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**A memoir of the life, writings, and mechanical inventions of Edmund Cartwright**

**Cartwright, Edmund**

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Appendix.

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## APPENDIX.

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### A.

#### ARMINE AND ELVIRA: A LEGENDARY TALE.

(See p. 17.)

THE preceding Memoir has been chiefly devoted to the history of Dr. Cartwright's mechanical and scientific labours. But as some of our readers may wish to be further informed as to his poetical powers, we have been induced to republish one of his early productions, which, though enjoying great popularity in its day, has been long out of print. The reader will perceive that it belongs to the refined and classic school of the last century, before poets had ventured on those brilliant but eccentric flights which attract so much favour at the present day.

#### PART I.

A hermit on the banks of Trent,  
Far from the world's bewildering maze,  
To humbler scenes of calm content  
Had fled from brighter, busier days.

If haply from his guarded breast  
Should steal the unsuspected sigh,  
And memory, an unbidden guest,  
With former passions fill'd his eye;

Then pious Hope and Duty praised  
 The wisdom of th' Unerring Sway ;  
 And while his eye to heaven he raised,  
 Its silent waters stole away.

Life's gayer ensigns once he bore—  
 Ah! what avails the mournful tale ?  
 Suffice it, when the scene was o'er,  
 He fled to the sequester'd vale.

"What though the joys I loved so well,  
 The charms," he cried, "that youth has known,  
 Fly from the hermit's lonely cell!  
 Yet is not Armine still my own ?

"Yes, Armine, yes, thou valued youth !  
 'Midst every grief thou still art mine !  
 Dear pledge of Winifreda's truth,  
 And solace of my life's decline !

"Though from the world and worldly care  
 My wearied mind I mean to free,  
 Yet ev'ry hour that Heav'n can spare,  
 My Armine, I devote to thee.

"And sure that Heaven my hopes shall bless,  
 And make thee famed for virtues fair,  
 And happy, too, if happiness  
 Depend upon a parent's prayer.

“ Last hope of life's departing day,  
In whom its future scenes I see !  
No truant thought shall ever stray  
From this lone hermitage and thee.”

Thus, to his humble fate resign'd,  
His breast each anxious care foregoes ;  
All but the care of Armine's mind,  
The dearest task a parent knows !

And well were all his cares repaid ;  
In Armine's breast each virtue grew,  
In full maturity display'd  
To fond Affection's anxious view.

Nor yet neglected were the charms,  
To polish'd life that grace impart ;  
Virtue, he knew, but feebly warms,  
'Till Science humanize the heart.

And when he saw the lawless train  
Of passions in the youthful breast,  
He curb'd them, not with rigid rein,  
But strove to soothe them into rest.

“ Think not, my son, in this,” he cried,  
“ A father's precept shall displease :  
No—be each passion gratified  
That tends to happiness or ease.

“ Nor shall th' ungrateful task be mine  
Their native generous warmth to blame,  
That warmth if Reason's suffrage join  
To point the object and the aim.

“ This suffrage wanting, know, fond boy,  
That every passion proves a foe :  
Though much it deal in promised joy,  
It pays, alas ! in certain woe.

“ Complete Ambition's wildest scheme ;  
In Power's all-brilliant robes appear ;  
Indulge in Fortune's golden dream ;  
Then ask thy breast if Peace be there :

“ No : it shall tell thee, Peace retires  
If once of her loved friends deprived ;  
Contentment calm, subdu'd desires,  
And happiness that's self-derived.”

To temper thus the stronger fires  
Of youth he strove, for well he knew,  
Boundless as thought though man's desires,  
The real wants of life were few.

And oft revolving in his breast  
Th' insatiate lust of Wealth or Fame,  
He, with no common care opprest,  
To Fortune thus would oft exclaim :

“ O Fortune ! at thy crowded shrine  
What wretched worlds of suppliants bow !  
For ever hail'd thy pow'r divine,  
For ever breath'd the serious vow.

“ With tottering pace and feeble knee,  
See Age advance in shameless haste ;  
The palsied hand is stretched to thee  
For wealth he wants the power to taste.

“ See, led by Hope, the youthful train,  
Her fairy dreams their hearts have won ;  
She points to what they ne'er shall gain,  
Or dearly gain—to be undone.

“ Must I, too, form the votive prayer,  
And wilt thou hear one suppliant more ?  
His prayer, O Fortune, deign to hear,  
To thee who never pray'd before.

“ O may one dear, one favour'd youth,  
May Armine still thy pow'r disclaim ;  
Kneel only at the shrine of Truth,  
Count Freedom Wealth, and Virtue Fame.”

Lo ! to his utmost wishes blest  
The prayer was heard ; and Freedom's flame,  
And Truth, the sunshine of the breast,  
Were Armine's wealth, were Armine's fame.

His heart no selfish cares confined,  
He felt for all that feel distress,  
And, still benevolent and kind,  
He blest them, or he wish'd to bless.

For what though Fortune's frown deny  
With wealth to bid the sufferer live?  
Yet Pity's hand can oft supply  
A balm she never knew to give:

Can oft with lenient drops assuage  
The wounds no ruder hand can heal,  
When Grief, Despair, Distraction, rage,  
While Death the lips of Love shall seal.

Ah! then, his anguish to remove,  
Deprived of all his heart holds dear,  
How sweet the still surviving love  
Of Friendship's smile, of Pity's tear!

This knew the sire: he oft would cry —  
“ From these, my son, O ne'er depart!  
These tender charities, that tie  
In mutual league the human heart.

“ Be thine those feelings of the mind  
That wake at honour's, friendship's call;  
Benevolence, that unconfined  
Extends her liberal hand to all.

“ By Sympathy's untutor'd voice  
Be taught her social laws to keep ;  
*Rejoice with them that do rejoice,*  
*And weep with them that weep.*

“ The heart that bleeds for others' woes,  
Shall feel each selfish sorrow less ;  
His breast who happiness bestows,  
Reflected happiness shall bless.

“ Each ruder passion still withstood  
That breaks o'er Virtue's sober line,  
The tender, noble, and the good,  
To cherish and indulge be thine.

“ And yet, my Armine, might I name  
One passion as a dangerous guest ?  
Well may'st thou wonder when I blame  
The tenderest, noblest, and the best.

“ Nature, 'tis true, with Love design'd  
To smoothe the race our fathers ran,  
The savage of the human kind  
By Love was soften'd into man.

“ As feels the ore the searching fire,  
Expanding and refining too,  
So fairer glow'd each fair desire,  
Each gentle thought so gentler grew.

“ How changed, alas ! those happier days !  
A train how different now succeeds !  
While sordid Avarice betrays,  
Or empty Vanity misleads.

“ Fled from the heart each nobler guest,  
Each genuine feeling we forego ;  
What Nature planted in the breast,  
The flowers of love, are weeds of woe.

“ Hence all the pangs the heart must feel  
Between contending passions toss'd,  
Wild Jealousy's avenging steel,  
And life and fame and virtue lost !

“ Yet falling life, yet fading fame,  
Compared to what his heart annoy  
Who cherishes a hopeless flame,  
Are terms of happiness and joy.

“ Ah ! then, the soft contagion fly !  
And timely shun th' alluring bait !”  
The rising blush, the downcast eye,  
Proclaim'd—The Precept was too late.

## PART II.

Deep in the bosom of a wood,  
Where Art had form'd the moated isle,  
An antique castle towering stood ;  
In Gothic grandeur rose the pile.

Here Raymond, long in arms renown'd,  
From scenes of war would oft repair ;  
His bed an only daughter crown'd,  
And smiled away a father's care.

By Nature's happiest pencil drawn,  
She wore the vernal morning's ray :  
The vernal morning's blushing dawn  
Breaks not so beauteous into day.

Her breast, impatient of control,  
Scorn'd in its silken chains to lie,  
And the soft language of the soul  
Flow'd from her never silent eye.

The bloom that open'd on her face  
Well seem'd an emblem of her mind,  
Where snowy innocence we trace,  
With blushing modesty combined.

To these resistless grace impart  
That look of sweetness form'd to please,  
That elegance, devoid of art,  
That dignity that's lost in ease.

What youth so cold could view unmoved  
The maid that every beauty shared?  
Her Armine saw—he saw, he loved,  
He loved—alas! and he despair'd!

Unhappy youth! he sunk oppress'd;  
For much he labour'd to conceal  
That gentlest passion of the breast,  
Which *all* can feign, but *few* can feel.

Ingenuous fears suppress'd the flame,  
Yet still he own'd its hidden power;  
With transport dwelling on her name,  
He soothed the solitary hour.

“How long,” he cried, “must I conceal  
What yet my heart could wish were known?  
How long the truest passion feel,  
And yet that passion fear to own?”

“Ah! might I breathe my humble vow!  
Might she, too, deign to lend an ear!  
Elvira's self should then allow  
That Armine was at least sincere.”

“ Wild wish! to deem the matchless maid  
Would listen to a youth like me,  
Or that my vows could e'er persuade,  
Sincere and constant though they be!

“ Ah! what avails my love or truth?  
She listens to no lowly swain;  
Her charms must bless some happier youth,  
Some youth of Fortune's titled train.

“ Then go, fallacious Hope! adieu!  
The flattering prospect I resign;  
And bear from my deluded view  
The bliss that never must be mine!

“ Yet will the youth, whoe'er he be,  
In truth or tenderness excel?  
Or will he on thy charms, like me,  
With fondness never dying dwell?

“ Will he with thine his hopes unite?  
With ready zeal thy joys improve?  
With fond attention and delight  
Each wish prevent, each fear remove?

“ Will he, still faithful to thy charms,  
For constant love be long rever'd?  
Nor quit that heaven within thy arms  
By every tender tie endear'd?

“ What though his boastful heart be vain  
Of all that birth or fortune gave ?  
Yet is not mine, though rude and plain,  
At least as noble and as brave ?

“ Then be its gentle suit preferr'd !  
Its tender sighs, Elvira, hear !  
In vain—I sigh, but sigh unheard ;  
Unpitied falls this lonely tear !”

Twice twelve revolving moons had past,  
Since first he caught the fatal view ;  
Unchanged by time his sorrows last,  
Uncheer'd by hope his passion grew.

That passion to indulge, he sought  
In Raymond's groves the deepest shade ;  
There Fancy's haunting spirit brought  
The image of his long-loved maid.

But hark ! what more than mortal sound  
Steals on Attention's raptur'd ear !  
The voice of Harmony around  
Swells in wild whispers soft and clear.

Can human hand a tone so fine  
Sweep from the string with touch profane ?  
Can human lip, with breath divine,  
Pour on the gale so sweet a strain ?

'Tis she—the source of Armine's woe!  
 'Tis she—whence all his joy must spring!  
 From her loved lips the numbers flow,  
 Her magic hand awakes the string.

Now, Armine, now, thy love proclaim—  
 Thy instant suit the time demands;  
 Delay not! Tumult shakes his frame,  
 And lost in ecstasy he stands!

What magic chains thee to the ground?  
 What star malignant rules the hour—  
 That thus, in fix'd delirium drown'd,  
 Each sense intranced hath lost its power?

The trance dispel! Awake! arise!  
 Speak what untutor'd love inspires!  
 The moment's past—thy wild surprise  
 She sees, nor unalarm'd retires.

“ Stay, sweet illusion, stay thy flight!  
 'Tis gone! Elvira's form it wore.  
 Yet one more glimpse of short delight!  
 'Tis gone! to be beheld no more.

“ Fly, loitering feet, the charm pursue  
 That plays upon my hopes and fears!  
 Ha! no illusion mocks my view!  
 'Tis she—Elvira's self appears!

“ And shall I on her steps intrude ?  
 Alarm her in these lonely shades ?  
 O stay, fair nymph ! no ruffian rude,  
 With base intent, your walk invades.

“ Far gentler thoughts”—his faltering tongue,  
 By humble diffidence restrain'd,  
 Paus'd in suspense—but thus, ere long,  
 As love impell'd, its power regain'd.

“ Far gentler thoughts that form inspires !  
 With me, far gentler passions dwell ;  
 This heart hides only blameless fires,  
 Yet burns with what it fears to tell.

“ The faltering voice, that fears control,  
 Blushes, that inward fires declare,—  
 Each tender tumult of the soul  
 In silence owns Elvira there.”

He said; and as the trembling dove,  
 Sent forth t' explore the watery plain,  
 Soon fear'd her flight might fatal prove,  
 And sudden sought her ark again—

His heart recoil'd, as one that rued  
 What he too hastily confest ;  
 And all the rising soul, subdued,  
 Sought refuge in his inmost breast.

The tender strife Elvira saw,  
Distress'd; and as some parent mild,  
When arm'd with words and looks of awe,  
Melts o'er the terrors of her child,

Reproof prepar'd, and angry fear,  
In soft sensations died away;  
They felt the force of Armine's tear,  
And fled from pity's rising sway.

"That mournful voice, that modest air,  
Young stranger, speak the courteous breast;  
Then why to these rude scenes repair,  
Of shades the solitary guest?"

"And who is she whose fortunes bear  
Elvira's melancholy name?  
O may those fortunes prove more fair  
Than hers who sadly owns the same."

"Ah, gentle maid! in mine survey  
A heart," he cries, "that's yours alone!  
Long has it own'd Elvira's sway,  
Though long unnoticed and unknown.

"On Sherwood's old heroic plain,  
Elvira graced the festal day;  
There, foremost of the youthful train,  
Her Armine bore the prize away.

“ There first that form my eyes survey'd  
With future hopes that fill'd my heart ;  
But ah ! beneath that frown they fade—  
Depart—vain, vanquish'd hopes, depart !”

He said ; and on the ground his eyes  
Were fix'd abash'd : th' attentive maid,  
Lost in the tumult of surprise,  
The well-remember'd youth survey'd.

The transient colour went and came,  
The struggling bosom sunk and rose ;  
The trembling tumults of her frame,  
The strong-conflicting soul disclose.

The time, the scene, she saw with dread,  
Like Cynthia setting, glanced away ;  
But scatter'd blushes as she fled—  
Blushes that spoke a brighter day.

A friendly shepherd's neighbouring shed,  
To pass the live-long night, he sought ;  
And hope, the lover's downy bed,  
A sweeter charm than slumber brought.

On every thought Elvira dwelt—  
The tender air, the aspect kind,  
The pity that he found she felt,  
And all the angel in her mind.

No self-plumed vanity was there,  
With fancied consequence elate ;  
Unknown to her the haughty air  
That means to speak superior state.

Her brow no keen resentments arm ;  
No swell of empty pride she knew,  
In trivial minds that takes th' alarm,  
Should humble love aspire to sue.

Such love, by flattering charms betray'd,  
Shall yet, indignant, soon rebel ;  
And, blushing for the choice he made,  
Shall fly where gentler virtues dwell.

'Tis then the mind, from bondage free,  
And all its former weakness o'er,  
Asserts its native dignity,  
And scorns what folly prized before.

The scanty pane the rising ray  
On the plain wall in diamonds threw,  
The lover hail'd the welcome day,  
And to his favourite scene he flew.

There soon Elvira bent her way,  
Where long her lonely walks had been ;  
Nor less had the preceding day,  
Nor Armine less, endear'd the scene.

Of, as she pass'd, her rising heart  
Its stronger tenderness confess'd ;  
And oft she linger'd to impart  
To some safe shade her secret breast.

“ How slow the heavy hours advance,”  
She cried, “ since that eventful day,  
When first I caught the fatal glance  
That stole me from myself away !

“ Ah, youth beloved ! though low thy birth,  
The noble air, the manly grace,—  
That look, that speaks superior worth,  
Can fashion, folly, fear erase ?

“ Yet sure from no ignoble stem  
Thy lineage springs, though now unknown ;  
The world, censorious, may condemn,—  
But, Armine, I am thine alone.

“ To splendour only do we live ?  
Must pomp alone our thoughts employ ?  
All, all that pomp and splendour give  
Is dearly bought with love and joy !

“ But oh ! the favour'd youth appears !  
In pensive grief he seems to move !  
My heart forebodes unnumber'd fears ;  
Support it Pity, Virtue, Love !

“ Hither his footsteps seem to bend—  
Come, Resolution, to my aid !  
My breast, what varying passions rend !  
Averse to go—to stay, afraid.”

“ Dear object of each fond desire  
That throbs tumultuous in my breast,  
Why with averted glance retire ?  
At Armine's presence why distress'd ?

“ What though he boast no titled name,  
No wide extent of rich domain ?  
Yet must he feel a fruitless flame,  
Must truth and nature plead in vain ?”

“ Think not,” she said, “ by forms betray'd,  
To humbler worth my heart is blind ;  
For soon shall every splendour fade,  
That beams not from the gifted mind.

“ But first thy heart explore with care,  
With faith its fond emotions prove ;  
Lurks no unworthy passion there ?  
Prompts not ambition bold to love ?”

“ Yes, lovely maid,” the youth replies,  
“ A bold ambition prompts my breast ;  
The tow'ring hope that love supplies,  
The wish in blessing to be bless'd.

“ The meaner prospects I despise,  
That wealth, or rank, or power bestow ;  
Be yours the grovelling bliss ye prize,  
Ye sordid minds, that stoop so low !

“ Be mine the more refined delights  
Of love, that banishes control ;  
When the fond heart with heart unites,  
And soul in unison with soul.”

Elvira blush'd the warm reply,  
(To love a language not unknown,)  
The milder glories fill'd her eye,  
And there a softer lustre shone.

The yielding smile that 's half suppress'd,  
The short, quick breath, the trembling tear,  
The swell tumultuous of the breast,  
In Armine's favour all appear.

At each kind glance their souls unite,  
While love's soft sympathy imparts  
The tender transport of delight  
That beats in undivided hearts.

Respectful to his lips he press'd  
Her yielded hand ; in haste away  
Her yielded hand she drew, distress'd,  
With looks that witness'd wild dismay.

" Ah! whence, fair Excellence, those fears?  
What terror unforeseen alarms?"

" See, where a father's frown appears!"  
She said, and sunk into his arms.

" My daughter! Heavens, it cannot be!  
And yet it must—Oh, dire disgrace!  
Elvira have I lived to see  
Clasp'd in a peasant's vile embrace?"

" This daring guilt let death repay!"—  
His vengeful arm the javelin threw;  
With erring aim it wing'd its way,  
And far by Fate averted flew.

Elvira breathes—her pulses beat,  
Returning life illumines her eye;  
Trembling a father's view to meet,  
She spies a reverend hermit nigh.

" Your wrath," she cries, " let tears assuage—  
Unheeded must Elvira pray?  
O let an injured father's rage  
This hermit's sacred presence stay!"

" Yet deem not, lost in guilty love,  
I plead to save my virgin fame;  
My weakness, Virtue might approve,  
And smile on Nature's holy flame."

“ Oh ! welcome to my hopes again,  
My son !” the raptur'd hermit cries,  
“ I sought thee sorrowing on the plain,”—  
And all the father fill'd his eyes.

“ Art thou,” the raging Raymond said,  
“ Of this audacious boy the sire ?  
Curse on the dart that idly sped,  
Nor bade his peasant soul expire !”

“ His peasant soul !”—indignant fire  
Flash'd from the conscious father's eye,  
“ A gallant Earl is Armine's sire,  
And know, proud Chief, that Earl am I.

“ Though here, within the hermit's cell  
I long have lived, unknown to fame ;  
Yet crowded camps and courts can tell—  
Thou, too, hast heard of Egbert's name !”

“ Ah ! Egbert ! he whom tyrant rage  
Forced from his country's bleeding breast ?  
The patron of my orphan age,—  
My friend, my warrior, stands confess'd !

“ But why ?”—“ The painful story spare,—  
That prostrate youth,” said Egbert, “ see !  
His anguish asks a parent's care,—  
A parent once who pitied thee !”

Raymond, as one who, glancing round,  
Seems from some sudden trance to start,  
Snatch'd the pale lovers from the ground,  
And held them, trembling, to his heart!

Joy, Gratitude, and Wonder, shed  
United tears o'er Hymen's reign,  
And Nature her best triumph led,—  
For Love and Virtue join'd her train.

## B.

## LETTERS FROM SIR W. JONES.

(See p. 45.)

AMONGST the letters from Sir W. Jones to Dr. Cartwright, which are inserted in the Life of the former by Lord Teignmouth, there are two, of which portions only are published by his lordship. As the suppressed passages tend to throw light upon Sir William's character and opinions, they are here published entire, and distinguished by *italics*.

Friday night, 8 Sept. 1780.

DEAR SIR,—Your last favour I have this instant received, and am obliged to answer it in the greatest haste. I hope you have by this time received my letter, in which I informed you that I had declined a poll at Oxford, but was as much obliged to you and my other friends as if your kindness had been attended with the most brilliant success. I saw an advertisement also, in the paper, that Dr. Scott had declined. *I rejoice that our sentiments coincide; but, indeed, our sentiments are not much in fashion.* I have been told that the very Ode to which you are so indulgent lost me near twenty votes: this, however, I am unwilling to believe.

I am, with high respect and gratitude,

Your ever faithful servant,

W. JONES.

Lamb Buildings, Temple, 12 Nov., 1780.

DEAR SIR,—You have so fully proved the favourable opinion which you do me the honour to entertain of me, that I am persuaded you acquit me of any culpable neglect

in delaying, for more than two months, to answer your very obliging letter. The truth is, that I had but just received it when I found myself obliged to leave England on very pressing business, and I have not long been returned from Paris. The hurry of preparing myself for so long a journey, at such a season, left me no time for giving you my hearty thanks, which I now most sincerely request you to accept, both for your kind letter and for the very elegant Sonnet with which you have rewarded me abundantly for my humble labours in the field of literature. I give you my word, that your letters and verses have greatly encouraged me in proceeding, as expeditiously as I am able, to send abroad my *Seven Arabian Poets*; and I propose to spend next month at Cambridge, in order to finish my little work, and to make use of a rare manuscript in the library of Trinity College. My own manuscript, which was copied for me at Aleppo, is very beautiful, but, unfortunately, not very correct. You may depend on receiving a copy as soon as it can be printed. *In these rambles into the wilds of Arabia, I soften the anguish which I feel, whenever I reflect on the melancholy times in which we live—times when many of the best men I know have actually resigned their seats in parliament, from a full conviction that no exertions whatever can preserve our free constitution, and that there is no room left in this country for honest ambition.* How happy I shall be, if I should be able to wait upon you in Leicestershire, or to see you in London; and assure you in person, that I am, with the greatest sincerity, dear sir, your much obliged

And ever faithful servant,

W. JONES.

## C.

PORTION OF MR. CARTWRIGHT'S  
POWER-LOOM,

AS DESCRIBED IN HIS PATENT OF 1790.

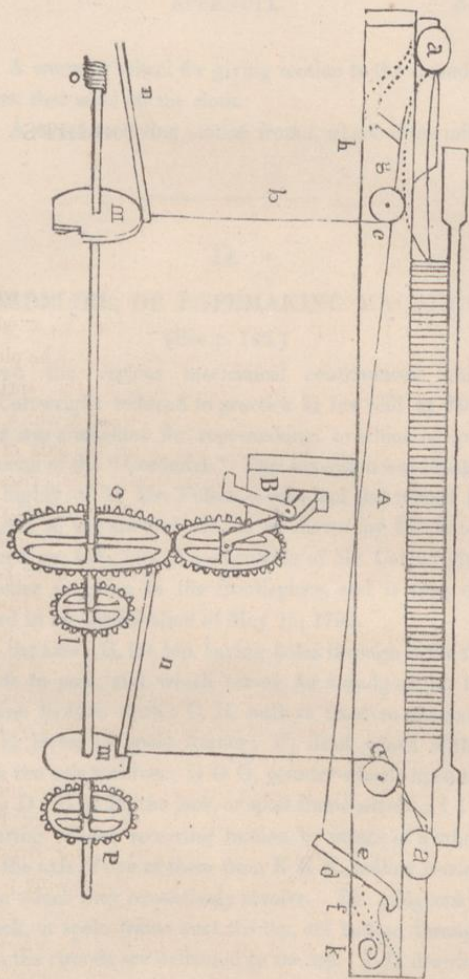
(See p. 67.)

A. THE lathe, or frame which carries the reed.

B. The crank which moves the lathe, having a wheel upon its axis, which receives motion from C, a wheel on the principal axis. *aa*. The pickers. *bb*. The picker strings, passing over pulleys, at *cc*, to the springs. *d*. A hook, or radius, turning with its axis at *e*, which axis passes through the lathe, and also forms the axis of another hook, *f*, expressed by dotted lines, which rises up through the fly. The picker, as it is driven back by the shuttle, depresses the hook *i*, and consequently depresses the point of the hook, or radius, *g*; and this hook being connected with the hook *d*, by means of a wire passing from above the centre of the hook, or radius, *g*, to below the centre of the hook *d*, the point of the hook *d* is elevated or receives an oblique direction when the hook *i* is depressed, in the same manner as when the hook *f*, upon its own axis, is depressed.

*k*. A spring which keeps the hook *d* in a perpendicular direction, when the pickers are not driven or put back; in which case, when the lathe comes to, a lever, struck by the hook *d*, disconnects the loom from the moving power, and causes it to stop.

C. A wheel giving motion to the axis on which are the tappets for treading the shed. *mm*. Tappets for working the shuttle-springs. *nn*. The shuttle-springs.



PORTION OF MR. CARTWRIGHT'S POWER-LOOM OF 1790.



*o.* A worm or wheel for giving motion to the calender-rollers, that wind off the cloth.

*p.* A wheel receiving motion from a wheel of the mill.

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### D.

#### CORDELIER, OR ROPEMAKING MACHINE.

(See p. 146.)

AMONG the various mechanical contrivances which Mr. Cartwright reduced to practice in his mill at Doncaster was a machine for rope-making, to which he gave the name of the "Cordelier." This invention was thought very highly of by Mr. Fulton,—who had also turned his thoughts to the same object, as is shewn by his letters inserted pp. 141, 146. An engraving of Mr. Cartwright's Cordelier is given in the frontispiece, and is thus described in his specification of May 15, 1792.

A, the axis; B, the top, having holes through it for the strands to pass, and which serves for a gudgeon for the machine to turn upon; C, D, pulleys fixed to the axis; E E E, jacks, or spole frames; F, dead wheel within which the axis revolves; G G G, counter wheels upon the pulley D; H H H, the jack, or spole frame wheels; I I I, delivering rollers, receiving motion by means of a wheel upon the axis of one of them from K K K, hollow worms, within which they respectively revolve. The gudgeons of the jack, or spole frame next the top, are hollow, through which the strands are delivered to the top. L L, drawing rollers.

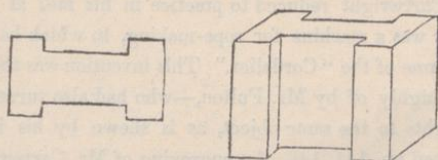
## E.

## MR. CARTWRIGHT'S PATENT BRICKS.

(See p. 118.)

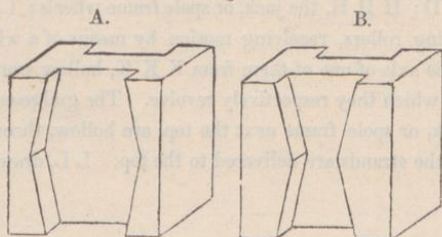
THE principle of these bricks consists in making the two opposite sides of a brick with a groove or rabbet in the middle. The groove must be a little more than half the width of the side of the brick, to allow room for the mortar. (See fig. 1.)

Fig. 1.



This is the simplest form of these bricks, but the principle will be preserved, though the form of the groove or rabbet may vary, provided the opposite side of the brick vary in proportion, so as to fit together when built into a wall. (See figure 2, where A and B are the two opposite sides of a brick.)

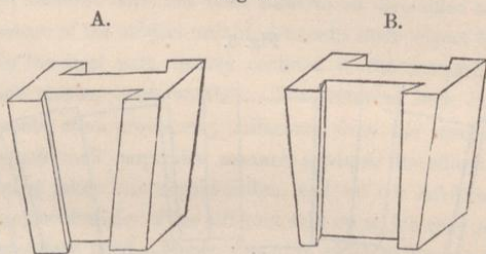
Fig. 2.



For the purpose of breaking the joints in the depth of the wall, bricks may be made of different lengths, though of the same width. Buildings constructed with these bricks will require no bond timbers, as the walls can neither bulge nor crack without breaking through the bricks themselves.

In applying this principle to arches, the sides of the grooves and the shoulders should be radii of a circle of which the arch is a segment, though if the circle be very large, a minute attention to this point is scarcely necessary. When the arch is very flat it may be well to have the shoulders dovetailed, to prevent the arch from cracking across, as is seen in figure 3.

Fig. 3.

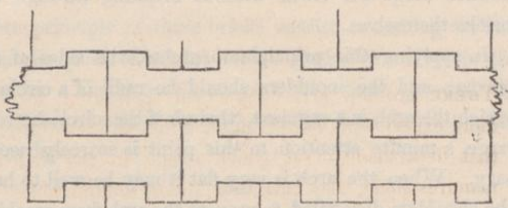


When the bricks are as wide at the bottom as at the top, the manner of dovetailing them is obvious, but when they are wider at the top, the sides of the *shoulders* must be parallel on one side of the brick (Fig. 3, A.) and the side of the *groove* on the other. (B.)

The appearance of the bricks in the face of an upright

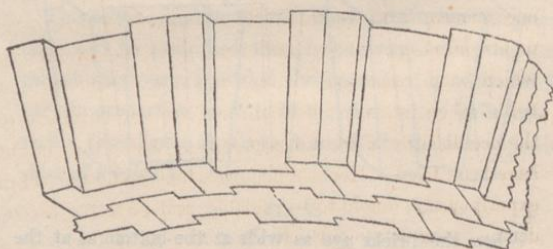
wall, and also on both surfaces of an arch (when not dove-tailed) is shewn in figure 4.

Fig. 4.



The mode of constructing an arch is shewn in figure 5.

Fig. 5.



## F.

MR. CARTWRIGHT'S PRIZE ESSAY  
ON MANURES.

(See p. 206.)

With Notes by Sir Humphry Davy.

THERE are few arts of practical application in which more experiments have been tried than in agriculture. In that department of it which relates to the article of manures alone, they have been almost innumerable. The theories on which they have been founded, or have given rise to, have been nearly as numerous as the experiments themselves. Yet it will be admitted, that the experiments on manures have not been hitherto so diversified as the nature of the subject might demand; their object being, for the most part, merely confined to the comparison of one manure with another. The result of such experiments often proves very fallacious, from the manner in which each respective manure produces its effects not being taken into consideration, and by not adverting to the peculiarities of the different soils on which they might have been tried. Hence a manure which under one set of experiments is found to be valuable, under another is condemned as useless; and that which is esteemed useless by the first experimenter, in the hands of the next is considered as the reverse. This benefit, however, has arisen from these experiments, imperfectly conducted as they have been: they furnish reasonable data for estimating the quantum of one manure as equivalent to the quantum of another of the same class, so as to make it a matter of

mere pecuniary calculation, according to local circumstances, which is to be preferred.

There are many facts yet to be ascertained respecting the nature of manures, on which the general opinion is by no means agreed; and even from those facts which are already ascertained, the conclusions are not always uniform.

This uncertainty seems in part to have arisen from not considering the manner in which the different substances used as manures act under different circumstances. Were all substances so used, the immediate food of plants, their operation, in proportion to the quantity of nutriment which each substance might afford, would, under all circumstances of variation of soil, be nearly the same; but this we find is by no means the case. Hence the conclusion is, that there are substances used as manures whose beneficial effects proceed from other causes than the mere furnishing sustenance to the growing vegetable. To investigate these causes has been the object of the experiments detailed in this essay. As there has been no set of experiments, as far as I know, for the express purpose of elucidating this view of the subject, familiar as the ideas it suggests are to every one who has paid any attention to the philosophy of manures, I thought I might render some small service at least to the cause of agriculture by stating them.

The substances employed as manures are, mineral, vegetable, and animal, or animalized matter:\* of these,

\* I do not know that animalized matter is different from animal matter.—H. D.

some appear to produce their effects chiefly, if not altogether, by their mechanical operation on the soil itself, by altering its texture; others, by their chemical agency on the different substances contained in the soil; others, by furnishing nutriment or stimulus to the assimilating or (if I may so express myself) the digestive organs of the plants themselves.

The method which I have adopted, as being that which appeared the most obvious for arriving at the deductions I was in pursuit of, has been, first, to try the manures in each class separately, which might furnish the opportunity of remarking their simple operation, and then to use them in combination, from whence might be deduced their chemical influence on each other.

The mineral substances I have employed are—lime, gypsum, sulphuric acid, and common salt.

The vegetable substances are—peat, peat-ashes, wood-ashes, decayed leaves, saw-dust, malt-dust, alkaline salts, and (though not strictly in all cases a vegetable production) soot.

The animal substances are—bone-dust and chandlers' graves. The animalized matters are stable and fold-yard dung. The vegetable and animal, or animalized matters, that might have been used as manures, are almost infinite; but as I consider them as respectively the same in their component parts, only varying as one or other component part may chance to be more or less concentrated, and to predominate, I confined myself to such as can be most easily obtained.

Having appropriated half an acre to each set of experi-

ments, I divided it into sixty equal parts, which were manured (the first excepted) as follows:—

No.	Quantities.	No.	
1.	No manure.	28.	Lime, sulphuric acid, salt.
2.	Sulphuric acid - 3 oz.	29.	Lime, salt, peat.
3.	Sea-salt - - - $\frac{1}{2}$ peck.	30.	Lime, salt, dung.
4.	Lime - - - - 1 bush.	31.	Lime, peat, dung.
5.	Gypsum - - - $\frac{1}{4}$ peck.	32.	Lime, salt, gypsum, peat
6.	Soot - - - - 1 peck.	33.	Gypsum, dung.
7.	Wood-ashes - - 2 pecks.	34.	Gypsum, peat.
8.	Saw-dust - - - 3 bush.	35.	Gypsum, graves.
9.	Malt-dust - - - 2 pecks.	36.	Gypsum, bone-dust.
10.	Peat - - - - 3 bush.	37.	Gypsum, wood-ashes.
11.	Decayed leaves - 3 bush.	38.	Gypsum, leaves.
12.	Fresh dung - - 3 bush.	39.	Soot, dung.
13.	Rotted dung - 1 bush.	40.	Soot, peat.
14.	Bone-dust - - 1 peck.	41.	Soot, salt.
15.	Chandlers' graves, 9 lb.	42.	Wood-ashes, dung.
16.	Lime, sulphuric acid.*	43.	Wood-ashes, peat.
17.	Lime, sea-salt.	44.	Wood-ashes, salt.
18.	Lime, soot.	45.	Wood-ashes, decayed leaves.
19.	Lime, wood-ashes.	46.	Wood-ashes, bone-dust.
20.	Lime, saw-dust.	47.	Wood-ashes, malt-dust.
21.	Lime, malt-dust.	48.	Saw-dust, dung.
22.	Lime, peat.	49.	Saw-dust, salt.
23.	Lime, leaves.	50.	Malt-dust, salt.
24.	Lime, dung.	51.	Peat, dung.
25.	Lime, bone-dust.	52.	Peat, salt.
26.	Lime, chandlers' graves.	53.	Peat, decayed leaves.
27.	Lime, pond-mud.		

\* In this and the following numbers the quantities of each ingredient are the same as when used singly.

No.	No.
54. Peat, bone-dust, salt.	58. Peat-ashes, salt.
55. Decayed leaves, salt.	59. Peat-ashes, lime.
56. Decayed leaves, dung.	60. Chandlers' graves, salt.*
57. Peat-ashes, dung.	

On the 14th of April, 1804, the whole was planted with potatoes; and that the experiment might be conducted with all possible accuracy, each part received the same number of sets. On the 14th of May, a few days after the plants appeared, No. 9, malt-dust, was perceptibly the most vigorous, next to which, in succession, were the following:—

No.	No.
15. Chandlers' graves.	1. No manure.
26. Lime, chandlers' graves.	7. Wood-ashes.
21. Lime, malt-dust.	10. Peat.
34. Gypsum, peat.	13. Rotted dung.
35. Gypsum, chandlers' graves.	14. Bone-dust.
40. Soot, peat.	16. Lime, sulphuric acid.
47. Wood-ashes, malt-dust.	18. Lime, soot.
32. Lime, salt, gypsum, peat.	22. Lime, peat.
60. Chandlers' graves, salt.	23. Lime, decayed leaves.
50. Malt-dust, salt.	25. Lime, bone-dust.
11. Decayed leaves.	27. Lime, pond-mud.
6. Soot.	28. Lime, sulphuric acid, salt.
5. Gypsum.	24. Lime, dung.
3. Salt.	31. Lime, peat, dung.
2. Sulphuric acid.	36. Gypsum, bone-dust.

\* I am sorry to see metallic matters omitted; such as green vitriol, or sulphate of iron; oxyde of iron, or ochre, &c.—H. D.

No.	No.
37. Gypsum, wood-ashes.	4. Lime.
38. Gypsum.	8. Saw-dust.
39. Soot, dung.	12. Fresh dung.
41. Soot, salt.	17. Lime, salt.
42. Wood-ashes, dung.	19. Lime, wood-ashes.
43. Wood-ashes, peat.	20. Lime, saw-dust.
44. Wood-ashes, salt.	24. Lime, dung.
45. Wood-ashes, decayed leaves.	30. Lime, salt, dung.
46. Wood-ashes, bone-dust.	33. Gypsum, dung.
51. Peat, dung.	48. Saw-dust, dung.
52. Peat, salt.	56. Decayed leaves, dung.
53. Peat, decayed leaves.	57. Peat-ashes, dung.
54. Peat, bone-dust, salt.	58. Peat-ashes, salt.
55. Decayed leaves, salt.	59. Peat-ashes, lime.
	49. Saw-dust, salt.

It will be necessary here to observe, that from No. 9 to No. 3 inclusive, the gradation of excellence was obviously perceptible. From No. 2 to No. 55 inclusive, there was little or no perceptible difference. From No. 4 to No. 49 the plants were considerably inferior to those included in No. 2 and No. 55.

It is worthy of remark that, in this stage of the business, the experiment is in favour of malt-dust, soot, and graves; and the reason why it is so seems to be apparent. Sugar,\* mucilage,† and carbon,‡ being the principal in-

\* I should say, because saccharine matter is probably more nutritious than any other vegetable matter, or than any animal matter.—H. D.

† Chandlers' graves, I suppose, are beneficial because the mucilage is in the fittest state for speedy or immediate absorption.—H. D.

‡ This experiment seems to shew, what has not been done

redients and constituent parts in the composition of vegetables, it is natural to suppose that those substances which are most readily disposed to putrefy, or which present themselves in a state of the nearest assimilation to the plant which is to be fed by them, will be more immediately imbibed than such as must previously be decomposed either by their own internal fermentation or by the action of external causes.

On the 28th of May, the apparent vigour of the plants was in the following order:—

9. Malt-dust. 15. Chandlers' graves. 26. Lime, chandlers' graves. 21. Lime, malt-dust. 40. Soot, peat. 47. Wood-ashes, malt-dust. 13. Rotted dung. 6. Soot. 18. Lime, soot. 59. Peat, bone-dust. 10. Peat. 31. Lime, peat, dung. 32. Lime, salt, gypsum, peat. 34. Gypsum, peat. 35. Gypsum, chandlers' graves. 36. Gypsum, bone-dust. 37. Gypsum, wood-ashes. 38. Gypsum, leaves. 39. Soot, dung. 41. Soot, salt. 43. Wood-ashes, peat. 46. Wood-ashes, bone-dust. 50. Malt-dust, salt. 51. Peat, dung. 52. Peat, salt. 53. Peat, decayed leaves. 55. Decayed leaves, salt. 60. Chandlers' graves, salt. 1. No manure. 2. Sulphuric acid. 3. Salt. 5. Gypsum. 7. Wood-ashes. 11. Decayed leaves. 14. Bone-dust. 19. Lime, wood-ashes. 22. Lime, peat. 23. Lime, decayed leaves. 25. Lime, bone-dust. 27. Lime, pond-mud. 28. Lime, sulphuric acid, salt. 29. Lime, salt, peat. 33. Gypsum, dung. 42. Wood-ashes, dung. 44. Wood-ashes, salt. 45. Wood-ashes, decayed leaves. 58. Peat-ashes, salt.

before,—that carbon in the state of a subtle powder, as in the sublimate called soot, is really absorbed with facility, and accordingly either nourishes or stimulates more speedily.—  
H. D.

12. Fresh dung. 4. Lime. 54. Peat, bone-dust, salt. 57. Peat-ashes, dung. 56. Decayed leaves, dung. 49. Saw-dust, salt. 48. Saw-dust, dung. 20. Lime, saw-dust. 30. Lime, salt, dung. 24. Lime, dung. 17. Lime, salt. 16. Lime, sulphuric acid. 8. Saw-dust.

The variations between this table and the former are worthy of observation. In the first table, sixteen of the experiments take place of No. 1, in this, twenty-eight have the superiority. The same reason which is applied to the former table may assist us in accounting for the results of this. The different manures beginning now to develop themselves, and to be decomposed, give out (though as yet in moderate proportion) the requisite aliment to the plants they are to sustain.

On the 2nd of July, Nos. 26 and 21 had taken the lead of No. 9; and on the 24th of the same month No. 35 had visibly outstripped them all.

On the 21st of September, when the roots were taken up, the order of precedence was as follows:—

No.		Produce.
35.	Gypsum, graves - - - - -	250 lbs.
41.	Soot, salt - - - - -	240
21.	Lime, malt-dust - - - - -	239
18.	Lime, soot - - - - -	231
39.	Soot, dung - - - - -	228
40.	Soot, peat - - - - -	225
34.	Gypsum, peat - - - - -	222
15.	Graves - - - - -	220
26.	Lime, graves - - - - -	219
44.	Wood-ashes, salt - - - - -	219

No.		Produce.
37.	Gypsum, wood-ashes - - - -	218 lbs.
43.	Wood-ashes, peat - - - -	217
16.	Lime, sulphuric acid - - - -	213
45.	Wood-ashes, decayed leaves - - - -	213
47.	Wood-ashes, malt-dust - - - -	213
42.	Wood-ashes, dung - - - -	210
46.	Wood-ashes, bone-dust - - - -	208
33.	Gypsum, dung - - - -	207
36.	Gypsum, bone-dust - - - -	206
38.	Gypsum, dry leaves - - - -	205
13.	Rotted dung - - - -	201
32.	Lime, salt, gypsum, peat - - - -	201
30.	Lime, salt, dung - - - -	199
3.	Salt - - - -	198
56.	Decayed leaves, dung - - - -	198
60.	Graves, salt - - - -	195
31.	Lime, peat, dung - - - -	194
14.	Bone-dust - - - -	193
6.	Soot - - - -	192
12.	Fresh dung - - - -	192
25.	Lime, bone-dust - - - -	190
50.	Malt-dust, salt - - - -	189
24.	Lime, dung - - - -	188
7.	Wood-ashes - - - -	187
55.	Decayed leaves, salt - - - -	187
19.	Lime, wood-ashes - - - -	185
58.	Peat-ashes, salt - - - -	185
9.	Malt-dust - - - -	184
29.	Lime, salt, peat - - - -	183
51.	Peat, dung - - - -	183
57.	Peat-ashes, dung - - - -	183
48.	Saw-dust, dung - - - -	180

No.		Produce.
49.	Saw-dust, salt - - - - -	180 lbs.
22.	Lime, peat - - - - -	179
5.	Gypsum - - - - -	178
54.	Peat, bone-dust - - - - -	178
11.	Decayed leaves - - - - -	175
28.	Lime, sulphuric acid, salt - - - - -	175
53.	Peat, decayed leaves - - - - -	172
23.	Lime, decayed leaves - - - - -	171
52.	Peat, salt - - - - -	171
59.	Peat-ashes, lime - - - - -	171
2.	Sulphuric acid - - - - -	170
17.	Lime, salt - - - - -	167
20.	Lime, saw-dust - - - - -	166
10.	Peat - - - - -	159
1.	No manure - - - - -	157
8.	Saw-dust - - - - -	155
4.	Lime - - - - -	150
27.	Lime, pond-mud - - - - -	150

The final result of these experiments not only tends to ascertain some doubtful facts, but leads, it is presumed, to some important conclusions.

The first article used as manure is sulphuric acid. The use of this substance was first suggested, if I mistake not, by the late ingenious Dr. G. Fordyce; whether it ever was brought to the test of experiment, I am not able to ascertain. It appears, however, that its effects are beneficial; but whether those effects are produced by its assisting in the decomposition\* of animal or vegetable matter in the soil, by stimulating the organs of the plant, or by supplying it with oxygen, are questions which I

\* Not by decomposing but by stimulating.—H. D.

will not take upon me to answer. Dr. George Fordyce, if I remember right, leans to the latter opinion.\*

In experiment No. 16, where the sulphuric acid is combined with lime, my object was to try the effect of an artificial gypsum, in which, however, the lime very much predominated. A reference to the foregoing table will shew that it may be used with considerable efficacy. The expense of gypsum in many parts of the kingdom, remote from where it is found, admitting not of its being applied to agricultural purposes, it occurred to me that a factitious gypsum might be a valuable succedaneum.

In experiment No. 28, the sulphuric acid being diluted with a sufficient quantity of water, and the salt mixed with it, the whole was thrown upon the unslaked lime; by this commixture of sulphuric acid and salt, I was of opinion that the marine acid would fly off, leaving the soda; and that the heat and effervescence excited by slaking the lime might possibly assist in the operation.

If we compare this experiment with No. 4, it certainly is not without a beneficial effect; but whether in consequence of the expulsion of marine acid, it may be difficult to determine.

Opinions have been long divided on the subject of sea-salt as a manure. From this set of experiments, at least, there is reason to conclude it possesses considerable activity. It is matter of observation, that in thirteen different combinations of salt with other substances, four only are superior to salt used alone—namely, No. 32,

\* His experiments with sulphuric acid will be found among the papers of the Board of Agriculture during the reign of Sinclair.—H. D.

41, 30, and 44; and in eight out of thirteen the salt added to the efficacy of the matters combined with it;— as, for example,

No.	Produce.
4. Lime alone gives - - - - -	150 lbs.
Combined with salt, No. 17, the produce is	167
Superiority - - - - -	17
22. Lime and peat give - - - - -	179
29. Ditto, with the addition of salt	183
Superiority - - - - -	4
6. Soot - - - - -	192
41. Soot and salt - - - - -	270
Superiority - - - - -	48
44. Wood-ashes and salt - - - - -	219
7. Wood-ashes - - - - -	187
Superiority - - - - -	32
8. Saw-dust - - - - -	155
49. Saw-dust and salt - - - - -	180
Superiority - - - - -	25
9. Malt-dust - - - - -	184
50. Malt-dust and salt - - - - -	189
Superiority - - - - -	5
11. Decayed leaves - - - - -	175
55. Decayed leaves and salt - - - - -	187
Superiority - - - - -	12
24. Lime and dung - - - - -	188
30. Lime, dung, and salt - - - - -	199
Superiority - - - - -	11
In four instances, the salt appears to have done harm :	
16. Artificial gypsum - - - - -	213
28. Artificial gypsum and salt - - - - -	175
Superiority - - - - -	38

No.		Produce.
16.	Artificial gypsum - - - - -	213 lbs.
32.	Lime, peat, gypsum, and salt - - -	201
	Superiority - - - - -	12
14.	Bone-dust - - - - -	193
54.	Bone-dust and salt - - - - -	178
	Superiority - - - - -	15
15.	Graves - - - - -	220
60.	Graves and salt - - - - -	195
	Superiority - - - - -	25

In the two last of the above experiments, possibly the antiseptic quality of the salt might retard the putrefactive process, so as to render the bone-dust and graves less efficacious than they would have been had the salt been omitted.

Were I to hazard a conjecture on the general good effect of salt in these experiments, I should attribute it, in a considerable degree, to its property of attracting moisture; for I observed that those parts of the field where the salt was applied were for a considerable time visibly moister than the rest,—I mean, so long as the dry weather continued; after the rains fell, that distinction, of course, was obliterated.

But in none of these experiments have theory and practice been so at variance as in the application of lime and its different combinations. The general good effect with which lime is applied led me to expect that, though the simple application of it might not prove strikingly beneficial, yet combined with other manures, and those so different in their qualities, its effects could not but be obvious.

No. 4, lime alone, and No. 27, combined with pond-mud, are the least productive. In sixteen experiments it does not appear to have been particularly efficacious, except in four instances; when applied by itself, it does harm rather than good, producing only 150 lb. The produce of No. 27, when mixed with the pond-mud, is the same. This latter fact is rather curious.\* The soil on which the experiment was tried was a loose ferruginous sand, but was brought to its present texture by a very thick covering of pond mud; so that it received no accession of fertility by the additional quantity that was given to it, nor did the lime meet with anything to operate upon in that additional quantity, which was not in the soil before.

Gypsum, though used with great success on the Continent and in America, has not hitherto been considered as a very efficacious manure by the English farmer. My experiments, however, induce me to think very favourably of it, especially when combined with other substances.

No.		Produce.
5.	Gypsum - - - - -	178 lbs.
1.	No manure - - - - -	157
	Superiority - - - - -	21
32.	Lime, salt, peat, and gypsum - - - - -	201
29.	Lime, salt, and peat - - - - -	183
	Superiority - - - - -	18
33.	Gypsum, dung - - - - -	207
12.	Dung - - - - -	192
	Superiority - - - - -	15

\* Probably the mud was little else than clay or sandy matter; and if so, would be harmful.—H. D.

No.		Produce.
39.	Gypsum and peat - - - -	222 lbs.
10.	Peat - - - -	159
	Superiority - - —	63
35.	Gypsum and graves - - - -	250
15.	Graves - - - -	220
	Superiority - - —	30
36.	Gypsum and bone-dust - - - -	206
14.	Bone-dust - - - -	193
	Superiority - - —	13
37.	Gypsum and wood-ashes - - - -	218
7.	Wood-ashes - - - -	187
	Superiority - - —	31
38.	Gypsum and dried leaves, not decayed	205
11.	Decayed leaves - - - -	175
	Superiority - - —	30

To these instances we may add No. 16, factitious gypsum.

The most striking of these experiments is No. 35; and it is to be remarked, in general, that previous to the middle of July, the plants where the gypsum had been used gave no indication of superiority; their subsequent vigour can be accounted for on no other ground than on the supposition that the septic quality of the gypsum had not, till then, produced its effects in the decomposition of the substances (the wood-ashes excepted) which the gypsum was combined with.\*

\* Or that the gypsum impeded the absorption of the mucilage in the graves, although it continued to stimulate; for in this case we had two kinds of manures—viz., a stimulating and a nutritious one.—H. D.

Of soot, the most remarkable circumstance is its efficacy in combination with salt, in experiment 41, and this efficacy I am disposed to attribute to a property in salt taken notice of before—namely, its attraction of moisture; a property which could not fail of being beneficial when the salt was combined with so hot and dry a manure as soot, which, from its acrid nature, requires to be much diluted.

It was expected that wood-ashes, from the power which alkaline salts have of decomposing animal and vegetable matter, would have been more efficacious than they appear to have been by these experiments. By referring, however, to the foregoing table, it will be seen that they have in no instance been applied without efficacy.

The article of which I had the greatest doubt was saw-dust, from its known effect of destroying weeds when spread tolerably thick on gravel walks. In the first stages, indeed, of the business, it was very unpromising. The plants at first were very backward and sickly; by degrees, however, they recovered themselves, which I attributed to the acid, or tanning principle in the saw-dust being spent or washed out by the subsequent rains. That the saw-dust, even after it had lost its tanning principle, should have no material operation on the soil the first year is not to be wondered at, as the carbon, which is its principal ingredient, will remain for some time in a state of great insolubility. There can be little doubt of its effects being very apparent at a future season.

It will be seen, by referring to the former tables, that malt-dust is very immediate in its operations; but from the last table it would appear that its effects are not so

permanent as some other manures of slower dissolution, and which require longer time before they can be decomposed and become soluble in water.

Though malt-dust may possess no durable property, yet its immediate and powerful operation in promoting a rapid vegetation points it out as a valuable manure, especially when it can be used as a top-dressing to plants in an advanced state of growth. In this mode I have used it, in a set of experiments unconnected with the present, with the greatest success, applying it to the potato crop immediately before earthing up.

The peat in the part of the country where these experiments are tried containing a considerable proportion of oxyde of iron, I was not very sanguine in my expectations of any very powerful effect from it, in whatever form it might be applied, on a soil of which the iron it already contains constitutes about a fifty-seventh part. Leaves, in a state of imperfect decay, bearing no very remote resemblance to peat in its simple state, uncombined with iron or sulphur, I wished to compare them together. I had, however, another object in view in introducing leaves into the experiment, which was, to recommend a practice, too much neglected, of collecting them in the autumn, (when it can be conveniently done,) either to be laid in a heap to ferment and rot, or to be mixed with dung; or which, perhaps, is a better way still, to furnish litter for the fold-yard, mixing with them a due proportion of straw or stubble. When singly applied, the advantage in this experiment is in favour of decayed leaves; in combination with other substances, they appear nearly upon a par.

It is usually calculated that three, if not four, loads of

fresh dung from the fold-yard will be required to make one load after the dung has undergone the putrefactive process. I wished, therefore, to institute a comparison between them in these two different stages, with a view to ascertain the advantage or disadvantage of the usual method of not laying on dung till it is completely or nearly rotted. In this comparison I tried only three bushels of fresh dung against one of rotted dung.

No.	Produce.
13. Rotted dung* - - - - -	201 lbs.
12. Fresh dung - - - - -	192
Superiority in favour of rotted dung - — 9	

The experiment, however, does not terminate here: their comparative effects must be pursued through subsequent seasons till the soil requires to be renovated afresh. It is reasonable to conclude that the dung which is now laid on fresh will continue its efficacy after the rotted dung is exhausted.

Dung combined with soot, No. 39; with wood-ashes, No. 42; and with gypsum, No. 33, seems to have been benefited by the combination; but its greatest effects are to be looked for in the succeeding crop.

Bone-dust being of difficult dissolution, it was natural to suppose its effects would be considerably augmented by combination with such substances as would assist in its decomposition. The justice of this opinion will appear by

\* It must be a most wasteful custom to keep dung till it is further putrefied, because the sole use of the putrefactive process is to break down the texture to fit the matter for dissolution and absorption, in which state fresh dung is already. Straw is not so; it should be rotted; so should saw-dust.—H. D.

comparing the effect of bone-dust when used by itself, and when in combination with gypsum, or wood-ashes.\*

No.		Produce.
36.	Bone-dust and gypsum - - - - -	206 lbs.
14.	Bone-dust - - - - -	193
	Superiority - - —	13
46.	Wood-ashes and bone-dust - - - - -	208
7.	Wood-ashes - - - - -	187
	Superiority - - —	21

Bones are a manure as efficacious as permanent, and consequently they should be collected wherever they are to be met with—a practice, however, which is never attended to by the farmer, except in situations where there are mills for grinding them.

Of the same nature with bone-dust are chandlers' graves; but from their more rapid tendency to become putrid and soluble in water, their operation as manure is also more rapid.

Of the fifteen simple manures, chandlers' graves stand first, as they do also in combination; though soot, in combination, is scarcely inferior.

The operation of every manure must, in a greater or less degree, be influenced by the quality of the soil on which it is applied. That every possible light may be thrown on the subject of these experiments, I have subjoined an analysis of the soil on which they were tried.† Four

\* The superiority was from the stimulating quality of the gypsum and wood-ashes.—H. D.

† These analyses were made by Sir H. Davy, as appears from the letters between him and Mr. Cartwright, at p. 206.  
—EDITOR.

hundred grains gave of siliceous sand of different degrees of fineness about—

	Grains.
	280
Of finely divided matter, which appeared in the form of clay - - - - -	104
Loss in water - - - - -	16
	400

The 104 grains of finely-divided matter contained

Of carbonate of lime - - - - -	18
Oxyde of iron - - - - -	7
Loss by incineration, most probably from vegetable decomposing matter - - - - -	17

Remainder principally silex and alumine. There was no indication of gypsum or phosphate of lime.

This analysis accounts, not unsatisfactorily, for two at least of the phenomena in the foregoing experiments—namely, the great activity of gypsum, and the inutility of peat-ashes. The soil, containing in itself no gypsum, receives from the application of that mineral an accession of active power which it wanted; and having already more than a necessary share of iron in its composition, it becomes, by the addition of peat-ashes, supersaturated with that which in certain proportions is an invigorating stimulant, but when too abundant, operates as a poison.

Two sets of experiments, and with the same proportion of manures, were tried, on a soil of a very different nature, with buck-wheat and turnips. As my object in these two sets of experiments was to try the intrinsic effects of

manures, unaided by any vegetating principle in the soil, I chose the poorest I could meet with. Of its poverty judgment may be made by the following analysis:—

	Grains.
400 grains gave, of siliceous sand - - -	320
Of finely divided matter, which appeared as brown mould - - - - -	68
Loss in water - - - - -	12
	<hr style="width: 10%; margin-left: auto; margin-right: 0;"/> 400

The finely divided matter lost nearly half its weight by incineration, which shews that it contained a great deal of vegetable matter. The residuum was principally a mixture of aluminous and siliceous earths, coloured red by oxyde of iron, and containing very little calcareous matter. There was no indication of either gypsum or phosphate of lime.

The detail of these experiments will be short.

July 6th, 1804, I sowed one piece with turnips, the other with buck-wheat. On the 26th of the same month, each piece was examined minutely. Nos. 1, 2, 3, 5, 6, 7, 8, 9, 14, 49, 50, 54, 58, 60, shewed little or no marks of vegetation. The rest were only in the seed leaf. On the 16th of August, one-half of the turnips and about two-thirds of the buck-wheat were dead. From that period to the 15th of September, after a few alternations of health and sickness, the turnips all died away, except Nos. 12, 18, 21, 24, 25, 26, 30, 35, 39, 42, 47, 56.

On these experiments I have to observe, generally, that where the manures made use of, whether stimulant or nutritive, (as, for instance, salt or malt-dust, did not contri-

bute in some degree to the texture and consistence of the soil, the plants scarcely got into the seed leaf; and that what little health and vigour they afterwards possessed seemed to depend more on the texture and consistence which the soil acquired from the respective manures, than on any other circumstance. Hence the beneficial effects of lime on these soils, as also of clay and argillaceous marls.

It may not be foreign to the purpose of this essay to observe, that adjoining to the piece where these experiments were tried is a field of the same original quality, which within these few years has been reclaimed from a state of nature, and brought into a state of cultivation and fertility, chiefly by improving its texture by a thick coat of marly clay.

Enough has been said, it is presumed, in the detail of the foregoing experiments, to shew the general nature and properties of manures. Respecting their application, I have to observe, that the circumstance of most importance to attend to is the texture of the soil; where it is too loose, such manures should be applied as will add as much as possible to its solidity and consistence, such as marly clay, lime, thoroughly digested dung, graves, or any other unctuous and fertilizing substance which is of little bulk, and which, when reduced to its first principles by decomposition, will not increase the openness and porosity of the soil.

For stronger soils I should recommend, not only semi-digested dung, but dung or litter even in as fresh a state as it could conveniently be applied. Decayed leaves, also, are an excellent manure for strong land; being of

very slow dissolution, when once mixed with the soil it is a long time before they permit it to resume its natural tenacity. Lime, also, is beneficially applied to strong as well as light land; being more open in its texture and less adhesive than clay, and less open in its texture and more adhesive than sand, it is applied with equal benefit to soils of either description. I am speaking now merely of its mechanical agency, but of all ameliorating applications to strong land, perhaps sand is the best. The reason is too obvious to insist upon.

Besides a general knowledge of the nature and properties of the manures he employs, the farmer should also be acquainted with the component parts of the soil he intends they should operate upon; otherwise he may be in danger of aggravating its defects, or, at least, wasting his efforts to no purpose.

As a general rule it may be observed, that no mineral manure should be applied to a soil abounding in the same mineral already. As mineral manures appear to operate more by their chemical agency than in any other way, their principal use seems to be to correct and neutralize what is noxious in the original composition of the soil, and to assist in the decomposition of those substances which, in their present state of insolubility, are useless.

For the purpose of preparing fold or stable manure for the field, it has been proposed to manufacture it (if I may so express myself) under covered buildings, with a view of defending it from the influence of the elements. In this there is certainly more of refinement than practical utility. Add to this the inconvenience of having to carry the manure perhaps a mile or two, at a time when, if it were even

laid in the very field where it is wanted, the farmer can hardly find time to spread it before the seed ought to be in the ground.

It is needless to dwell upon the expensiveness of this plan. Landlords already find the providing and keeping in repair such buildings as are of unavoidable necessity a tax sufficiently heavy, without incumbering themselves with others, which, perhaps, their tenants would not thank them for.

The most advantageous, and in the end, perhaps the cheapest way, is, to form the dunghill, or compost heap, as near to the field where it is to be used as conveniently may be. It is true, more labour is required in the first instance; but labour is of different value at different seasons. The farmer can better appropriate four days, at some seasons of the year, to the leading his dung from the fold-yard to the field, that it may be ready against the time it is wanted, than he can spare one day in the hurry of seed time.

In forming a dunghill, it is of more importance than is commonly imagined to mix a certain portion of soil with it. When dung is formed into a heap by itself, it is exposed on all sides to the rain and to the exhaling influence of the sun and wind; by mixing and covering it with soil, these inconveniences may in a great measure be prevented. But this is not all; a dunghill thrown up in a common way loses, by unavoidable drainage and evaporation, a greater proportion of its fertilizing principles than can be well calculated. What it loses by drainage is, indeed, obvious to the eye; and it is easy to conceive what it must lose by evaporation, by only observing the steam which is perpe-

tually rising from it during its fermentation. But when soil is mixed with it, the drainage is prevented, and the gaseous fluid and volatile alkali, which would otherwise fly off, are prevented from escaping; or, if they quit the dunghill, are absorbed and retained by the soil.

To ascertain how far soil, when only laid upon a dunghill, absorbs and retains those fertilizing principles which would otherwise be lost in the atmosphere, I took from an old hot-bed, which had been employed through the winter in forcing asparagus, as much soil as would fill a trench one foot deep and six feet square. From the same heap of earth whence this soil was taken, but which had been fallow through the winter, I filled another trench of the same dimensions. I planted the two with lettuces, all, as nearly as possible, of equal size and vigour. When full grown, I drew and weighed them. The produce of the first trench was 42 lb.; of the latter, 33 lb. If the increased fertility of soil is so great from merely lying on the surface of a dunghill, what must it be when generally mixed with it? To this it may perhaps be objected, that by mixing soil with dung you impede or retard its fermentation. This, however, ought to be no objection; unless the farmer is hurried in point of time, as dung cannot ferment too slowly.

In forming a compost heap, the farmer cannot bring together too many or too discordant ingredients, as they will all mutually assist in the decomposition of each other. Amongst other articles, I particularly recommend bones, unless where there is a bone-mill. These should be laid in the middle of the heap, where the fermentation is greatest. When the heap is removed, the bones are to

be taken out and put into the next compost heap that may be made, as they will undergo a partial dissolution in every heap which they are put into; each heap will, as far as that dissolution goes, be benefited by them, till at length the bones are totally dissolved.

Before I conclude this essay, it may be necessary to observe, that it has been my endeavour (and in which I am willing to hope I have succeeded) to express myself in such terms as to be intelligible, not only to the theoretical and scientific, but to the mere practical farmer. I have endeavoured also to avoid, as much as possible, indulging in theory and hypothesis. Though the inferences which I have occasionally drawn seem warranted by the facts that have presented themselves, yet are they offered with the greatest diffidence. Sensible of the uncertainty attendant on experiments, liable not only to the influence of latent, and perhaps inscrutable, causes in the element in which they have been tried, but subject also to every variation of the atmosphere, it would have been rashness and presumption to have spoken with absolute decision on points which possibly may yet require many years, if not ages, to determine.

## G.

## MANCHESTER MEMORIAL, AUGUST, 1807.

(See p. 222.)

To His Grace the Duke of Portland, First Lord, and the other Lords Commissioners of his Majesty's Treasury.

The Memorial of the undersigned inhabitants of the town and neighbourhood of Manchester,

Sheweth,—

That the great advantages which have arisen to this country from the increase of its manufactures, and the consequent extension of its commerce, have been chiefly derived from the application of the powers of water and steam to the operations of spinning and weaving, which before were performed by the slow, expensive, and less effectual strength of man.

That the Reverend Edmund Cartwright, D.D., by his various useful inventions to render the process of weaving practicable by the above powers, as well as by his machines for combing wool, and other mechanical inventions for the improvement of British manufactures, has rendered most essential services to this country.

That the continued application of Dr. Cartwright to the discovery and improvement of these inventions, has not only deprived him of the pecuniary advantages which he might have derived from them, but has caused him to expend a large private fortune in bringing to perfection his valuable inventions.

That, under these circumstances, your Memorialists humbly hope that Government will be pleased to reward his important services with some substantial mark of their favour and the gratitude of the country.

Peter Marsland.	Ottiwell Wood.
Samuel Oldknow.	John Lowe.
John Marsland.	Josephus Smith.
Hen. and J. Barton & Co.	Thomas Tipping.
B. H. Green.	James Heald.
John Fisher.	Henry Fielding & Brothers.
Nathaniel Gould.	William Starkie.
Samuel Greg.	G. Philips.
Peter Ewart.	John Atkinson.
J. Jackson.	John Close.
Richard Rushford.	Thomas Drinkwater.
J. Gill.	Ch. Fred. Brand & Co.
W. Potter.	R. and J. Jackson.
Roger Holland.	Charles Wood & Co.
Horrocks & Co., Preston.	Samuel Peel.
J. Watson & Sons, Preston.	James Touchet.
Paul Cotterall and Co., Preston.	Joshua Barnsley.
Sidgreaves, Leighton, and Co., Preston.	William Mitchell.
Riley, Paley, & Co. Preston.	Entwistles & Steirtivant.
Robert and W. Jarrett.	W. Myers and Nephew.
	Joseph Siddon, borough- reeve of Manchester.

## H.

## LIST OF DR. CARTWRIGHT'S PATENTS.

1. A machine for weaving, April 4, 1785.
2. Improvements in the same, October 30, 1786.
3. Further improvements, August 1, 1787.
4. Further improvements, November 13, 1788.
5. Wool-combing machine, August 22, 1789.
6. Further improvements in wool-combing, April 27, 1790.
7. Further improvements, December 11, 1790.
8. For manufacturing wool, hemp, flax, &c., into yarn, twist, ropes, &c., May 15, 1792.
9. Improvement in the form of bricks, April 14, 1795.
10. Incombustible material for dwelling-houses, October 11, 1797.
11. Steam-engine, November 11, 1797.
12. Improvements in steam-engines, February 5, 1801.