{1}{2}$ |
| 2. Clay, mixed with ſand - - - - | 11 | $5\frac{1}{2}$ |
| 3. Culm and clay - - - | 3 | $1\frac{1}{4}$ |
| 4. Indurated clay - - - - | 2 | $2\frac{1}{2}$ |
| 5. Indurated clay, of a ſtony hardneſs - | 4 | 2 |
| 6. Coal of bad quality - - - - | 1 | 4 |
| 7. Martial clay and mica - - - | 1 | $3\frac{3}{4}$ |
| 8. Coal - - - - - | — | $1\frac{1}{2}$ |
| 9. Brown martial micaceous clay - - - | — | $1\frac{1}{3}$ |
| 10. The ſame, but fatter - - - | 2 | 4 |
| 11. Apyrous or fire clay, called ſill - - | 4 | $4\frac{3}{4}$ |
| 12. Clay, mixed with iron ore - - | 6 | 2 |
| 13. Culm - - - - - - | — | $3\frac{1}{3}$ |
| 14. Micaceous ſandſtone - - - | 9 | $4\frac{1}{3}$ |
| 15. Clay mixed with ſand and mica - - | 8 | 5 |
| 16. Blue clay - - - - | — | 2 |
| 17. Principal bed of coal - - - - | 1 | 3 |
| | 59 | 3,75 |

THE ſtrata here extends from north to ſouth, but their inclination is from eaſt to weſt.

*At* ALFRETON COMMON *.

| | | Feet. | Inches. |
|---|---|---|---|
| 1. | Clay | 7 | — |
| 2. | Ratchil, or fragments of ſtone | 9 | — |
| 3. | Bind (an indurated clay) | 13 | 4 |
| 4. | Stony clay | 6 | — |
| 5. | Bind | 33 | 8 |
| 6. | Black ſtony clay | 5 | — |
| 7. | Bind | 2 | — |
| 8. | Stony clay | 2 | — |
| 9. | Bind | 10 | — |
| 10. | Coal | 1 | 6 |
| 11. | Bind | 1 | 6 |
| 12. | Stony clay | 37 | — |
| 13. | Bind | 7 | — |
| 14. | Smut (a black ſubſtance reſembling coal duſt) | 3 | — |
| 15. | Bind | 3 | — |
| 16. | Stony clay | 20 | — |
| 17. | Bind | 16 | — |
| 18. | Principal bed of coal | 7 | 4 |
| | | 184 | 4 |

* Whitehurſt's Theory, page 211.

*At*

*At* HETRUVIA *in* STAFFORDSHIRE *.

1. Ratchil, or fragments of ſtone.
2. Limeſtone, one foot thick.
3. Sand.
4. Argillaceous ſtone.
5. Bind.
6. Coal.

*At* BAGELT *in* NORTH WALES †.

| | Feet. | Inches. |
|---|---|---|
| 1. Gravel and ſand | 45 | — |
| 2. Shale or Slate | 9 | — |
| 3. Argillaceous ſtone | 6 | — |
| 4. Slate | 1 | — |
| 5. Coal | 6 | — |
| 6. Clay | 9 | — |
| 7. Argillaceous grit or ſandſtone | 44 | — |
| 8. Coal | 2 | 3 |
| 9. Sandſtone | 90 | — |
| 10. Slate | 15 | — |
| 11. Coal | 15 | — |
| | 242 | 3 |

* Whitehurſt's Theory, page 211.

† Ibid, page 242.

At

*At* LITCHFIELD *.

| | Feet. | Inches. |
|---|---|---|
| 1. Black clay | 4 | — |
| 2. Rotten ſtone | 6 | — |
| 3. Marle | 18 | — |
| 4. Thin coal | 4 | — |
| 5. Black rock | 2 | — |
| 6. Black bat (a marle) | 18 | — |
| 7. White rock | 6 | — |
| 8. Clunch (a marle) | 21 | — |
| 9. Grey rock | 3 | — |
| 10. Black bat | 3 | — |
| 11. Coal | 30 | — |
| | 115 | — |

*At* COLEBROOK DALE †.

| | | |
|---|---|---|
| 1. Brick clay | 3 | — |
| 2. Potter's clay | 15 | — |
| 3. Smut | 1 | — |
| 4. Blue bat (an indurated clay or marle) | 3 | 6 |
| 5. Sandſtone | 7 | — |
| 6. Coal | 4 | — |
| 7. Potter's clay | 3 | — |
| 8. Beſt coal | 3 | — |
| 9. Brick clay | 18 | — |
| 10. Clod coal | 2 | 6 |
| 11. Clay | 18 | — |
| 12. Flint coal | 4 | — |
| | 82 | — |

* In a letter from Mr. Godefroy de Villetaneuſe to Mr. Morand.

† Young's Annals of Agriculture, vol. iv. p. 168.

SCOTLAND.

## SCOTLAND.

### BALDO *near* FALKIRK *.

| | | Feet. | Inches. |
|---|---|---|---|
| 1. Clay | | 7 | — |
| 2. Slate | | 33 | — |
| 3. Limeſtone | | 3 | — |
| 4. Slate and earth | | 6 | — |
| 5. Coal | from | 3 to | 6 |
| | | 52 | — |

## GERMANY.

### WETTEN *in the* DUTCHY *of* MAGDEBOURG †.

*In Sophia Shaft.*

| | Feet. | Inches. |
|---|---|---|
| 1. Mould | 1 | 6 |
| 2. Coarſe brown martial ſlate | 66 | — |
| 3. Reddiſh blue micaceous ſandſtone | 15 | — |
| 4. Blue ſandſtone | 21 | — |
| 5. A calcareous ſtone filled with red and white flints | 19 | — |
| 6. Soft grey micaceous ſandſtone | 18 | — |
| 7. Bluiſh grey calcareous ſlate | 13 | 6 |
| 8. Micaceous ſlate | 3 | — |
| 9. Bituminous ſhiſtus | — | 9 |
| 10. Pyritous coal | 3 | 6 |
| 11. Bituminous ſhiſtus | — | 1 |
| 12. Pyritous coal | — | 2 |
| 13. Micaceous ſlate | 9 | — |
| 14. Blue micaceous ſandſtone | 12 | — |
| 15. Solid fine grained ſlate | 4 | — |
| 16. Principal bed of coal | 1 | — |
| | 187 | 6 |

* vi. Phil. Tranſ. Abr. Part II. page 223.

† 2d Gerhard Beytrage.

*At*

*At* LOBEGIN, *Dorothia Shaft* *.

| | Feet. | Inches. |
|---|---|---|
| 1. Mould - - - | 2,33 | — |
| 2. Whitiſh yellow clay mixed with calcareous earth - - | 24 | — |
| 3. Yellow ferruginous ſand - - | 4,5 | — |
| 4. Blackiſh grey micaceous ſlate - | 36 | — |
| 5. Soap rock mixed with quartz and flint - | 26 | — |
| 6. Bituminous ſhiſtus - - | 21 | — |
| 7. Coal - - - | 4,5 | — |
| | 118,33 | — |

IN the country of Liege, coal is conſtantly ſurmounted by a hard argillaceous grit or ſandſtone, and lies in the form of a horſe-ſhoe.

THE coal-mine of Kladraw in Bohemia is but ſix fathoms under the turf, and covered with a white micaceous ſand.

* 2d Gerhard Beytrage.

SWEDEN.

# SWEDEN.

## Boscrup *in* Scania *.

| | Feet. |
|---|---|
| 1. Mould and clay mixed with ſand | 12 |
| 2. Grey ſandſtone, conſiſting of quartz with an argillaceous cement and iron ore | 20 |
| 3. Coal | 1 |
| 4. Black indurated martial clay | 5 |
| 5. Yellowiſh ſandſtone | 7 |
| 6. Black ſandy ſlate | 3 |
| 7. Pyritous coal | 2 |
| | 50 |

## *Near* Helsinburgh.

| | |
|---|---|
| 1. Sandſtone | 36 |
| 2. Coal | 2 |
| 3. Argillaceous ſlate | 12 |
| 4. Sandſtone | 6 |
| 5. Coal | 1 |
| | 57 |

* Schwed. Abhand. 1773.

## FRANCE.

Coal has been diſcovered and worked in different parts of France; the beſt are found in Forez, Bourbonnois and Auvergne, it lies at inconſiderable depths and generally in heaps (and not in beds) on the ſides of hills, and therefore is eaſily extracted.

## IRELAND.

### Drumglass †.

| | Feet. |
|---|---|
| 1. Clay and rubble ſtones | 48 |
| 2. Soft argillaceous ſtone | 30 |
| 3. Indurated clay | 35 |
| 4. Slate | 15 |
| 5. Coal | 4, 5 |
| | 132, 5 |

### Ballycastle.

| | |
|---|---|
| 1. Whin ſtone (baſaltes) | 60 |
| 2. Slate | 24 |
| 3. Yellow freeſtone | 42 |
| 4. Slaty coal | 21 |
| 5. Hard grey freeſtone | 90 |
| 6. Coal at preſent worked | 5 |
| | 242 |

† Whitehurſt, p. 246.

# *Obſervations on the Properties commonly attributed by medical Writers to* HUMAN MILK, *on the Changes it undergoes in Digeſtion, and the Diſeaſes ſuppoſed to originate from this Source in Infancy. By* JOSEPH CLARKE, *M.D. M.R.I.A.*

SOME years ago, when I was appointed aſſiſtant to the Lying-in-Hoſpital of this city, an uncommon mortality prevailed among the infants born therein: Induced by this diſagreeable neceſſity to peruſe the works of many of the principal medical writers relating to infantile diſeaſes, I was forcibly ſtruck with the ſimplicity and uniformity of their pathology on the ſubject. For more than a century paſt it has been very generally ſuppoſed that the diſeaſes of infants are all of the ſame genus, proceed from the ſame cauſes, and differ only in degrees *. Natural

Read Dec. 4, 1786.

* Vide Harris de Morbis acutis Infantum.

ſenſibility and delicacy of frame have been conſidered as the prediſponent cauſes, and predominant acidity in the ſtomach and inteſtinal canal, as the occaſion of almoſt all their complaints.

Reasoning in this manner, *a priori*, we ſhould expect in the cure of their diſeaſes the practice to be ſimple and the event ſucceſsful. In the adult ſtate we know that there are few morbid cauſes leſs noxious to the human frame than acidity, and few more ſubject to the controul of medicine. A little experience and reflection ſhould, in my opinion, be ſufficient to convince an unprejudiced mind that the mortality of infants is much greater than could reaſonably be expected, if the preceding theory, with regard to the exciting cauſes of their diſeaſes, were well founded.

The four following propoſitions will be found to contain the ſubſtance of the opinions of medical writers on this ſubject.

1ſt, That human milk is a chylous fluid, and readily affected by the kind of nouriſhment which nurſes make uſe of.

2d, That it is coagulated in the ſtomach of infants, and that it is coagulable by acids, ardent ſpirits, and other known coagula.

3d, That it is *very prone* to run into an aceſcent or acid ſtate.

4th,

4th, THAT from morbid deviations towards coagulation or acidity, by far the greater number of infantile diſeaſes originate, and that a variety of ſaponaceous and abſorbent remedies ought to be uſed to counteract theſe morbid cauſes.

THE firſt general propoſition, viz. "that milk is a chylous fluid, and readily affected by food, &c." is of a nature which it is impoſſible to decide by experiment. Pure chyle is a fluid which has hitherto been collected in ſuch ſmall quantity, that its nature and properties are not yet well underſtood. It is ſaid to coagulate on expoſure to air or by ſtagnation. If ſo, I ſhall ſoon make it appear that in this particular at leaſt chyle differs widely from human milk.

WHETHER the milk of a nurſe be readily affected by the kind of food ſhe eats or by medicines, is a queſtion of which my own obſervation does not enable me to ſpeak with deciſion. I ſhall therefore proceed to conſider the ſecond propoſition, viz. "that milk is coagulated in the ſtomach of infants, and coagulable "by acids, ardent ſpirits, &c." This is a generally received maxim which admits of more prompt and deciſive evidence than the former, and than which there is not perhaps one in all the medical folios more erroneous. In direct oppoſition to ſuch ſentiments, it may be ſafely aſſerted that woman's milk, in an healthy ſtate, contains no coagulable mucilaginous or cheeſy principle in its compoſition, or that it contains ſo little as not to admit of ſenſible proof. The late Dr. Rutty *, whoſe indefatigable

* Analyſis of milk, appended to a pamphlet on ſulphureous waters. A. D. 1762.

induſtry

induſtry and accuracy in experiment is univerſally acknowledged, in treating of the comparative quantity of curd contained in different kinds of milk, ſtates " that woman's milk, mixed with " a quantity of runnet equal to what coagulated cow's milk, " gave of *curd very* little, even *not* a ſixth part of what cow's " milk did." Had he taken off the cream before he added the runnet, I am perſuaded he would have ſtated the quantity of curd obtained as little or none. In fact his concluſion implies nearly what I have ſtated; he does not inform us what the quantity obtained was, but what it was not.

Professor Young's concluſion, from a number of very ſatisfactory experiments, is, that human milk is not coagulated by runnets; nor do acids, whether mineral or vegetable, mixed with it in large quantity, produce any ſeparature of curd from whey, whether the milk be tepid or raiſed to the boiling point.

Doctor Ferris, whoſe diſſertation on milk gained the Harveian prize medal at Edinburgh in the year 1782, confirms Young's experiments on this ſubject; and I have made a great number to the ſame purpoſe in endeavouring to detect the curd of human milk, but without ſucceſs. I made uſe of all the different kinds of acids, ardent ſpirits, infuſion of infants ſtomachs, &c. in various proportions and degrees of temperature, and I had perhaps a greater variety of milk from different women than any of the gentlemen already mentioned; and except in one or two inſtances never could perceive any thing like curd. In both the inſtances to which I allude there appeared, in conſequence of ſpontaneous aceſcency, a ſmall quantity of ſoft flakey matter

matter floating in the ſerum. Ought not an appearance which does not occur above once in forty or fifty times to be conſidered as a morbid deviation from the healthy ſtandard?

We conclude that the milk of other animals contains curd, becauſe it is readily detected by a watery infuſion of the ſtomachs of ruminating, and of ſome non-ruminant animals, by acids, by ardent ſpirits, and by the juices of certain plants, and becauſe by the admixture of theſe we are enabled to collect a quantity of viſcid matter, which when expoſed to preſſure is well known by the name of cheeſe. But every part of this evidence is deficient in regard to human milk. Whence then is the concluſion drawn? It is a concluſion depending on one ſingle circumſtance, viz. the appearance of the fluids vomited by infants after ſucking. In deſcribing the diſeaſes of young children, authors have been in the habit of enumerating "vomiting "of curdled milk," as a frequent ſymptom, and hence ſeems to have ariſen the general opinion. But ſurely ſuch deſcriptions would have been more accurate had they been thus ſtated, "infants often throw up quantities of a ſoft viſcid matter "reſembling the coagula of milk, and this is frequently mixed with "a good deal of turbid whey-like fluid."

It appears to me ſurprizing that Dr. Young was not able to ſolve this difficulty, after he was fully convinced that no artificial means were ſufficient to ſeparate a curd from woman's milk; "yet," ſays he, "this ſeparation takes place ſpontaneouſly, "eſpecially if it be placed in a ſituation equal to 96° of Farenheit's "thermometer, and it is daily obſerved in the milk which

"infants

" infants vomit." It deſerves to be here remarked that theſe obſervations are ſtated as matter of opinion, and not the reſult of any experiment. I determined however to try them as far as poſſible by this teſt. I took equal quantities of three different kinds of milk, put them into bottles ſlightly corked, and theſe bottles into water, the temperature of which was kept up by a ſpirit of wine lamp as near to 96° of Farenheit as poſſible. But after frequently examining each bottle, during the courſe of the experiment, at the expiration of ſeveral hours there was not the ſmalleſt tendency towards coagulation to be perceived in any of them. As uſual, the cream was thrown to the ſurface thick and adheſive, and entirely ſeparated from the fluid underneath, which had ſomewhat of a grey wheyiſh appearance.

As the matter vomited by infants is ſometimes more adheſive than we might ſuppoſe cream to be, I ſuſpected that the curd might be ſo entangled with the cream as to be with difficulty ſeparated from it; I therefore collected a quantity of rich cream from a large quantity of milk of different women, and repeated the former experiment with preciſely the ſame event. Towards the concluſion I added acids, both mineral and vegetable, but without producing any thing like curd. Indeed I had little doubt, before any experiment was attempted on this ſubject, that Dr. Young was miſtaken in the idea of milk ſeparating into curds and whey in a certain degree of temperature; for was this fact we ſhould every day meet with ſtagnant milk in the mammæ, where it is expoſed to the heat of the human body,

thus

thus ſeparating and producing very troubleſome obſtructions; but this we know does not take place.

That the powers of an infant's ſtomach may produce effects on milk which no other power can, is extremely poſſible; but that it cannot create any new principle, or cauſe a ſeparation of a principle which it does not contain, can hardly be doubted. Repeated experiments have ſhewn that the ſtomachs of ruminant animals for ſome time after death poſſeſs ſome of their moſt remarkable powers while living, and particularly that of coagulating milk; there is every reaſon to expect the ſame of the human ſtomach, and in ſeveral trials we have not been diſappointed.

I took out the ſtomach of a fœtus deprived of life in the birth by leſſening the bulk of its head. The gaſtric fluids in ſuch a ſtomach could neither be altered by diſeaſe nor the admixture of food. I infuſed it in a ſmall quantity of hot water, ſo as to make what might be conſidered a ſtrong infuſion. To equal quantities of cows and human milk I added a tea-ſpoonful of the above infuſion; in a ſhort time the cows milk was firmly coagulated, the human not in the leaſt changed. At the end of the firſt hour I added a ſecond tea-ſpoonful of runnet to the human milk, and ſoon after a third, without producing the ſmalleſt perceptible tendency to coagulation.

Upon the whole then I am perſuaded it will be found that human milk, in an healthy ſtate, contains little or no curd, and

 that

that the general opinion of its nature and properties is founded on fallacious analogy and ſuperficial obſervations made on the matter vomited by infants.

We may preſume that the cream of woman's milk, by its inferior ſpecific gravity, will ſwim on the ſurface of the contents of the ſtomach, and being of an oily nature, that it will be of more difficult digeſtion than any other conſtituent part of milk. When an infant ſucks very plentifully then, ſo as to over diſtend the ſtomach, or labours under any weakneſs in the powers of digeſtion, it cannot appear unreaſonable to ſuppoſe that the cream ſhall be rejected firſt by vomiting. Analogous to this we know that adults affected with dyſpepſia often bring up greaſy fluids from the ſtomach by eructation, and this eſpecially after eating fat meat. We have in ſome inſtances known this to blaze when thrown into a fire, like ſpirits of wine or oil.

That viſcid cream has given riſe to the opinion of curd in the milk vomited by infants, is ſtill farther confirmed by the following fact: Having conſtantly obſerved that the milk of women, for ſome days after delivery, threw up a copious *yellow* cream, it occurred to me that, if my ideas on this ſubject were juſt, what is commonly called curds, as vomited by infants, ought to be of a yellow colour for the firſt few days after birth. Accordingly I put this queſtion to all our experienced nurſe-tenders in the Lying-in-Hoſpital: " Is there any difference " of colour in the curds vomited by infants of four or five " days old and by thoſe of a fortnight or three weeks?" It happened that two or three of them were ſitting together when I firſt

firſt thought of propoſing this queſtion. They anſwered unanimouſly, and without heſitation, " Surely, Sir, there is, until the " beeſting milk is over the curds are *yellow*, and afterwards they " become *white*."

I SHALL now haſten to conſider the third general propoſition, viz. " That woman's milk is prone to run into an aceſcent or " acid ſtate." Aceſcency and acidity are relative terms, and can be applied with propriety only in conſequence of accurate compariſon. Whoever takes the trouble of attentively comparing human milk with that of the ruminant animals will ſoon find it to be much leſs prone to run into the aceſcent or acid proceſs. I have very often expoſed equal quantities of human and cows milk in degrees of temperature, varying from the common ſummer heat, or 65 to 100, and I have conſtantly found that cows milk acquires a greater degree of acidity in thirty-ſix hours than the human did in many days; cows milk becomes offenſively putrid in four or five days, a change which healthy human milk, expoſed in the ſame manner, will not undergo in many weeks, nay ſometimes in many months. I once kept a few ounces of a nurſe's milk, delivered about ſix or ſeven days, for more than two years in a bottle moderately corked. It ſtood on my chimney piece, and was frequently opened to be examined. At the end of this period it ſhewed evident marks of moderate acidity, whether examined by the taſte, ſmell, or paper ſtained by vegetable blues or purples; the latter it changed to a florid red colour, whereas cows milk kept a few days changed the colour of the ſame paper to a green, thereby clearly ſhewing its putreſcent tendency.

Doctor Young obſerves in general that the milk of the whole claſs of non-ruminant animals is leſs aceſcent than that of the ruminants.

I have been able to find but one other author whoſe obſervations at all coincide with mine, and for his authority I am indebted to the induſtry of the late Baron Haller. This author is a M. Navier. His words are "*Lac femininum nullum prodit* "*acoris ſignum. Poſt quadraginta et tres integros dies non magis* "*acet quam lac vaccæ recens.*" Haller's obſervation on this paſſage is "*Ea vis eſt victus animalis*;" and thus he ſeems to think this ſingularity accounted for. But many of my experiments were made on the milk of women rigidly confined to gruel, bread and whey, and therefore the phenomenon obſerved by Navier was probably not the effect of animal diet. Perhaps another inſtance could not be adduced of an animal fluid reſiſting ſo powerfully the changes produced on moſt bodies by fermentation. Whether it is to be attributed to the ſaccharine nature of milk taking up a length of time in going through a vinous fermentation previous to the acid ſtage, or whether this ſaccharine principle, ſo abundant in human milk, be of an antiſeptic nature, and thus prevents the other principles from running into the putrid ſtage of fermentation, I ſhall not pretend to determine. Of the fact I have no doubt, however it may be explained. If we find milk out of the body ſo very ſlow in running into an aceſcent ſtate, does it not afford ſtrong preſumptive evidence that the milk of nurſes cannot be ſo very prone to run into acidity in the ſtomachs of infants as authors endeavour to perſuade us?

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Our ſuſpicions on this head will be ſtrongly increaſed if, on reviewing the ſigns ſuppoſed to indicate acid acrimony, they be found deficient and inconcluſive. Curdled milk and green ſour-ſmelling fæces are the marks which have been generally thought to characteriſe predominant acidity. Enough, I hope, has been already ſaid to expoſe the miſtaken notions derived from the firſt appearance, viz. " curdled milk." Againſt the ſecond, we are enabled to ſpeak on the authority of Sydenham: In his letter to Dr. Cole, on hyſteria, he aſſerts, that the green herbaceous coloured ſtuff thrown up in hyſteric cholic is no proof of acrid humours being the cauſe of the diſeaſe; for, ſays he, healthy people when ſea-ſick evacuate ſimilar matter. And further, let us take his own words, " *Annon et infantes in pa-* " *roxyſmis convulſivis, in quibus ſpirituum animalium maxime res* " *agitur, tam per ſuperiora quam per inferiora materiam ejuſdem* " *plane coloris ejiciunt? Emeticis etiam et catharticis frequentius* " *propinatis uberior* materiæ viridis *naſcitur ſeges. Et profecto.*" Says he elſewhere, " *Ita lubrica eſt et evanida colorum ſpeculatio ut* " *nihil certi exillis de corporum in quibus adparent natura queat* " *deprehendi.*"

The opinion of green fœces in infancy being occaſioned by predominant acidity, reſts very much on a ſuppoſition that bile and acid mixed produce a green compound. Sylvius ſays, " *Non* " *dubitamus aſſeverare, ortum habere notatam alvi dejectionem* viridef- " centem *á bile ab acido acri corruptâ, et in virorem deductâ; quales* " *mutationes colorum, haud ignotæ ſunt tinctoribus.*"

Harris,

Harris, who expanded the doctrine of Sylerus, and who from his high rank and ſuppoſed ſucceſs in practice brought this doctrine into great faſhion in England, ſays, " *Quod viridis* " *ſæcum color acido bili admixto ſe prorſus debeat, obſervationi plane* " *ſenſibili illorum, qui experiri amant colorum in viridem mutationes* " *aceto et ſpiritibus acidis perficiendas, evidentiſſimé apparebit.*" Having already found many aſſertions equally poſitive to be erroneous, I determined to doubt every thing advanced on the ſubject; I therefore procured ſome bile from the gall bladder of a fœtus which was deprived of life in the birth; it was of a deep yellow colour and thick conſiſtence. After diluting ſome of this bile with milk, I gradually dropped into it ſome ſtrong vinegar without being able to perceive the leaſt change of colour; whereas on adding nitrous acid, even in very ſmall quantity, to a portion of the ſame diluted bile, it immediately changed it to a deep *green*. This experiment I repeated in preſence of ſome of the pupils of the Lying in-Hoſpital with preciſely the ſame event. I ſhould not venture to ſtate two experiments as proof in any doubtful caſe, did I not find them confirmed by Dr. Maclurg, the lateſt and moſt accurate experimenter on this ſubject. In the firſt eight experiments * on human cyſtic bile, this author endeavours to aſcertain the effects of mineral acids on bile; theſe he found, when applied ſtrong, united with it and diſſolved it in a ſhort time, with ſome variations of the phænomena, producing a fine *green* colour.

* See an analyſis of Dr. Maclurg's experimental enquiry on bile in the Edinburgh Medical Commentaries. Vol. 1ſt, p. 150.

In

In the ninth and tenth experiments, this author gives an account of the effects of vegetable acid on bile: He found that vinegar and lemon juice inſtantly coagulated it, at the ſame time changing its colour to *yellow*.

From theſe facts then it appears that the aſſertions of Sylerus, Harris and others, in regard to the mixture of bile and acids, are but partially true. It is to be remembered that the mineral acids only form a green compound with bile. Nothing equivalent to any of the mineral acids can with probability be ſuppoſed to be generated in the inteſtines of an infant, and therefore recourſe muſt be had to ſome other mode of accounting for their green fœces. Why ſhould ſour milk, granting its exiſtence, give riſe to them in infants and not in adults? Have butter-milk, ſummer-fruits of the moſt aceſcent kind, lemon or orange juice, always this effect in adults by their admixture with bile? This is a queſtion which cannot, I believe, be anſwered in in the affirmative.

Upon the whole, I hope it will appear probable to the generality of readers, that predominant acidity in the primæ viæ is by no means ſo general as to be conſidered the *only* or even *principal* ſource of infantile diſeaſes; that ſuch a morbid cauſe may now and then occur in infancy as in adult age, from weakneſs of ſtomach, coſtiveneſs or improper food, can admit of no doubt. Fœces changing paper ſtained by vegetable blues or purples to a red colour, afford ſatisfactory evidence of the fact; but any concluſions drawn from their colour or ſmell muſt from the nature of things be liable to great uncertainty. Thoſe writers

who

who have laid the greateſt ſtreſs on ſuch appearances in infancy, do not pretend to apply the information to be derived from them to the treatment of the diſeaſes of adults.

The fourth general propoſition, viz. " That from morbid " deviations towards coagulation or acidity in the milk of nurſes, " the greater number of infantile diſeaſes originate, &c." I think extremely doubtful, and for the following reaſons:

Woman's milk, in an healthy ſtate, contains little or no coagulable matter or curd.

It ſhews leſs tendency out of the body to become aceſcent than many other kinds of milk.

The appearances which have been generally ſuppoſed to characterize its acidity do not afford ſatisfactory evidence of the exiſtence of ſuch a morbid cauſe.

But granting ſuch acidity to prevail, we are in poſſeſſion of many harmleſs medicines (called abſorbents) capable of neutralizing acids, and thus forming innocent compounds. We have every advantage to be wiſhed in exhibiting ſuch remedies. They have no taſte; they may be ſafely given in large quantities; they may be freely uſed both by the nurſe and infant to prevent as well as to cure ſuch diſeaſe, and notwithſtanding we have every day the mortification to ſee infants languiſh and die under ſuch courſes.

The

The young of all the ruminant animals, fed on milk of a much more aceſcent nature, ſuffer no inconvenience from this ſource.

History furniſhes examples of whole nations uſing ſour curdled milk as part of their daily food; we cannot ſuppoſe that ſuch a practice would be continued were it often followed by pernicious effects.

Registers of births and deaths prove that in one ſituation a half of the whole human race born dies under the age of two or three years; whereas in another ſituation one half ſhall live to the age of thirty-five or forty years and upwards.

From the ſame authority it appears, that in every ſituation and country a much greater proportion of the male ſex dies than of the female, and particularly in early infancy. In the Lying-in-hoſpital of this city, during a period of about twenty-ſeven years, of three thouſand one hundred and ten infants dead under the age of fourteen days, one thouſand ſeven hundred and ſeventy-two were of the male ſex, one thouſand three hundred and thirty-eight of the female; the deaths of the former exceeding that of the latter nearly by one third.

Such are my reaſons for doubting of the prevailing opinions concerning human milk and the origin of infantile diſeaſes. Neither the affectation of ſingularity, nor the deſire of ſubſtituting any new theory in place of that commonly received, have had any ſhare in prompting me to ſtate theſe doubts to this Academy.

I have been actuated to do ſo ſolely by the hope of exciting others to enquire after truth. I do not expect that my arguments will afford conviction to any firm believer of the eſtabliſhed opinions on this ſnbject; the authority of one man is rarely ſufficient to overturn or even invalidate an opinion generally and long received, eſpecially when the nature of the ſubject does not admit of demonſtrative proof. The united labours of Willis, Baglivi, Hoffman and Cullen, were neceſſary to reform the humoral pathology of their predeceſſors in regard to the diſeaſes of adults; the hypotheſis of almoſt all diſeaſes being produced by morbific matter and various kinds of acrimony abounding in the human fluids ceaſes to be believed, nay is generally denied.

I CANNOT conclude without expreſſing a hope that a well-directed attention from phyſicians of the preſent or ſucceeding age may ſtrike out a more rational and ſucceſsful ſyſtem of practice than the preſent in regard to the diſeaſes of infancy.

## ECLIPSE *of the* SUN, *observed June the 3d*, 1788, *by the Rev. Doctor* USSHER *and others. Communicated by the Rev.* HENRY USSHER, *D.D. F.R.S. and M.R.I.A.*

| | Mean time. H. ′ ″ | |
|---|---|---|
| BEGINNING, by Doctor Usher - - | 19 3 42,7 | Read Dec. 1st, 1788. |
| The moon touches penumbra of the first spot at - | 19 13 21,6 | |
| touches nucleus of ditto - - | 19 15 25,3 | |
| bisects ditto - - - - | 19 17 37,0 | |
| last small spot covered - - | 19 20 43,3 | |
| Small sharp protuberance on the moon's limb off the disk - - - - - | 20 23 28,4 | |
| End, by Doctor Usher - - - | 20 25 38,8 | |
| by Rev. William Hamilton - - | 20 25 37,8 | |
| by my son - - - - | 20 25 39,8 | |

I OBSERVED this eclipse with a parallatic telescope of seventeen inches focus, having a triple object-glass; magnifying power about 75.

Mr. Hamilton obſerved the end with a teleſcope of thirty inches focus double object-glaſs; magnifying power about 120.

My ſon obſerved it by projection on paper, with the teleſcope of a ſmall equatorial of about ſeven inches focus.

Not being yet furniſhed with a micrometer for meaſuring the diſtances of the cuſps, I obſerved the appulſes to the ſpots, propoſing to determine their places by the equatorial; but clouds coming on immediately after the eclipſe, I was diſappointed, and ſhould be extremely obliged to any perſon that may have ſettled them on that day for a communication.

Both Mr. Hamilton and I obſerved a diſtortion and diſcoloration of the ſpots as the moon's limb approached them; and this effect took place at ſuch a diſtance, that I think it cannot be attributed to the inflection of the rays of light, but ſeems more like the operation of the lunar atmoſphere.

Mr. Sutton obſerved this eclipſe at his obſervatory at Drumcondra-hill in Lat. 53. 22. 45.

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|---|---|---|---|---|
| Begininng | - | - | 19. 6. 20. | App. time. |
| End | - | - | - 20. 27. 40. | |

# *An Account of an* AURORA BOREALIS *ſeen in full Sunſhine.*

*By the Rev.* HENRY USSHER, *D.D. F.R.S. and M.R.I.A.*

THE following phænomenon being very uncommon, if not entirely new, I think it worth communicating to the Academy, principally with a view to learn whether any other perſon has obſerved a ſimilar one at any time. Read Dec. 1ſt, 1788.

On Saturday night, May 24, 1788, there was a very bright aurora borealis, the coruſcating rays of which united, as uſual, in the pole of the dipping needle. I have always obſerved that an aurora borealis renders the ſtars remarkably unſteady in the teleſcope. The next morning, about eleven, finding the ſtars flutter much, I examined the ſtate of the ſky, and ſaw whitiſh rays aſcending from every part of the horizon, all tending to the pole of the dipping needle, where at their union they formed a ſmall thin and white canopy, ſimilar to the luminous one exhibited by an aurora in the night. Theſe rays coruſcated or ſhivered from the horizon to their point of union.

THESE

These effects were diſtinctly ſeen by three different people, and their point of union marked ſeparately by each of them.

There is certainly no reaſon for confining the effects of aurora borealis to the night, although it then makes its moſt magnificent diſplay, contraſted by the darkneſs of the ſky.

The tumulous motion of the ſtars at certain times in ſerene ſkies has been taken notice of by the Abbe De La Caille at the Cape of Good Hope; and M. De La Lande remarks that ſometimes, when a ſouth weſt wind prevails at Paris, the ſame effect is produced. An aurora borealis in this country is generally ſucceeded by a ſouth weſt wind, and frequently the wind veers round to that point during its appearance; now if this phænomenon, as ſuggeſted by an ingenious member of this Academy, ſhould be inflammable air in a ſtate of inflammation, the water ſo produced by ſuch inflammation might ſatisfactorily account for this unſteadineſs of the rays, whether we ſuppoſe it either in the act of abſorption, or in the ſtate of veſicular vapour deſcending from the upper regions of the atmoſphere.

That inflammable air, at leaſt ſome ſpecies of it, contains iron, cannot well be diſputed, as its effect on an infuſion or tincture of galls ſhews the preſence of iron. That there is ſome connection, hitherto unexplored, between magnetiſm and the aurora borealis ſeems highly probable. The unſteadineſs of the magnetic needle during the appearance of this phænomenon is known to every one, and indicates ſuch connection; the union of the radii of a

ſtrong

ſtrong aurora borealis in the pole of the dipping needle ſtrengthens the ſame conjecture, which is ſtill further confirmed by the ſituation of the luminous northern arch, generally the firſt ſymptom of a ſtrong aurora, and from whence, in all probability, the name was taken; for the higheſt point of this arch is always found in the magnetic meridian.

This phænomenon is certainly more common now than it was a century or even half a century ago; this I find moſt people, even the moſt illiterate, agreed in. Upon examining the accounts of the authenticated appearances of the aurora borealis, ſo carefully collected by the celebrated De Mairan, I perceive a chaſm in the liſt of obſervations for about forty years in the laſt century, in the middle of which chaſm, nearly, is the year 1661, in which year we are told the variation of the needle at Paris was o. We ſeem alſo to collect from the ſame author's reſearches that the frequency of this appearance ſeems to have decreaſed with the diminution of the eaſtern variation, and it now ſeems to encreaſe with the encreaſing weſtern variation. What real connection there may be between the *variation* of the needle and the aurora borealis, or the cauſe of it, I acknowledge myſelf entirely ignorant; but perhaps this trifling hint may engage the attention of others who have both more leiſure and abilities for ſuch an intereſting diſquiſition.

# POLITE LITERATURE.

# *An Examination of an* ESSAY *on the* DRAMATIC CHARACTER *of Sir* JOHN FALSTAFF. *By the Rev.* RICHARD STACK, *D.D. F.T.C.D. and M.R.I.A.*

THE eſſay, which I intend to examine, muſt be acknowledged to be one of the moſt ingenious pieces of criticiſm any where to be found: For though its deſign ſeems to be in contradiction to the general ſentiment of mankind, yet has the writer managed his ſubject with ſo much ability and addreſs, that ſome have been gained over to his opinion, others heſitate, and all muſt admire. We are pleaſed with his dexterity in ſupport of a paradox in the ſame manner as we are charmed with Falſtaff's wit and humour, even when employed in defence of his vices. In my opinion it is in a great meaſure owing to this entertaining eſſay, that, according to the writer's own words, " it ſhould now " be a queſtion, whether Falſtaff is or is not a man of courage." The ground upon which I ſtand with this expert antagoniſt, whether we conſider the ſuperiority of his talents or the novelty of his cauſe, is ſo unequal, indeed, that I ſhould avoid meeting him, if I could be influenced by any conſideration but a love of truth,

Read Feb. 11, 1788.

truth, and a defire to fix what appears to me the true notion of the moft delightful dramatic character ever drawn. I muft therefore confefs, that a *conftitutional courage* does not feem to me any part of the *impreffion* which Shakefpear defigned to give of Falftaff's character: nor do I fear that fuch a charge will tend to make us lefs delighted with this wonderful perfon, who contrives to render thofe vices, which expofe all others to hatred and contempt, principally and immediately fubfervient to the purpofes of mirth and humour. If I can weaken the force of the ingenious writer's arguments on the other fide, I fhall confider my opinion as fully eftablifhed; for he has omitted nothing of any moment that could fupport his fingularity and refinement.

The author introduces his effay with a diftinction between the conclufions of the underftanding formed upon actions, and the impreffions upon a certain fenfe fomewhat like inftinct, which immediately acquaints us with the principles of character without any confideration of actions, and fometimes determines our heart even againft the conclufions of our reafon. This obfervation he feems to apply in the prefent cafe thus: " The character of " Falftaff has indeed ftrong appearances of cowardice. In the " firft moment of our acquaintance with him he is involved in " circumftances of apparent difhonour. We hear him familiarly " called coward by his moft intimate companions. We fee him " on occafion of the robbery at Gadfhill in the very act of running " away from the prince and Poins: on another of more honourable " obligation, in battle and acting in his profeffion as a foldier, " efcaping from Douglas, even out of the world as it were; " counterfeiting death and deferting his very exiftence; betrayed

" into

" into thoſe lies and braggadocios, which are the uſual concomi-
" tants of cowardice. But theſe appearances are only errors
" of the underſtanding; and the poet has contrived with infinite
" art to ſteal impreſſions upon his hearers or readers, that ſhall
" keep their hold in ſpite of theſe errors; yet ſo latent and ſo
" purpoſely obſcured, that we only feel ourſelves influenced by
" the effects without being able to explain the cauſe. Falſtaff, in
" ſpite of all thoſe ſtrong appearances, recommends himſelf to
" the heart by a conſtitutional courage: and the occaſions alluded
" to are only accidental imputations on this quality deſigned for
" ſport and laughter, on account of actions of apparent cowardice
" and diſhonour." The matter which I have here brought together into a ſhort view is ſubtle and refined. I may therefore be miſtaken; but after an attentive reading I can make no other application of his diſtinction between the concluſions of the underſtanding and thoſe mental impreſſions: and this I apprehend to be the true ſcope and ſubſtance of the author's criticiſm upon this part of the ſubject.

I AM willing then for the preſent to admit that all men are conſcious to themſelves of certain feelings about character, independent of and even in oppoſition to the concluſions of the underſtanding. And upon the ground of this very diſtinction I think it might be ſhewn, that Shakeſpear has deſigned cowardice, rather than conſtitutional courage, to be a part of Falſtaff's real character. When a character appeals to the underſtanding, the judgment formed of it ſeems to me the reſult of all its various parts compared together. Its ſeveral actions, with their ſeveral ſprings and motives, ſo far as reaſon can diſcover them, muſt be

be taken into account before the underſtanding can form a juſt eſtimate. An accidental appearance or momentary impreſſion will not in this caſe give a proper view of the character, but the whole ſeries of conduct manifeſtly pointing to certain leading principles and regulated by them. A writer, therefore, with ſuch a deſign need not be very ſolicitous where or when circumſtances might fall in, which may be deemed exceptions to the principles that he meant to exhibit. For whether they appeared early or late, in this or that part of the character, they would upon the ſumming up of the whole be taken into the general account, and their weight would be determined by their true importance and relation to other matters. The underſtanding would then judge how far their operation extended, whether they were ſuch groſs violations of the principles as to be unnatural and improbable, or merely deviations from them, conſiſtent with the varieties uſually found in human nature.

But in addreſſing a character to the ſenſe or inſtinct abovementioned, the caſe appears entirely different. As no exerciſe is here given to the underſtanding to compare, digeſt and reflect, the firſt impreſſions are of the higheſt moment. The operation of this ſenſe, like that of other inſtincts, is inſtantaneous and ſtrong. It lays hold of the minuteſt circumſtances, and takes impreſſions from them which may not eaſily be effaced. It will not abide the ſlow proceſs of unfolding the character by degrees, ſuſpending its determinations upon the poſſible exiſtence of future matter, and coldly waiting on the judgment. In appealing to this ſenſe, the writer muſt be careful to introduce his character with impreſſions ſuitable to what he deſigns. If he does not give theſe in

in very ſtriking colours, we at leaſt expect ſome delicate touches to inform the ſenſe. Theſe obſervations I believe will be found to apply to moſt dramatic characters, and to Shakeſpear's moſt eminently. But if a writer ſhould neglect them, he would at leaſt avoid all early impreſſions of an oppoſite nature: for theſe might engage and miſlead the heart too far, and become the ſources of incorrigible errors. Can we ſuppoſe then that Shakeſpear, if he had deſigned to exhibit Falſtaff as naturally brave, would in the firſt ſcene of our acquaintance with him have given ſtrong intimations of his cowardice? which he has unqueſtionably done in the ſcheme laid for him by Poins, and in the obſervations made upon the probable conduct of Falſtaff. "The "virtue of this jeſt," ſays Poins, "will be the incomprehenſible "lies this ſame fat rogue will tell us when we meet at ſupper: "how thirty at leaſt he fought with; what wards, what blows, "what extremities he endured; and in reproof of this lies the "jeſt." All this clearly implies that he would play the firſt part of a coward in action, and the ſecond in lying and boaſting. And as if the poet were not content with theſe ſtrong appearances, grounded upon the opinion of Poins, Falſtaff's intimate companion, he appeals in the next ſcene to facts and the judgment of the ſpectator himſelf. There we ſee Falſtaff, with his three ſcurvy companions, put to flight by Hal and Poins, and hear him roaring for mercy. But as the queſtion of Falſtaff's courage muſt turn in a great meaſure upon theſe two ſcenes, I will examine the ingenious critic's elaborate vindication of him on theſe occaſions.

I do

I DO not here inſiſt upon the critic's own implied admiſſion, that the ſcenes before us contain a weighty charge of cowardice. If he had not conſidered them as bearing hard upon his theory, he would ſcarcely have ſet aſide the very firſt ſcenes, in which Falſtaff appears, to the laſt. But let us ſee how he ſatisfies the reader, even with the advantage of theſe prejudices with which, not the poet, but the critic hath prepared his mind. In the firſt place, we are taught to entertain an ill opinion of Poins, as an unamiable, if not a bad and brutiſh character: and to conclude his conduct towards Falſtaff to have ariſen from malice and ill-will. I muſt own this is a new impreſſion of his character on me, who have been accuſtomed to view him as a wild and diſſipated fellow like the reſt of the party; and though he never failed to uſe Falſtaff as a butt, yet doing this without the leaſt malicious intent, and merely to draw out of him entertainment for the prince. To ſuppoſe that Poins contrived this plot with an ill-natured deſign, would greatly impair, if not utterly deſtroy its humour: nor can I diſcover throughout the whole character any thing to juſtify the cenſure here paſſed upon him, with a view, as it ſhould ſeem, to render his opinion ſuſpected. In the next place, the writer endeavours to prove Falſtaff's courage, even from the judgment of this Poins. When the prince ſays, " I " doubt they will be too hard for us." Poins replies, " Well, " for two of them, I know them to be as true-bred cowards as " ever turned back; and for the third, if he fight longer than " he ſees cauſe, I will forſwear arms." Upon this paſſage the criticiſm is remarkable. " As to the third, for ſo he deſcribes " Falſtaff, as if the name of this veteran would have excited too " ſtrongly the ideas of courage and reſiſtance, &c. &c." The

reaſon

reaſon here aſſigned for deſcribing rather than naming Falſtaff, is curious indeed; in truth, it is ſo ludicrous that I can hardly think the writer is in earneſt; Falſtaff's own rhodomantade cannot exceed it. But with reſpect to the real point here to be conſidered, viz. the diſtinction between Falſtaff and the others, the poet appears to have made it merely becauſe he was deſigned to be an extant character in the drama; for I am perſuaded the words in their original impreſſion convey no idea of valour, unleſs it be of its better part, diſcretion, which ſo highly diſtinguiſhed our hero. And I cannot but obſerve here again, that the conſtruction given to this paſſage by the able critic conſiderably leſſens its merit; for according to him, though ſpoken in the very ſpirit of detraction, it yet contains a reluctant admiſſion of his courage: whereas the paſſage, as commonly underſtood, is highly humorous; one of thoſe forms of expreſſion, which ſlily conveys a ſarcaſm under the guiſe of commendation.

The next ſcene is the preparation at Gadſhill for the robbery. In this we meet with two expreſſions that ſeem to reflect on Falſtaff's courage; the firſt, his exclamation upon hearing the number of the travellers, "Zounds! will they not rob us?" The ingenious writer defends his hero from this charge by ſaying, that the prince had uſed an expreſſion of ſimilar caution in the laſt ſcene, "I doubt they will be too hard for us." Let us examine both occaſions. The prince, reflecting that he and Poins were to be oppoſed to four men in arms, weighed the hazard of the jeſt with proper diſcretion; for had they proved too ſtrong for them, the joke might have turned out very ſeriouſly; or if not, Falſtaff's triumph would have been intolerable; his caution

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was therefore wiſe and prudent. But was Falſtaff's nothing more, when upon hearing there were eight or ten travellers he exclaimed as he did? In his own party he found but ſix; and attentive only to ſuperior numbers, he ſeems to have loſt all other hope of ſuperior ſtrength; it never once occurred to him that his own party were provided, and the poor travellers unprepared for the attack. Here we ſee his mind alive to the remoteſt apprehenſion of danger, unable to collect itſelf and deprived of all manly reſource: nay, his imagination acts ſo ſtrongly, that he inſtantly fancies the characters of the parties interchanged, and that he was likely to ſuffer the very thing he came to execute. The ſecond point is the charge made upon him in conſequence of this by the prince, "What! a coward, Sir "John Paunch!" The defence ſet up here is his own reply, "I am not indeed John of Gaunt, your grandfather, but yet no "coward, Hal." It is alſo ſaid "to contain the true character "of Falſtaff, and to be thrown out here probably as a caution "to the audience not to take too ſadly, what was intended "only as argument for a week, laughter for a month, and a jeſt "for ever after." If this be the natural impreſſion of the anſwer, and not the very refinement of criticiſm, my ſentiments I muſt own are very miſtaken; for I have always conſidered it rather evading a charge, the force of which he had felt; and in this view of it there appears admirable addreſs, as by indirectly admitting the charge to a certain extent, and flattering the prince with the remembrance of his grandfather's prowefs and courage, he has contrived to diſarm him of his wit, and prevented him from urging matters to extremity.

But

But we have at laſt come to the field of action; here we ſee Falſtaff laying upon the poor helpleſs travellers without mercy; while he and his three companions are ſharing the booty, the prince and Poins come upon them and demand their money; the reſt run away; and Falſtaff, after a blow or two, runs away too, leaving the booty behind him. Here again the poet has diſtinguiſhed him from his raſcally companions, but he has not even condeſcended to give the argument of his courage, derived from this random blow or two, a place of higher dignity and obſervation than a marginal note; and it is by no means certain, or even probable, that the poet had any ſhare in this argument at all: it is more likely the note was a mere direction for the players, inſerted by the manager. And that we may clearly ſee the poet's own ſenſe of the tranſaction, let us hear the prince's remarks:

*P. Hen.* Got with much eaſe: now merrily to horſe;
The thieves are ſcattered, and poſſeſſed with fear
So ſtrongly, that they dare not meet each other.
——————— Falſtaff ſweats to death,
And lards the lean earth as he walks along:
Wer't not for laughing I ſhould pity him.
*Poins.* How the rogue roar'd!

The ingenious critic ſeems to doubt the truth of this reflection made upon him by Poins; but it is hardly conceivable that Poins would have made it without ſufficient grounds; and ſtill leſs ſo that the prince would have urged it again upon Falſtaff in a future ſcene uncontradicted, where we may obſerve he advances nothing but facts, and puts him down with a plain tale; ſo

 that

that his vindication here could only arife from a laudable zeal in the writer of queftioning every thing which might reflect on the character of his hero.

The fcene where the tranfaction at Gadfhill is canvaffed is intimately connected with the former, and ferves to throw much light upon it. The writer affirms, " that it is clearly the lies " only, not the cowardice of Falftaff, which are here detected: " lies, to which, what there may be of cowardice is incidental " only, improving indeed the jeft, but by no means the real " bufinefs of the fcene." This is a kind of abftraction which I muft own myfelf incapable of making; neither do I well conceive how the writer has done fo; for thefe lies could in fact have had no exiftence, unlefs we imagine fome foundation upon which they were raifed; fo that, as well in the order of our ideas as degree of importance, the cowardice of Falftaff at Gadfhill is not incidental, but the primary and effential impreffion. And this, or fomething very like it, I think the writer admits in the following paffage: " let us only fuppofe," fays he, " that Falftaff was a man of natural courage, though in all " refpects unprincipled; but that he was furprifed in one fingle " inftance into an act of real terror; which, inftead of excufing " upon circumftances, he endeavours to cover by lies and brag- " gadocio; and that thefe lies become thereupon the fubject, in " this place, of detection." Here the act of real terror is granted; Falftaff appears before us in this fcene under the weight of the charge, and put upon his vindication in the beft manner he is able. His defence, indeed, amply difplays another part of his character, already foretold by Poins; yet, furely, without dif-

charging

charging the former impreſſion: on the contrary, both parts are naturally and cloſely connected; the ſuſpicion fixed upon him from the ſurrender of the booty, heightened by his own conſciouſneſs of his ſcurvy retreat, ſet his invention at work, and produced his vindication.

And here I cannot help obſerving that the ingenious critic's over-ſtrained defence of Falſtaff's courage does not make amends for the loſs of his inimitable wit and humour which have been ſacrificed on this occaſion. "Falſtaff's evaſions," ſays he, "here "fail him: he is at the end of his invention; and it ſeems fair, "that in defect of wit the law ſhould paſs upon him, and that "he ſhould undergo the temporary cenſure of that cowardice "which he could not paſs off by any evaſion whatever." Strange, indeed, that the writer ſhould diſcover a defect of wit in a ſcene where it ſeems to have triumphed with a more wonderful ſuperiority over ſurrounding difficulties than in any other part of his dramatic character. Let us attend for a moment to the occaſion: when Falſtaff had finiſhed his incomprehenſible lies about the exploit at Gadſhill, the prince ſuddenly puts him down with a plain tale, of which poor Jack could not deny a ſyllable. In this ſtate of embarraſſment we feel a peculiar intereſt about him, not conceiving how his wit, though variable and inexhauſtible, could extricate him, when on a ſudden, with a ſort of charm, he ſets both us and himſelf free. To the ſarcaſm of Poins: "Come, let us hear, Jack, what trick haſt thou now?" he replies, "By the L—d I knew you as well as he that made you," and then profeſſes himſelf a coward upon inſtinct. Nothing can be more exquiſite and delightful; it is not cutting the intricate

tricate knot, but unfolding it with a wonderful ſleight and characteriſtic eaſe. His adverſaries, who were taunting and bitter enough, have nothing to reply to this explanation. He ſeems to feel his victory complete, when he adds, " But, lads, I am " glad you have the money: hoſteſs, clap to the doors; watch " to-night, pray to-morrow, &c." The prince, it is true, replies to his propoſal for having a play extempore. " Content; " and the argument ſhall be thy running away." From which, by the way, we may ſee the point of cowardice was a main object of the ſcene; and this is confirmed both by Falſtaff's confeſſion and manner of accounting for it, and alſo by his concluding reply to the prince in this ſcene. " Ah, no more of " that, Hal, if thou lov'ſt me." Upon the whole, the lies do not appear to be the ſole, nor even the principal object of this ſcene; the plot was originally contrived upon a previous conjecture from his character, that he would firſt act the coward and next the liar: the affair at Gadſhill juſtified the opinion of Poins as to both, and the preſent occaſion goes to their joint conviction: and yet thus convicted he baffles every attempt; the verſality of his wit and gaiety of his humour delight and ſurpriſe us, ſo ſucceſsfully does he play with thoſe weapons which other hands dare not touch.

I HAVE gone pretty largely into an examination of thoſe firſt ſcenes of Falſtaff's appearance, becauſe I cannot help thinking that the poet deſigned them to be of great importance in impreſſing his character: and I have examined the impreſſions, not in the order aſſigned them by the ingenious critic, but that in which they aroſe under the hands of the poet. Theſe firſt appearances,

appearances, ſo far as they affect his courage, the critic maintains to be errors of the underſtanding; in ſpite of which, impreſſions of a very minute and delicate nature, adapted to the critical ſenſe alluded to above, gain upon the heart and preſerve their hold. Now, in my opinion, thoſe early impreſſions are rather notices to that ſenſe, and any following appearances that may ſeem contradictory to them, I ſhould incline to call errors of the underſtanding. My meaning is ſimply this: the early impreſſions of Falſtaff's ſpirit are certainly thoſe of cowardice; the heart I think ſoon reckons this among the number of his infirmities, and whatever appearances ariſe in the courſe of his dramatic life, which might ſeem inconſiſtent with them, cannot eaſily make their way to the heart, already prediſpoſed; ſo that if there be any ſuch they would have leſs influence to determine the whole impreſſion of his character, as they have been delayed to be brought forward.

Whether there be any ſuch, remains to be enquired: and here I ſhall follow the able critic upon his own plan.

He firſt conſiders what impreſſions Sir John Falſtaff made on the characters of the drama, and in what eſtimation he is ſuppoſed to ſtand with mankind in general as to the point of perſonal courage. His firſt authorities are Snare, the conſtable, and Hoſteſs Quickly. " It may chance," ſays Snare, " to coſt ſome " of us our lives, for he will ſtab."

Hostess. " Alaſs, the day, take heed of him: he ſtabbed me " in mine own houſe, and that moſt beaſtly; he cares not what " miſchief

" mischief he doth, if his weapon be out; he will foin like " any devil: he will spare neither man, woman nor child." This passage might have been as well omitted; it seems to be one of those where the poet has shewn too great a compliance with the vicious manners of the times: but supposing it had no indecent allusion, what insight do these expressions give into his character? evidently nothing more than this; that Falstaff would not much scruple at shedding blood, a property surely belonging more to a coward than a brave man: and what are we to think of his attacking the person of a woman? In short, one would rather conclude these passages, if serious, to be an indication of treachery and violence than of true courage. And what was his conduct when they attempted to arrest him? It does not appear that he made any active defence on his own part. He cries out, " Away, varlets—draw, Bardolph—cut me off the " villain's head—throw the quean in the kennel." And again, " Keep them off, Bardolph." All this, I say, looks not only as if he had felt no sufficient resource in himself, but as if he committed the main action to his scurvy companion; nor does there appear any thing in the whole scene that argues the least spirit in him, whether we judge from the sentiments of Snare and Quickly, or his own conduct in the transaction.

On another occasion his wench, Doll Tearsheet, asks him when he will leave fighting, and patch up his old body for heaven? It was at his return from having routed Pistol. We may judge of this feat from Falstaff's own account of this Pistol. " He's no " swaggerer, Hostess, a tame cheater he; you may stroke him " as gently as a puppy greyhound; he will not swagger with a " Barbary

" Barbary hen, if her feathers turn back in any ſhew of re-
" ſiſtance." The critic himſelf appears to rely very little upon this proof of his courage, but endeavours to draw another from Falſtaff's expreſſion: " A raſcal bragging ſlave; the rogue fled
" from me like quickſilver." " Which words," ſays the critic, " as
" they remember the cowardice of Piſtol, ſeem to prove that
" Falſtaff did not value himſelf on the adventure." This I think is a refinement: the plain and obvious impreſſion is nothing more than that the raſcal had teazed them with his bragging and bombaſt, and that Falſtaff had put him to flight for it. If any thing further be ſought in the words, I ſhould rather think his expreſſion, " the rogue fled from me like quickſilver," an attempt to reflect a luſtre on his own proweſs, in repreſenting Piſtol as impreſſed with ſo great terror.

The next appeal is to Juſtice Shallow, who had known him when a boy and page to Thomas Mowbray, Duke of Norſolk. He ſaw him break Schogan's head at the court gate, when he was a crack not thus high. The critic ſuppoſes this Schogan to be ſome boiſterous fencer, for what reaſon we know not. It is much more probable that he was ſome jeſter or buffoon about the court. There was one of his name in Edward the IVth's time, whoſe jeſts were now in the mouths of every body; and in all likelihood Shakeſpear has applied the name of this eminent buffoon to ſome one of a ſimilar character and profeſſion in Henry's time. Shallow ſays that Falſtaff was a good backſwords man; which might have been the caſe without his poſſeſſing true courage, as it is at this day the caſe with many a good fencer: but in fact the whole teſtimony of this Maſter Shallow is a

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miſerable ſupport; he was not only a poor, weak ſilly creature, but had the abſurd vanity of being thought a hero in his day. Nothing then could be more natural than for ſuch a fellow to puff the characters of his own time, and particularly of his acquaintance. Though he was forlorn, as well in ſpirit as in perſon, we hear him mix an account of his own feats with Falſtaff's, and we may well imagine that he was diſpoſed to exaggerate both. "Lord, Lord," ſays Falſtaff, "how ſubject "we old men are to this vice of lying! this ſame ſtarved Juſtice "hath done nothing but prate to me of the wildneſs of his "youth; and every third word a lie, duer paid to the hearer "than the Turk's tribute." He had juſt wit enough to know that an intimacy with wild and daring ſpirits in his youth might give him ſome character, and that his lies of himſelf, unleſs accompanied with equal praiſes of his companions, could not poſſibly eſcape detection. We "ſee to the bottom of Maſter Shal-"low" in this caſe; nor is the ſmalleſt credit due to the teſtimony of the bragging fool.

Another ſentiment in his favour is ſought for in the miſtaken account given by Lord Bardolph of the battle of Shrewſbury. "The king, by this account, was wounded; the prince of Wales "and the two Blunts ſlain; certain nobles, whom he names, "had eſcaped by flight; and Harry Monmouth's brawn, the hulk, "Sir John Falſtaff, was taken priſoner." Hence the writer would conclude that Sir John was a ſoldier of good fame; otherwiſe he would not have had a place in this liſt. But this ſtrikes me in a very different light; I am rather inclined to think that the poet has mentioned him in this place and company, deſigning him

him through the whole to be a very principal figure in the drama: and, beſide that he was a very remarkable perſonage for his form, his wit, and many other entertaining qualities, he was univerſally known to be a conſtant follower of the prince; ſo that we might have reaſonably expected ſome mention of him on the occaſion. Whether the notice taken of him be reſpectful or otherwiſe, is, I think, no queſtion; nor can I help thinking that in thus leaving him behind thoſe who had eſcaped by flight, the poet might have intended to convey an impreſſion of his being unable to follow ſo faſt as the reſt, and that his captivity was owing to his corpulence.

One ſhould hardly think that the ingenious critic would attempt to draw an argument for Falſtaff's courage from the mouth of the prince, who ſeems to take a pride in girding at his cowardice on every occaſion. The prince ſays, " I will procure this fat " rogue a charge of foot." And again, " I will procure thee, " Jack, a charge of foot; meet me to-morrow in the Temple hall." Both expreſſions ſeem to have been uſed with a view to harraſs and teaze him, by putting him upon a ſervice for which he was ſo unfit. We are told with much gravity, " that a prince of ſo " great ability, whoſe wildneſs was only external and aſſumed, " would not have procured in ſo nice and critical a conjuncture, " a charge of foot for a known coward." But what was this weighty charge? Why, no more than was barely enough to ſupport the importance of his dramatic character, one hundred and fifty men of his own raiſing. This wiſe young prince does not appear to have been aware that the fat rogue would miſuſe the king's preſs damnably; in truth, the thought probably never

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entered into his head, at leaſt gave him no concern. Falſtaff ought to appear in the battle, and could not well aſſume a character below that of a commander: beſides, this very capacity furniſhes matter of excellent wit and humour, which very naturally accounts for the introduction of him on this and other occaſions; and I muſt obſerve that the critic ſeems to have overlooked this remark too much, in ſearch of thoſe ſubtle and remote impreſſions on which he has formed his theory. What was the conduct of the prince, when he had actually diſcovered this groſs abuſe of the king's preſs? One might expect from his wiſdom and ability to hear a moſt ſevere rebuke, or even to find Sir John very gravely caſhiered; but the ſame vein of humour and entertainment which procured him his commiſſion ſtill continues. " Tell me, Jack," ſays the prince, " whoſe fellows are theſe that " come after?

*Falſtaff.* " Mine, Hal. mine.

*P. Henry.* " I did never ſee ſuch pitiful raſcals.

*Falſtaff.* " Tut, tut, good enough to toſs; food for powder; " they'll fill a pit as well as other men: Tuſh, man, mortal " men, mortal men." And again, " Faith, for their poverty I " know not where they had that; and for their bareneſs, I am " ſure they never learned that of me.

*P. Henry.* " No, I'll be ſworn, unleſs you call three inches on " the ribs bare."

THE

The writer's encomium on the wiſdom of the prince anticipates the matter a little too ſoon; at this period, and for ſome time after, he never mixes a ſerious thought in his conduct to Falſtaff: And I am ſure the dignity of his princely character would have ſuffered more from this incongruous mixture of levity and ſobriety, of buſineſs and diſſipation, of virtue and vice, than by his appearing "a while to uphold the unyoked humour of his idleneſs." The ſeverity of that poetic juſtice, which alone can make us endure with any patience the prince's final treatment of his old companion, cannot be ſo well maintained, if we ſuppoſe him to have done at times good ſervice to the ſtate, as to have been uniformly worthleſs and profligate.

The next evidence produced is no leſs a perſon than the chief juſtice of England; who tells Falſtaff, "that his day's ſervice at "Shrewſbury had gilded over his night's exploit at Gadſhill." "This," ſays the writer, "is ſurely more than common fame. "The chief juſtice muſt have known his whole character taken "together, and muſt have received authentic information, and "in the trueſt colours, of his behaviour in that action." But how was this at all neceſſary? It no where appears that the chief juſtice was deeply verſed or concerned in matters of ſtate; his judicial character is all we are acquainted with; and from the dignified integrity with which he has diſcharged it, we have reaſon to imagine that it engaged his whole attention. Falſtaff was brought forward to his notice, as concerned in the robbery at Gadſhill. In this light he came directly within his juriſdiction: as to his military conduct, he was probably quite ignorant. The very point before us, his knowledge of Falſtaff's ſervices at Shrewſbury,

Shrewſbury, appears to have been ſuggeſted in this ſcene, and almoſt in the ſame words by the ſervant waiting on the chief juſtice.

*Chief Juſtice.* " What's he that goes there?

*Servant.* " Falſtaff, a'nt pleaſe your lordſhip.

*Chief Juſtice.* " He that was in queſtion for the robbery?

*Servant.* " He, my lord; but he hath ſince done good ſervices " at Shrewſbury."

It would have been wholly impertinent to have put this obſervation into the mouth of the waiting gentleman, if the chief juſtice be ſuppoſed to have been circumſtantially acquainted with the military character of every officer. The natural impreſſion of the paſſage is, in my opinion, clearly this: he had known him as a criminal when there were matters againſt him for his life; the buſineſs was huſhed up through the interference of the prince, and Falſtaff was ſent off to the wars. Upon his return, the chief juſtice meets him, and is informed that ſince his former miſconduct he had done good ſervice. The whole ſcene can be perfectly accounted for in this way; and to reſort to any foreign matter, upon a ſuppoſition of the chief juſtice's acquaintance with his whole character, is as unneceſſary as it is forced and unnatural. The introduction of Falſtaff into the royal preſence, and the eager ſearch after him to bring him to court, amount in my mind to very ſlender evidence of his reſpectability as a

counſellor

counſellor or a ſoldier. All this, I think, was deſigned to throw a buſtle and importance round his character. There is nothing, indeed, ſo very ſtrange or indecent in his attending the prince in the camp at Shrewſbury; where, by the way, we may obſerve he gives no ſort of advice, but mixes his humour with their moſt important councils. Can any one ſeriouſly imagine that he was called into the king's preſence from a regard to his merit? If there were any reaſon for introducing him, it was probably to raiſe a laugh againſt the rebels; but, indeed, I look upon his preſence as a matter of courſe, a part of the prince's train, who was too fond of his company to ſacrifice it to every little punctilio of decorum. Beſides, if the king be ſuppoſed to have known any thing of Falſtaff, his corrupting of the prince, his licentious manners and ſcandalous debaucheries muſt have been at leaſt as notorious as his pretended military merit; and therefore it would have been equally indecent to give him the ſanction of his countenance, as if he were the moſt arrant coward. The ingenious writer will anſwer, "That in camps there is but one virtue "and one vice: military merit ſwallows up or covers all." Whatever force might be in this obſervation, made in the field at large, I apprehend that it cannot apply in the preſent inſtance. A king unconcerned in Falſtaff's moral character, might, in public emergencies, overlook his vices that he may profit by his talents. But king Henry was deeply affected by the prince's looſe behaviour, and by the rude and barren ſociety to which he reſigned himſelf. We have abundant proof of this in his whole conduct, particularly in his pathetic addreſſes to him. It would therefore be an inſult on his majeſty to bring "that reverend vice, that father "ruffian," before him with any ſerious deſign. Here, indeed, would

would be a real indecorum in forcing him as it were upon the king's attention; whereas at present there is none, as he may well be supposed to escape his observation.

I HAVE now gone through an examination of all those opinions, which the writer has advanced as in this respect the strength of his cause, Colville's excepted, which shall be considered presently. The opinions of the prince and Poins he admits to contain strong appearances the other way, and therefore he reserved them for the end of his work. I have followed the order of the poet for reasons assigned above. Those which now remain for me are Colville's and Lancaster's, and they are connected in one transaction.

WHEN the rebel army, by the treachery of Lancaster, had been dispersed and pursued by the royal troops, Falstaff comes up with his prisoner, Sir John Colville, and is thus addressed by Lancaster:

> " Now, Falstaff, where have you been all this while?
> " These tardy tricks of yours will, on my life,
> " One time or other break some gallows back.

THE writer employs great address to shew from various circumstances that we ought to give a very qualified credit to any thing advanced by this " cold, reserved sober-blooded boy." " His " temper might lead him to injure a frank unguarded man of " wit and pleasure; a little cruelty and injustice toward a man " of distinguished wit and noted poverty, might be accounted " to Lancaster a virtue in the eye of the grave and prudent part

" of

" of mankind: the tone of the court was ſtrongly againſt Falſtaff
" as the miſleader of the young prince: ſomething, therefore,
" that would not too much offend the prince, yet leave behind
" a diſgraceful ſcar upon Falſtaff, was very ſuitable to the temper
" and ſituation of parties and affairs." My objection to theſe remarks, as indeed to the general ſcheme and tenor of the whole criticiſm, is their exceſſive refinement. Dramatic characters are not drawn for ſpeculative ingenious men in their cloſets, but for mankind at large. Now, I ſay, theſe fine-ſpun deductions from the temper and ſituation of Lancaſter and the reſt of the parties, even though they could be made out to our ſatisfaction, have not a ſtrong and immediate influence: the part of his character which we know, however unamiable, does not, I think, excite thoſe impreſſions of courſe: and for the moſt part arguments from one part of character to another, unleſs the connection be univerſally acknowledged, is too philoſophical a buſineſs for the public underſtanding. We had better, therefore, examine Falſtaff's own defence. " I never knew yet," ſays he, " but rebuke and
" check was the reward of valour. Do you think me a ſwallow,
" an arrow, or a bullet? Have I in my poor and old motion
" the expedition of thought? I have ſpeeded hither with the
" extremeſt inch of poſſibility. I have foundered nineſcore and
" odd poſts: and here, travel-tainted as I am, have, in my pure
" and immaculate valour, taken Sir John Colville of the dale,
" a moſt furious knight and valorous enemy. But what of that?
" He ſaw me and yielded; that I may juſtly ſay with the
" hook-noſed fellow of Rome—I came, ſaw and overcame.

*Lancaſter.* " It was more of his courteſy than your de-
" ſerving.

*Falſtaff.* " I know not: here he is, and here I yield him, &c."

It is pleaſant enough to think how this defence has impreſſed the writer. " Falſtaff," ſays he, " anſwers the general effect of " Lancaſter's ſpeech by a feeling and ſerious complaint of in-" juſtice. He then goes on to apply his defence to the vindication " both of his diligence and courage; but he deſerts by degrees " his ſerious tone, and taking the handle of pleaſantry which " Lancaſter had held forth to him, he is prudently content, as " being ſenſible of Lancaſter's high rank and ſtation, to let the " whole paſs off in buffoonery and humour." Here again, I think we ſee a ſolemn air thrown round this buſineſs, and eſpecially the character of Falſtaff, which the poet never deſigned. Lancaſter, in the firſt inſtance, is made to play off the deep and ſubtle politician, for the purpoſe of ruining Falſtaff and recommending himſelf to the court. Then Falſtaff, perceiving the malice of his intent, begins a ſerious vindication of himſelf, which he might have continued to the end, had not Lancaſter by chance given him a handle of pleaſantry, and had it not been ſafer to paſs it off in a joke. Every thing here appears to me uncharacteriſtic in the higheſt degree. The writer ſeems to have loſt ſight of the true intent of Falſtaff's character, which ſurely never was to excite ſentiments of jealouſy and malice, but to entertain the whole world, even thoſe who were objects of his wit and humour. " Men of all ſorts," ſays he, " take a " pride to gird at me. The brain of this fooliſh-compounded " clay,

" clay, man, is not able to invent any thing that tends to " laughter more than I invent, or is invented on me: I am " not only witty in myſelf, but the cauſe that wit is in other " men." Here we have his very eſſence: and it was with a view to this, that every inimitable ſcene, in which he appears, was contrived by the wonderful poet. But to return: We may obſerve that Lancaſter's charge has a reference to former miſconduct of a like nature. His opinion had evidently been formed before this occaſion; and therefore if Falſtaff could even account for his tardy tricks in the preſent caſe, it would have only proved that his conduct was now leſs blameable than uſual. As to his defence I cannot think he meant it to be rational and ſober. We find in it the ſame humorous extravagance as in every other narrative of his exploits. The fact, indeed, was true, that Sir John Colville had ſurrendered to him; but it does not appear from any teſtimony, except his own and Falſtaff's, that he was a man of courage; and if he even were, the circumſtances of the tranſactions, in my opinion, give Falſtaff very little to boaſt of perſonal bravery. The rebel army had been betrayed and diſſipated. In this ſituation of affairs, the reſiſtance of a brave officer, deſerted by his troops, would have been utterly fruitleſs, ſo that there was no great hazard in the attack. The dialogue between the knights, from which the critic would infer, that his hero's name was ſo terrible to the enemy, conveys not to my mind the beſt idea of his courage. Had this been the poet's deſign would he have given him ſuch ſentiments as theſe? " Do ye yield, Sir? Or ſhall I ſweat for you? If I do ſweat, " they are drops of thy lovers, and they weep for thy death; " therefore rouſe up, fear and trembling, and do obſervance to

" my mercy." By the way what becomes of the critic's nice diſtinction between boaſting before and after events; for upon this diſtinction he relies greatly, when ſpeaking of Falſtaff's bragging lies after the affair of Gadſhill. Colville's reply to this ſtrange rhodomantade is, " I think you are Sir John Falſtaff, and " in that thought yield me." If Falſtaff's ſpeech determined Colville's mind, he muſt have been an arrant coward; if not, his queſtion was the mere formality of honour, requiring an aſſurance that he was going to ſurrender to a man of ſome rank and name. At this day the point is ſometimes inſiſted upon, and certainly prevailed more generally in times of knight-errantry, when the dignity of knighthood was held in higher eſtimation than at preſent. Colville was ſo circumſtanced, that he muſt in prudence have yielded to the commoneſt ſoldier in the field; but it was a conſolation to know that he fell into the hands of a perſon of equal rank with himſelf, and at the ſame time it was an act of courteſy upon which the knights of old piqued themſelves. In this view Lancaſter's obſervation is juſtified. " It was " more of his courteſy than your deſerving." Falſtaff's reply, " I know not; there he is, and there I yield him, &c." is a clear admiſſion of its truth. Lancaſter's opinion of his general character for backwardneſs in the field is clear and deciſive: and Colville's behaviour is eaſily accounted for without aſcribing it to the terror of his name. The whole incident ſeems to have been choſen with great art by the poet. Poor Jack had hitherto been found in his military capacity under circumſtances of diſgrace. How he would conduct himſelf as a conqueror ſtill remained to be ſhewn. And here Shakeſpear's contrivance is inimitable; he has prediſpoſed matters in ſuch a way as that he

he ſhould obtain his victory *ſine pulvere*, and what is more ſtrange, *ſine ſudore*; and at the ſame time he has furniſhed appearances, which Falſtaff might turn to his advantage in his account of this exploit. Had Falſtaff's military conduct been praiſe-worthy or indifferent on former occaſions, or had there been any thing of real courage in the tranſaction before us, Lancaſter's imputation had been imprudent and prepoſterous in the extreme; and Falſtaff's vindication might have brought the malice of his commander to open ſhame in the face of the whole army. This too might have been done with his uſual pleaſantry and wit; but there is no ſuch thing. As the victory was but a ceremony, ſo his defence is but a *jeſt*.

The writer makes an appeal likewiſe to facts. Let us ſee how far theſe eſtabliſh his courage. We have had occaſion to examine ſome already, the affair of Gadſhill and others, that incidentally occurred in treating of opinions. At the battle of Shrewſbury Falſtaff is introduced ſpeaking thus in ſoliloquy: "I have led my ragamuffins where they are peppered; there's "not three of my hundred and fifty alive." In reading this paſſage it never occurred to me to ſuppoſe that Falſtaff choſe for himſelf the deſperate ſcene of action here deſcribed; it ſeems utterly inconſiſtent with that better part of valour, called diſcretion, of which he was ſo great a maſter on all other occaſions, nay in this very battle. "But there is no queſtioning the fact he "had led them." I am not at all ſure that we are obliged or even warranted to abide a literal conſtruction, which violates all probability. The writer may ſay, this is taking for granted what is to be proved, Falſtaff's cowardice. But I think it as in-

conſiſtent with his own Falſtaff as with mine. Some things prove a great deal too much, and ſo loſe their credibility. John of Gaunt himſelf could not do more than this; and who can believe an account of ſuch romantic bravery in Sir John Falſtaff, in a man who the moment after counterfeits death to eſcape a ſingle adverſary? It cannot be. Shakeſpear never could have committed ſo great a breach of decorum; for though not the ſtricteſt obſerver of it in all caſes, yet no dramatic poet ever obſerved it more perfectly in character. I ſhould therefore rather adopt the idea of his having *ordered* his ragamuffins upon this dangerous ſervice: or if this be thought a ſtraining of the words too far, that having led them, he there left them. There is certainly no reaſon to think that at the time of his making this ſoliloquy, he is at or near the ſcene of action; the reverſe is obviouſly to be inferred: either therefore he never was upon the ſpot, or he had, agreeably to his conduct on every occaſion of danger, prudently conſulted for his ſafety by a timely retreat. Does the ingenious critic really think that Falſtaff had held his poſt till he had witneſſed the fact in queſtion? The improbability of it is too groſs, and he ſeems aware of this when he admits that Falſtaff might have exaggerated the danger. Under this idea he ſets about correcting Falſtaff's account, and reduces the number to two-thirds of the whole. I ſay nothing at preſent of his thus accommodating facts, related in ſoliloquy, to his own fanciful theory, though he denies this liberty to others. We might ſay to him, "the fact cannot be queſtioned." But in truth I can as eaſily believe one account as the other. If Falſtaff's diſcretion had ſlept on its poſt till two-thirds of his men were killed, it might have remained ſo till three only ſurvived, or in

my

my opinion to the day of judgment. The truth is, it was awake early in the action, and ſuſpecting that ſcene to be a little too diſturbed for keeping a good look out, it choſe ground of more advantage. I believe this to be the natural and almoſt univerſal impreſſion of the paſſage.

We come next to examine his action with Douglas. The writer has urged a great deal of matter on this head, and made juſt diſtinctions between courage and honour. But, indeed, the text is too plain to be obſcured or refined away by his comments. By comparing Falſtaff's conduct on this occaſion with his words on another, we may diſcover ſuch a contradiction as ſhews it did not ariſe from any ſettled principle, *v. g.* a contempt of honour. "If Percy be alive," ſays he, "I'll pierce him—If "he do come in my way, ſo—If he do not—if I come in his, let "him make a carbonado of me." Suppoſe this to have been ſpoken by a perſon poſſeſſed of conſtitutional courage, we might reaſonably expect that although he would by no means ſeek danger, yet he would meet it, if neceſſary, with ſome degree of firmneſs. But how does Falſtaff's conduct anſwer this expectation? In the moment of danger he counterfeits death. When the writer advances this as a proof of a collected mind, I think he is run very hard indeed; for unleſs we ſuppoſe that fear ſuſpends all action, and locks up every faculty of the mind, (which very ſeldom happens) we muſt admit Falſtaff's reſource to have been very natural for a coward. But if we ſuppoſe the leading idea in his mind during the battle to be a ſtrong ſenſe of perſonal danger, the paſſage juſt now quoted and his conduct are eaſily reconciled. "If Percy be alive, I'll pierce him." Theſe words,

words, I believe, nobody conſiders as ſpoken with any view except to the pun. What follows them implies, that if Percy ſhould come in his way, he can't help it; he muſt abide the conſequence; every man's deſtiny awaits him; but that he will avoid it as long as he can. With this impreſſion of his character we ſee his behaviour in this ſcene with Douglas is very natural; the readineſs of his wit ſupplies him with an expedient, and he baffles his adverſary as he always does. But neither the quickneſs of his invention on this occaſion, nor his ſporting with danger on others, prove a conſtitutional courage; they only ſhew an inexhauſtible vein of wit and humour predominating through every part of his character; triumphant over every thing, over calamity, danger and diſgrace; and we might as well aſſert, that he was inſenſible to all the miſeries of poverty, infamy and diſeaſe, when we hear him ſporting with thoſe diſmal ſubjects, as ſuppoſe him courageous for expreſſing his ſenſe of danger in a witty form. At the moment we feel him a coward, we are delighted with his humour amid ſurrounding dangers; for we know and feel that habits of character break out upon the moſt unlikely occaſions; and that habit above all others, I believe, which we are now conſidering. I have heard of inſtances of its fantaſtic ſport in the extremes of violent grief, and even at the hour of death. And ſurely if ever there was a wit which could tinge every affection and paſſion of the ſoul with its gay colours, it was the inimitable vein of Falſtaff, which converts every thing it touches to gold.

What remains behind of this ſcene is, in my humble opinion, a damning proof of Falſtaff's cowardice, his ſtabbing Percy after his

his death. The critic calls this indecent, but ſays it has nothing to do with his courage. I think otherwiſe. This is one of thoſe caſes where a certain principle of action, beſide its own immediate effects, draws after it other conſequences which have a very near affinity with it; the connection between the primary and ſecondary actions is here inſeparable. To run away armed from a living man, or to eſcape by counterfeiting death, are direct acts of cowardice. To ſtab a dead man is equally ſo, though not directly. For I aſk, is it poſſible for ſuch an idea to enter into the mind of a brave man? or of any man, except the baſeſt coward? I am not ſure whether the charge of cowardice, ſo inferred, be not full as ſtrong as any can be, though founded upon a direct and immediate courſe of action. This, I ſay, ſuppoſing the action to be cowardly by inference only; but perhaps this would be conceding too much, if we conſider Falſtaff's avowed motive on this occaſion: "I am afraid," ſays he, "of "this gunpowder Percy, though he be dead; therefore I'll make "him ſure: yea and I'll ſwear I killed him. Why may he not "riſe as well as I? Nothing confutes me but eyes, and nobody "ſees me; therefore, ſirrah, with a new wound in your thigh, "come you along with me." Hence it appears that he ſtabbed him partly for the full aſſurance of his own perſonal ſafety, although his apprehenſions were in themſelves ſo groundleſs and improbable, that none but a coward's heart could entertain them. The writer has with delicate judgment ſlurred this matter over; and I wiſh his whimſical theory had not obliged me to unfold an action of ſuch a nature, but there was no paſſing it by, for it ſpeaks too plainly the poet's deſign as to the character.

I HAVE now gone through every thing in this ingenious eſſay which appears to bear upon the matter in queſtion. I dare not promiſe myſelf that what I have offered will be deemed an anſwer. The limits of ſuch an eſſay as I now preſent to the academy would not allow me to treat it more at large; and what is a more important difficulty, the advocates are not fairly matched. I have only one or two obſervations more to offer on the ſubject.

THE firſt I would make has, indeed, occaſionally occurred, and was pretty conſtantly in my view in the courſe of the eſſay, viz. in what manner each hypotheſis would affect the eſſential qualities of Falſtaff's character. I have endeavoured to ſhew that a great and delightful portion of his wit and humour would be loſt if we were to adopt the writer's idea; and, indeed, he himſelf has ſacrificed them to his theory in one of the moſt perfect ſcenes of the whole character. This I conſider as a radical error, for which all his ingenuity cannot atone. I muſt next obſerve, that to accommodate his theory, falſe opinions of Poins, Lancaſter and others, muſt be reſorted to, and ſyſtems of malice intermixed in the plot, which certainly the poet never deſigned. Theſe are not only in themſelves miſtakes of character, but have a powerful influence on the plot, and ſuch an one as I think takes away a great deal from its real pleaſantry and good humour. Another ſtrong objection to the writer's criticiſm is, that he often miſtakes the true intent of thoſe ſcenes where Falſtaff is introduced. The occaſions are contrived as productive of mirth; every incident conſiſtent with the plot which conduced beſt to this end is choſen by the poet; but the critic

ſeems

ſeems to have overlooked this principal view in queſt of ſubtle impreſſions; and while we are enjoying the feaſt of wit and humour, he is refining. Had Shakeſpear ſometimes violated decorum a little to attain his end, we might excuſe him for the entertainment he affords: but I am far from admitting this; and have attempted to maintain, through my remarks, that the new theory is more deſerving of the charge. My next reflection goes upon a difficulty ſtarted by the writer upon the uſual judgment of Falſtaff's character. "There is ſomething ſtrangely "incongruous," ſays he, "in our diſcourſe and affections con-"cerning him. We all like old Jack; yet by ſome ſtrange "perverſe fate, we all abuſe him and deny him the poſſeſſion "of any one good or reſpectable quality. There is ſomething "extraordinary in this. It muſt be a ſtrange art in Shakeſpear "which can draw our liking toward ſo offenſive an object. He "has wit, it will be ſaid, chearfulneſs and humour of the moſt "characteriſtic ſort. And is this enough? Is the humour and "gaiety of vice ſo very captivating? Or does not the apparancy "of ſuch humour, and the flaſhes of ſuch wit, by more ſtrongly "diſcloſing the deformity of character, but the more effectually "excite our hatred and contempt of the man?"

This reaſoning, carried to its full extent, would prove one of theſe two things, either that Falſtaff was not a man of vicious morals, or that his wit and humour were not entertaining: but both are ſo palpably abſurd, that the critic qualifies the general aſſertion in this manner. "I am willing, however, to admit "that if a dramatic writer will but preſerve to any character "the qualities of a ſtrong mind, particularly courage and ability,

 "it

" it will be afterwards no difficult taſk to diſcharge that *diſguſt* " which ariſes from vicious manners, and even to attach us to " the cauſe and ſubject of our mirth with ſome degree of affection." That Falſtaff is vicious, a rogue, a liar, and a profligate, is allowed on all hands; yet covered with all this infamy, he entertains, ſurpriſes and charms, nay he engages our hearts. What then? Shall an infuſion of cowardice reduce the character to a caput mortuum, and no ſpirit, no ſalt remain? For my part, I can ſee no reaſon for this. A man may, in my opinion, be very witty and pleaſant upon his own defects, and even upon ſuch qualities as, though acknowledged vices, cannot be deemed flagitious. Now cowardice, if it can be called by a harſher name than defect, will at leaſt be allowed to have in it nothing flagitious. It certainly gives a mean and contemptible idea of its poſſeſſor; but ſo do fraud and lying. But neither theſe, nor any other qualities beſtowed upon Falſtaff, are in their nature ſo far deteſtable, but that great endowments of mind, eſpecially if they be ſuch as univerſally charm, ſhall be able completely to diſcharge the diſguſt ariſing from them. Genius and wit never fail to recommend themſelves to the notice and admiration of mankind; and always throw a dignity round a character even above its true merit. Theſe principles are ſufficient to explain the ſuperior pleaſure and peculiar intereſt we feel in Falſtaff above all other characters which have not half his vices. His creative fancy, playful wit, characteriſtic humour, admirable judgment and nice diſcernment of character, are ſo rare and excellent endowments, that we loſe the exceptionable matter in contemplating them. Nor is it owing to theſe alone that we admire and almoſt love Falſtaff, but to another exquiſite contrivance of the poet in catching

catching occaſions of mirth from his very vices. Thus, by making them the ground into which he has wrought the moſt entertaining fancies and delightful humour, he has made it almoſt impoſſible to ſeparate matters thus cloſely interwoven, and has ſeduced judgment to the ſide of wit. Theſe are the ſtrange arts by which Shakeſpear has drawn our liking toward ſo offenſive an object; or to ſpeak with more preciſion, has contrived to veil the offenſive parts of his character. Defence is a thing of too ſerious a nature for Falſtaff; he laughs at all vindication; *creſcit ſub pondere virtus*; his elaſtic vigour of mind repels all difficulties; his alacrity bears him above all diſguſt; and in the gay wit we forget the contemptible coward.

# OBSERVATIONS *on the* FIRST ACT *of* SHAKESPEAR's TEMPEST. *By a young Gentleman, an Under-graduate in the Univerſity of Dublin. Communicated by the Reverend* DIGBY MARSH, *F.T.C.D. and M.R.I.A.*

AMONG literary compoſitions, ſome are directed ſolely to the *underſtanding*, others to the *paſſions* and *imagination*. To diſcover the excellencies and defects of the former belongs properly to the *logician*; the latter alone are the peculiar object of *criticiſm*. A good critic therefore muſt unite a perfect knowledge of the human heart with ſoundneſs of judgment and delicacy of taſte. For this art is chiefly valuable as it tends to lay open the conſtitution of our nature, as it traces the pleaſure or diſguſt we receive from compoſitions of genius to thoſe ſecret ſtrings in the frame of man, which ſound in harmony or diſcord according to the ſkilfulneſs of the hand that touches them. Conſidered in this view, criticiſm yields to few ſciences, in the importance of its end, the qualifications it requires, or the extenſive province which it commands. Among its various objects *dramatic poetry* ſeems

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ſeems to afford the nobleſt field in which the critic can try his ſtrength; and of all dramatic poets *Shakeſpear* is entitled to peculiar attention. For the drama, as it is a repreſentation of actions and characters adapted to intereſt the paſſions, depends wholly for ſucceſs on its conformity with *nature*. And the excellence of Shakeſpear is the reſult not of art or ſtudy (which in their cloſeſt imitations of nature may be ſtill perceived to *imitate)* but of intuitive perception. In him, indeed, nature ſpeaks. Nature, like a vital principle, animates his ſcene; it is nature alone that gives to his careleſs effuſions, amidſt all their blemiſhes, that ſecret charm which ſeizes the heart, while more correct productions are regarded with indifference. The eye is quickly ſatiated with the ſmooth lawn or regular parterre; but will dwell with delight on the woods, the rocks and torrents of the uncultivated waſte.

Hence it is, that to *reliſh* Shakeſpear's beauties may be regarded as the criterion of an undepraved *taſte*; to *analize* them, of *critical* abilities. And with critics of all ſizes Shakeſpear has abounded, from the voluminous editor to the weekly eſſayiſt. Whether he has been as fortunate in the kind as in the number of his critics, I acknowledge myſelf incompetent to decide. Among the various editions of his dramatic works I can boaſt an acquaintance with but one: the joint edition of a poet and a ſcholar. All the modern commentators are known to me only by their names, and reputation for literary talents. Had I enjoyed the advantage of their writings, doubtleſs I ſhould now have no occaſion to complain that in the poet and the ſcholar I have too often ſought in vain for the critic; while the one is

content

content with directing me by a marginal diſtinction *, where I am to admire; and the other forgets his author in the triumph of learned pride over the blunders of a former commentator. The meaning of a word, or the conſtruction of a ſentence, has given birth to ample comments; while thoſe ſtrokes of nature which give Shakeſpear an abſolute power over the human breaſt, are either left unnoticed, or pointed out as the objects of unmeaning admiration. For my own part, while my ſoul is hurried along by the magic of poetry through the regions of pity, indignation, aſtoniſhment or terror; when my heart expands to graſp a ſublime image, and ſurrenders all its faculties to the guidance of a maſter's hand, at ſuch moments I cannot thank the man who forces me to deſcend to the niceties of verbal criticiſm †, or to

" * The moſt ſhining paſſages are diſtinguiſhed by *commas* in the margin; and " where the beauty lay not in particulars but in the whole, *a ſtar* is prefixed to the " ſcene." Mr. Pope's preface.

† What is generally called *verbal criticiſm* is, I believe, more properly the office of a grammarian or collator of manuſcripts than of a critic. Yet there is a ſpecies of it which has a juſt title to the name, as it does not terminate in words, however words may be its immediate object; I mean that ſpecies of criticiſm which delivers rules for the *ſtructure of ſentences;* rules to which the antients paid much more attention than moſt of our Engliſh writers; and which many, I believe, have neglected as inapplicable to modern languages. Whether this opinion be founded in truth I ſhall not here enquire; but the reaſon why I look upon this ſubject to involve in ſome meaſure the conſtitution of the human mind, and therefore to fall under the critic's province, will appear by an example. I ſhall take it from the 2d philippic of Cicero, in which the following ſentence occurs: " *Utinam, Cn. Pompei, cum C. Cæſare* " *ſocietatem, aut nunquam coiſſes, aut nunquam diremiſſes, fuit alterum gravitatis, alterum* " *prudentiæ tuæ.*" In one of our Engliſh tranſlations it runs thus: " I wiſh, O " Pompey, that you never had contracted, or never had broken your friendſhip with

 " Cæſar.

to unimportant altercations about a phrase in which study is requisite to discover obscurity. Who, indeed, while rapt in the harmony of Handel, can listen with patience to remarks on the structure of the instrument or dress of the performer? Here and there, indeed, (even in the edition I speak of) an observation truly

" Cæsar. The one had been consistent with your patriotism, the other with your " prudence." There is no one who reads these two sentences that will not immediately give a decided preference to the original. But a reason for this preference may be required, and must be deduced from nature. Let us compare the several parts of each. " *Utinam, Cn. Pompei!*" Our attention is awakened by the solemnity of this opening, and the dignity of the person who is addressed; while the cold " *I wish,*" of the translation, prepares us for a wish of equal importance with *my uncle Toby's*— " I wish, said my uncle Toby—I wish, Trim, *I was asleep.*" After we have learned that the speaker is expressing a wish, we naturally expect to be informed of the subject of this wish. And this the Roman orator tells us in the next words, " *cum C. Cæsare societatem.*" After which the wish itself is declared, when the mind is enabled to judge of its propriety, " *aut nunquam coisses, aut nunquam diremisses.*" But the translator, inverting this order, informs us that *something* should never have been contracted or never broken; and then tells us what this *something* is. So that after the conclusion of the sentence, we must *go back* to consider the justice of the speaker's sentiment. In the original the sentence is closed with that on which the mind should dwell: in the translation, the attention is called off from this to a particular which ought to have been known before. In the confirmation which is subjoined, the concluding word implies an artful compliment, wisely intended to efface those disagreeable sensations which might have been excited by the preceding reproof. This also is lost in the translation. The language of the antients was certainly more favourable than ours to such delicacies of arrangement. Yet I believe our language is not so much in fault as our negligence. The present sentence might be translated to more advantage thus: " That union with Cæsar—would to heaven, Cn. Pompey! either " that you never had formed or never had dissolved it. The one was the part of " dignity—the other of prudence—such as your's."

truly critical appears; but appears like the ſolitary ſhrub in a barren deſert—a memento of the ſurrounding waſte. In the *Tempeſt*, where ſuch remarks occur moſt frequently, they are yet ſcattered with ſuch a niggard hand as will by no means ſatisfy the reader who deſires to inveſtigate the ſource of thoſe feelings which are excited in every page of a favourite poet. That deſire gave birth to the following pages in the hours of relaxation from ſeverer ſtudies. And that deſire, it is hoped, will at leaſt avert the ſeverity of cenſure from an attempt which muſt fall indeed far ſhort of meriting applauſe.

The firſt thing which claims our attention in this play is the *opening*. This is a part in which of all others it is moſt difficult to ſucceed. And accordingly we find it generally unnatural and almoſt always languid. It is a part to which, when we liſten moſt favourably, we liſten with cold indifference, and in which the poet's higheſt ambition ſeems to be to inform the underſtanding, not to affect the heart. That it is no eaſy taſk to attain even this end without diſguſting by frequent tranſgreſſions of nature and probability, we may be convinced from the number and eminence of thoſe who have failed in the attempt. Hence on the antient ſtage, even after it had made large advances towards perfection, the *prologue* frequently gave ſuch information to the audience, as was neceſſary for underſtanding the ſucceeding ſcenes. And to me indeed this cuſtom appears far preferable to that of attaching an aukward introduction to the body of the drama. Nor do I ſee why we ſhould ſtill retain the prologue, yet reject the principal advantage which may be derived from its introduction. That painting, no doubt, is moſt excellent

 which

which explains itſelf; but not by a label iſſuing from the mouth of the portrait. In fact thoſe prefatory ſcenes are appendages perfectly diſtinct from the play, of which they no more conſtitute a part than ſuch a label is part of the figure to which it is affixed. For that alone can properly be ſaid to belong to the drama, which tends in ſome degree to accelerate the cataſtrophe. This is the bond which muſt unite the ſeveral members into one uniform whole. And where this bond is wanting, any other that can be ſubſtituted muſt be equally ridiculous and vain. The attempt to incorporate diſcordant parts can only ſerve to raiſe our laughter or diſguſt. Some however of the antient prologues told too much; for the end of information is ſufficiently anſwered, when we *know* ſo much as may qualify us for taking part in the various incidents which the poet repreſents, and at the ſame time *are ignorant* of ſo much as will keep alive our deſire of knowing more. There is a point between too much and too little knowledge, from which a deviation on either ſide muſt tend to repreſs curioſity or anticipate conjecture.

But though I wiſh that the antient prologue ſhould take place of thoſe forced ſoliloquies and improbable dialogues which have been the diſgrace of the ſtage; and though I think that in the management of it, no ſmall degree of judgment may be ſhewn; yet that drama which aſpires to perfection, muſt aſpire at the ſame time to *independence*—muſt be ſomething in itſelf abſolute, and unindebted to the aſſiſtance of an interpreter. For the knowledge which we collect ourſelves always yields more ſatisfaction than that which we derive from others. To effect this, indeed, an uncommon felicity in the fable muſt concur in ſome meaſure

with

with the art of the poet: And I believe each of theſe no where appears more eminent than in the Tempeſt of Shakeſpear. There in the very firſt ſcene the attention is arreſted, the paſſions intereſted, the mind hurried into *action* where ſhe recognizes nature, and is unable to remain an indifferent ſpectator. A ſhip appears at ſea in a ſtorm. The paſſengers are diſcovered to be noble; but diſtinctions of rank are loſt in danger: The great then feel their dependance on the meaneſt, and the meaneſt become ſenſible of their own importance. Hence it is that the boatſwain dwells with pleaſure on the reflection, that "*theſe roarers care* "*not for the name of king*;" and that power and wiſdom are now of no avail. Hence that contemptuous ſuperiority with which he replies to the ſoothing admonitions of Gonzalo, and which muſt naturally ariſe from the conſciouſneſs that a monarch's ſafety depended upon him. The paſſengers, as ſoon as they have diſcarded hope, give vent to all the impatience of deſpair. The terror which had firſt ſeized them now ſpreads among the mariners. The deſpair becomes general. All is given up for loſt. The ſhip ſplits, and we are for awhile left in a ſtate of anxiety and ſuſpenſe.

We may obſerve the diſtinctive manners of an old man maintained in the cautions of Gonzalo; the ſatisfaction he takes in the ſagacity of his own remarks, and his reliance on their juſtice even in the extremity of danger. But I haſten to a more ſignal inſtance of Shakeſpear's inſight into the human mind. The greateſt difficulty in the conduct of this drama conſiſted in reconciling us to the marvellous, with which the play abounds; and which in the hands of any other poet muſt, inſtead of raiſing admiration,

admiration, have only ſhocked belief. How judiciouſly therefore is the imagination prepared by terror and compaſſion for the enchanted ſcenes to which we are now to be introduced. It is a common obſervation that the weakeſt minds are moſt inclined to credulity. And it is no leſs true that fear, grief, pity, and all thoſe paſſions which tend to depreſs the ſoul, produce (in proportion to their violence) a ſimilar effect. Hence the numerous prodigies with which hiſtorians abound, in times of danger and diſtreſs. Hence that proneneſs to ſuperſtition which has appeared in the greateſt characters, when oppreſſed by the ſhock of any ſudden calamity. To be convinced of the importance of this remark, let us only conſider how differently we ſhould have been affected by the appearance of Proſpero and his ſpirits, had not the awfulneſs of a ſtorm and ſhipwreck preceded their introduction. Should we not have turned with diſguſt from that which at preſent only fills us with aſtoniſhment?

The poet now tranſports us to the cave of an enchanter, whoſe potent art had "*called forth the mutinous winds.*" His daughter beſeeching him to allay the ſtorm to which ſhe had been witneſs, is comforted with the aſſurance that no life was loſt, and that what was done, was done "*in care of her.*" The plot gradually opens in a manner natural, ſolemn and affecting. "*The hour was now come,*" when Proſpero's daughter muſt be informed of that which to have known before would have been both uſeleſs and prejudicial. We become every moment more intereſted in the fortunes of Miranda and her father. The one, who at firſt only excited ſurpriſe and awe as a magician, now claims our pity and reſpect, as a prince unjuſtly diſpoſſeſſed of his

his dominions by the treachery of a brother. And the averſion with which we are apt to regard the character of an enchanter, is loſt in that of a man "*rapt in ſecret ſtudies*," and devoted to the love of letters. Still had ſuch a perſon been repreſented in the midſt of civilized ſociety, the fiction perhaps would have been looked upon as incredible. But in ſolitude, in the loneſome uninhabited waſte, and in darkneſs, (that temporary ſolitude) men have ever been forward to embrace the wildeſt deluſions of fancy. For this reaſon Shakeſpear lays his ſcene in a deſert iſland; where, before Proſpero's arrival, no human being had trod except an exiled ſorcereſs.

MIRANDA from the beginning appears in the true feminine charms of ſoftneſs, compaſſion and ſimplicity. She is now preſented in the more intereſting view of rightful heir to her father's dukedom, and companion of his ſufferings. Our curioſity alſo is ſtill kept alive: Proſpero's enemies are now in his power: his fate depends on ſeizing this opportunity; but in what manner he will ſeize it we remain uncertain. Thus is Shakeſpear equally judicious in what he diſcloſes and conceals. Longinus admires an expreſſion of Herodotus. "*The whole theatre was melted into* "*tears*." Similar to this, but much more noble, is Shakeſpear's:

> "No, not ſo much perdition as an hair
> "Betid to any creature *in the veſſel*,
> "*Which thou heard'ſt cry*."

How cloſely too does he imitate nature, even in the circumſtance which he ſelects for Miranda's remembrance, namely, the number of her attendants. That, by the frequency of repetition, muſt have

have made a ſtronger impreſſion on her memory than the ſingle event of her tranſportation to the iſland, the importance of which her infant mind was incapable of knowing. But let us leave theſe remarks to conſider the miniſtering ſpirit who is now exhibited.

PRÆTERNATURAL agents, however they may ſurpriſe, ſeldom intereſt us. The difference of their nature, paſſions and purſuits, makes us regard them as an order of beings in whom we have no concern. It remained for Shakeſpear to give them ſuch characters as muſt excite our love or abhorrence, ſuch ſentiments and manners as never intrude upon thoſe of the human ſpecies, yet force us to ſympathize in their pleaſure and their pains. The ſpirit now introduced at once lays hold on our affections; its character is immediately diſcovered, and is ſuch a character as we cannot contemplate with indifference. Proſpero himſelf is, with the greateſt propriety, repreſented as loving it. Delicate, gentle, timid and ſubmiſſive, it executes the commands of its employer with an alacrity quickened by gratitude, and by the expectation of promiſed liberty. But whence is it that we are more intereſted by Shakeſpear's Ariel, than by the attending ſpirits in Milton's Comus? I anſwer, becauſe the former has paſſions ſimilar to our own, burns with deſire, or exults in hope; chearfully ſubmits to bondage from motives of generoſity, yet at the ſame time feels the wretchedneſs of bondage, and pants for the enjoyment of freedom. But of the latter, we only know that they are ſent to ſuccour virtue in diſtreſs; that they diſcharge their commiſſion with cold apathy; that they enjoy unruffled happineſs themſelves, and look down upon the perturbations and cares which agitate

mortals.

mortals. What emotion, but that of reverence, can be excited by a character which is itſelf exempt from all? Hence we may obſerve that if at any time ſpiritual agents be repreſented, they ſhould be of a middle order, ſubject to various degrees of pleaſure and of pain. Human paſſions are moſt of them founded on the imperfections of our nature, and nothing that is perfect can become their proper object.

But to return to our author. Ariel's impatience for freedom gives Proſpero a natural opportunity of recounting what had paſſed upon his firſt coming to the iſland, and prepares us for the appearance of Caliban. Mean while the ſtory continues to be unfolded, or rather unfolds itſelf. We become acquainted with the principal actors; we learn a more particular account of the king's fate and his followers; and at the ſame time, leſt curioſity ſhould be weakened, the poet artfully heightens our ſuſpenſe by the *ſecret commiſſion* given to Ariel. In this ſcene a ſignal inſtance occurs of Shakeſpear's accuracy in adapting his language to the different perſonages he exhibits. The ſpirit informing its maſter of the harbour in which the king's ſhip is concealed, inſtead of deſcribing it from the ſituation, or the nature of the place, marks it out by a circumſtance ſuitable to its own character:

——————— "Where once
"Thou call'dſt me up at midnight to fetch dew
"From the ſtill-vext Bermoothes."

Such an incidental reference to a preceding event tends to corroborate those which are now represented, and insensibly persuades us of their reality.

We come now to a character the most extraordinary, most strongly marked, and uniformly supported, that imagination has ever pictured or language described. The stubborn, the malignant, the ungrateful Caliban, forms a perfect contrast to the amiable, the gentle Ariel. Unmoved by kindness, fear alone makes him submit to the power of Prospero, whom he at once detests and dreads. His malevolence breaks out the moment he appears in the bitterness of imprecation — that greatest pleasure which he derives from the use of speech. Liberty he desires no farther than as it affords an exemption from labour, and where servility promises the gratification of his indolence or his malice he is eager to be a slave. But though we must admire the strength and justness of colouring with which this character is drawn; yet, I fear, the introduction of it must be condemned, as destructive to the unity of a drama, which might otherwise have been pronounced complete. It is a shining blemish which we can scarcely wish removed; and I think it confirms a remark that has often occurred to me in reading Shakespear, namely, "that many of his defects proceed from "too close an imitation of nature." Nor does this contradict the great rule, that nature should be the standard of dramatic poetry. We must distinguish between what is natural in events, and what is consonant to the nature of the human mind. The latter must be universally observed, as the chief object of the drama is to affect the passions. But the former is to be studied only

only in ſubſervience to this, which therefore it muſt never be ſuffered to counteract. Thus in *real life* we ſcarcely ever ſee any train of events uniformly tending to one end, without the intervention of others, between which and that end there ſubſiſts no neceſſary connection. Yet the *unity of action* ought always to be maintained by the dramatic poet; becauſe the human mind is moſt powerfully intereſted, when the force of all its faculties is concentered in a ſingle object. Shakeſpear has often deviated from this rule, and abounds with faults; but ſeldom deviates from nature, and therefore abounds with beauties. Hence many even of his faults carry that charm along with them, which more than atones for their imperfection.

But Ariel is now introduced again, in the execution of Proſpero's commiſſion; drawing Ferdinand to the ſight of Miranda by the ſound of aerial muſic. She, accuſtomed to the appearance of ſpirits under various forms, naturally ſuppoſes that a figure uncommonly beautiful is not human; yet his appearance is ſo intereſting that ſhe plainly wiſhes her conjecture may be falſe.

——— "What is't? *A ſpirit?*
——— "Believe me, Sir,
"It carries a brave form—*but 'tis a ſpirit.*"

The natural ſimplicity of Miranda's character is uniformly maintained. She attempts not to diſſemble the partiality which ſhe feels for Ferdinand. It is a falſe refinement that will uſe a veil where there is nothing which deſerves concealment. Proſpero's ſeeming oppoſition to a connection which he wiſhed to bring about, is founded on the juſteſt obſervation of nature. Difficulties

in the attainment of an object which has once engaged our desires, have been ever found to encreaſe the ardour of purſuit. Beſides, the roughneſs of his demeanour and his apparent cruelty tend to ſet the tenderneſs and gentle ſympathy of his daughter in a more engaging light; ſo that we can ſcarcely wonder at the ſuddenneſs of Ferdinand's attachment. Yet let the advocates for firſt-ſight impreſſions obſerve, that *Shakeſpear* ſuppoſed all theſe concurring circumſtances inſufficient, and has called in *ſuper-natural influence* to effect what *they* think may be ſufficiently accounted for by their "*Je ne ſcai quos*"—that *John-a-Stiles* of modern novel-writing.

WARBURTON's remarks on the remainder of this ſcene ſupercede the neceſſity of any farther criticiſms. I ſhall therefore conclude, after obſerving, in general, with what peculiar art the cataſtrophe of this piece is conducted. In order to the recovery of Proſpero's dukedom, Alonzo was to be impreſſed with remorſe for having been the author of his depoſition. For this purpoſe he is viſited with accumulated misfortune. And leſt the voice of that ſtern monitor ſhould be ineffectual, the agency of Ariel is employed to ſet his guilt before him in the ſtrongeſt colours; 'till at length he ſees and trembles at the characters of divine vengeance. The billows, the winds, the thunder, ſound in his ears "*the name of Proſpero*;" and he is ſtung to frenzy by the reflection that, for his father's treſpaſs, Ferdinand is "*bedded in the ooze.*" When his diſtraction is now at the height, the charm diſſolves. The king's affliction for the loſs of his ſon is changed to tranſport for his recovery. Tranſport, ſuch as his, kindles all the ardour of affection for the moſtdiſtant

inſtrument.

inſtrument. The happy parent is naturally led to regard Proſpero as the author of his joy. All remains of former enmity are effaced ; and leſt it ſhould ever break out again, their reconciliation is cemented by the union of their children.

Among Shakeſpear's plays it is not eaſy to determine which is moſt excellent. Perhaps the *Tempeſt* has fewer faults than any other, and as ſtriking beauties. There is not one, certainly, in which the poet gives a greater looſe to the vivid powers of his imagination, nor one in which his imagination is more regulated by the ſtricteſt rules of nature and of art.

# *Thoughts on ſome particular* PASSAGES *in the Agamemnon of* ÆSCHYLUS.

*By* FRANCIS HARDY, *Eſq; M.R.I.A.*

IN Mr. Wood's Eſſay on Homer there is the following paſſage: "That we may conclude from him (that is, Homer) that the "language of Greece was that of Troy." Read Dec. 20, 1788.

SEVERAL writers have concurred with Mr. Wood in this opinion. The principal reaſon which they aſſign for it, independent of the ſuppoſed affinity and connection between the countries, is this: That in all the interviews which take place in the Iliad between the warriors of both nations, the ſpeakers ſeem to underſtand each other perfectly well, without the intervention of an interpreter, a perſonage who in ſhort never appears throughout the whole poem; that as Homer has tranſmitted to us ſuch a faithful copy of the manners of this very early period of ſociety, and has not ſuffered any incident or circumſtance to eſcape him which could perfect the reſemblance, and mark the characters of individuals as well as of nations with preciſion, it is inconſiſtent with the accuracy of ſo great a painter not to have taken

taken notice of the different language made uſe of by Greece and Troy, if any ſuch difference had really ſubſiſted.

This argument appears at firſt to be perfectly concluſive. Homer's great conſiſtency, his hiſtorical truth, his unvarying attention to the coſtumi in every inſtance, cannot be doubted. His total ſilence in the Iliad, as to the language of Greece and Troy, certainly favours the idea that it muſt have been common to both countries. Strongly fortified and ſupported as this idea ſeems to be, I think I ſhall be able to prove that it had not always that currency which it has now: That the greateſt tragic poet Athens ever ſaw (the greateſt incontrovertibly in point of original genius) entertained a different opinion, is a certain fact, in which conjecture has no room. From ſome circumſtances which I ſhall mention in the courſe of this eſſay, we may reaſonably preſume that the people of Athens concurred in opinion with him.

In the Agamemnon of Æſchylus, which, take it all together, is one of his moſt finiſhed compoſitions, he introduces that monarch as juſt returned from the deſtruction of Troy to his palace at Argos. Agreeable to the faſhion of thoſe heroic ages, when a general urbanity of manners had not ſoftened the horrors of war, he is attended by a train of unhappy captives The principal figure in this groupe is Caſſandra, the celebrated and wretched daughter of Priam. She appears before Clytemneſtra, and the principal old men of Argos who compoſe the chorus. The queen addreſſes her in a mixed ſtrain of courteſy and ſeverity. The miſerable princeſs makes no anſwer. At length Clytemneſtra

temneſtra becomes impatient, and tells her if ſhe does not underſtand their language to make ſigns with her hands. The chorus then obſerves that ſhe comes from a foreign city, and ſtands in need of an interpreter. This checks the riſing anger of the queen, who goes into the palace to ſacrifice, as ſhe ſays, to the Gods, for Agamemnon's happy return. As ſoon as Clytemneſtra had retired, Caſſandra no longer preſerves ſilence, but with a noble wildneſs and dignity of ſorrow invokes Apollo as the author of all her calamities. She then proceeds to prophesy her own death and that of Agamemnon. The chorus are at firſt all amazement; however, when they have in ſome degree recovered from that aſtoniſhment and terror into which the terrific frenzy and ambiguous forebodings of the beautiful propheteſs have thrown them, they expreſs their ſurprize that a foreigner, as ſhe is, could ſpeak the Grecian language as fluently as if ſhe had been educated at Argos. Again, when continuing her prophecies, the chorus confeſs their utter inability to comprehend her meaning, ſhe immediately replies, " Yet you allow that I ſpeak " your language perfectly." All this is ſo ſtrongly marked, and the difference between the Trojan and Grecian tongues ſo diſtinctly pointed out, that it is impoſſible not to take notice of it.

We have here then a celebrated dramatic poet, the father of tragedy, who not only does not allot the ſame language to the queen of Agamemnon and the daughter of Priam, but thinks it proper to repreſent the natives of Argos as ſurprized and confounded that the latter ſhould ſpeak their language at all. Can we ſuppoſe that if at that time it was generally admitted as true,

that the Grecians and Trojans ſpoke the ſame language, that he would have hazarded ſuch an unneceſſary violation of hiſtorical truth, and before ſuch judges? Can we ſuppoſe that a poet, who above all others was the avowed admirer of Homer; who, with that unaffected diffidence which ever characterizes real genius, always ſpoke of his tragedies as ſingle diſhes from the great entertainment of Homer, would have deviated from him in ſo material a point if he really imagined that Homer conſidered his countrymen and the Trojans as uſing the ſame language?

The magnanimity of Agamemnon, and the misfortunes of Caſſandra, certainly have no relation to this circumſtance; yet I am perſuaded that Æſchylus did not mention it without deſign. Such minutiæ fall more generally, though not more properly, within the hiſtoric than the tragic ſphere; for we may obſerve that unintereſting authors who write for the theatre, without the true genuine talents for it (a caſe by no means uncommon) never attend to ſuch minutiæ in the leaſt, and that a real dramatic genius always does. It is this which conſtitutes the great difference between the French theatre and that theatre which Shakeſpear eſtabliſhed. Corneille, whoſe Roman characters in general are only ſo many gigantic diſproportioned ſtatues of the Pompeys and the Emiliani, "ſtept from their pedeſtals to take the air," and who ſeems always unhappy when he is not indulging his paſſion for declamation, and quoting Lucan, looked down from his dramatic roſtrum on ſuch ſeeming trifles with the utmoſt contempt; whilſt Shakeſpear, on the contrary, ſelects them with the utmoſt aſſiduity and taſte; well knowing that they gave that air of truth and probability to his pieces which is the very ſoul of

of theatric repreſentation. Now if ſuch a maſter as Æſchylus has thought fit, in the midſt of a moſt intereſting and impaſſioned ſcene, on a ſudden to check the tide of our feelings, to bid the moſt powerful paſſions to ſtand ſtill for a moment whilſt he calls our attention to ſuch a minute circumſtance as this, will it appear chimerical or viſionary to ſay that he touched on it becauſe it was exactly agreeable to the popular opinion of the antient limits of the Greek language, and of courſe neceſſary to the hiſtorical perfection of his drama; and that his judgment, as well as Shakeſpear's, told him that it is this minute and delicate conformity to eſtabliſhed traditions which affixes the ſeal of authenticity to the works of the poet.

It may be ſaid that the drama of Æſchylus is not always perfectly regular, and that the Athenians did not look for that correctneſs which an acquaintance with the works of his great rival Sophocles taught them afterwards to exact. It is true. Æſchylus was crowned for this play of Agamemnon, and yet there is one material and palpable error in it. The laſt of the ſucceſſive ſignals by fire, which was agreed to be given immediately on the taking of Troy, has been ſcarcely ſeen by the watchman who was ſtationed to obſerve them, and their progreſs deſcribed (moſt beautifully indeed) by Clytemneſtra, when Agamemnon himſelf appears at Argos. This is certainly a violation of all probability. However, I believe it will be admitted that an audience might with great facility overlook a treſpaſs on the unities, and not paſs over any inattention to a matter of public notoriety, as I ſhould ſuppoſe that of Greece ſpeaking a different language from Troy, muſt in ſome degree have been at Athens. I acknowledge

that the Athenians were a people fond even to a proverb of fiction and romance; that they frequently adopted and maintained opinions relative to antient cuſtoms, &c. without any foundation: I acknowledge that the moſt impartial of all hiſtorians, Thucydides, freely declares his apprehenſions that his account of the Peleponneſian war will not pleaſe, on account of the attachment of the Athenians to fable. But although it might have been matter of diſpute at Athens whether Iphigenia was really ſacrificed at Aulis or not, yet whether their anceſtors and the Trojans ſpoke the ſame language was a queſtion not confined to the poets; it related to the whole community, and conſequently, whatever diſtance of time there was between the taking of Troy and the days of Æſchylus, could not have been involved in much obſcurity.

The works of Homer were not confined to a particular claſs in ſociety; they were not read by hiſtorians, or philoſophers, or ſtateſmen alone. If they were ſtudied by Anaxagoras or Pericles, or applauded by the uncommon ſenſe and ſuperior taſte of Aſpaſia, they were at the ſame time the delight and the inſtruction of the multitude: They were, as every one knows, recited at the ſacred feſtivals; their authority was admitted as unqueſtionable in judicial pleadings. It is ſcarcely poſſible to ſuppoſe that a people ſo penetrating, ſo inquiſitive, ſo ingenious as the Athenians, could have been ſo converſant as they were with the works of Homer without inveſtigating a queſtion the moſt natural that could occur to them on reading that poet; did the Greeks and the Trojans uſe the ſame language? If the times in which the tragedies of Æſchylus were acted with peculiar approbation

bation had been clouded with barbariſm or ignorance, it would have been idle to have touched on this queſtion for a moment; but the days in which this great poet was moſt admired, were, above all others in the hiſtory of Greece, peculiarly refulgent. Never did the genius of Athens appear with more dazzling luſtre than juſt at that period. The age of Demoſthenes, of Hyperides and Alexander, was the age of eloquence, and to a certain degree of the fine arts; but with ſuch predominating ſplendour did the period which I allude to ſhine forth, that no ſubſequent æra in the annals of mankind has, in ſome inſtances, at all equalled it. It was amidſt this intellectual blaze, "in this moſt high and "palmy ſtate" of Greece, that the tragedies of Æſchylus laid hold on the Athenian mind; and though he was exceeded by Sophocles in regularity and elegance, and by Euripides in tenderneſs and moral ſentiment, yet the uncommon force of poetry with which he had elucidated and adorned the more ſhadowy and uncertain parts of Grecian ſtory, and the noble patriotiſm and magnificence of numbers with which he cloathed the illuſtrious day of Salamis in double luſtre, rendered him the object of delight and admiration to his countrymen. Perhaps if we conſider for a moment the nature of thoſe ſubjects which form the tragedies of thoſe great poets, we may be induced to pay more attention to the ſentiments of Æſchylus, as far as they relate to the preſent queſtion. The misfortunes of

"Thebes, or Pelops line,
"Or the tale of Troy divine,"

ſeem to be the general and indeed inexhauſtible ſource from whence they all drew their richeſt materials: Sophocles, and Euripides,

Euripides, however, more particularly. In the drama of the former, the woes of Oedipus, of Electra, and perhaps more than either, the awakened tenderneſs and ſelf-condemnation of Deianira, lay claim to and engage all our ſenſibility. The ſplendour and elegance of the poetry, the judicious ſelection of the fable, and peculiar correctneſs of taſte for which this poet has been ſo juſtly celebrated, muſt be obvious to the moſt careleſs obſerver. In Euripides, the poet of the heart, we are charmed with the eaſy and artleſs ſimplicity of his diction, the elevated yet appropriate ſentiments of each chorus, and the mild philoſophy of Socrates which glides through and enriches the whole. The tragedies of Æſchylus wear a different from ; irregular, often extravagant, more ſublime and magnificent in his conceptions than either of his rivals; it is not the dignified ſufferings of Hercules, the ſolitudes of Lemnos re-echoing to the anguiſh of Philoctetes, the unhappy paſſion of Phædra, or the graceful and reſigned tenderneſs of Alceſtis, that ſolicit the exertions of his muſe. A predilection for whatever was auguſt, awful and commanding, for thoſe ſubjects which were almoſt hid in antiquity, and by the developement of which he could pour new light on the hiſtory and manners of his countrymen, ſeem to pervade almoſt the whole of his favourite compoſitions. In his Prometheus, the gloom, the dread uncertainty which reign through part of that ſublime performance, the indiſtinct idea which we have of ſome of the objects of the dialogue, give an air of ſolemnity and grandeur to it, no leſs impoſing than the unappalled humanity of Prometheus, and the introduction of the daughter of Inachus, muſt have been flattering to the prejudices, the taſte and ardent feelings of an Athenian audience. So attached was he to this

ſubject,

ſubject, that he wrote three tragedies on it, two of which are now unfortunately loſt. In his play of the Supplicants, we find him again treading the almoſt impervious paths of antiquity. I adduce this performance with particular ſatisfaction, not only as it favours the poſition which I have juſt laid down, but as an additional argument for our reliance on the candid teſtimony of Æſchylus. Danaus, an Egyptian, is ſaid to have eſtabliſhed a colony in Greece, and tranſmitted the kingdom of Argos to his poſterity. Agreeable as this account might have been to antient tradition, it certainly was by no means ſo to the ſelf love and national prejudices of the Greeks; juſt the reverſe. However, we find that no conſideration of that nature prevented Æſchylus from giving this event to his countrymen juſt as it was. He has accordingly thrown this migration into a dramatic form; and the arrival of Danaus, and the ſupplications of his daughters, form the ſubject of the play. The poet in this, as in other inſtances, has adhered then exactly to tradition; his general integrity cannot be impeached, and indeed his ſtrict and delicate obſervation of manners *, and the conſonance of his teſtimony to that of the beſt hiſtorians, where it has been found neceſſary to compare them, are particularly acknowledged by the moſt reſpectable authors.

The time of the celebrated migrations from Greece is well aſcertained, and Thucydides expreſsly ſays that the Grecians did

* As in the Perſians, where in the account given to Atoſſa of the flight of the Perſians, their worſhip of the earth and ſky is particularly noticed. See Dr. Potter's incomparable tranſlation.

not

not engage at all in regular colonization until long after the Trojan war. However, it is afferted by fome that the Trojans were a colony from Greece, and fettled there, according to tradition, about two hundred years before the Trojan war. Now the language of the mother country is generally, indeed almoft invariably, adopted by her colonifts. Is it not then a fingular circumftance that Æfchylus fhould in the moft unequivocal manner mention Troy as a city fpeaking a language different from that of Greece? Whether a tradition of this nature, unfupported by any great hiftorical authority that I know of, is entirely to overbalance the plain and unbiaffed teftimony of Æfchylus, may reafonably be queftioned. The account of Dardanus, from whom the Trojans were faid to be defcended, is certainly given by an excellent author * and admirable critic; but it is almoft loft in poetic fable, and unconnected with any proof whatever. Let us fee what it amounts to: Atlas, the firft king of Arcadia, had feven daughters; Jupiter married one of them, and had two fons, Jafus and Dardanus: A great deluge which took place in Arcadia feparated the brothers, and the family of Dardanus migrated to Afia, where they fettled in that country, which was afterwards called Phrygia. Jafus, it feems, when in Samothrace, paid his addreffes to the goddefs Ceres, and in return for his affiduities was ftruck dead by lightning; a very common mode amongft the ladies of the heathen mythology of getting rid of an importunate lover. After ftating thefe and fome other particulars of equal importance and authenticity, he (Dionyfius) fays, " I have now " made it evidently appear that the Trojans are defcended from the

* Dionyfius of Halecarnaffus.

" Greeks."

"Greeks." Whether they were or not it is impoſſible at this diſtance of time to pronounce with any degree of certainty; but the Trojans were a mixture of Greeks and Phrygians, ſay ſome authors. If the Hymn to Venus is allowed to be genuine (and ſome of the moſt penetrating critics never denied its authenticity) it will appear, from the authority of Homer himſelf, that the Trojans and Phrygians ſpoke different languages. This difference is taken notice of in the Hymn to Venus, not in the Iliad; a circumſtance which deſtroys the force of that argument which is drawn from the general ſilence of Homer as to the languages of the contending nations. If the Hymn to Venus had been loſt, few perhaps would have thought of aſſigning different languages to the Trojans and Phrygians; the general inference from the Iliad would have been, that they were the ſame. If, therefore, Homer is totally ſilent in the latter poem as to the language of Greece and Troy, he is equally ſo as to that of Troy and Phrygia; and yet in another place we have his own words to prove that the laſt-mentioned countries did not ſpeak the ſame tongue. Virgil, ſays Mr. Wood, always confounds the Trojans and Phrygians, and repreſents them as one people, when in fact they were by no means ſo. If ſuch an accurate obſerver of Homer has fallen into this error, what may not other authors have done? In a queſtion, therefore, where there is ſo much doubt, ſo much confuſion, ſo much uncertainty on the one hand, and a reſpectable and evidently impartial authority on the other, to which ſide ought we moſt to incline? The extent of the language of the Greeks, or of Grecian colonization, does not come exactly within the ſcope of the preſent enquiry. That their language was very generally diffuſed at the earlieſt periods is certain.

 Chios,

Chios, in the Ægean Sea, is mentioned by Homer as the place of his residence; and from the account which Herodotus gives of the auxiliaries of Xerxes, there is every reason to imagine that some of those nations from whence that monarch drew assistance were of Greek extraction. That the Grecian language was unknown to Troy in every period of its history cannot be at all conceived; but that it was common to both countries at the time of the Trojan war, may, from the authority of Æschylus, admit of some degree of question. The passage in Agamemnon cannot with much facility be passed over. But in this I may be mistaken. No satisfactory reason, however, in my humble opinion, can be assigned for its insertion, if (as has been already suggested) Æschylus did not conceive it necessary to the historical accuracy of his performance; and that he was eminently qualified to decide with tolerable certainty as to this, and similar subjects, the whole tenor of his compositions evidently proves.

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Page 57, Line 14, *They express their surprize that a foreigner, &c.*] The literal translation from the original is—" But I am surprized that you, brought " up beyond the sea, *in a city that uses a different tongue*, should be able, &c."

*Some*

*Some of the Passages alluded to in the foregoing Observations are in the Original as follows:*

*Clytemnestra.* Αλλ' ἔιπερ ἐςὶ μὴ χελιδόνος δίκην
Αγνῶτα φωνὴν βάρβαρον κεκτημένη.

*Clytemnestra.* Εἰ δ' ἀξυνήμων ὕσα μὴ δέχῃ λόγον
Σὺδ ἀντὶ φωνῆς φράζε καρβάνῳ χερί.

*Chorus.* Ερμηνέως ἔοικεν ἡ ξένη τορῦ
Δεῖσθαι.————

*Chorus.* ———— Θαυμάζω δέ σε
Πόντου πέραν τραφεῖσαν ἀλλόθρεν πόλιν
Κυρεῖν λέγουσαν ὥσπερ εἰ παρεςάτεις.

*Cassandra.* Καὶ μὴν ἄγαν γ' Ἑλλὴν ἐπίςαμαι φάτιν.

# *Essay on* RIDICULE, WIT *and* HUMOUR.

*By* WILLIAM PRESTON, *Esq*; *M.R.I.A.*

## PART THE FIRST.

*RIDICULE* is that branch of the *fine* or *mimetic* arts which professes to excite the emotion of *mirth*. It is seen more striking and forcible in poetry and painting, where the imitations of nature are more general, as well as more apt and pointed; but even music is capable of it in a certain degree, as for example, by a burlesque or sort of parody on some grave composition, by an imitation of odd and unseemly noises, or by strains expressive of whimsical and grotesque emotions and situations. *Ridicule* excites *mirth* by the RIDICULOUS; that is to say, by an exhibition of defects and blemishes of the lighter kind, which neither imply a sense of pain and misery in the object or substratum to which they belong, nor contain any thing noxious or alarming to external

Read Dec. 27, 1788.

nal beings. Should the blemiſh or defect be in any vital attribute or quality, either eſſential to the health and well-being of the ſubject, or requiſite to the due performance of its duty and functions for the common good, mirth will not be the conſequence; the gay contempt will be checked either by a ſenſe of the pain or inconvenience which the defect or blemiſh in queſtion muſt cauſe to the ſubject before us, or the alarming conſequences which may redound from it to ſociety; and our feelings, inſtead of mirth, will be ſomething far different; ſorrow and pity in the one caſe; terror, diſguſt, indignation or hatred in the other.

THE foregoing definitions of RIDICULE and the RIDICULOUS take in mental as well as corporeal objects, and are literally borrowed from the great philoſophical critic of Greece—" Το γαρ " γελοιον (ſays *Ariſtotle*) ἐςιν Ἁμαρτημα τι και αἰσχος ἀνωδυνον και ἐ " φθαρτικον οἷον ευθυς το γελοιον προσωπον αἰσχρον τι και διεςραμμενον ανευ " Ὀδυνης." And *ridicule*, according to him, conſiſts in the repreſenting (το φαυλοτερον αλλ' ἐ μεντοι καθα πασαν κακιαν) the foibles and lighter vices of the mind, and ſlight corporeal blemiſhes and defects. Theſe are what Mr. Hobbes diſtinguiſhes by the name of infirmities.

THE peculiar emotion excited by ridicule, independent of the pleaſure reſulting from the truth of the imitation, is called MIRTH; a ſenſation which has been improperly confounded with *laughter* by ſome writers who have profeſſed to treat this ſubject, particularly by Mr. *Hutcheſon*, the moral philoſopher, and a Dr. *Campbell*, in a book which bears the impoſing title of *Philoſophy of Rhetoric*. *Laughter* is a mere corporeal involuntary affection,

affection, like crying, coughing or ſneezing; it is defined by ſome writer that I have ſeen to be a ſucceſſion of naſcent or imperfect ſhrieks *; it ſometimes indicates an emotion of the mind, but often proceeds from cauſes purely mechanical and external, like any other convulſion; tickling, for inſtance, or the ſight of violent laughter in others, will produce it; in hyſterical patients it is a mere diſeaſe, equally ſo with the *cynic ſpaſm* or the *dance of St. Vitus.*

To define the nature of *mirth*, in other words, to explain the cauſe of that pleaſure which we derive from *ridicule*, we muſt recur to the theory of Hobbes, which is conformable to the definition of Ariſtotle, and will on examination appear to be founded in nature. Mirth (ſays the philoſopher of *Malmſbury)* ariſes from a ſudden conception of ſome eminency in ourſelves, by compariſon with our own infirmity formerly, or that of others. Here we muſt obſerve the force of the expreſſion *ſudden conception*, which implies that the whole pleaſure of the mirthful ſenſation does not proceed from conſcious triumph, any more than it does from the truth of the repreſentation: Part is to be attributed to the odd and unforeſeen ſituation or conduct of the ridiculous thing or agent; thus we find, by experience, that our mirth is anticipated and deſtroyed by any thing which checks or prevents the ſurpriſe of this ſudden conception; for example, when the perſon, who means to be facetious, prefaces his obſervation or his tale with the promiſe of a good jeſt or a laughable ſtory, whereby we are prepared for ſomething ludicrous, and loſe the pleaſure of the ſurprize.

* As well as I can recollect, by Dr. *Hayley*, a profound writer on metaphyſics, from whom the ingenious Dr. *Prieſtley* has taken many valuable hints.

As

As to that part of Hobbes's theory, which makes the triumph arifing from comparifon a principal efficient caufe of the pleafure attending on ridicule, I think we need only recur to our own experience for a confirmation of its truth. Why do not men chufe to be laughed at? certainly becaufe it indicates that they are objects of contempt. How happens it that a fportive word is more feverely felt, and excites more lafting refentment, than the keeneft reproaches? Why do we hold it indecorous and profligate to laugh at our parents, benefactors and feniors? Why is it held impious and profane to laugh at things divine and holy? Why do public fpeakers and controverfial writers endeavour to turn the laugh againft their opponents? Why is ridicule fo powerful an engine of debate, even while it difclaims an appeal to fober argument? Surely becaufe the very effence of mirth is a latent contempt, and there is a fort of general intuitive perception that ridicule degrades and vilifies its object. Hence it is, that a perfon who laughs at his own foibles and defects is thought to fhow an extraordinary effort of good fenfe and good humour, inafmuch as, by fo doing, he makes a painful facrifice of felfifh feelings. We fee too, that many people can jeft freely on their own infirmities, who will not bear the leaft degree of raillery on that head from others; undoubtedly this proceeds from a feeling that ridicule implies contempt. When people laugh at themfelves, the felf-humiliation is more than counterbalanced by the felf-applaufe; and, inftead of finking, they rife in the opinion of the world, by a frank confeffion, which at once fhows fortitude and good fenfe, and difarms envy by a confeffion of weaknefs. The fact is, that people never do laugh at themfelves except from fome political motive; either to

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acquire the character of good humour, to ingratiate themſelves with thoſe whom it is their intereſt to pleaſe, or to diſarm the ridicule of others by anticipation. But ſtill (which is all that is neceſſary to my argument) whether a man laughs at himſelf or his neighbour, whether the ſubject of his ridicule are his own paſt infirmities or the preſent infirmities of others, contempt is the baſis of his mirth.

To illuſtrate what has been ſaid by a few examples:—Impotence and decrepitude, conſidered merely as ſuch, do not excite mirth, but compaſſion; yet ſhould we find the impotent cripple boaſting of his agility, and attempting to mix in the dance; or ſee age and deformity plaiſtered over with lace, and affecting the gallant; this attempt at ſome character or atchievement, to which the perſonage is ſo notoriouſly inadequate, impreſſes us with a ſtrong ſenſe of his inferiority, the emotion of contempt is excited, and mirth is produced, unqualified by compaſſion for infirmities, of which the ſufferer himſelf ſeems ſo little conſcious. An odd and groteſque countenance, a whimſical and outreè configuration of body, uncommon grimaces and diſtortions of the features and limbs, provided they are unattended with pain, may excite laughter; while the convulſions of pain, the deformity of ſickneſs or of ſorrow, affect us only with terror and pity. The abſurdity and incoherence of a drunken man excite laughter, for they move contempt; the ravings of a maniac fill us with melancholy and horror. Want and beggary do not of themſelves excite mirth; but ſhould we ſee a beggar with velvet, or lace, or embroidery mixed among his rags, that incongruous union of finery and wretchedneſs would provoke our laughter. And theſe

inſtances may ſerve to ſhow, that they are only the lighter defects or blemiſhes, unaccompanied by pain or miſery on the one hand, or virulence and danger on the other, that are the proper ſubjects of mirth. And to convince us that contempt, a certain ſelf-triumph of the mind, is a principal ſource of the pleaſure which we derive from mirth, let us recollect that there muſt, to conſtitute ridicule, be ſome competition, as well as inferiority; a reſemblance and a contraſt in the objects compared. The oyſter, or the earth-worm, the poor beetle which we tread upon, are vaſtly inferior to man; yet that inferiority does not produce contempt, becauſe theſe creatures never imitate us, and are as perfect in their kind as imperial man in his. Some approximation, ſome reſemblance there muſt be; ſo that not every animal is a ſubject of mirth, but thoſe only which imitate human nature, whether that imitation be near or remote; ſuch are dogs, monkies, kittens, parrots, magpies, jays, and ſome others. Song birds and exotic animals may be kept for the purpoſes of luxury in our cages and menageries, and afford pleaſure by the melody of their notes, the beauty of their forms, or their rarity; ſome animals, inſtead of pleaſure or mirth, produce, by their appearance, only terror, diſguſt or pity; every one of thoſe creatures, which are capable of exciting mirth, are capable alſo, in a certain degree, of imitating ſome action of man. The monkey confeſſedly reſembles the human ſpecies at all points; the cat uſes her fore paws like hands, and for that purpoſe nature hath provided her with *clavicles*; the dog and the bear may be taught to walk upright on two legs like man; the jay, the parrot and the magpie have the power of forming articulate ſounds. Nor is our mirth excited indiſcriminately by thoſe creatures; it

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is in thoſe moments only, when they attempt to imitate human actions, that they become objects of laughter.

If it ſhould be enquired why mirth is often excited by the repreſentation of things, which in their actual exiſtence would, perhaps, move compaſſion, perhaps conciliate approbation and eſteem; ſuch are many of thoſe paintings called converſation pieces; ſuch are poems like Shenſtone's School-miſtreſs, and many ſcenes in comedies and novels which profeſs to exhibit pictures of real life; nor is it difficult to explain this matter. In the firſt place, though the repreſentation follows nature, it is nature diſtorted, and her diſtorted features are more condenſed and accumulated together than they commonly exiſt in real life; but ſuppoſing thoſe features to be exactly copied, without the adding of any thing, ſtill there is a riant and groteſque colouring diffuſed through the picture, by the ſkill of the artiſt; while, in real life, the rude and vulgar manners, the odd and groteſque incidents, may be combined, with ſuch collateral circumſtances, as may excite emotions widely differing from contempt and triumph, and which predominate over them; for inſtance, the ideas of rural innocence and honeſt induſtry, that ariſe from ſeeing the family of a peaſant at their labours, will conciliate our eſteem, and the appearance of poverty and wretchedneſs will move our compaſſion; beſides, the recollection that the picture before us is but a fiction, prevents our having ſuch ſtrong feelings of eſteem or compaſſion as if we contemplate the reality.

To proceed to the infirmities and defects of the mind, they are mild infirmities, and moderated defects only, that are fit ſubjects of

ridicule. Infirmity and vice, not flagitious guilt, are the proper food of mirth; Ariſtotle expreſſes it *το φαυλον αλλ' ε καθ' πασαν κακιαν.* The repreſentation of cowardice, affectation, avarice or vanity may be ridiculous; it may afford a triumph by compariſon, unallayed by any feeling or apprehenſion of ſerious evil to any body; but cruelty, ingratitude, perfidy, and the whole black catalogue of gigantic crimes and flagrant paſſions, that rend aſunder the ſocial ties, and heap the meaſure of human calamity, theſe, far from exciting laughter, raiſe in us emotions of abhorrence, indignation or fear. In the occurrences of real life a ſlight miſchance or blunder, even of our beſt friend, will raiſe a ſmile; but a more ſignal misfortune or fatal error, even of an enemy, will move our compaſſion. The fact is, that mirth, though a very prompt and lively emotion, yet not being ſo very neceſſary to our exiſtence and the preſervation of ſociety as many others, gives no very deep tincture to the mind, but mildly diſperſes itſelf, and vaniſhes before ſuch as are of more general and important uſe, and of courſe armed with ſtronger powers of embracing and poſſeſſing the human ſpirit.

# *Essay on* RIDICULE, WIT *and* HUMOUR.

*By* WILLIAM PRESTON, *Esq*; *M.R.I.A.*

## PART THE SECOND.

HAVING considered the nature of ridicule, and traced out the sources of the pleasure which attends it, let me, for a moment, advert to the corporeal external expression of that pleasure, I mean *laughter*, and endeavour to investigate its physical cause, so far as it is an expression of *mirth*, or a *corporeal movement* indicating *pleasure*. I speak with this reservation, because, as I have already, in some measure hinted, *laughter* is not always expressive of *mirth*, no, nor even of a pleasurable sensation; *laughter*, when produced by tickling, is expressive of *pain*; in choleric persons it is expressive of *anger*. Read Jan. 10, 1789.

Mr. Burke, in his Essay on the Sublime and Beautiful, takes occasion to consider the mechanical or physical cause of *pleasure* in

in general. He is of opinion that it is produced by a certain relaxation of the frame, and reaſons very ingeniouſly in ſupport of this theory from the nature and conſtitution of thoſe objects that communicate pleaſure. " Beauty (ſays this ingenious writer) " acts, by relaxing the ſolids of the whole ſyſtem. There are all " the appearances of ſuch a relaxation; a relaxation ſome- " what below the natural tone ſeems to me to be the cauſe of " all poſitive pleaſure *."

Now, to apply this principle to the *phyſical cauſe*, or *animal mechaniſm* of *laughter*. The ſlight blemiſhes, imperfections or miſchances, the ſmall deviations from order, ſymmetry and decorum, that are the ſubjects of *ridicule*, and excite *pleaſure* through the medium of *contempt*, reſting in qualities, actions or things in themſelves *light* and *trivial* (they could not elſe be the objects of *contempt)* have ſmall *momentum*, either with reſpect to *individual preſervation* or *ſocial happineſs*, and of courſe excite no very violent *emotion* of the *mind:* While the ſtronger paſſions, love, fear and anger, wake, and range abroad, to guard the exiſtence of man, to continue his ſpecies, or connect him in leagues of civil union; the lighter feelings, like mirth for inſtance, enliven and embelliſh familiar intercourſe with ſportive charms and fugitive graces; or poliſh and correct it with minute decencies and mutual obſervances. Where the mind is but ſlightly affected, no great degree of *relaxation* is induced. The due ſecretion of the humours is but little diſturbed, and no very violent acceſs of *animal ſpirits* is thrown on the breaſt, far leſs than is requiſite

* Eſſay on Sublime, p. 163, § on the phyſical cauſe of love.

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to produce the ſenſe of weight, that feeling bordering on pain, which accompanies our enjoyments of a more exquiſite degree. The pleaſure attending *mirth* being, comparatively ſpeaking, faint, the relaxation of the nerves muſt conſequently be inconſiderable. The due ſecretion of the humours is but little interrupted; the acceſs of animal ſpirits to the breaſt is trifling; barely ſufficient, not to overwhelm, but ſtimulate the nerves; and, by a certain mild irritation, to produce that agreeable convulſion called *laughter*. That *irritation* is the immediate cauſe of *laughter* is evident, from involuntary laughter being produced by *tickling*, which can only operate by irritating the nerves. That the *irritation*, in the caſe of *mirth*, proceeds from an extraordinary afflux of humours may be inferred from this, that violent and long continued *laughter* is always attended by an evacuation of humours in the form of *tears*. That the emotion of the mind, of which *laughter* is an expreſſion, does actually produce ſome *relaxation* of the frame, and that the nerves are indeed *irritated*, may fairly be collected from our experience, that involuntary *laughter* is incident to hiſterical patients, in whom the nerves being weak and irritable, an uneven and interrupted ſecretion is produced by their weakneſs, and perpetually aſſails their irritability. That *laughter*, when expreſſive of *pleaſure*, expreſſes but a *pleaſure* of a faint and ſubordinate kind, is manifeſt from its taking place ſo early in young children. It is obſervable that infants not many days born laugh; they even laugh in their ſleep long before they are ſuſceptible of mirth or ſorrow, even before they begin to ſhed tears. In that early ſtage, before the nerves have gained their tone, or the organs learned their uſe; before the creature pays any attention to exter-

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nal things, laughter ſeems to be its uniform, indeed its only expreſſion of pleaſure or delight, from whatever cauſe. That pleaſure muſt be merely animal, and if we conſider the dulneſs and imperfection of the child's perceptions, we may well ſuppoſe it to be of a very faint and ſubordinate kind, perhaps produced by ſome external cauſe, that mildly irritates, and ſtimulates his nerves.

I PROCEED now to trace out the ſources of the ridiculous; and I think all its objects, various as they ſeem to be at firſt glance, may be found in one or other of the following claſſes:

FIRST. Thoſe actions and geſtures of the brute creation, which imitate the actions and geſtures of man. Here the reſemblance leads to a compariſon with ourſelves, the compariſon produces a ſenſe of comparative ſuperiority, that ſenſe of ſuperiority a triumph, and that triumph is expreſſed by laughter. Theſe imperfect and groteſque imitations, by the brute creation, are a ſort of practical *caricatures* of human actions; or, as Mr. Addiſon very juſtly expreſſes it, the actions of beaſts, which move our laughter, bear a reſemblance to a human blunder. This ſource of the *ridiculous* is but ſcanty, and the pleaſure derived from it of a ſubordinate degree. The inferior creatures that imitate man are not numerous; and the human actions, which they are competent to mimic, are but few. The reſemblance is generally remote, often rather fanciful than real; and, as the diſtance is ſo wide, and the inferiority ſo palpable, the comparative triumph, and the pleaſure reſulting from it, will be proportionably ſmall.

SECONDLY.

SECONDLY. Slight corporeal blemiſhes and defects are the next ſource of the *ridiculous*, to which we are led by an eaſy tranſition from the former; Cicero himſelf tells us—*eſt etiam deformitatis & corporis vitiorum ſatis bella materies ad jocandum*; but this muſt be taken with the reſtriction I have already mentioned, that the defects and blemiſhes muſt not prevent the perſon from enjoying the pleaſures, or performing the functions of life. They muſt not include the ſuppoſition of cauſing pain; they muſt not be ghaſtly or offenſive to the ſight; for in ſuch caſes they would cauſe in us not mirth, but pity, diſguſt or averſion *. To this claſs we may refer *caricatures*, and other burleſque paintings, and many dramatic characters where much of the pleaſantry is drawn from the corporeal peculiarities of the perſonage introduced; as, for inſtance, the Falſtaff and Bardolph of Shakeſpear, the Corbacchio of Ben Johnſon.

THIRDLY. Unforeſeen diſaſters or miſchances, which are no way tragical, nor of a ſerious nature; as, for inſtance, ſhould a beau dreſt out for an aſſembly fall in the dirt, or a blaſt of wind hurry away a fine lady's cap and artificial treſſes: Here the accident excites our triumph, by a miſchance from which we are exempt; and there is no collateral affecting circumſtance to call in the graver emotions of humanity, and check the riſing contempt. Under this head we may include practical jokes, a never-

* I know not whether I ſhould refer to this or the foregoing head, that mirth which ariſes from tracing out ſome reſemblance to the brute creation in the form and lineaments of man; and from ſeeing or hearing human creatures imitate the motions, noiſes, and other actions of brutes.

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failing ſource of merriment among the vulgar; ludicrous paintings, like the *Enraged Muſician*, *Hints for bad Horſemen*, and other productions of *Hogarth* *, and his ſchool; and moſt of the laughable ſituations and comic incidents in dramatic and other humorous writings.

Fourthly. The laſt and principal ſource of the ridiculous is an incongruity or inconſiſtency in the words and actions, and as far as they can be traced or are notified to us, in the thoughts of men. This fund of ridicule is by far the moſt copious, from the infinite diverſity of objects which it comprehends; and it excites a ſpecies of mirth more refined and pointed, becauſe the triumph being over man himſelf, in ſomething peculiar to him as ſuch, is more full and complete than that over the brute creation, or man with reſpect to external accidents; and in this we recognize the admirable contrivance of providence. For this is the branch of ridicule which has the moſt important influence on the conduct of life and manners, and therefore it is deſtined to affect us the moſt forcibly. This laſt ſource of the ridiculous may be ſubdivided into ſeveral members. I do not propoſe the following diſtribution as ſtrictly logical and ſcientific, but it may ſerve well enough to explain the ſubject.

First. Incongruity between the words, actions or ſentiments of a perſon, and his phyſical ſituation; that is to ſay, his corporeal accidents of youth, age, beauty, deformity, ſtrength,

* I cannot mention the name of that excellent ſatiriſt and moral painter without expreſſing my admiration of his ſkill in depicting life and manners.

weakneſs,

weakneſs, ſickneſs, health. When a very young man, for inſtance, talks in a ſtyle of dogmatical gravity; when an old decrepid wretch conceals his years, and boaſts of his youth and vigour; when a ſtrong Herculean fellow aſſumes the dreſs of a petit-maitre, and affects to liſp and amble; or ſome diminutive and feminine form would, with the military garb, put on the menacing brow and martial ſtride; all theſe abortive attempts to aſſume a quality which the perſon does not poſſeſs are as fair ſubjects of laughter as a monkey when he imperfectly mimics the actions of man. The incongruity ſtriking us excites the idea of relative imperfection; the ſenſe of our own ſuperiority, in this inſtance, produces an inward triumph, and this triumph is expreſſed by laughter.

But here it may be objected, and I ſhall once for all anſwer the objection, that laughter is ſometimes produced where no idea of relative inferiority is impreſſed, no triumph excited. In ſupport of this objection we are referred to the inſtances of witty drolls, and facetious perſons, who, though capable of acting with the utmoſt decorum and accuracy, fall into voluntary blunders and ſtudied ſoleciſms, merely to entertain their companions; and of performers on the ſtage, who repreſent clowns, and other low and abſurd characters. To this I reply, that both the jeſter and the player exhibit to us a fictitious character; we laugh rather with them than at them; not at what they really are, but at what they would ſeem to be; the firſt emotion excited by blunders and improprieties is contempt: This is the impreſſion of the moment; it is not until afterwards, and on reflection, that we perceive the imperfection or abſurdity to be merely affected,

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and that the jeſter plays the fool or the blunderer for his own and our amuſement. We are moved to laughter in preciſely the ſame manner by the real blunders and *groſſièrté* of a country bumpkin, and by the repreſentation of a ſkilful actor, who exhibits ſuch a character on the ſtage; in the firſt feelings there is no difference whatſoever, but this is the illuſion of the drama; in the ſequel, and on reflection, we deſpiſe the abſurdity and ignorance of the clown, and admire the ſkill and addreſs of the player. So that the whole argument turns on the overlooking a circumſtance very obvious to be ſeen, namely, that affected imperfection or incongruity excites only a tranſient and momentary contempt, whereas a ſimilar emotion of a permanent duration is excited by that which is real. In ſhort, whether we laugh or weep at the drama, our emotion is excited, not by the real, but aſſumed perſon and character of the actor before us; and the affected blunderer in company is, in that inſtance, an actor; and on the ſame principles we may explain the effects of *irony*. Where a perſon ſeems to poſſeſs an opinion, or aſſert a fact the very contrary of what he means to eſtabliſh; this is a ſort of intellectual acting, or playing a feigned character. We diſtinguiſh in a moment between the real and effectual aſſertion or opinion of the perſon.

Secondly. *Incongruity* between the manner of ſpeaking, acting and thinking, and the civil or political ſituation of the perſon; a departure from the decorums of character and propriety of acting conformable to rank and ſtation; as if a grave perſonage, a ſtateſman or philoſopher, ſhould be diſcovered riding on a hobby-horſe;

horſe; or a great monarch be ſurprized at the unkingly paſtime of playing taw, or catching flies. Yet even ſuch mean and ridiculous actions as theſe (which confirms the preceding theory) may be qualified and ennobled by collateral circumſtances. Socrates was not aſhamed to be caught in ſome ſuch ſituation; nor would it degrade even a monarch, in the eye of wiſdom, ſhould he be found, in a moment of paternal tenderneſs, playing at taw among his children.

UNDER the foregoing head we may include ſuch characters as the Parſon Trulliber of Fielding, the ambitious cobler mentioned in the Spectator, who contrived to gratify his pride by framing the figure of a beau in wood, who kneeled before him in a ſuppliant poſture; female pedants, and ſmall politicians. From this fund of the ridiculous are derived the *mock heroic* or *parody*, and the low burleſque. The *mock heroic* repreſents mean agents, and low characters ſpeaking the language which common uſe has appropriated to the auguſt and exalted; *parody* applies the very identical expreſſions which had been employed on ſome great and ſolemn occaſion, and by an exalted and dignified perſonage, to ſome vulgar and little incident. The low burleſque, on the contrary, repreſents exalted perſonages engaged in mean purſuits (as, for inſtance, Dido building an *houſe of eaſe*) and uſing the dialect of the rabble. It is remarkable that theſe two ſpecies of compoſition, although they ſeem to differ ſo widely in their genius, produce their effect, *laughter*, by the very ſame ſort of incongruity.

THIRDLY.

THIRDLY. A departure from the manners, language and cuſtoms of the age and country, or even of our own peculiar claſs in life, profeſſion or province. The rude and vulgar every where are diſpoſed to laugh at the peculiar habits and cuſtoms of foreigners; and even the polite and liberal, who have learned from an extenſive commerce with the world the precept of Horace, *nil admirari*, could ſcarce reſtrain their mirth were they to ſee a modern Engliſhman dreſt in the ruff of Queen Elizabeth's day, and hear him talk in the dialect of Spenſer, with his antiquated words, *eftſoons*, *yclept* and *whilome*. Every nation has that degree of predilection for its own cuſtoms and manners, that it ſuppoſes a departure or variance from them to be an inſtance of inferiority, and to ſhow a want of refinement or of underſtanding. The difference of garb is found to have a ſtriking effect on the human mind; even in the ſame country and nation, the reſpect which individuals pay to each other is, in ſome degree, regulated by an attention to dreſs; the mutual contempt and antipathy which ſometimes ſubſiſt between nation and nation are very much ſupported and kept alive by the difference of habiliment. Under this head we may claſs the travelled coxcomb and fop, who affects to renounce the garb, language and manners of his own country; and ſcenes of low humour, that turn on national peculiarities and prejudices; or profeſſional modes of thinking or ſpeaking, as the characters of Frenchmen, Teagues, ſailors, lawyers, ſo frequent in comedy; and on this principle it is that the ſimple repreſentation of humble life ſometimes excites mirth.

FOURTHLY.

Fourthly. A diſparity between paſſions and their objects, between means and their ends, which ſtand forth in human life, and excite contempt under the denomination and form of foibles and abſurd opinions. It were endleſs to adduce examples of theſe, they are multiform and various as the purſuits and actions of man; ſuffice it to ſay, that every paſſion, when carried to exceſs, impreſſes us with the idea of incongruity, and conſequently of relative imperfection; and ſo does every palpable diſproportion between the end and the means, on which ſide ſoever the deficiency or inferiority falls, and will excite laughter by contempt; provided, however, that there is nothing of ſerious affliction to the agent himſelf, or ſerious damage or danger to other perſons, which may call forth emotions of a more vigorous character and a deeper hue.

Were I to ſearch for a portrait which at once combines in itſelf and illuſtrates all the different forms of the ridiculous abovementioned, I ſhould inſtance that of Don Quixote; his words and actions do not accord with his phyſical ſituation, for with his ſingle arm he would rout armies and overthrow giants; nor with his civil and political exiſtence, for he pretends to overthrow empires, diſtribute kingdoms, and confer titles and honours. His dreſs, his arms, his notions, his phraſeology, are not of the country or age in which he lives; his paſſions, love and honour, for inſtance, are in exceſs, and their objects mean and contemptible; the ends he propoſes are extravagant, and the means he employs are inſufficient; all theſe form ſuch a tiſſue of incongruity, unqualified by any tragical circumſtance or incident, as

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is truly comic ; and they are heightened by ſlight corporeal defects, and called out and illuſtrated in a variety of croſs adventures and petty misfortunes.

For the ſake of perſpicuity I ſhall rank BLUNDERS IN SPEAKING AND ACTING in a diſtinct claſs of the ridiculous, being the fifth, of what I ſhould call the intrinſically ridiculous, or incongruity in the words, actions or thoughts of men. Yet this is but a baſtard claſs; for it will appear, on examination of every individual circumſtance belonging to it, that they may be referred to one or other of thoſe preceding.

Though I have hitherto conſidered and treated the ſources of the *ridiculous*, as if ridicule were ſomething ſtable and certain, nothing in fact can be more variable and fluctuating in its nature. Things appear ridiculous or not according to the education, courſe of life, conſtitution and temper of the obſerver, which vary his notions of propriety, perfection and order on the one hand, and of indecorum, defect and incongruity on the other. Virtue, religion, truth, honour, every thing ſerious and venerable, have and daily do become ſubjects of ridicule among certain unhappy claſſes of men. The vulgar will laugh at many coarſe jeſts and indelicate alluſions, while perſons of a more happy education and refined taſte will be ſhocked at ſuch mirth as inhuman and indecent. One man may receive as facetious obſervations what would offend his neighbour as daring impieties ; but wherever a laugh is produced it invariably proceeds from

from the conſcious triumph of ſelf-ſuperiority, either real or imaginary.

The variable nature of ridicule may ſerve to convince us that *ridicule* cannot be the *teſt* of *truth*; a *teſt* ſhould be independent and ſubſtantive; *ridicule* depends in a great meaſure on the temper and diſpoſition, the education, endowments, acquiſitions, habits, and purſuits of the obſerver; *truth* is univerſal and invariable; but were *ridicule* the *teſt* of *truth* the ſame identical propoſitions would be *true* to one man and *falſe* to another.

Mr. *Brown*, in his eſſays on *Shaftſbury*, has laboured, and at ſome length, to ſhow that *ridicule* cannot be the *teſt* of *truth*, becauſe it is a mode of *eloquence* tending to affect and agitate the mind; as much a mode of eloquence as the ἐλεεινον, the pitiable or pathetic; and his reaſoning is concluſive; but this point may be demonſtrated in a few words, and I think with a mathematical ſtrictneſs: *Ridicule* cannot be the *teſt* of *truth*, for being a branch or mode of the imitative arts, it preſents, as that name imports, a picture of ſome object, and cannot be the *criterion* of that of which it is only the *repreſentation*. 2dly, The *ridiculous* not only conſiſts in the repreſentation of a picture, but it is a ſingle poſitive picture; there is no relative view, no collation of two objects; but to the exiſtence of *truth* or *falſhood* the collation of two objects is neceſſary. 3dly, The perception of *ridicule* is inſtantaneous, the perception of *truth* or *falſhood* is a progreſſive operation of the mind. A propoſition muſt be formed; the ſubject and predicate of this propoſition

muſt be compared, and from this compariſon the underſtanding collects their agreement or diſagreement. This progreſſion takes place even in propoſitions called *intuitive*, that is to ſay, where the truth or falſhood is perceived without the intervention of proofs or means. Now, if *ridicule* were the teſt of truth, the perception of the *ridiculous* and the perception of *falſhood* would be one and the ſame, and would in every caſe be not *progreſſive* but *inſtantaneous*.

But I find I have tranſgreſſed the limits uſually preſcribed to papers of this kind. I ſhall therefore conclude for the preſent; but may perhaps reſume theſe topics at another day, and offer to this ſociety, as the ſubject of a future communication, ſome reflections on *Wit* and *Humour*.

# ANTIQUITIES.

Three Metal Trumpets found near Limerick May 1787.


W. Dudley Del. 1787

*An Account of* THREE METAL TRUMPETS, *found in the County of Limerick, in the Year* 1787. *By* RALPH OUSLEY, *Esq; M. R. I. A. Communicated by* JOSEPH COOPER WALKER, *Esq; Secretary to the Committee of Antiquities.*

As every attempt to elucidate the antiquities of this country has of late been favourably received, the following ſhort deſcription of three uncommon muſical inſtruments is with great deference offered to the Royal Iriſh Academy. Read March 29, 1788.

These trumpets were found by a peaſant cutting turf in the bog of Carrick-O'Gunnell, county of Limerick, in the month of May, 1787, and by him ſold to a brazier in the city of Limerick, who reſerved them for the preſent poſſeſſor. They are of a rich mixed metal, neither copper nor braſs, but inclining rather to a copper colour. They reſemble ſtrongly thoſe deſcribed in Walker's

Walker's Hiſtorical Memoirs of the Iriſh Bards, (page 109, Appendix) except in the middle piece, which differs from any I ever heard of, and is I believe an unique. This tube is 23 inches $\frac{6}{10}$ long, of one entire piece, and has a loop in the centre to run a cord through. At each end it has four holes, correſponding to four in each trumpet, through which two pins or pegs faſtened the inſtrument. Both trumpets were fixed on the middle piece like the joints of a German flute, when firſt found, and very firm with ruſt and dirt, but the pins were loſt. I ſhould imagine this tube was only to hang them up by. Doctor Fiſher (a celebrated performer on the violin, and Doctor of muſic in the univerſity of Oxford) who ſaw them with me in Limerick, conjectures Fig. I. and II. are *firſt* and *ſecond*. The mouth or large end of Fig. II. is $4\frac{1}{2}$ inches diameter, being one inch wider than the other. Fig. III. is the Stoc or Stuic, a ſort of ſpeaking trumpet deſcribed by Colonel Vallancey in the Collectanea, No. XIII. page 46, and in Hiſtorical Memoirs of Iriſh Bards, page 83. The mouth-hole is oval, $1\frac{3}{4}$ inches long by $1\frac{1}{4}$ wide, and was cut acroſs by the turf ſpade; but the other two and middle piece are in fine preſervation. They are all ornamented with little conical teats or projections at each end, as in the drawing, viz. four at the ſmall and ſix at the large ends, and four near each extremity of the middle piece. Fig. I. and Fig. III. have four holes at the wide ends, which ſeems as if ſome other tube was to be faſtened occaſionally within them, perhaps in the manner of Lord Drogheda's, deſcribed by Colonel Vallancey. It is natural to think there muſt have been mouth pieces for Fig. I. and II. but none were found with them, nor

with

with any others I believe in the kingdom, being made probably of perishable materials. The three trumpets and middle piece weigh 9 lb. 11½ oz. viz.

| | lb. | oz. |
|---|---|---|
| Middle piece - - | 1 | 11 |
| Fig. I. - - - | 2 | 0 |
| Fig. II. - - | 2 | 9½ |
| | 6 | 4½ |
| Fig. III. - - - | 3 | 7 |
| | 9 | 11½ Avoirdupoise |

A VERY curious brass spur-rowel, of 2 inches $\frac{4}{10}$ diameter, and eight prongs or rays, was dug up with the trumpets, and is now in my possession.

*Willsborough, near Castlerea,*
*August* 15, 1787.

RALPH OUSLEY.

# *A* RORG-CAEAL, *or* MARTIAL ODE, *ſung at the Battle of Cnucha by* FERGUS, *Son of* FINN, *and addreſſed to* GOLL, *the Son of* MORNA; *with a literal Tranſlation and Notes. By* SILVESTER O'HALLORAN, *Eſq; M.R.I.A. &c. Communicated by the Right Honourable the Earl of* CHARLEMONT.

GOLL, the hero of the following rhapſody, was ſaid to be of the blood royal of the Danaan princes, who ruled over Ireland for near two centuries before the arrival of the Clana-Mile, commonly called Mileſians. He ſucceeded his father as hereditary grand maſter of the knights of Connaught. Theſe had been called the HEROES OF IRRUS, from the ſeat of their principal academy or college in the county of Mayo; but ſo great was the glory and renown acquired by Morna, that from him they were called, THE FOLLOWERS OF MORNA; by which name they are known, and by no other, at this day. Goll having finiſhed his academic exerciſes, and taken the laſt and ſolemn vows of chivalry, proved himſelf, by a variety of exploits, worthy that place

Read Jan. 10, 1789.

which his rank and blood entitled him to fill. Accordingly, ſoon after the death of his father, we find him called to the chief command of the Imperial army by the monarch Con, ſurnamed OF THE HUNDRED BATTLES, to ſuppreſs a moſt powerful and dangerous confederacy formed againſt him. In the engagement that enſued, called the battle of Cnucha (fought A.D. 155.) the enemy were not only completely defeated, but Goll had the additional glory of killing, in ſingle combat, Cumhal, maſter of the Leinſter knights, commander of the enemy's army, and a champion highly celebrated for his valorous deeds both in Britain and Gaul. It was on marching to the onſet, it was in the heat of the fight, and until fortune declared in favour of the imperialiſts in this battle, that this ode was ſung by Fergus *, the chief bard of Goll. The conſequences of this battle were well remembered above a century after; where Oiſin, in his Laoj na Seilge, or hunting ode, deplores the death of Cumhal, " ſlain by Mac Morna, of the " Golden Shield." The preſent Ode, or rather Rhapſody, I flatter myſelf will appear no unacceptable preſent to the Academy, as well for its *originality*, as for the lights it throws on ſome obſcure paſſages in the antients. But to me it ſeems of ſtill greater moment, by (I apprehend) proving " ad inſtantiam " crucis," as is ſometimes expreſſed by philoſophers, the early ſtate of arts, letters and civilization in this country.

* This Fergus is not to be confounded with Fergus, ſon of Fion Mac Cumhal; for Fion was but a boy at the time of the battle of Cnucha. The author of this ode was a Connaught bard, and celebrated for the harmony of his numbers.

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ROSD GHUILL MAC MORNA SON SIOS.

THE ODE OF GOLL, THE SON OF MORNA.

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## [a] Rosg Ghuill Mac Mhorna son sios.

Goll mear Mileata : Cear[b] na Cnoḋaċta.
Lajn ṡhjal arraċta : mjan na Morḋaſa.
[c] Mir leim lanteinne : ṡróċ nach bṡuarṫear.
Lóch go lan ndeabhnajġ : reim an ṡjéṙnajḃ.

Leoṁan lráċarmaċ. a leónaḋ bjoḋbajḋ.
Ton ag trean tragṁn. Goll na ngnaṫ jorgṁl.
Nar ṫróch a treim taċar.
- - - - - -

Ag gan ṡrarachrajġ ; ṁál ajg méadachrajġ [d].
Laoch ġaċa lamach. Leoṁan lonn ġnjoṁach.

beoḋa

[a] Rorga Caċa, an extempore ode or martial rhapſody. This we may conjecture was ſometimes uſed by the Greeks ; of whom ſee Tyrtæus, who Horace, *De Art. Poeticâ*, thus celebrates—" Tyrtæus mares animos in Martia Bella verſibus " exacuit."

[b] Goll was hereditary general and commander of the Connaught legions, from his father, called Clana-Morna.

[c] Could we ſuppoſe that the original was Mṡir, it would greatly heighten the metaphor,—*a ſwelling ſea of fire !*—as it is known that in ſtormy nights the ſea appears a blaze of fire.

[d] Goll, at the battle of Cnucha, was rather young ; and though great in arms, yet higher expectations were formed of him by his friends, and they were not diſappointed. In this battle he ſlew the famous Cumhal, father to Fion (M'Pherſon's

## THE ODE OF GOLL, THE SON OF MORNA[a].

Goll, vigorous and warlike, chief[b] of heroes!
Generous and puiſſant hand: meditator of glorious deeds.
Bulwark[c] dreadful as fire: terrible is thy wrath!
Champion of many battles: royal hero!

Like a lion, rapid to the attack: ruin to the foe.
Overwhelming billow: Goll, frequent in action.
Invincible in the moſt dreadful conflicts.
- - - - - - -

Great in the conflicts: warrior of increaſing glory[d].
Hero of mighty deeds. Lion furious in action;
Animating,

(M'Pherſon's Fingal). Succeeding exploits added to his glory; and an action recorded of him when further advanced in years, proves the exalted ſentiments of honour of the Iernian knights. It was at the battle of Lena, in the King's county. The army of Con appearing inferior in number and diſcipline to that of his antagoniſt Eogan the Great, it was reſolved, in a private council, to attack them before ſun-riſe of the day on which, by mutual conſent, the battle was to be fought. Goll was ſent for, and this reſolution imparted to him; but he returned the following noble anſwer: " On the day that my firſt arms were put into my " hands *I vowed* never to attack my enemy by night, by ſurprize, or under any " kind of diſadvantage; nor ſhall I, at this day, violate that vow." The attack was nevertheleſs made: Goll was in vain called for; but he did not appear till day-light. He attacked ſword in hand, and ſlew the intrepid Eogan. This hero's body, raiſed on the ſhields of his enemies, Goll eſpying, cried out, " Lay down the body of " the king of Munſter, for he died like a ſoldier!"

[e] beoḋa bjnn ḋranaċ. cneaſach ċoṁḋalaċ[f];
eréċtach jolbraḋach.

braḋ oſ borb ſlraġajb: ḋjc ⁊ ḋlġ ḋ'óinjb.
ſjaċ naċ an ollaṁ. rajll oſarḋ-rjoġtjb.
trjáṫ na trom ċaña. bujaṫra bjnn ṁala.
mjle mear ḋaña. ḋlíġṫeaċ ḋjonġṁala[g].

Goll mear móṙḋálach. tnean ſheaṙ tneanaṙmach.
ſéjṁſear ſlóġaṙmaċ. ſear loṅ laṅ ġnjoṁaċ.
aſgjaṫ ⁊ſgjaṫ ġoſne. bláṫ go mbrán ajlle[h].
tnile ṫnéjṅ tſleíbe. brjlle abran lajṁe.

Mnṙ óſ mjonajbnrjb. ḋoṙḋa anjom ġrjn.
cnoḋa, ccaṫ jor ġrjl. trjṙ ga tnom ſhoṙṙom.
tonn oſ tnean ſhaṙṙge. Goll naċ glóṙ ḋoṙḋa.
ſear na ſjóṙ ſhoġla. mac mear móṙ ṁoṙna.

ſjal

[e] The knowledge of arms was but a part of the education of Celtic warriors. In Ireland they muſt ſtudy hiſtory, poetry, genealogy, &c. They were ſworn to be the protectors of the fair, and the avengers of their wrongs; polite in words and addreſs, even to their greateſt enemies. Behold then the early and cloſe unions between chivalry and romance, in oppoſition to modern opinions. When the deputies of Agamemnon waited on Achilles, they found him in his tent, chaunting to his lyre the valorous deeds of heroes.—*See the ninth Iliad.*

[f] *Deſtroyer of Councils*, i. e. defeating, by his ſuperior knowledge in war, the deſigns of his enemies.

[g] As it may appear ſtrange to ſee Goll celebrated as a great legiſlator, it is to be obſerved that this was a particular department of ſtudy, not only to the princes but to

Animating, harmonious bard[e]. Deſtroyer of councils[f].
Puiſſant, all victorious!

Subduer of fierce legions. Ruin to the renowned.
In anger impetuous. Admired by mighty monarchs.
Chief of heavy tributes. Of all-perſuaſive eloquence.
Bold and intrepid warrior. Unbiaſſed legiſlator[g].

Goll, of martial pride. Strong in body, great in arms.
Courteous and polite to the legions. Fierce and powerful in action.
Shield of great luſtre. Flower of unfading beauty[h].
Rapid as the mountain flood is the force of your ſtrong arm.

A ſea over rivulets. Sullen in the duel.
Great in the uproar of battle. Tower of ſtrong defence.
Billow over ſwelling ſeas. Goll, terrible in the ſhouts.
Lover of conſtant deſolation. Son to the great *Morna*.

Patron

to the military chiefs. Goll was an able legiſlator; ſo was his antagoniſt Cumhal; and Fion, ſon to the latter, wrote a treatiſe on the laws. All theſe duties were pointed out in a work wrote ſome time after by the renowned Cormac, grandſon to the monarch Con, yet extant, called *Advice to a King*.

[h] It was not enough, by the Iriſh code of laws, that the military ſhould be tall, well-made, active and ſtrong, but their countenances muſt be ſuch as to command love and reſpect. The prince and the common ſoldier muſt be equally unblemiſhed; and it ſtands on record that Cormac himſelf reſigned the crown on having loſt an eye.

[i] Fial ne filidhaibh. Fighi an Cruadhaibh.
Cíos an éineadhaibh. Dit an dhanaraibh.
Flaith nach fíondhainnir. Gach tír trén leónmhigh;
Ní go ní ḡ níaghail. Fear fhúigle ailgeana.

Triath gach tromdhaimhe. Dhaf go nDearbh fheile.
Curaf gach com dala. Mac Dian Deagh dhaire [k].
Fhil gach fíon mirrainn. Clir nach ccaín fightear.
[l] Gríf an bhran eimigh. Béo nach bhaith fear tear.

Muir trinn tonnmhór. Féimhidh fearann mhín [m].
Ceilt comhall glór. Beim ghrill glan álainn.
Fhile fíon fhlaghach. Dealbha dhéa ghníomhach.
Fearda fíon bradhach. Maireach mór fhrighleach.

Goll borbh beimíonach. Curadh chráidh neannach.
[n] Dóghbrigh éineanach. Colg lom lrath brilleach.

Flaith

[i] The munificence and liberality of the Celtic nations to the literati was aſtoniſhing.—*Vide Hiſt. of Ireland, page* 199, 254, *&c.*

[k] It is very ſingular and worthy notice, that the name Phenius, Darius, Aongus, or Eneas, &c. viſibly of oriental origin, have been alſo at all times peculiar to this country: a collateral proof of our Aſiatic deſcent. But what more particularly ſtrikes me is, that *Gollam*, which was the name of Mileſius, has been and ſtill is a name common in India and Perſia. It is not above twenty-five years ago that the preſidency of Bombay concluded a treaty with *Gollam*, a prince of the country.

[l] Goll was deſcended from the kings of Connaught of the Danaan race. They ruled Ireland for 195 years, under nine ſucceſſive monarchs. But after the Mileſian conqueſt

[i] Patron of bards! respite to champions.
A tribute on Septs. Ruin of invaders.
Prince of sure protection. Subduer of every country.
Conspicuous in regal laws. Imposer of heavy tributes.

Presiding in every great assembly. Unboundedly generous.
Penetrating in council. Gallant issue of the great Darius [k].
Watchful of every great charge. Of unsullied reputation.
Head of the long reigning Sept [l]. Valiant and invincible.

Sea of resounding billows. Lord of high cultivations [m].
Companion of gallant feats. Mighty are the strokes of the illustrious Goll!
Vigilant commander of the legions. Deviser of exalted deeds.
Fierce, all victorious. In words graceful and nervous.

Goll, of fierce and mighty blows. Hero of rigid partition.
Despoiler of the Ernains [n]. Sword of rapid and severe execution.

conquest their power was confined to the province of Connaught; and this also, by marriage, fell to the Milesians in the fourth century.

[m] The Irish, like the Chinese, always revered the plough. Though many deeds of our early monarchs have been lost, yet such as eminently promoted agriculture have never been forgot. Even the names of private adventurers in this way have been preserved; and many tracts of land in the kingdom *yet* retain the names of their first reclaimers. Behold, then, the taste and good sense of the bards in celebrating Goll for so essential a quality to an Irish hero! See the expanded education of our antient knights!

[n] The inhabitants about Loch Erne were called Ernains and Erenochs.

ꝼlaiġ na bꝼhoġl ġreac. Maiġ don iṁṁain ġnáṫ [o]
ꝼṁuṫ ag ꝼirbal lraṫ. ġrṫ ní ġrbꝼ blaṫ.

Cliaṫ na Ccoṁnaꝼaṫ. ġn ꝼhear ioṁarcaṫ.
[p] trén ꝼhear trom ꝼholtaṫ. ꝼgiat na ꝼgeiṁioltaṫ.
ceann ꝼlraiġ ro ṫrom. raṫ gaṫ ón acṁuiṁ.
aġreiꝼ gear ꝼhaiꝼiṅġ, ní ṫreaꝼ trean taṫꝼiṁin.

Mórṫa an ṁór ġollꝼa. ꝼéiṫm naṫ mór ꝼhallꝼa.
beim an ṁór ġuillꝼe. ꝼroṫa an coṁ lanuꝼa.

[q] Goll ṁear meleata ꝼé.

[o] I ſhould rather read mortla, ruin, deſtruction; becauſe nothing is more certain than the conſtant enmity between the two provinces, from an early period, and the preſent county of Clare the bone of contention. The Conacians claimed it, as being included in the partition of Leth Thuath, or northern Ireland. At an early period the Momonians were obliged to make *Fearan Cloidhmh*, or ſword land, of all the weſtern coaſt; as they were, after the death of Goll, of many other parts. How early and how clear can we trace the fœdral ſyſtem in Ireland!

[p] The hair was an eſſential ornament to the free Celtic warriors; for which reaſon Clovis got the name of *Chevelu*, as then ruling over a free people. In Ireland he could not appear in arms, nor was he permitted to appear candidate for any employment in the ſtate, who wanted his hair. The celebrated Cucullin, being foiled

Hero of heavy contributions. *Conſtant benefactor to Munſter* [o].
A ſwift flowing ſtream; fair as the ſnowy foam.

Protector of Connaught. Of unbounded enterprize.
Generous hero of the long-flowing hair [p]. Shield to the retreating.
Commander of mighty legions. Unrivalled in proweſs.
Solid and extenſive ſupport. Great in the rout of battle.

Great is the majeſty of my Goll; his glory is unſullied.
My Goll is a bulwark. The ſpirit of cloſe conflict.

[q] Goll, vigorous and warlike, &c.

foiled in ſingle combat, his adverſary cut off his hair, as a further mark of reproach to a knight *who had falſified his word;* and we are told he remained concealed for near a year, or 'till his hair grew again. The celebrated legiſlator Cormac, in the third century, when he firſt became candidate for the monarchy, his hair was intentionally burned at a public entertainment, and he for that time was obliged to relinquiſh his claim. It is further remarkable of this ſame prince, that after a glorious reign of twenty-four years, having by accident loſt an eye, he was obliged to relinquiſh the monarchy.—See alſo WALKER's *Hiſtorical Eſſay on the Iriſh Dreſs*, *page* 11.

[q] Moſt antient poems, as well as many of later date, cloſed with a recitation of part of the firſt verſe, not unlike the Da Capo in muſic.

# *Memoir of the* LANGUAGE, MANNERS *and* CUSTOMS *of an Anglo-Saxon Colony ſettled in the Baronies of* FORTH *and* BARGIE, *in the County of* WEXFORD, IRELAND, *in* 1167, 1168 *and* 1169. *By* CHARLES VALLANCEY, L. L. D. *Member of the Royal Societies of London, Dublin and Edinburgh; of the Academy of Cortona, and of Belles Lettres, of the Antiquarian Society of Perth, and of the Philoſophical Society of Philadelphia. Communicated by the Right Honourable the Earl of* CHARLEMONT, *P.R.I.A.*

THE baronies of Bargie and Forth are ſituated at the ſouthern extremity of the county of Wexford, and, together, contain about ſixty ſquare Iriſh miles. They lie due eaſt from Cardiganſhire, in Wales; the ſhortneſs of the paſſage cauſed a frequent intercourſe between the Iriſh and the Britons from the earlieſt account of their hiſtory. Read Dec. 27, 1788.

IN the year 1167 Dermod, King of Leinſter, was a powerful prince; the errors of his civil government, the oppreſſion of his ſubjects,

ſubjects, and the tyranny he exerciſed over his nobility, cauſed a total defection in them and the people. His kinſmen, friends, ſervants and followers, had all been prevailed on to forſake him.

In 1168 the diſtreſſed king repaired to England, to ſolicit the aſſiſtance of King Henry; telling him he was become an exile by the treachery of his vaſſals, and beſeeching him to give him aid, whereby he might be reſtored to his inheritance, which if it ſhould pleaſe him to grant, he would acknowledge him to be his lord, and ſerve him during his life.

King Henry, moved with compaſſion, promiſed him aid, and deſired him to remain at Briſtol until he ſhould hear further from him. Dermod, after ſtaying there one month, and hearing nothing from the king, weary of delay, he applied to Richard Earl of Strigul, commonly called Strongbow, promiſing that if he would aſſiſt him he would give him his daughter to wife, and with her the whole kingdom of Leinſter. The Earl excuſed himſelf, unleſs King Henry would give his conſent.

In the mean time Dermod applied to the princes of Wales, and Richard Fitz-Godobert accompanied him, but with ſo ſmall a body of men, they were of no uſe, and they ſoon returned home.

Dermod finding his ſubjects ſtill held out againſt him, cauſed proclamation to be made in Wales, offering large recompenſe in lands,

lands, money and cattle to ſuch as would give him aid. Immediately men of all ſorts, and from divers places, prepared themſelves to embark for Ireland, under the command of Fitz-Stephen, who had lately been enlarged from priſon by the mediation of Dermod with Rice, a king in Wales. This little army conſiſted of about three hundred horſemen and foot.

With this ſmall body Dermod did wonders, and being grown proud with victory, gave great diſcontent to the Engliſh, many of whom returned home. But in the year following (1169) Earl Richard ſent Raymond Le Groſs to Dermod's aſſiſtance, with a ſmall ſuite, promiſing to follow with a conſiderable army. Accordingly, in 1170, the Earl arrived at Waterford with ſixteen hundred ſoldiers.

This conſiderable reinforcement enabled Dermod not only to ſuppreſs his rebellious ſubjects, but alſo to make war on the neighbouring princes. Peace being once reſtored, Dermod made good his promiſes, and the part of the country we are now deſcribing was parcelled out to the Britiſh ſoldiers, who have remained in quiet poſſeſſion of their atchievements unto this day.

This colony have preſerved their ancient manners, cuſtoms and language; and fully occupying every inch of ground, the natives could never obtain a re-eſtabliſhment therein. As population encreaſed, ſome of the Engliſh have been obliged to remove into the neighbouring baronies within theſe fifty years, and by an intercourſe with the Iriſh, the language of theſe emigrants

grants became corrupted, and these, by their connections with their kindred remaining in the baronies of Bargie and Forth, have in some measure introduced this corrupted dialect there. The town of Wexford is the market to which this colony resorted to dispose of the produce of their farms, and in this market all things are bought and sold in the modern English dialect; this also is another cause of the decline of the language of the colonists, but not one word of Irish is understood or spoken in these two baronies; still they preserve many words and phrases of their original language, and some original songs, which having been committed to writing, will exist as long as the people.

WERE there no historical documents to ascertain the arrival and establishment of this colony, the language spoken by them would be a sufficient testimony. "Language," says Dr. Johnson, "is the pedigree of nations; there is no tracing the connections "of ancient nations but by language *." And the learned Dr. Priestley informs us "that the language of a people is a "great guide to an historian, both *in tracing their origin*, and "in discovering the state of many other important circumstances "belonging to them. Of all customs and habits (adds the "Doctor) that of speech being the most frequently exercised, is "the most confirmed, and least liable to change. Colonies, "therefore, will always speak the language of their mother "country, unless some event produce a freer intercourse with "people who speak another language; and even the *proportion* "of that foreign intercourse may in some measure be estimated

* BOSWELL'S *Journal of a Tour to the Hebrides.*

"by

" by the *degree* of corruption of the language *." To these authorities we will add a few more of equal weight: " cognitio " linguarum gentium *ortum* & *prosapiam* docet, indicatque, ut et " solum et genus vitæ mutaverint monstrat †." This author goes so far as to say, that language is to be preferred even to the annals of remote times, to prove the origin of a people, particularly of an emigrating people, such as the Scythian ancestors of the Irish are known to have been: " Vestigia migrationum " gentium quibuslibet fastis certius prodit," or as he more strongly expresses it in his own language, " som nationers flyt- " toringar är, ofta lemnar säkrare underrättelser, än alla sagor " och historier." " Linguarum cognatio cognationis gentium " præcipuum, certiosimumque argumentum est ‡."

On these great authorities we rest, to prove that the ancient history of the primitive inhabitants of this island is founded in truth; for if they had not had an intercourse in former days with the Phœnicians, Egyptians and Persians, how is it possible so many hundreds of words; so many idioms of speech, so many technical terms in the arts of those ages, could have been introduced into the old Irish dialect? terms not to be met with in the dialect of any other northern or western nation. What people, the Egyptians and Irish excepted, named the harp or music orjnj. ouini. Irish Aine. i. e. Oirfideadh, i. e. music, a musical

* *Lectures on History and General Policy*, Part. ii. Lect. viii.

† The very learned Ihre in his *Lexicon Lapponicum*, Pref. p. xxxiii.

‡ Sheringham.

inſtrument; oirphideadh or oirſideadh expreſſes the action of playing. What people in the world, the Orientaliſts and the Iriſh excepted, call the copy of a book the *ſon of a book*, and echo the *daughter of a voice?* With what northern nation, the Iriſh excepted, can the Oriental names of the tools and implements of the ſtone-cutter, the carpenter, the ſhip-builder, the weaver, be found? And with what people, the old Iriſh and Egyptians excepted, does the word *Ogham* ſignify a book, and the name of *Hercules* or *Mercury* * ? Of theſe we propoſe to treat more

* Copt. oughjam. Liber. KIRCHER. and WOIDE.

Copt. ghjam, and with the article, oughjam, Hercules, Ermes, Mercury. The very name Ermes lies concealed in the Iriſh compound *Ed-airmes*, i. e. the root, or art of invention. In Arabic ايجاطرام yejedaram. And we might add, in what part of the globe, Egypt, Ireland and Scotland excepted, were prieſts or holy perſons denominated Culdes or Caldes. Copt. Kaldes. Sanctitas. KIRCHER. 226 —Copt. ouab ſanctus. Copt. eſouab ſacerdos, whence the Iriſh *eaſcob*, a biſhop. To theſe we may add ſix hundred others, of which in their proper place: But the moſt ſtriking inſtance of the intercourſe of the Hiberno-Scythians with the Ægyptians and Phœnicians, is the præfixes to ſurnames, O, Ua and Mac; the former denoting the eldeſt of the family, the ſecond being a general name for the ſon. O, ſtirps, familia; hence, O Siris. (Kircher. Ling. Ægypt. reſti). Mac, uac filius. (Woide) —ὑὸα Arabicè, major natus (Georgius Cedrenus). Thus the Iriſh uſe either O or Ua; as Ua Con Cobhar, Anglicè O Coner, &c. &c. Again, Cubhar is the Arabic كبير Kubeer, major. major natus. So the name Cormac is the Arabic كريم Kuremac of the ſame meaning, major, maximus. nobilis. Chineſe heu. familia. nomen proprium unius familiæ Auguſtæ. LUCIAN tells us that the Celts named Hercules Ogmios, in their vernacular tongue—verum enimverò nomen illud (Ὀγμιος) (ſi quid me ſapiat conjectura) ortu, *Phœniceum* eſt. formatione Græcum: atque ſolummodò uſu, Celticum. (Dickinſon Faſiculus. 1. de Hercule Ægyptio. p. 45. —nam *Og*, philoſophus ſonat, idem,

more at large in a memoir on the *Ogham*, and from Iriſh documents ſhew the origin of alphabetical writing, which the Hiberno-Scythians muſt have learnt from the Egyptians, before their deſcent to the Mediterranean, to Spain, and thence to the Britannic iſlands.

To return to our coloniſts. When we were firſt acquainted with this colony, a few of both ſexes wore the ancient dreſs: That of the man was a ſhort coat, waiſtcoat, and trunk breeches, with a round hat and narrow brim; that of the woman was a ſhort jacket, a petticoat bordered at bottom with one, two or three rows of ribband or tape of a different colour. We have ſeen one, whoſe jacket was of ſuperfine woollen cloth, of a dark brown colour, edged with a narrow ſilver lace. The dreſs of the head was a kircher.

THE names of the old coloniſts are Hore, Cod, Stafford, Whitty, Roſſiter, Sinnot, Murphy, Stephen, Quiney, &c. The

idem, p. 29. Or with what people, the Egyptians and Iriſh excepted, did *Seach nab* ſignify the writing prieſt, he who was ſkilled in the ſacred writing. Antiquum nomen Ægyptiacum Græca ἱερογραμματέως reſpondens videtur fuiſſe Copt. Sach. quomodo in uerſione librorum Scripturæ Copticæ ſemper redditur γραμματέυς Scriba. Scripturæ peritus. Lingua Ægyptiorum nabat deſignatur νοήμων, i. e. ſapiens, intellectu pollens, indé Sach-nebat, the writing prieſt. (Jublonſki Panth. Ægypt. Prolegom. xciv.—xcvi.) Or with what people, the above excepted, does *ſhearr* ſignify a ſon, as in Sein-ſior or Sin-ſhior, the eldeſt born. Sear-eac, a colt, i. e. ſon of a horſe, which are evidently the ϣⲏⲣⲓ Sheri (filius) of the Ægyptians (KIRCHER. WOIDE.); whence ſhin-ſhior or ſhean-ſhior, the eldeſt born, ſignifies alſo the preſbytery, by which it would ſeem that the eldeſt born was dedicated to the church.

gentlemen who now inhabit the country are moſtly deſcended from the officers and ſoldiers of Cromwell's and King William's army, viz. Hervey, Nun, Edwards, Hughes, Palliſer, &c.

The people of theſe baronies live well, are induſtrious, cleanly, and of good morals; the pooreſt farmer eats meat twice a week, and the table of the wealthy farmer is daily covered with beef, mutton or fowl. The beverage is home-brewed ale and beer, of an excellent flavour and colour. The houſes of the pooreſt are well built and well thatched; all have out-offices for cattle, fowls, carts or cars. The people are well clothed, are ſtrong and laborious. The women do all manner of ruſtic work, ploughing excepted; they receive equal wages with the men.

In this delightful ſpot the greateſt harmony ſubſiſts between the landlord and the farmer; and it is common to meet the tenant at the landlord's table. Such is their averſion to idleneſs, that if a beggar is met in theſe baronies he is immediately handed from houſe to houſe until he is out of the barony.

The profeſſed religion here is the Roman Catholic; there are about one hundred to one Proteſtant.

Marriage is ſolemnized much in the ſame manner as with the Iriſh. The relations and friends bring a profuſion of viands of all kinds, and feaſting and dancing continues all the night; the bride ſits veiled at the head of the table, unleſs called out to dance, when the chair is filled by one of the bride-maids. At every marriage an apple is cut into ſmall pieces, and thrown among the croud; a cuſtom they brought from England, but the origin of it had not deſcended with it.

The

THE produce of the ſoil in theſe baronies is great *, the whole is under tillage, and near the ſea-ſhore they manure with the ſea-weed twice a year, and in the memory of the oldeſt man the ground has never been fallowed, but a plentiful crop obtained every year. The pariſh of Carne contains five hundred acres, all or moſtly under tillage; this pariſh pays 100l. a year for tithes to the rector. The church-land of Carne contains ſixty acres, of which forty are plowed, and pays to the rector 14l. 14s. and to the landlord 90l. a year.

FUEL is ſcarce in this diſtrict; the chief firing is furze, planted on the tops of all the dikes; theſe are cut and dried, and bring a good return. Along the coaſt there has formerly been a bog or turbary, which has been encroached on by the ſea, ſo much that now it is covered with ſand, and that at high water, with many feet of the watry element. The great expenſe of cutting and drying this turf renders this kind of fuel too dear for the common people. In this turbary, many feet under the ſea at high water, trees are daily found, and ſome dug up; they conſiſt chiefly of oak, fir and hazle.

* The old Iriſh names Bargie and Forth ſignify a fertile ſpot, viz. *Bar*, fruitful; *go*, the ſea. The fertile land on the ſea coaſt. *Fortha*, plenty. Arab. بهر buhar. Perſ. بهار bahar; a rich and extenſive province (in Hindoſtan)—بر bar, fruitful; بـــاردار bardar, idem—بـــار bar, idem.

VOCABULARY

# VOCABULARY *of the* LANGUAGE *of the Barony of* FORTH *and* BARGIE.

## A.

*Aloghe*, below.
*ammache*, a dwarf.
*arkagh*, eager.
*amize*, amazed.
*aim*, design.
*amezill*, themselves.
*arich*, the morning.

## B.

*bodee*, *bothige*, } the body. A. S. *bodige*.
*buye*, a boy.
*bash*, the palm of the hand.
*bellee*, the belly.
*bane*, a bone. A. S. *ban*.
*blooed*, blood.
*brian*, the brain.
*blauthur*, the bladder.
*brazon*, bold.
*breed*, bread.
*bawcoon*, bacon.
*buthther*, butter.
*bouchure*, a butcher.
*baree*, the goal at the game of ball or hurly.
*bibbern*, trembling, fearful.
*blackeen*, bawling.
*blayeen*, shouting.
*boust*, boast.
*bra*, brave.
*bathes*, the goal at the game at ball.
*barnaugh*, a limpit, a wilk (or shell-fish) which adheres to the rocks so as to require a strong blow to disengage it.
*brough*, to break.
*boththone*, a button.
*brower*, a brother.
*brekvast*, breakfast.

*cole*,

C.

*co*, quoth, ſayeth.
*coſhes*, conſcience.
*clugercheen*, a flock, a clutch, a croud.
*cowlee-man*, the keeper of the goal at the game of ball.
*chote*, to know; *chote well*, to know well, to think, ſuſpect.
*cornee*, peeviſh.
*curcagh*, ſnappiſh.
*corkite*, tumbling or thruſting one another down, wreſtling.
*comman*, the bat or hurling club.
*coureate*, carrots.
*cooloors*, pigeons. Angl. Sax. *culfre*, a pigeon; *culufre*, idem.
*callef*, a calf.
*cawle*, a horſe.
*cozeens*, kinsfolks.
*crweſt*, a cruſt.
*coſhur*, a feaſt.
*cowm*, a comb.
*comree*, truſt, confidence.
*choule*, the cheek; *recte choule*, i. e. the jole.
*coolane*, the hinder part of the head.
*cortere*, a quartar, as
*arraugh cortere*, ſpring.
*zimmer cortere*, ſummer.
*harreſt cortere*, autumn.
*wonter cortere*, winter.
*cole*, cold.
*crooken*, croſsneſs, peeviſhneſs.

D.

*dellen*, to dig.
*dearnt*, to look, to behold, to look up.
*d'off*, to ſtrip, to put off.
*draught*, a drawing ſtroke with a weapon.
*drowe*, to throw or caſt.
*doneb*, a dunce, blockhead.
*deight*, to put.
*dap*, a touch.
*durk*, dark.
*dunder*, thunder (Daniſh).
*die*, the day.
*danecn*, the dawn.
*Mondei.*
*Tuſedei.*
*Wenneſdei.*
*Thorſdei.*
*Vridei.*
*Zathardei.*
*Zindei.*
*Dei oaſkean*, Aſh Wedneſday.
*dreade*, thread (Daniſh).
*denear*, dinner.
*doaugh*, dough.
*driſh*, a thruſh (bird).
*droſtal*, a blackbird.

E. *ee*,

E.

*ee*, the (article).
*errone*, errand.
*earchee*, every.
*ete*, point, quarter.
*ein*, eyes.
*egaſt*, fear; *egaſted*, frightened.
*iee*, *iec*, the eye. A. S. *eage*.
*eene*, the end.
*eatheit*, evening.
*eart*, *eard*, earth.
*eord*, *eorth*, earth. A. S. *eord*.
*emothee*, an emmet, ant or piſmire.

F.

*fug*, fog.
*fauſe*, the face; the features of the face, *lickeen*. A. S. *wlita*, *anwlita*, the face, the features. A. S. *neb*, the face.
*feelen*, feeling.
*fartoo*, ailing.
*f'ad*, for what?
*fan*, when.
*fouſteen*, confuſed, trembling.
*fade*, what.

G.

*gridane*, ſorrow.
*gandet*, wonder'd.
*gazb*, duſt, breath, fume. *There's no gaſb in him*, i. e. he is dead.
*gentrize*, gentry.
*glade*, ſun-ſet. *Goe to glade*, i. e. *Zin zettene*, ſun-ſetting.
*gabble*, talk, prattling.
*gay*, fair, calm.
*gubbach*, cabbage.
*gearte*, a ſhe goat; *puckane*, a he goat.
*garrane*, a gelding.
*granouge*, a hedge-hog.
*geinuare*, a joiner, a carpenter.
*gurl*, a child; *gurleliſh*, childhood.
*gurtear*, a garter, bandage.
*garr*, anger.
*grizee*, ugly.
*gent*, a joint.
*gue*, dew.
*gaſt*, a ſprite. A. S. *gaſt*.
*garſon*, a youth.

H.

*heoven*, heaven.
*helle*, hell. A. S. *helle*.
*hote*, heat.
*holgave*, Shrove-Tueſday. A. S. *halga*, holy; *halgan fæſten*, Lent.
*haade*, the head.
*helboghe*, the elbow. A. S. *elboga*.
*hone*, the hand; *riaught hone*, the right hand.

*hip*,

*hip*, the thigh. A. S. *theoh*.
*heal*, health.
*herieen*, hearing.
*hornta*, horned; *hornta baſt*, a horned beaſt.
*hiver*, a heifer.
*harpleat*, a ſnipe.
*hereen*, a herring.
*heiſtem*, weight, burthen.
*har-nothes*, pig-nuts.
*hachee*, croſs, ill-tempered.
*hey*, an incloſure; *chourch-hey*, church-yard.
*hole*, buried.
*hap*, chance.
*halluf*, half; *halluf-mona*, half-moon.

I.

*joud*, croud; *joud an moud*, crouds and throngs of people.

K.

*keileſs*, ſkittles, nine-pins.
*kink*, to kick.
*keilt*, to roll on the ground.
*knaggee*, croſs, ill-tempered, peeviſh.
*kewe*, a ſhove, a thruſt.
*kimlere*, a fumbler, aukward.
*keine*, cows.
*knaghane*, an ant or piſmire hill, a little hill.

L.

*leigheen*, laughing.
*llean*, miſchief.
*lluſkes*, flocks.
*leigh*, idle; *leigh out ee dei*, idle out the day.
*loutheed*, ſheltered.
*lournagh*, melancholy.
*letch*, ſmall-beer; *ty o' letch*, a drink of ſmall beer.
*lug*, hollow.
*lerock*, a lark.
*lowem*, a lamb.
*leioon*, a lion.
*lawveen*, leaven.
*laus*, lace.
*lethel*, little; *lethel vinger*, the little finger.
*ligt*, light.
*lappeen*, a plover.
*lous*, open.
*lickeen*, the features. A. S. *wlita*, *anwlita*, the face.
*lone*, land; *Englone*, England; *Erelone*, Ireland.
*lug*, a hollow.

M.

*methel*, middle.
*man*, a man; *yolaw man*, an old man; *man*, a huſband.

*mawen*, a woman; *poclla mawen*, an old woman, a wife.
*mide*, a maid.
*moweth*, the mouth.
*marrough*, marrow.
*met*, food.
*mothoon*, mutton.
*moothar*, mother.
*maſtrace*, miſtreſs.
*milleare*, a millar.
*magetty-pie*, a magpie.
*miſtern*, dazzled.
*muzlere*, worthleſs.
*moud*, crowd, throng.
*mot*, aſking.
*mot*, but.
*mope*, aſtoniſhed, a fool.
*mothee*, a little hill.
*milagh*, trefoil, clover.
*mell*, meal, flour.
*mire*, ſurprize, in amazement.

N.

*nouth*, knoweth.
*nate*, *anate*, prepared.
*nize*, the noſe; *niztrols*, noſtrils.
*neapeſs*, parſnips.
*nipore*, neighbour.
*neal*, a needle.
*neeght*, night.
*noughel*, a knuckle.
*naatur*, nature.

O.

*oree*, one another.

P.

*poul*, the crown of the head.
*pethy*, pity.
*pooke*, pocket.
*puckane*, a he-goat.
*pether*, pewter.
*pit*, put.
*pouſtee*, power.
*pomell*, a fool.
*piz*, peaſe; *piz porachis*, peaſe porridge.
* *paug-mele*, feaſt of harveſt-home.
*paug*, the harveſt; *mele* or *mael*, a feaſt.

R. *riſhp*,

* This extraordinary word *paug*, if I miſtake not, is borrowed from the Iriſh phogh or fogh, which literally means panis ſubcinneratus, and is borrowed from the Egyptian *pioik*, of the ſame meaning; it is the Chaldean עוג Ogh. (for *pi* is

R.

*rishp*, a stroke; A. S. *rese*.
*rapple*, to rattle.
*rushsheen*, afternoon's luncheon.
*rub*, a rib.
*riaught*, right; *riaught hone*, right hand; *riaught earme*. right arm.

S.

*sankts*, the saints.
*skee*, the sky.
*steorr*, a star; A. S. *steorra*.
*sneew*, snow.
*starm*, a storm.
*smill*, the smell.
*shameface*, bashful.
*stuckeens*, stockings.
*shoone*, shoes.
*snisheen*, snuff.
*seppear*, supper.
*skir*, to rise in the air.
*shuller*, shoulder.
*snite*, to appear, to shew one's self.
*stone*, to stand.
*shimmereem*, glittering.
*scoth*, a shirt.
*scudden*, rubbing the back.
*stouk*, a fool.
*smort*, smothered.
*stell*, the handle of a thing.

is the Egyptian article) whence in Hebrew עוז עשה Oghose, i. e. factor aut sacrificator panis subcineritii (see Jacob Bolducus, and Dickinson Fasciculus, p. 169); it was the feast of first fruits, whence the Irish word Fogh-mir, harvest, literally, the autumn cake of new wheat, for *mir* is the Persian ⲙⲓⲣ mihr, or the Arabic ⲙⲟⲩⲣⲓⲁⲛ muhrjan, Autumn. I think we cannot be mistaken in this derivation, because the Irish do still preserve the custom of making the blessed cake at this season, called Baran bereac, or vulgo' Barreen breac, which is literally the בר ברוך Bar baruk, or frumentum benedictum of the Jews and Chaldeans. We might also derive paug or phogh from the Hebrew כנ bag or vag, which signifies food, what one eats; whence ἐίκ in Greek is bread, and hence the Spanish *Figon*, a seller of food; hence also the Gothic *baccen* and the German *bek*, a meal-man, pistor, hence paug-meal, signifies the autumnal cake of new wheat, which the old Irish dedicated to *Cann*, or the Queen of Heaven, and the Egyptians to Isis. Another name for this cake in Irish is Sudoig, borrowed of the Egyptians, who sacrificed to their gods the Sod-oik, a compound of *oik* placenta and of *soti* farina, or of *sed*, sacrificare, I know not which, from whence *sod*, victima, sacrificium.

 T. *teap*,

T.

*teap*, toſſing and tumbling one another about.
*troll*, to roll.
*'twiſh*, between, betwixt.
*teight*, taught.
*tarvizeen*, tormenting.
*titch*, a kid.
*ty*, a drink, ſee *letch*.
*taweſt*, taſte.
*thouum*, the thumb, A. S. *thuma*.

V.

*vier*, the fire, A. S. *fir*. *Belgis Vier*.
*vaaper*, vapour.
*vraſt*, froſt.
*vorreate*, the forehead.
*voote*, the foot.
*vleſh*, fleſh; *byiltta vleſh*, boiled meat.
*vat*, fat.
*vice*, voice.
*volleat*, a handkerchief.
*vurſt*, firſt.
*vier*, a weazel.
*vream*, from; *vreem*, idem.
*vappereen*, bragging, boaſting.
*valler*, more.
*vezzeen*, driving or ſtriking a ball hard.
*vengem*, ſpite, malice.
*vell*, fell; *vall*, to fall.
*vlee*, to fly.
*valler*, more, longer (in time).

W.

*wafur*, uneaſy.
*wouriok*, to tremble.
*wedeen*, a wedding.
*wather*, water.
*woul*, to wiſh.
*witheen*, the looks, the countenance or features.
*whating*, ſneezing.
*weepeen*, weeping.
*wraſte*, the wriſt.
*wik*, a week.
*weend*, the wind; *Eaſt weend*, *Weſtan weend*, *Zouth weend*, *Nordh weend*.
*wazcoote*, a waiſtcoat.

Y.

*yerſtei*, yeſterday; *ear yeſtei*, the day before yeſterday.
*yolaw*, old m; *yoella*, old f.
*yowe*, an ewe.
*yalpen*, ſpewing.
*y'oure*, give over, ceaſe.
*ye*, give; *yate*, give.
*yith*, if.

Z. *zitch*,

Z.

*zitch*, ſuch.
*zin*, the ſun; *zin zettene, or, go to glade*, ſun ſetting.
*zichel*, ſuch.
*zey-ſaw, ze*, to ſee.
*zar*, to ſerve.
*zill*, ſelf; *theezill*, thyſelf.
*zed*, ſtewed; *zed-mett*, ſtewed meat.
*zalt*, ſalt.
*zeide*, the ſide.
*zongh*, a ſigh.

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I ſhall here ſubjoin

A N  O L D  S O N G,

in the dialect of theſe baronies, which has been handed down by tradition from the arrival of the colony in Ireland. Subject, the game at ball called Camánn or Hurley. Scene, the commons in the Barony of Forth. Time, a church holy-day. *Walter* relates how his ſon *Thomas* loſt the game, by aiming a ſtrong blow at the ball, and miſſing it, broke his bat againſt a piſmire hill.

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A YOLA

## A YOLA ZONG. *Tune—Collin and Phebe.*

FADE teil thee zo lournagh, co Jone, zo knaggee.
Th' weitheſt all curcagh, wafur, an cornee.
Lidge w'ous ana milagh, tis gay an louthee,
Huck nigher, y'art ſcudden, fartoo zo hachee.

Well, goſp, c'hull be zeid, mot thee fartoo, an fa'de
Ha deight ouz var gabble, tell ee Zin go t'glade
Ch'am a ſtouk, an a donel; wou'll leigh out ee dey
Th' valler w'ſpeen here, th' laſs i Chourch-hey.

Yerſtey w'had a baree, giſt ing our hone
Are gentrize ware bibbern, amezill, cou no ſtone.
Yith Muzlere had ba hole, t'was me Tommeen,
At by mizluck was i pit t'drive in.

Joud an moud, vrem earchee ete, was i Lough
Zitch vaperren, an ſhimmereen, fan ee daff i tha'r ſcoth
Zitch blakeen, an blayeen, fan ee ball was ee drowe
Chote well 'ar aim was t'yie ouz n'eer a blowe.

Mot w'all 'ar bouſt, hi ſoon was ee teight
At 'ar errone was var ameing 'ar 'ngiſh i height
Zitch vezzen, tarvizzen 'till than w'ne'er zey
Nore zichel, n'eer well nowe nore n'eer mey.

Many

## AN OLD SONG.

WHAT ails you ſo melancholy, quoth John, ſo croſs,
You ſeem all ſnappiſh, uneaſy and fretful:
Lie with us on the clover, 'tis fair and ſheltered;
Come nearer, you're rubbing your back, why ſo ill tempered.

Well, goſſip, it ſhall be told, you aſk what ails me, and for what;
You have put us in talk, 'till the ſun goes to ſet.
I'm a fool and a dunce; we'll idle out the day;
The more we ſpend here, the leſs in the church-yard.

Yeſterday we had a goal juſt in our hand,
Their gentry were quaking, themſelves could not ſtand.
If good for little had been buried, it had been my Tommy,
Who by miſluck, was placed to drive in.

Throngs and crouds from each quarter of the Lough [*of Ballymacuſhin near the commons;*]
Such vapouring and glittering, when ſtript in their ſhirts.
Such bawling and ſhouting, when the ball was thrown;
I ſaw their intent was to give us neer a ſtroke.

But with all their bravado they were ſoon taught
That their errand was aiming to bring anguiſh upon 'em.
Such driving and ſtruggling 'till then we ne'er ſaw,
Nor ſuch never will, no, nor never may.

Many

Many a bra draught, by Tommeen was ee mate,
Th' cowlee-man fauſteen; zey well 'twas a nate
Yith w'had any lluck our name wou'd b' zung
Vreem ee *Choure* here aloghe up to *Cargun.*

Th' heiſtem o' pley, vell all ing to lug,
An there w' had Treblere an ſturdy Cournug.
Th' commanes t'rapple, th' ball ſkir an vlee,
Our eein woud b' miſtern t' dearnt up ee ſkee.

Than came ee ſhullereen i teap an corkite,
Hi kinket an keilt i vewe ame t'wode ſnite;
Zim dellen harnothes, w'are nize i reed cley
More trollen, an yalpen an moulten away.

Na nowe or neveir w' cry't t' Tommeen,
Fan Cournug yate a riſhp, an Treblere pit w'eeme.
A clugercheen gother, all ing pile an in heep
Wourlok'd anan 'oree, lick lluſkes o' ſheep.

T' brek up ee bathes, h' had na pouſtee,
Tommeen was lous, an zo was ee baree;
Oure hart cam' t' our mouth, an zo w' all i green
Th' hap an ee ferde an ee crie was Tommeen.

Up came ee ball, an a dap or a kewe
Wou'd zar, mot all arkagh var ee barnaugh-blowe
W' vengem too hard, he zunk ee commane
An brough et i ſtell ing a emothee knaghane.

Th'

Many a brave ſtroke by Tommy was made,
The goal-keeper trembling, ſaid well 'twas intended them.
If we had any luck our name would have been ſung
From the Choure here below up to Cargun. [*two diſtant points of the Barony.*]

The weight of the play fell into the hollow,
And there we had Treblere and ſturdy Cournug. [*two famous players.*]
The ball-clubs they rattled, the ball roſe and flew;
Our eyes would be dazzled to look up to the ſky.

Then came the ſhouldering, toſſing and tumbling;
They kicked and rolled the few that appeared.
Some digging earth-nuts with their noſes in red clay,
More rolling and ſpewing and pining away.

Nay, now or never we cry'd to Tommy,
When Cournug gave a ſtroke, and Treblere put with him; [*helped*]
A croud gathered up, all in pile and in heap
Tumbled on one-another like flocks of ſheep.

To break up the goal they had not power,
Tommy was open, and ſo was the goal.
Our hearts came to our mouth, and ſo did all in the green,
The chance and the fear and the cry was Tommeen.

Up came the ball, and a tap or a ſhove
Would ſerve; but all eager for the barnagh ſtroke
With venom too hard, he ſunk his bat-club or bat,
And broke the handle, in an emmot [*piſmire*] hill.

Th' ball want a cowlee, th' gazb mate all rize
Licke a mope an a mele; he gazt ing a mire,
Than ſtalket, an gandelt, w'ie o! an gridane
Our joys all ee ſmort, ing a emothee knaghane.

Ha-ho! be me coſhes, th'aſt ee pait it, co Jone
You're w' thee crookeen, an ye me thee hone.
He it nouth fade t'zey, llean vetch ee man,
Twiſh thee an Tommeen, an ee emothee knaghane.

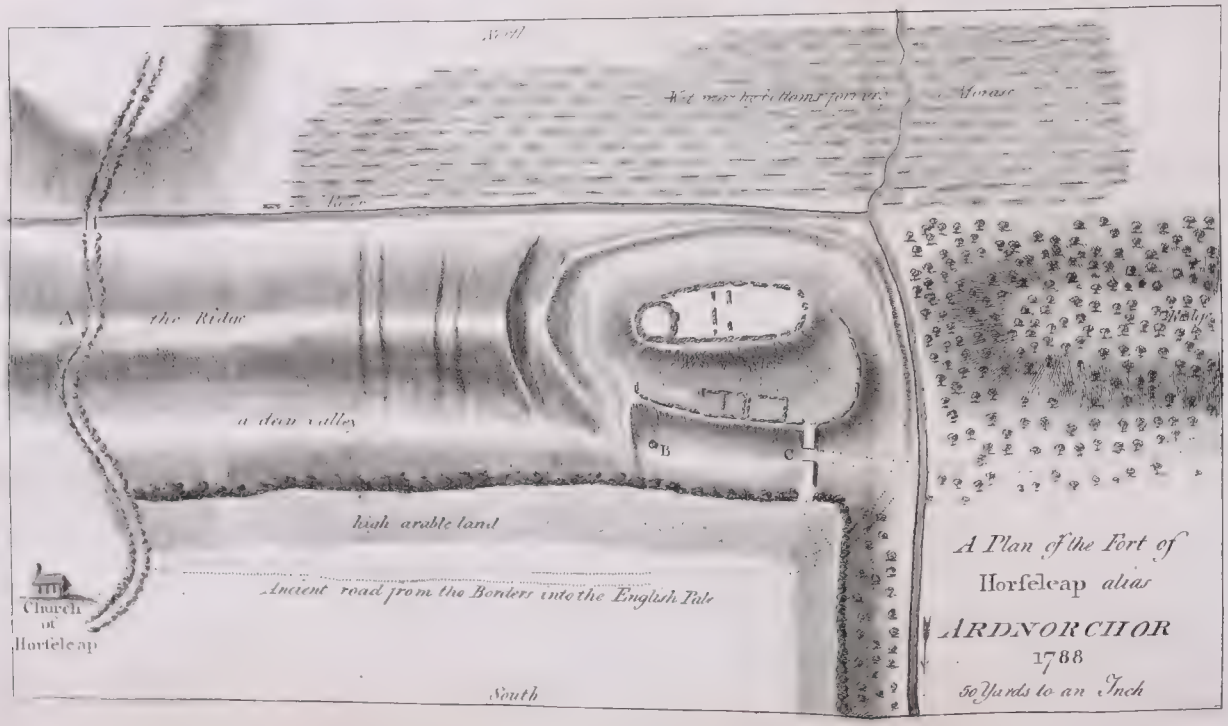
Come w' ous goſp Learry, theezil and Melchere;
Outh o'me hone ch'ull no part wi' Wathere.
Jowane got leigheen, ſhe pleaſt ame all, fowe—
Sh' ya ame zim to doone, as w' be doone nowe:
Zo bleſs all oure frends, an God zpeed ee plowe.

The ball o'erſhot the goal, the duſt roſe all about.
Like a fool in a mill, he looked in amazement;
Then ſtalked and wondered, with Oh! and with grief
Our joys are all ſmothered in a piſmire hill.

Hey-ho! by my conſcience, you have paid it, quoth John,
Give o'er your croſsneſs, and give me your hand.
He that knows what to ſay, miſchief fetch the man,
Betwixt you and Tommy and the piſmire hill.

Come with us, goſſip Larry, yourſelf and Miles;
Out of my hand I'll not part with Walter.
Joan ſet them a laughing, ſhe pleaſed them all, how—
She gave them ſome to do, as we are doing now: [*Drinking.*]
So bleſs all our friends, and God ſpeed the plough.

A View of the South side of the Fort of Horseleap alias ARDNORCHOR in Westmeath



# *A* DESCRIPTIVE ACCOUNT *of the* FORT *of* ARDNORCHER *or* HORSELEAP, *near* KILBEGGAN, *in the County of* WESTMEATH, IRELAND; *with Conjectures concerning its Use, and the Time of its Erection. By Mr.* JOHN BROWNRIGG. *In a Letter to* JOSEPH C. WALKER, *Esq; Secretary to the Committee of Antiquities.*

SIR,

AS you were so kind as to approve of my antiquarian attempts, I am induced to send you the following observations on the fort of Horseleap, with a view and plan of the fort. Read Dec. 6, 1788.

THE very ancient fort of Ardnorcher has been for some centuries past vulgarly called the fort of Horseleap, on account of a most extraordinary leap which is said to have been formerly made into it over the drawbridge, by an English knight in escaping from a close pursuit.

SIR

Sir Hugh De Lacy is generally reputed to have been the founder, if not finiſher of this curious fortification; but I apprehend this to be an haſty and ill-founded opinion, like many other errors in our hiſtory, occaſioned by the Britiſh writers being ignorant of the language and cuſtoms of Ireland; for the bare view of the fort is ſufficient to ſhew any man of obſervation that it is an original work of the ancient Iriſh, and of very great antiquity, even long before the time of De Lacy.

The forts of Granard in the county of Longford, and of Dundonald in the county of Down, where the Engliſh pale did not extend for three centuries after De Lacy's time, might with as much reaſon be attributed to him, ſince they are exactly of the ſame kind and much larger than that of Ardnorcher. Its very name, indeed, is ſufficient to ſhew that De Lacy was not the firſt founder of it, for it is highly improbable that he, who was of a Norman family and whoſe language was a mixture of French and Saxon, ſhould give a name of pure old Iriſh, ſuch as the word Ardnorchor * is, to a fortreſs erected in Ireland for a Britiſh garriſon. In this and the like inſtances, the Iriſh language is of ſignal uſe to diſtinguiſh the works of the ancient Celtæ from thoſe of the modern Britiſh nations in Ireland; but the old Engliſh inhabitants of Meath having no authentic records, attribute every work of great labour or antiquity to Sir Hugh De Lacy, as the illiterate modern Iriſh do to Fin Mac Cumhal.

When Sir Hugh De Lacy was made governor of Meath by Henry the Second, he took every precaution to ſecure the new

* Ardnorcher or Ard-an-orchor, literally *the fort of ſlaughter.*

poſſeſſions

poſſeſſions for the Engliſh crown, by erecting ſtrong forts and caſtles throughout the country, and eſtabliſhing therein valiant knights, with colonies of Norman and Anglo-Saxon ſoldiery, and by beſtowing on them extenſive tracts of country which they were to defend for themſelves by their own perſonal courage and proweſs againſt the ancient Iriſh proprietors. He took advantage of every circumſtance and ſituation, whether ſacred or prophane, that aſſiſted his purpoſe; turning abbies into fortified caſtles, and their terraſſes, walks and groves into trenches and bulwarks; ſome alſo of ancient Celtic, Iriſh and Daniſh forts or mounds, he repaired and ſtrengthened by additional works of lime and ſtone, to check the violent and ſudden efforts of the natives, who unaccuſtomed to ſlow ſieges or blockades, were uſed to attack and carry the earthen forts of their country by aſſault, firing the palliſadoes and ſtorming the trenches with furious, rapid and active courage. * It is probable that when the Engliſh extended themſelves over the greateſt part of Meath, the diſpoſſeſſed in-

* In the reign of Henry the eighth Meath was divided into two counties. The preamble to the act of parliament, nearly four hundred years after De Lacy's time, clearly demonſtrating the truth of the conjecture, that the weſtern parts were not entirely in the hands of the Engliſh.

34 Hen. viii. chap. I. An act for the diviſion of *Methe* into two ſhires.

" For as much as the ſhire of Methe is grete and large in circuit, and the weſt part " thereof laid about and beſet with diverſe of the King's rebells, and that in ſeve- " ral parts thereof the King's writs, for lack of miniſtration of juſtice, have not " of late been obeyed," &c.

habitants retired towards the Shannon, and ſtrengthening themſelves in great numbers in that rough part of the country, which is known at this day by the name of The Woods, and is ſtill much encumbered with bogs, ſteep hills, rocks, ſtreams and ſhrubby ground. Here the natives made ſtand, and headed by the chiefs of the country, principally the Macgeoghegans and O'Malones, began to repel the invaders, and for ſeveral centuries maintained their independency under their ancient laws. This obliged the Engliſh to fortify their frontiers with long trenches, forts and caſtles; and although we have no authentic records of the conflicts that enſued between the Britiſh and Iriſh in this part of the country, yet the military works that remain here ſufficiently ſhew the efforts of one party to regain, and of the other to defend, that large portion of Meath that was within the Engliſh pale. The ancient doon or moat of Ardnorcher ſeems to have preſented itſelf to De Lacy as a ſtrong link in his chain of forts and caſtles, which were drawn along that country from the great bogs in the ſouthern parts of Meath towards the borders of Brehny or Brefny O'Reilly, to cover the new ſettlers and check the inroads of the Iriſh. I think he found it, like all others of the curious ancient moats (as they are called in Ireland) an high truncated cone, though not quite circular or inſulated, as it is part of a long and narrow ridge. It is ſurrounded with a trench and an outer mound of earth, having very rude caves down through its centre, which were open lately, and may be examined at any time by the curious, their entrance being known to every one in the neighbourhood. It is defended on the north by a long moraſs, through which a rivulet paſſes to the outer mound

of

of the fort, where another ſtream falls into it, running from the weſt cloſe by the foot of the ridge, of which Ardnorcher is a part as above-mentioned. On the eaſt it is ſtrengthened by a deep valley in which the united ſtreams run cloſe by the works; and on the ſouth by a ſudden deep valley that ſeparates it from the high grounds. It was weakeſt on the weſtern ſide, becauſe the ridge on which it ſtands continues to riſe and run on weſtward from the fort; but De Lacy's military knowledge taught him to improve this ſituation ſo as to render it a moſt formidable and almoſt impenetrable fortreſs before the uſe of fire arms. He cut the ridge acroſs with two intrenchments at a ſmall diſtance from each other; theſe are not very large, but he ſeems to have raiſed and ſtrengthened the outer mounds of the old fort, and to have made the trench deeper. On the weſtern part of the high mount are the remains of a ſmall round tower built of lime and ſtone, which I ſuppoſe was high enough to overlook and command the ridge; and a ſtone wall, whoſe fragments are ſtill viſible, ſurrounded the remainder of the platform of this high mount, and not only overlooked the lower works of the fort, but commanded the circumjacent country. The next lower area on the ſouth-eaſt ſide, was defended by a ſweeping wall, in which was the great gate into the body of the place, acceſſible only by a draw-bridge over a very deep valley or foſſé ſupported by two piers of ſtone work, one communicating with the gate of the fort, and the other joined to the high land on the ſouth ſide of the foſſé, the wall continuing round the eaſt ſide of the fort till it cloſed with the high mount in the north-eaſt point, where I apprehend the communication between the higher and lower

 areas

areas to have been. All the walls that ſurrounded theſe works are demoliſhed and tumbled over into the lower area, where they lie ſcattered in large fragments; but they have left in ſome ſpots viſible traces of their foundations, and alſo of the foundations of ſome partition walls on the upper fort, and of ſome ſquare buildings on the next lower area near the great gate, as is marked on the plan. The only ſtone work that has eſcaped the ravages of war and time are the two piers of the draw-bridge and lower gate, now vulgarly called the *Horſeleap;* theſe were not only piers of the draw-bridge into the fort, but ſerved alſo as ſides to a gateway which ſhut up the loweſt area or deep foſſé of the fort, wherein I conceive that in time of danger they kept their cattle and fuel, and every other ſtore which required room. This hollow place is very deep and well ſheltered; and, notwithſtanding two rivulets ran along two ſides of the fort, a well was dug in it at B, to ſupply the garriſon and their cattle with water during a blockade, and which I ſuppoſe was deep enough to draw water thereto from the river by a ſubterraneous drain. I have no doubt that there were other works both of earth and ſtone belonging to this fort, which are now ſo decayed and defaced as not to be diſtinctly obſerved.

There was a wall of lime and ſtone on the ſummit or ſpine of the hill or ridge, the foundation of which can be traced all the way from the fort to the road at A, where, in the ditches on each ſide of it, the lime and ſtone are ſtill viſible. The uſe of this wall I cannot conceive, except it was carried quite round the hill upon which the church ſtands, to circumſcribe a town,

town, and to guard the ancient road from the borders into the pale which croſſes the church hill, as on this ſame ridge of ground, better than a mile diſtance weſtward, ſtands the ſtrong caſtle of Larah, cloſe to another high road from The Woods, which it ſhut up and commanded, preventing any poſſibility of a body of men coming into the pale from this quarter. But this caſtle I take to be a later work, and an advancement of the borders of the pale; and I believe the word Larah ſignifies the border.

Having ventured to mention the fort of Ardnorcher as one of the frontier forts of the pale, I ſhall here offer my reaſons for that aſſertion: And firſt, I will obſerve, that many of the Iriſh families beyond this point remained in poſſeſſion of their lands for ſeveral centuries after Hugh De Lacy's time, and ſome of them continue in poſſeſſion to this hour; but that not one Iriſh family have any landed property within it; and that beſides, in Abbè Mac Geoghegan's map of Ireland, the delineation of the Engliſh pale will be found to run near this direction.

The river that comes from the northward to Ardnorcher I ſuppoſe to have been the boundary of the pale, becauſe at the ford on this river, at the green of Donore Geoghegan, where another road enters the pale from The Woods, there is a ſtrong fort on the Engliſh ſide of the river, commanding the ford and the road, and rendering the paſſage this way an enterprize of danger; and becauſe that, from this point northward, as far as my eye could reach, I traced through a low ſwampy bottom a wide

wide entrenchment, which I am aſſured may be followed many miles further in the ſame direction, and which the neighbouring peaſants ſaid, in anſwer to my enquiries concerning the uſe of it, had been cut by Sir Hugh De Lacy, as he intended to draw the waters of Lough Ennel to Horſeleap, a tradition which is much to my purpoſe, though a little tinctured with modern ignorance; for certainly the trench commencing under a fort, and carried on for miles through a very rough hilly country, was not intended for a water courſe, but a boundary.

I am,

S I R,

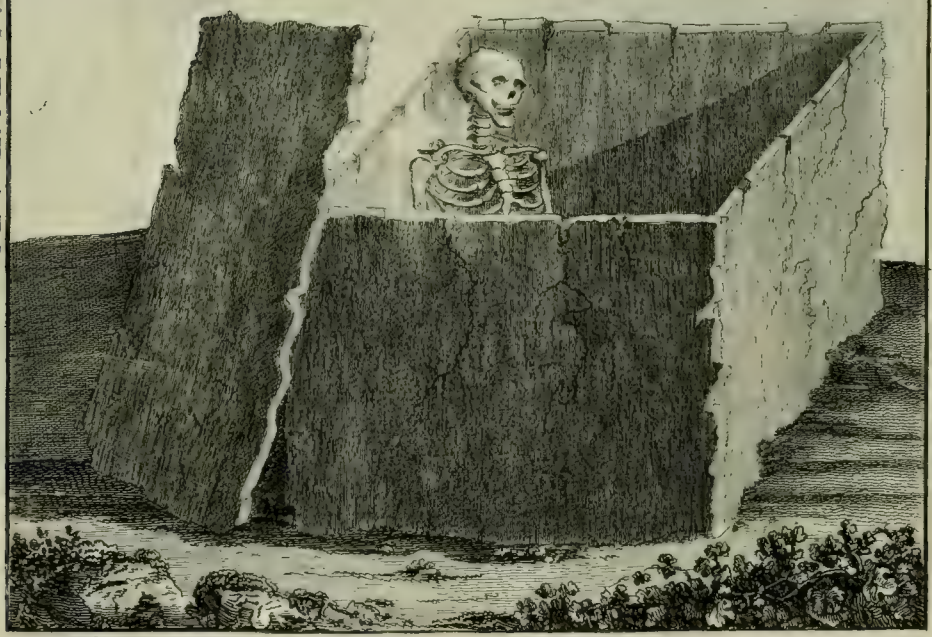
Your moſt obedient ſervant,

J. BROWNRIGG.

DUBLIN, Grafton-ſtreet,
16th February, 1788.

Fig. 2

Fig. 1.



# *An* ACCOUNT *of an* ANCIENT SEPULCHRE *discovered in the* COUNTY *of* KILDARE, IRELAND, *in the Year* 1788. *By* WILLIAM BEAUFORD, *A. B. In a Letter to* JOSEPH C. WALKER, *Esq; Secretary to the Committee of Antiquities.*

S I R,

As some peasants in February, 1788, were digging in a garden at Calverston near Kilcullen, in the county of Kildare, one of them dropped his sack or spade in a hole under what was always deemed a large rock-stone, which just appeared above the ground. To recover the spade they attempted to remove the stone; this they completed by breaking it into several pieces. Underneath was an oblong cavity or tomb, the sides and ends composed of large flat stones, about five feet long, four deep and four wide. In this tomb was found a skeleton in a sitting attitude, facing the south, and

Read March 3, 1789.

and by its ſide, near the head, a ſmall urn *, or rather baſon, of very rude workmanſhip, made of earth very hard baked, and of a light brown colour. This was a little broken when found, by pieces of the covering ſtone falling on it; but when entire was five inches and a half diameter at the top, two inches at the bottom, and four inches and one eighth deep, as is repreſented in Fig. II. with its ſeveral carvings, which though rude are not in a bad taſte, being both in creux and relief. Many of theſe ancient ſepulchres are found in different parts of the kingdom, ſeveral of which have been opened, in which have been diſcovered urns with burned bones and aſhes, ſkeletons extended on their backs, and heaps of bones in a confuſed and irregular form. See Fig. I.

In reſpect to the period in which this tomb was erected, and the perſon to whom it appertained, little can be advanced beſides conjecture; but in whatever age the body was interred, it was apparently in a period when cremation began to ceaſe, and the mode of interring the body intire began to prevail. The burning of the body after death was univerſal throughout ancient Europe; and Wormius, in Monum. Danic. † tells us, that among the northern nations the body reduced to aſhes was placed in an urn, and laid in the earth, over which was raiſed a conical mound. The urn was of baked clay, and the mouldings round the rims of ſuch as have been diſcovered, often ſhew a conſiderable degree of elegance. Numbers of ſuch ſepulchral urns have been diſcovered

* This urn has been lately depoſited in the muſeum of the Royal Iriſh Academy.

† "Rudiores ex ſola in rotundidatem et conum conjecta."
*Worm. Monum. Dan.*

in

in Ireland, whoſe colour, texture and ornaments are ſimilar to this under conſideration. From Keating, Ware and other Iriſh antiquaries, we learn that burning was exchanged for burying in this iſland, by Eochadh Aireamh, who according to Keating was brother to Eochaidh Feidhlioch, and reigned A. M. 3952, or about fourteen years before the Chriſtian æra :—but Keating's dates are generally his own.

The Iriſh long retained an attachment to their ancient cuſtoms and pagan ſuperſtitions, eſpecially in the modes of interment; and the cuſtom of burying in conſecrated ground was not univerſal in Ireland in the twelfth century, on the arrival of the Engliſh, as we find it enjoined in the council of Caſhel, held in 1172, mentioned by Cambrenſis. From theſe circumſtances we may reaſonably infer, that the monument under conſideration may be either of Iriſh or Daniſh origin; if of the former, it is probably not later than the ſeventh century. In thoſe ſpecies of ſepulchres which have been opened in which ſkeletons have been found, the body was laid at length on the back, agreeable to the aſſertions of the Iriſh antiquaries, who relate that Eochadh Aireamh ordered that the grave ſhould be ſeven feet long and three deep, the corpſe ſtretched on its back, with a ſtone over it, and the name of the perſon written thereon. This is the only one yet diſcovered where the body was placed in a ſitting poſture; indeed a ſhort time ſince ſome ſmall earthen tumulii were opened on the Curragh of Kildare, under which ſkeletons were found ſtanding upright on their feet, and in their hands, or near them, ſpears with iron heads. The cuſtom of placing their dead erect was general among all the northern nations,

tions, and is ſtill retained in Lapland and ſome parts of Norway*; and the natives of North America bury their dead ſitting in holes in the ground, and cover them with a mound of earth†.

ADMITTING therefore the monument under conſideration to be of Daniſh origin, we come to conſider the uſe of the urn or baſon encloſed in it. Herodotus, in MELPOMENE, informs us that the ancient Scythians, not only in making contracts, alliances, &c. but at the ſepulchres of their chiefs, drank out of earthen cups or bowls, wine mixed with their own blood, with which liquor alſo they ſtained their ſcimitars, ſwords and arrows; and with theſe arms they either decorated the tomb, or interred them with the body. Other ancient and modern writers mention the cuſtom of the Scythians, Tartars and northern inhabitants of Europe, burying victuals with their dead. The Danes and Scots eat frequently oatmeal or rye-meal mixed with water, which was continued by the latter to the preſent century, under the denomination of *croudy*; ſome ſuch mixture appears to have been in the urn under conſideration, for the inſide ſeems to be incruſted over with a kind of bran, which being ſpilled over, alſo covers part of the outſide. It was, therefore, moſt probably a bowl of meal and water interred with the corpſe, to ſubſiſt him during his paſſage to the other world, after the cuſtom of the northern Pagans.

I OFFER theſe thoughts only as conjectures or hints, to be further inveſtigated by ſome more able pen. As the Danes, Iriſh, and all the northern and weſtern nations of Europe, had the

* See *Deſcription of Lapland.* † BUFFON.

ſame

ſame or ſimilar modes of interment, it is almoſt impoſſible to aſcertain the date of any particular one. There are a number of ancient ſepulchral monuments ſtill remaining in Ireland, which are certainly anterior to Chriſtianity in this iſland, whilſt there are others of the ſame ſpecies which ſhew evident marks of being erected ſubſequent to that period, and ſome perhaps as late as the tenth or eleventh century.

If you think the above merits the attention of the Royal Iriſh Academy, you will do me the honour to lay it before that learned body.

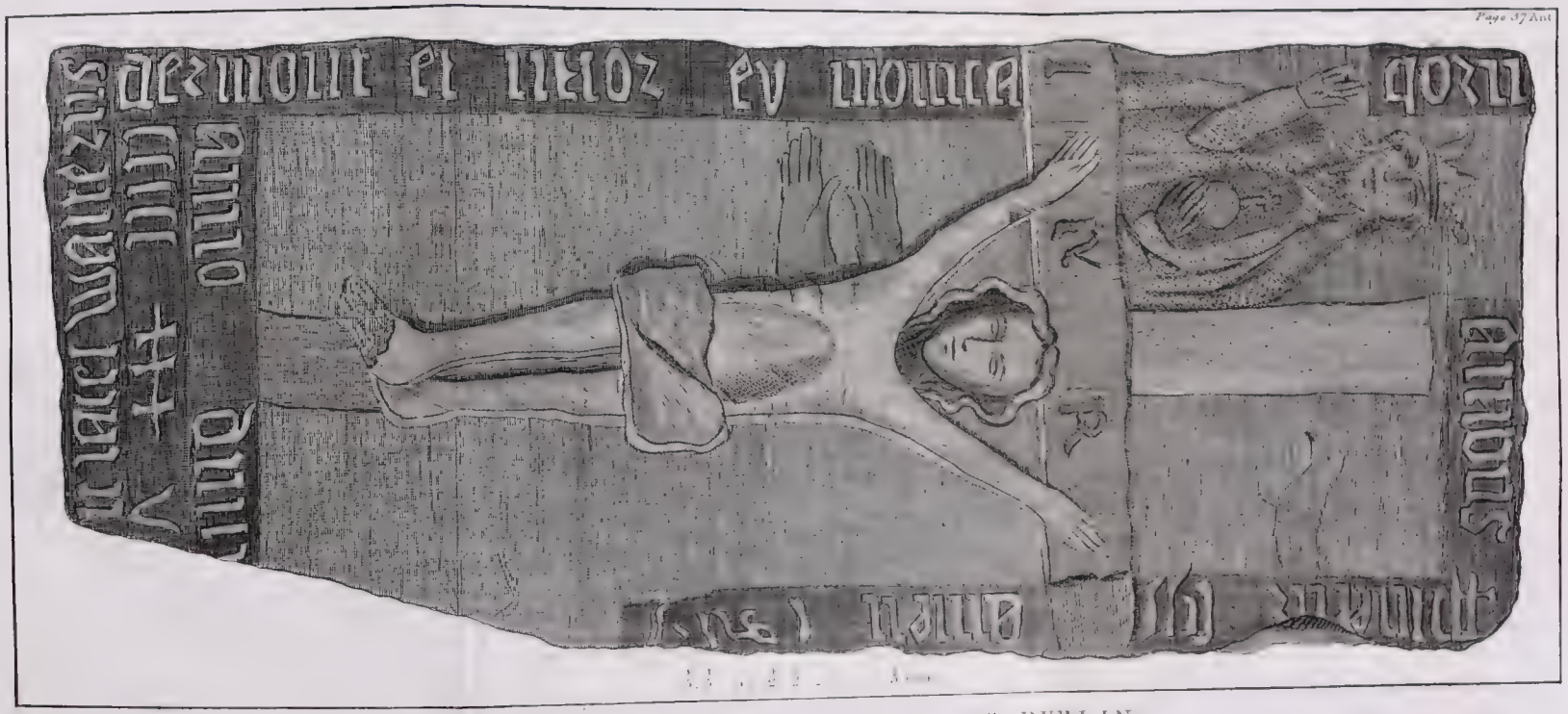
I am,

S I R,

Your's, &c.

W. BEAUFORD.

*Athy, Sept.* 2, 1788.



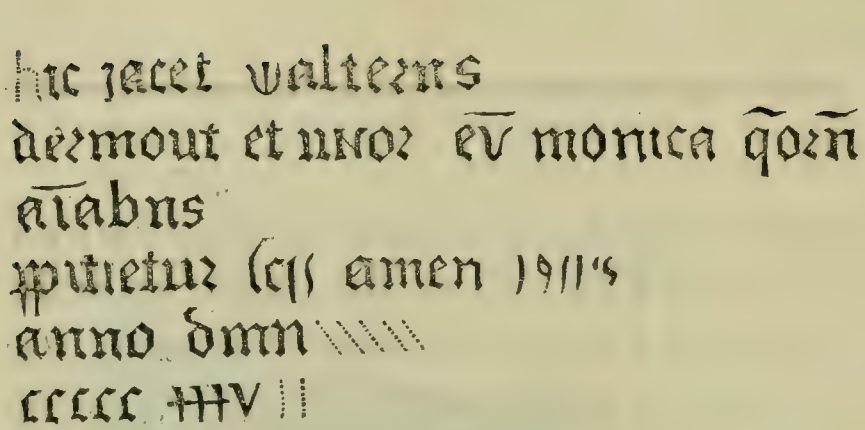
A TOMB STONE at Lusk in the County of DUBLIN.

# DESCRIPTION *of an* ANCIENT MONUMENT *in the* CHURCH *of* LUSK *in the County of* DUBLIN.

*By Colonel* CHARLES VALLANCEY, *Member of the Royal Societies of London, Edinburgh and Dublin, &c. Communicated by the Earl of* CHARLEMONT, *P. R. I. A.*

THIS monument (or tomb-ſtone) was found covered with earth in the church of Luſk in the year 1753, when a fair drawing of it was made by Mr. Martin Gaven. One corner is broken off, which contained the letter H in the word *Hic*; and probably the M in the date was either omitted or alſo broken off. Read March 3, 1789.

THE ſtone meaſures five feet five inches in length, two feet two inches in breadth, and is five inches thick. The inſcription is very legible, and is as follows:



Hic jacet Walterus Dermout et uxor ejus Monica, quorum animabus, propitietur Chriſtus, amen Jeſus. Anno Domin. &c.

I WILL not here diſpute whether the word following *propitietur* be deſigned for *Chriſtus* or *Nion*; it has more the appearance of the latter; and we know the Iriſh Chriſtians expreſſed ſometimes the name of the *Meſſiah* by the Chaldean word *Nion* *.

THE figures on the ſtone denote the Trinity, with the Meſſiah on the croſs. But there is an *unique* in this monument I have not met with on any other, formed ſince the introduction of

* *Vindication of the ancient hiſtory of Ireland*, p. 200.

Chriſtianity.

Chriſtianity. At the ſide of our bleſſed Saviour are two hands open, pointing to the names of the deceaſed. There is no circumſtance in our Saviour's life that can any way be alluded to by theſe hands, and from the poſition of them I am induced to think they are *Hieroglyphics*.

No ſymbol was more in uſe with the Ægyptians and with the ancient Iriſh than the *hand*.

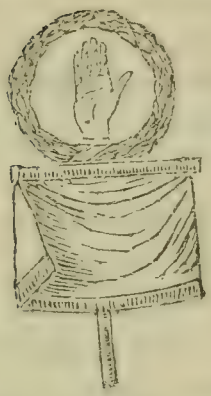
THE ſign armorial of the kings of Ireland was the hand pointing upwards; it was painted red, and is ſtill the arms of the O'Brien family, with this motto, *Lamh laidir an uachdar*, i. e. "the ſtrong hand up," or "the ſtrong hand will prevail."

THUS the monarchs *Lugh*, *Reachta* and *Cathal*, obtained the names of the *red hand*; as *Lugh-Lamhdhearg*, *Reachta-Righdhearg*, *Cathal-Crobhdhearg*; for *lamh*, *righ* and *crobh*, are ſynonima for the hand.

THE Romans had a ſtandard on which was painted an *hand erect*, as we find among the figures of the Trojan column; it was a ſymbol of power * which has eſcaped the notice of the Roman antiquaries.

* See KENNET's *Antiq.* JUST. LIPSIUS, &c.

*Manus*



*Manus authoritatem & poteſtatem ſignatiſſimè indicat* †. *Manus ſacra infert altaribus & pietatis omne munus peragit* ‡. "The hand "of the Lord ſhall be exalted," ſays the Pſalmiſt; and the prophet Jeremiah, ſpeaking of the power of God, ſays, "as the clay in "the potter's hand, ſo is the houſe of Iſrael in the hand of "God."

The metaphorical ſenſe of the Hebrew word יד iod, *a hand*, is uſed more largely (obſerves Mr. Bates in his Lexicon) than we uſe the word in Engliſh; it ſignifies *the power or means by which any thing exerts itſelf*; *the power or ability of any perſon*; with a double D, ידד it ſignifies ſhouting or clapping of hands. Parkhurſt defines the ſame word to import the hand of a man, the

† *Pierii Hieroglyph. ex ſacris Ægypt. literis*, p. 357.

‡ Ibidem.

paw

paw of a beaſt, power, ability, means, aſſiſtance, endeavour; contrivance, a border, extremity, ſide, a tract, tenons, (reſembling hands) ſtays, projecting fulcra, axes, axle-trees, parts, portions. Giving the hand to another was a token of ſubmiſſion. Homage is ſtill preſerved in many places by the perſons who do the homage, kneeling down and putting his hands between the hands of the Lord. Ezekiah commands the children of Iſrael to give the hand unto Jehovah, that is, to ſubmit themſelves or aſcribe the ſuperiority to him. Thus the Heathens, ſtretching out their hands to Heaven, did acknowledge the power, and implore the aſſiſtance of their reſpective Gods.

——— " duplices tendunt ad ſidera palmas."

In the Arabic language يد *yed*, ſignifies the hand, power, vigour, ſtrength, aſſiſtance, aid, protection, a benefit, ſervice, ſurrender, ſubmiſſion; بين يديه *bin yedeh*, literally, between his hands, ſignifies, before him, in his preſence. The word in Hebrew and Arabic is alſo applied to penitence, to confeſſion, or as we ſay, *to make appear as plain as the palm of the hand.*

In the Perſian, the word دست *deſt*, a hand *, ſignifies power, ſtrength, pre-excellence, ſuperiority, victory, end, termination, limit, boundary; hence *deſtan*, a key, pin or peg of a muſical inſtrument. *Ligatura in collo inſtrumenti muſici, a deſt manus, quæ illis impoſita chordæ variat tonas* †. *Deſtè*, a handful, a

* In Iriſh *deas*, the right hand.

† Golius, p. 826.

ſheaf,

ſheaf, a noſegay; *deſtan*, a collection, hiſtory, romance; *deſtur*, a prime miniſter, ſenator, counſellor, i. e. *the right hand of the ſtate*; a collection, record, chronicle; whence the Iriſh *deaſaran*, a repoſitory, hiſtory, record, chronicle.

FROM the Arabic and Perſian منت *menn*, or *men*, benevolent, benign, propitious, favourable, conferring a benefit, beneficence, grace, favour, is derived the Iriſh *man*, a hand, ſignifying the inſtrument of beneficence; ſo, from יד iod, the hand in Hebrew, the Iriſh formed *edam*, to handle; from *carr*, good, (Arabic خار *chara*, bene habuit, bono boniſque polluit) the Iriſh formed *carred*, a boſom friend, and the Arabians have خير خوان *kheir khauh*, of the ſame import; from خير cher, bonus vir. bono boniſque abundans *.

IF we trace the word ſignifying a hand to the Egyptians, we ſhall find the ſame metaphorical ſignifications; as ⲧⲟⲧ *dod* (Iriſh *doid)* a hand; ⲏⲧⲟⲧ *edod*, to have in poſſeſſion; *erdod*, to have wealth and power—in fine

NOSTRIS manibus in rerum naturâ, quaſi alteram naturam efficere conamur †.

BEFORE the invention of letters, thoſe nations who uſed hieroglyphics or picture writing, muſt have expreſſed theſe different metaphorical ſignifications by different poſitions of the hand,

* GOLIUS.

† CICERO *de Nat. Deor*, l. 2d, c. 60.

or

or hands; and this was the caſe with the Egyptians, as may be ſeen in Horus Appollo, and Pierius. The hand open and expanded was the hieroglyphic or ſymbol of benevolence and propitiouſneſs; and the hands in the monument before us are placed cloſe to the ſide of Chriſt, pointing to the names of the deceaſed —correſponding to the prayer—quorum animabus *propitietur* Chriſtus *.

It is no very great compliment to the Hiberno-Scythians or ancient Iriſh to allow them the uſe of picture writing. Almoſt all nations, even the moſt barbarous, have practiſed it. The authors of the ancient part of the Univerſal Hiſtory † tell us of a curious Hunno-Scythian MS. partly hieroglyphical, and partly alphabetical, ſtill exiſting at Florence, and promiſe to treat at large upon it in the Modern Hiſtory of the Hungarians. The authors of the modern part of this hiſtory have neglected to ſay more of it. Mat. Belus does alſo aſſure us the Hunno-Scythians do at this day make uſe of an alphabet, partly ſymbolical, and partly alphabetical ‡.

It is recorded by the moſt ſerious hiſtorians, that when Darius demanded *earth* and *water* of the Scythians, as a token of homage,

* To effect this, the inſcription commences at the foot of the ſtone, inſtead of the head, as uſual.

† Vol. xx. p. 18.

‡ Two very learned nations, the Egyptians and Chaldeans, did the ſame. See Caylus and Cassiodorus, ube ſacra priſcorum Chaldaſcis ſignis, quaſi literis, indicantur. See alſo Marsham, *Seculum*, xvi. p. 4333.

 and

and of ſurrendering their country to him; inſtead thereof, Indathyrſus, their king, ſent him a *bird*, a *mouſe*, a *frog*, and *five arrows*. Darius would fain have conſtrued theſe into a ſubmiſſion; ſaying, the mouſe is bred in the *earth*, the frog lives in *water*, and the bird may be compared to a *horſe*, and by the arrows they ſeem to deliver their whole force into my hands. But Gobrias was of opinion that the Scythian gave them to underſtand by ſuch a meſſage, that unleſs the Perſians could aſcend into the air like a bird, or conceal themſelves in the earth like mice, or plunge into the fens like frogs, they ſhould inevitably periſh by the arrows.

We are told by Horus Apollo, that by the *hawk*, the Egyptians ſignified God, ſublimity, excellence, humility, wind, blood, victory, the ſoul, &c.; by the *dog*, a ſcribe, a prophet, ſpleen, ſmelling, laughter, ſneezing, an officer, a judge, for reaſons which appear as ridiculous as the meaning was precarious.

I cannot think that ſo wiſe a people as the Egyptians would regiſter their public acts in ſo vague and uncertain a manner, and that we want the key to explain their ſymbols in a more ſatisfactory manner. That key appears to me to have been the ſynonima of their language. As in the monument of Luſk *man* ſignifying the hand, implied alſo *propitiouſneſs*; *man* alſo ſignifies ſtrength; hence the hand, in another attitude, implies power. " Du Celte *man*, fort, elevation, parfait en bonté, &c. &c. vinrent " *man*, la main, lat. manus," &c. &c. *

* Gebelin, *Dict. Etymol. Lat.* p. 1124.

Let

LET us now try to explain the ſymbolic anſwer of Indathyrſus, by the Hiberno-Scythian dialect, taking the ſynonima of each object.

*Ean*, a bird, ſignifies alſo warlike inſtruments; war, as in *Ean gniomh*, dexterity at weapons. Heb. חנה *hhane*, to war.
*Luc*, a mouſe—a priſoner, an hoſtage.
*Loſgan*, a frog—wounded, maimed in battle.
*Crann-corr*, and *Suam-nim*, } to caſt lots by arrows; fate, deſtiny; and theſe were always five in number.

*Crann-corr* and *ſuam-nim* (i. e. facere *ſuam)* occur frequently in Iriſh, ſignifying to caſt a fate by arrows. *Crann* is an arrow, as in *crann-tabhal*, a baliſta, or caſter of arrows; *ſuam* is the Arabic سهام ſuham, an arrow; whence *ſuham-kuza*, the arrow of deſtiny; in Arabic قران kuran, or قرن kurn, is alſo an arrow; whence our *crann*.

I THEREFORE interpret Indathyrſus's meſſage thus, "If you "proceed in the war, the fate of your army will be, either to "be taken priſoners, or be cut in pieces in the field."

"Exemplo patrum commotus amore legendi
"Ivit ad Hibernos, ſophiâ mirabili claros."

EVEN miſtaken writers, ſays Mr. Collins, by putting men upon enquiries, may make them ſee farther than themſelves: and by this means both encreaſe the number of capable judges, and render ſome of the learned better judges than they were

 before.

before. " Neque vero erraſſe turpe eſt, eſt enim initium ſapientiæ ; " ſi non ei ipſi qui fallitur, at aliis non fallendi *."

SHOULD the learned favour this mode of explaining hieroglyphics and picture writing by ſynonima, inſtead of the uſual method, from the qualities of the thing repreſented, the attempt will afford me pleaſure ; if not, the reader may ſtill be indebted to my errors, and I truſt to the cenſure of the public.

THE reading of Egyptian hieroglyphics by the various interpretations of the word, ſignifying the object painted or repreſented, ſeems to have ſtruck *Horapollo*, or whoever was the author of that work, but it was barely conjecture :—βαι, bai, ſays he, ſignified a hawk, the ſoul, and the wind, therefore the Egyptians uſed the hawk as a ſymbol for the ſoul. The word is written *bais* in the Nomenclatura Egyptiaco-Arabica, publiſhed by Kircher. Doctor Woide follows Kircher ; but in the LEXICON COPTICO-GRÆCO, in the Bibliotheque du Roy at Paris, we find βαι bai, ſpecies aliqua accipitrum ; and the ſame occurs in Cælius, l. 4. c. 16, viz. " opinantur Egyptii animæ conceptum eſſe *cor* ; " qua ratione cum accipitris nomine indicari *animam* putent, " illum vocabulo gentilitio βαιηθ, bai-eth, nuncupant, quod " *animam* ſignat & *cor:* ſiquidem *bai*, anima eſt, *eth* vero " cor †."

* SCAL. *de Cauſ.* L. L.

† See alſo JABLONSKI *Egypt. Panth. Proleg.* p. cxxxvii. and EUSEBIUS *Præp.* l. 3. c. 12.

THIS

THIS brings to my mind another inſtance of Ægyptian hieroglyphics having been uſed by the Iriſh, and of having been blended with their monumental ornaments ſince Chriſtianity, as in that of WALTER DERMOT before us.

ON the walls of the ruined abbey of *Magheo** or Knockmoy, the burial place of many kings of Connaught of the *Hy-Briun* race, are the ſkeletons of ſeveral of theſe kings, painted in freſco over their tombs, and on the hands of the figures are repreſented *hawks* in the attitude of riſing to fly, to ſignify the ſeparation of the ſoul from the body.

THESE hieroglyphics are perfectly agreeable to the Iriſh language as well as to the Ægyptian, for *bai*, *be*, *bi*, *ba*, ſignify life, the ſoul and wind; *badbh* or *ba-dubh*, the north wind, becauſe blowing from *dub*, the bear, urſa major, or north pole.

IN my VINDICATION OF THE ANCIENT HISTORY OF IRELAND, p. 79 and p. 541, ſeveral Ægyptian hieroglyphics are explained by ſynonima of the Iriſh language, and to this language the learned muſt be indebted for the explanation of moſt other Ægyptian ſymbols where the old Egyptian dialect is loſt.

THE learned Gebelin ſeems to have formed ſome idea of interpreting or reading the Ægyptian hieroglyphics by the various meanings of the word, expreſſing the ſymbol, but he has not made more obſervations than one, viz. that *hours* or *days* were repreſented by an *ape*, becauſe the word ſignifying an *ape*, does

* *Magh-eo*, i. e. the plains of the graves or the field of ſepulchres.

alſo

alſo ſignify a *revolution*; therefore, adds this author, ſearch the dictionaries for the word ſignifying the object painted, and write down all the various meanings of the ſame word; do the ſame by each hieroglyphic, and the ſenſe of the whole may be collected *.

We have reaſon to think Monſ. Gebelin is right; but how are we to come at the knowledge of theſe words in a language now loſt?

C. VALLANCEY.

* GEBELIN, *Origine de l'Ecriture*, p. 384.

*On the* SILVER MEDAL *lately dug up in the* PARK *of* DUNGANNON, COUNTY *of* TYRONE, *the Seat of the Right Honorable Lord* WELLES. *By Colonel* CHARLES VALLANCEY, *Member of the Royal Societies of London, Edinburgh and Dublin, &c. &c. Communicated by the Right Honorable the Earl of* CHARLEMONT, *P. R. I. A.*

THIS is one of those Arabian telesmanic medals called by the Arabs *Ain*, from the first letter of the inscription always beginning with that character. The mystical word is generally composed

Read March 3, 1789.

posed of three letters, viz. Ain, Lam, Ya, forming the word *Ali*, which is very conspicuous on the front of this medal.

The Cabalistical Arabs have written volumes on the charms and powers of this character. Take one as an example of the rest: *Zain Abadaal* says, "Whoever beholds and reflects on the "form of the letter ع* *Ain*," (which is commonly written with the final Ain thus ) "and shall read the mystical name of "God therein contained, (viz. *Ali*) shall be beloved by all who see "him; and if he shall be overtaken by storms and tempests God "will save him, and cause fountains of wisdom to flow in his "breast; and God will instruct him in the hidden mysteries of "science, and the occult significations of them. Moreover, if "any one shall write the letter *Ain* in these forms ع or ع in "the first hour of the Sabbath day, the moon being at the extre-"mity of one of her mansions, and shall bury this letter in any "place whatever, that place will be desolated and laid waste, "and no one will ever after inhabit it."

The word *Ain*, in Arabic, signifies not only the letter of the alphabet known by that name, but also, the eye, sight, aspect, a fountain, a spy, a speculator, the best part of any thing, a digni-

* Est autem litera *Ain* index nominis seu attributi Divini, quod vocatur *Ali*, i. e. excelsus, sublimis: Satis mirari non possim, impiorum hominum cæcitatem, dum literis & figuris nulliùs energiæ & efficaciæ, tantum tamen potestatis inesse sibi persuadent, ut eorum subsidio nihil illis denegatum videatur.

Kircher.

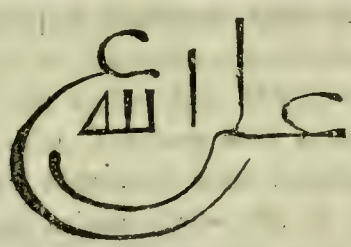
fied

ſied man, a Lord, the body of the ſun, alſo its rays, money, coin, gold or ſilver ſpecie, eſſence, any thing preſent, &c. &c. In Iriſh the word has nearly all theſe meanings, as the eye, water, fountain, noble, riches, cornu copiæ, the ſun, whence Belain, Griain, &c. &c.

THE inſcription *Ali* ſignifies high, noble, exalted; the proper name of a man, the ſon-in-law and fourth Khalif or ſucceſſor to Mahomet.

IN Iriſh the word *Ali* or *Eli* has the ſame ſignification, and was alſo a proper name, as Eli O'Carrol, Eli O'Ghurty, &c. &c.

SOMETIMES the Arabs included the word *Ali* within another *Ain*, with other myſtical characters, as in the following figure:



" Hoc ſigillum ſolita ſuperſtitione multum venerantur multumque
" geſtantibus conferre aſſerunt ad amoris allectamenta*."

* KIRCHER, *Oedip. Ægypt.*

I HAVE here ſubjoined a drawing of the medal of the ſize of the original. On the front is the word *Ali* encircled with the rays of the ſun; over the letters *Ya* is a ſtar. On the reverſe are two myſtical characters crowned with ſtars—I cannot explain them.

WHAT marks the ſingularity of this taliſman are the numerals under the word *Ali*. The figures are European, not Arabian.

FIGURES came firſt from the Perſians or Indians to the Arabians, and from them to the Moors, and ſo to the Spaniards, from whom the other Europeans received them. The Arabians acknowledge they had them from the Indians, as profeſſor Wallis has ſhewn from their writings.

WALLIS has offered ſome arguments to prove that Gerbertus, a monk, who was afterwards advanced to the Papal See, and took the name of Sylveſter II. had before the year 1000 learned the art of arithmetic as now practiſed, with the uſe of nine characters only (whatſoever their form then was) from the Saracens in Spain, which he afterwards carried into France. Theſe characters, however, were known for a long time after only to aſtronomers, and principally uſed by them in aſtronomical calculations; the Roman numerals being ſtill retained in common uſe to expreſs ſmaller numbers. Mr. Cope and Doctor Wallis, on ſtrict enquiry, find theſe numerals were firſt uſed in England about the year 1130.

THE

THE figures on our medal being moſt aſſuredly Spaniſh, Engliſh or Iriſh, and not Arabian*, Perſian or Indian†, it is probable this taliſman was ſtruck by the Saracens of Spain, at the requeſt of ſome European, who engaged them to put the date of the year in European figures. From the great intercourſe between this country and Spain, many of the taliſmans might have gained admittance into Ireland, and on that account they are worthy of explanation.

IN THE BOOK OF BALLYMOTE, among the Oghams, I find a perfect Perſian taliſman of the ſeven planets. If the ancient Iriſh or Hiberno-Scythians had theſe in common with the Orientaliſts, why might they not have been induced to ſtrike a medal alſo?

THE quotations from the Arabian author may be ſeen at large in the original language in Kircher's Oedipus Ægyptiacus, tom. II. part 1. p. 399. Cap. Cabala Saracenica.

C. VALLANCEY.

* Theſe numerals in Arabian characters would be thus //∧∨.

† See No. XII. of my *Collectanea de Rebus Hibernicis*, plate II. which ſhews the Indian, Arabian and European numerals in one table.

# *An* HISTORICAL ESSAY *on the* IRISH STAGE.

*By* JOSEPH C. WALKER, *Esq*; *Member of the Royal Irish Academy*; *Fellow of the Literary and Antiquarian Society of Perth, and honorary Member of the Etruscan Academy of Cortona.*

IN tracing the progress of society we discover the Drama amongst the first amusements of man. Soon as communities were formed, it appeared as well in the bleak regions of the North, as in those countries which feel the genial influence of the sun. Even History, when she first ventured to raise her voice, invoked the aid of the Dramatic muse. It is therefore very extraordinary that we cannot discover any vestiges of the Drama amongst the remains of the Irish Bards, or amongst the amusements of the vulgar Irish of this day*, though a people

Read March 3, 1789.

* It must, however, be observed that the vulgar Irish of the present day exhibit, in many parts of the kingdom, several awkward attempts at Comedy at their weddings and

ple ſo religiouſly obſervant of the cuſtoms of their anceſtors.

It is true that ſome Iriſh poems are conducted in a kind of dramatic narrative, and it is probable that theſe poems were recited at the convivial feaſts of the chiefs, and in the public conventions

and wakes; but theſe attempts cannot be conſidered as veſtiges of an ancient regular drama. Theſe pieces are called, *The Cottoning of Frize*; *The Marriage Act*; *The Servants ſerving their Lord at Table*; *The fulling or thickening of Cloth*, and *Sir Sop or Sir Sopin, the Knight of Straw.* The deſign of the laſt is evidently to hold up to ridicule the Engliſh character, and cannot therefore be a production of high antiquity. I will here give a ſhort analyſis of this piece. The principal characters, are an Iriſh chieftain, who always takes his title from the Iriſh family of moſt conſequence in the neighbourhood of the place where the play is exhibited; and an Engliſh chieftain, denominated Sir Sop or Sir Sopin. Sir Sop is dreſſed in ſtraw, with a clogad or helmet of the ſame materials on his head; but the Iriſh chieftain, who is the favourite hero, is clad in the beſt clothes that the wardrobes of his ruſtic audience can afford. When thoſe characters appear on the ſtage they are ſeparately attended by inferior officers and ſervants, who, like the ancient Greek chorus, ſtand at a reſpectful diſtance, while the chieftains converſe. Sometimes the chief officers are allowed to take a part in the dialogue. With the drift of the plot I am not perfectly acquainted, but know that the cataſtrophe is brought about by an altercation which ariſes between our two heroes, and terminates in ſingle combat. In this combat Sir Sopin wounds his adverſary, who falls, and a ſurgeon appears to examine the wound. Regaining his ſtrength the Iriſh chieftain retires, followed by Sir Sopin. Soon after they enter again, and renewing the combat, Sir Sopin receives a mortal wound, and is borne off the ſtage. The Iriſh chieftain having thus gained the field, brandiſhes his ſword and ſtrides exultingly acroſs the ſtage. Then pauſing a while, he addreſſes himſelf to heaven, offering thanks for his victory. This done, the curtain falls.—The dialogue is extremely humorous, and interſperſed with ſoliloques, ſongs and dances.

conventions by ſeveral bards, each bard aſſuming and ſupporting a character in the piece*: but no production in a regular Dramatic form is extant in the Iriſh language†, nor even alluded to by any of our ancient writers. So that if the Stage ever exiſted in Ireland previous to the middle ages, like the "baſeleſs fabric "of a viſion" it has melted into air, leaving not a trace behind.

YET in the Dances of the vulgar Iriſh we may diſcover the features of a rude Ballet, performed in honor of ſome Pagan deity, and accompanied, it may be preſumed, by hymnick verſes; and in an ancient deſcription of Tamer Hall, Druiſch Righeadh, or Royal Mimics or Comedians, are expreſsly mentioned‡. All this, however, only ſerves to open a field to conjecture, affording no

* Some of the Poems to which I allude will be ſhortly given to the public, tranſlated with elegance, ſpirit and fidelity, in *The Reliques of Iriſh Poetry*, now in the preſs.

† Mr. Macpherſon has indeed given, as a tranſlation from our Oiſin, a little dramatic poem called *Comala*, of which the Abbate CESSAROTTI, his elegant Italian tranſlator, thus ſpeaks: "La ſua picciolezza non pregiudica alla regolarità. Si "ravviſano in eſſa tutti i lineamenti a le proporzioni della Tragedia. C' è il ſuo "picciolo viluppo, i ſuoi colpi di teatro, e la ſua cataſtrofe inaſpettata: gran varietà "d' affetti, ſtile ſemplice e paſſionato: in ſomma queſta poeſia ha quelle virtù che ſi "ammirano tanto nei Greci." *Poeſie di Oſſian*, tom. I. page 181. But as the original of this poem has never been produced to the public, we cannot ſafely number it with the productions of our immortal bard.

‡ *Collect. de Reb. Hib.* vol. III. page 531.

no positive proof of the existence of a Stage amongst the early Irish.

We will then proceed to that period in which Irish history first introduces the Dramatic muse, mingling the waters of Jordan and Helicon *.

That the Irish clergy, as well as their brethren in England, occasionally exhibited Mysteries and Moralities previous to the reign of Henry VIII †, may be safely inferred from the following record preserved amongst the MSS. of Robert Ware.—

" Thomas

* Perhaps I should have commenced the history of the Irish Stage with the rise of the Mummers in Ireland. " The Mummers, (says Dodsley) as bad as they were, seem to be the true original comedians of England." *Collect. of Old Plays*, vol. i. pref. But the stage rather sprang from, than commenced with the Mummers. Here I will take leave to observe, that, at this day, the dialogue of the Irish Mummers in general (for I have collected it in different parts of the kingdom), bears a strict resemblance, in point of matter, with a specimen of the dialogue of the English Mummers in the reign of Edward III. which Mr. Ritson has happily rescued from oblivion. See *Rem. on the text, and last edit. of Shakespear.* It is also deserving of observation, that our Mummers are always accompanied by a Buffoon, whose dress and antic manners answer the description of the Vice of the old English comedies, the precursor of the modern Punch. This character likewise appears in the pageant with which the Irish rustics celebrate the first of May.

† Although the classical names of Comedy and Tragedy did not obtain in England till the reign of Henry VIII. (see Percy's *Reliq. of Anc. Eng. Poet.* vol. i. p. 137.) yet Sir James Ware, speaking of the rejoicings that followed the proclaiming Henry King

" THOMAS FITZ-GERALD, Earl of Kildare, and Lord Lieute-
" nant of Ireland in the year 1528, was invited to a new play
" every day in Chriſtmas, Arland Uſher being then mayor, and
" Francis Herbert and John Squire bayliffs, wherein the Taylors
" acted the part of Adam and Eve; the Shoemakers repreſented
" the ſtory of Criſpin and Criſpianus; the Vintners acted Bachus
" and his ſtory; the Carpenters that of Joſeph and Mary; Vulcan,
" and what related to him, was acted by the Smiths; and the
" comedy of Ceres, the goddeſs of corn, by the Bakers. Their
" ſtage was erected on Hoggin-green, (now called College-green,)
" and on it the priors of St. John of Jeruſalem, of the bleſſed
" Trinity, and of all All-hallows, cauſed two plays to be acted,
" the one repreſenting the paſſion of our Saviour, and the other
" the ſeveral deaths which the apoſtles ſuffered." From this record (which is the firſt expreſs mention that has occurred to me of the repreſentation of Myſteries and Moralities in Ireland) it ſhould ſeem, that it was cuſtomary with the chief magiſtrates of Dublin to invite the Lord Lieutenant to a new play every day in Chriſtmas *; and therefore, as I have already obſerved, it may be

 inferred,

King of Ireland, enumerates comedies with the amuſements on that occaſion.— " Epulas, *Comœdias*, et certamina ludicra, quæ ſequebantur, quid attinet dicere?" But Sir James, little ſkilled in polite literature, has probably dignified the rude Moralities of our anceſtors with the appellation of Comedies.

* I have been informed, that it was alſo formerly cuſtomary with the ſeveral corporations of Dublin to invite the Chief Governor to a play at St. George's Chapel on the anniverſaries of their patron Saints.

inferred, that Dramatic entertainments were exhibited in Ireland before this period. But it was not only to amuſe the Chief Governor that Myſteries and Moralities were performed in Dublin: they were got up (to ſpeak in the language of the modern theatre) on every joyful occaſion. In a MS. in the library of Trinity College, Dublin, it is related, " that in an expedition made " againſt James Mac-Connell by the Lord Deputy Suſſex in 1557, " he was attended by John Uſher, Captain, and Patrick Bulkeley, " Petty-Captain, with ſixty of the city trained-bands; and upon " their return THE SIX WORTHIES was played by the city, and " the Mayor gave the public a goodly entertainment upon the " occaſion, found four trumpeters horſes for the ſolemnity, and " gave them twenty ſhillings in money."

ALTHOUGH it may be preſumed, that theſe exhibitions, as well as thoſe in England at the ſame period, were conducted by the Church, yet we find, not only from the paſſages above quoted, but from the following entries in the CHAIN-BOOK of Dublin, that the corporations uſually ſupplied performers: it alſo appears from thoſe entries, that the dreſſes, ſcenery and machinery, were likewiſe ſupplied by the city.

" IT was ordered, in maintenance of the Pageant of St. George, " that the Mayor of the foregoing year ſhould find the Emperor " and Empreſs with their train and followers, well apparelled " and accoutered; that is to ſay, the Emperor attended with two doctors,

" doctors, and the Empreſs with two knights, and two maidens " richly apparelled to bear up the train of her gown."

" Item, 2dly. The Mayor for the time being was to find St. " George a horſe, and the wardens to pay 3s. 4d. for his wages " that day: The bailiffs for the time being were to find four " horſes, with men mounted on them well apparelled, to bear " the pole-axe, the ſtandard, and the ſeveral ſwords of the " emperor and St. George."

" Item, 3dly. The elder maſter of the guild was to find a " maiden well attired to lead the dragon, and the clerk of the " market was to find a golden line for the dragon."

" Item, 4thly. The elder warden was to find for St. George " four trumpets; but St. George himſelf was to pay their " wages."

" Item, 5thly. The younger warden was obliged to find the " King of Dele and the Queen of Dele, as alſo two knights to " lead the Queen of Dele, and two maidens to bear the train of " her gown, all being entirely clad in black apparel. Moreover, " he was to cauſe St. George's Chapel to be well hung in black, " and completely apparelled to every purpoſe, and was to pro- " vide it with cuſhions, ruſhes, and other neceſſaries for the " feſtivity of that day."

My record proceeds:—" No leſs was the preparation of Pa-
" geants for the proceſſion of Corpus Chriſti day, on which,

" The Glovers were to repreſent Adam and Eve, with an Angel
" bearing a ſword before them."

" The Corriſees (perhaps Curriers) were to repreſent Cain and
" Abel, with an altar, and their offering."

" Mariners and Vintners, Noah, and the perſons in his ark, ap-
" parelled in the habits of Carpenters and Salmon-takers."

" The Weavers perſonated Abraham and Iſaac, with their offer-
" ing and altar."

" The Smiths repreſented Pharaoh, with his hoſt."

" The Skinners, the Camel with the Children of Iſrael."

" The Goldſmiths were to find the King of Cullen."

" The Hoopers were to find the Shepherds with an Angel
" ſinging, *Gloria in excelſis Deo.*"

" Corpus Chriſti guild was to find Chriſt in his paſſion, with
" the Marys and Angels."

" The Taylors were to find Pilate with his fellowſhip, and his
" wife cloathed accordingly."

" The Barbers, Anna and Caiaphas."

" The Fiſhers, the Apoſtles."

The

" The Merchants, the Prophets."

" And the Butchers, the Tormentors *."

All these Pageants moved in solemn procession to St. George's Chapel, the scene of their Dramatic exhibitions †.

Grave as the subjects, in general, of those exhibitions appear to have been, it is probable that the blandishments of the comic muse sometimes lured their authors into the walks of wit and humour. Here indeed they might have ranged without offence: but not content to excite innocent mirth, they introduced profaneness and immorality on the Stage. The piety of John Bale ‡ (then

* The memory of those Pageants continued to be preserved in the Franchises that were rode triennially in Dublin till the year 1772, when they were abolished by the Lord Mayor's Proclamation.

† This chapel stood in St. George's-lane (now St. George's-street, South), whence it derived its name. Not a trace of the building remains. Stannihurst supposes it had been founded by some worthy knight of the Garter, and thus laments its fate: " This chappell hath beene of late razed, and the stones thereof, by consent of the " assemblie, turned to a common oven, converting the ancient monument of a doutie, adventurous and holie knight, to the colerake sweeping of a pufloafe baker." *Desc. of Irel.* in Holinshed's *Chron.* page 23.

‡ Bale was a versatile genius. Besides *God's Promises* and *John Baptist*, he wrote several other dramatic pieces, some of which still remain inedited. He also engaged in controversy, but with so much acrimony, that he has been called *bilious* Bale. But literary history was his favourite pursuit. When Bale's dramatic and controversial

(then Biſhop of Oſſory) taking the alarm, he aroſe, like another Collier, to preſerve the mirror of Nature from being ſullied. To effect this, inſtead of employing his favourite inſtrument of invective, he wrote ſome Dramatic pieces, inculcating morality and breathing the ſpirit of the Goſpel. Two of thoſe pieces—namely God's Promises and John Baptist—were acted by young men at the market-croſs in Kilkenny, on a ſunday, in the year 1552 *.

In order to convey an idea of the tendency of thoſe pieces, and of the rude ſtate of the Drama at this time, I ſhall here tranſcribe the argument of God's Promises †, as ſuppoſed to be delivered by the Author in perſon.—

Baleus proclocutor.

" If proſyght maye growe, moſt Chriſten audyence,
" By knowlege of thynges which are but tranſytorye,
" And

troverſial writings ſhall be forgotten, poſterity will continue to admire the author of *Scriptorum illuſtrium majoris Britanniæ quam Angliam et Scotam vocat Catalogus.* See Dodsley's *Collect. of Old Plays*, 2d Edit. vol. I. and Warton's *Hiſt. of Eng. Poet.* vol. III.

* See *Collect. de Rebus Hib.* vol. II. p. 388.

† In this piece, which was written chiefly to vindicate the doctrine of grace, againſt ſuch as held the doctrine of free-will and the merit of works, Adam, Abraham, Noah, Moſes, Iſaiah, David and John the Baptiſt, are all introduced on the ſtage with the Almighty!

" And here for a tyme: Of moch more congruence,
" Advantage myght ſprynge, by the ſerche of cauſes heavenlye,
" As thoſe matters are, that the goſpell ſpecyfye.
" Without whoſe knowledge no man to the truthe can come,
" Nor ever atteyne to the lyfe perpetuall."

" For he that knoweth not the lyvynge God eternall,
" The Father, the Sonne, and alſo the Holye Ghoſt,
" And what Chriſt ſuffered for redempcyon of us all,
" What he commaunded, and taught in every cooſt,
" And what he forbode, That man muſt nedes be loſt,
" And cleane ſecluded, from the faythfull choſen ſorte,
" In the heavens above, to hys moſt hygh dyſconforte."

" You therfor (good fryndes) I lovyngely exhort,
" To waye ſoche matters, as wyll be uttered here,
" Of whom ye maye loke to have no tryfeling ſporte
" In fantaſyes fayned, not ſoche lyke gaudyſh gere,
" But the thyngs that ſhall your inwarde ſtomake chear,
" To rejoyce in God for your juſtyfycacyon,
" And alone in Chriſt to hope for your ſalvacyon.

" Yea, firſt ye ſhall have the eternal generacyon
" Of Chriſt, like as Johan in hys firſt chaptre wryght,
" And conſequently of man the firſt creacyon,
" The abuſe and fall, through hys firſt overſyght,
" And the rayſe agayne, through God's hygh grace and myght:

" By

" By promyſes firſt, whych ſhall be declared all,
" Then by hys owne Sonne, the worker pryncypall."

" After that Adam bywayleth here hys fall,
" God wyll ſhewe mercye to every generacyon,
" And to hys kyngedom, of hys great goodneſſe call
" Hys elected ſpouſe, or faythfull congregacyon,
" As here ſhall apere by open proteſtacyon,
" Which from Chriſte's birthe ſhall to hys death conclude,
" They come that therof wyll ſhewe the certytude."

Regardless, however, of the Biſhop's ſtrenuous oppoſition to the ſufferance of profaneſs on the Stage, it ſhould ſeem from an act paſſed in the ſecond year of the reign of Elizabeth, that the comic muſe ſtill preſumed to ſport with the holy word, directing her wit againſt the Liturgy of the newly-eſtabliſhed Church. By this act (which is intituled, An Act for the uniformitie of Common Prayer and Service in the Church, and the administration of the Sacraments,) " it is ordeyned and enacted, that if any per-
" ſon or perſons* whatſoever, after the feaſt of St. John Baptiſt,
" ſhall in any *Enterludes*, *Playes*, Songs, Rimes, or by other open
" words, declare or ſpeake any thing in derogation, depraving or
deſpiſing

* The perſons alluded to in this act were probably *thoſe certain perſons* noticed by Spenser, *whoſe proper function it was*, to ſing at all feaſts and meetings, in his time, the productions of the Iriſh Bards. See *View of the State of Ireland*, and *Hiſt. Mem. of the Iriſh Bards*, p. 143.

" deſpiſing of the ſame booke, or of any thing therein conteyned, " or any part thereof, ſhall forfeit to the Queene our Sove- " raigne Lady, her heyres and ſucceſſors, for the firſt offence " an hundred markes; and if any perſon or perſons being " once convict of any ſuch offence, eftſoones offend againſt " any of the ſaid recited offences, and ſhall in forme afore- " ſaid be thereof lawfully convict, that then the ſame perſon " ſo offending and convict, ſhall for the ſecond offence forfeit " to the Queene our Soveraigne Lady, her heyres and ſucceſſors, " foure hundred marks; and if any perſon after he in forme " aforeſaid, ſhall have been twiſe convict of any offence, con- " cerning any of the laſt recited offences, ſhall offend the third " time, and be thereof in forme aforeſaid lawfully convict, that " then every perſon ſo offending and convict, ſhall for his " third offence forfeit to our Soveraigne Lady the Queene, " all his goods and cattels, and ſhall ſuffer impriſonment during " his life."

From the reign of Elizabeth to that of Charles I. a dark cloud obſcures the hiſtory of the Iriſh Stage. Yet Dramatic exhibitions had not ceaſed; for in the tenth and eleventh years of the reign of Charles I. an act was paſſed for the erecting of houses of Correction, and for the punishment of Rogues, Vagabonds, Sturdy Beggars and other lewd and idle persons, in which all Juſtices of the Peace of the different counties wherein they might be found, are directed to ſend to the houſes of correction all Fencers,

Bear-wardes, *Common Players of Enterludes*, and Minſtrels wandering abroad. So that we may hence conclude, the Stage had not only continued its amuſements, but, unawed by the puritanical ſpirit of the times, had become licentious. However, though coercive meaſures were thus taken by Parliament to ſilence the Stage, it was countenanced by the court. About this time a Maſter of the Revels * was placed on the eſtabliſhment, and under his direction a Theatre was erected (1635) in Werburgh-ſtreet, Dublin, whither were invited all the itinerant players of diſtinguiſhed merit, who had formerly been neceſſitated to ſtrole from booth to booth in the principal towns and cities, and to wander from hall to hall amongſt the rural manſions of the Gentry and Nobility.

It is very probable that previous to the period now under conſideration, Dramatic entertainments were not numbered with the elegant amuſements of the court, though Mr. Chetwood aſſerts, on the authority of a wax-chandler's bill, that Gorbuduc and ſeveral other plays, had been performed in the Caſtle of Dublin during the adminiſtration of Blount, Lord Mountjoy, in the reign of Elizabeth †. Now, had there really been ſuch exhibitions,

* John Ogilby, well known by his tranſlations of Homer and Virgil, was the firſt perſon appointed to the office of Maſter of the Revels in Ireland. Under his direction, and at his expenſe, the theatre in Werburgh-ſtreet was erected. According to Harris this theatre coſt two thouſand pounds. See Wares' *Works*, vol. II. p. 352, where all the extraordinary viciſſitudes of Ogilby's life are circumſtantially related.

† *Gen. Hiſt. of the Stage*, page 51.

exhibitions, the expenſes would certainly have been defrayed by an order of the Lord Deputy or Privy Council, on the Deputy Vice Treaſurer; yet no ſuch order appears either in the Treaſury office, or in the archives of the office of the Auditor General—at leaſt, if ſuch an order does exiſt, it has eſcaped my reſearches.

THE Theatre in Werburgh-ſtreet continued to be opened, occaſionally, under the ſanction of Government till the year 1641, when it cloſed for ever *.

FROM Werburgh-ſtreet the ſcene of the Drama was ſhifted to Orange-ſtreet (now Smock-alley) in 1661. But during the civil wars that ſoon after broke out, the whole company were diſperſed; ſo that when the people of Dublin, on the defeat of king James's army, at the battle of the Boyne, amongſt other expreſſions of joy, ſays Cibber, had a mind to have a play, they could find no actor to aſſiſt, and ſome private perſons agreed to give one, at their own expenſe, to the public at the Theatre †.

FROM

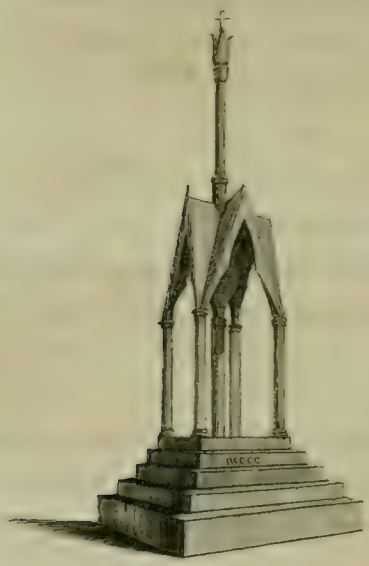
* The laſt play performed at this theatre was *Landgartha*, a tragi-comedy, written by HENRY BURNEL, Eſq. of whom I have only been able to learn, that he was born in Ireland, and flouriſhed about the cloſe of the reign of Charles I.

† *Apology*, page 136.

FROM this time every event of the Irish Stage has been so faithfully and so minutely recorded, that nothing is left for me to add to its history*. Here, therefore, I shall dismiss the subject.

JOSEPH C. WALKER.

* See CIBBER's *Apology;* CHETWOOD's *Gen. Hist. of the Stage;* VICTOR's *Hist. of the Stage;* DAVIS' *Life of Garrick;* and HITCHCOCK's *View of the Irish Stage.*



THE MARKET CROSS OF KILKENNY
See Page 86

END OF THE TRANSACTIONS FOR THE YEAR 1788.