

**THE PRACTICAL DRAUGHTSMAN'S BOOK
OF INDUSTRIAL DESIGN, AND
MACHINIST'S AND ENGINEER'S DRAWING
COMPANION: FORMING A COMPLETE
COURSE OF MECHANICAL, ENGINEERING,
AND ARCHITECTURAL DRAWING**

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The Practical Draughtsman's Book of Industrial Design, and Machinist's and Engineer's
Drawing Companion: Forming a Complete Course of Mechanical, Engineering, and
Architectural Drawing by William Johnson

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WILLIAM JOHNSON

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BOOK OF INDUSTRIAL DESIGN,

AND

MACHINIST'S AND ENGINEER'S DRAWING COMPANION:

FORMING A COMPLETE COURSE OF

Mechanical, Engineering, and Architectural Drawing.

TRANSLATED FROM THE FRENCH OF

M. ARMENGAUD, THE ELDER,

PROFESSOR OF DESIGN IN THE CONSERVATOIRE OF ARTS AND INDUSTRY, PARIS,

AND

MM. ARMENGAUD, THE YOUNGER, AND AMOUREUX,

CIVIL ENGINEERS.

REWRITTEN AND ARRANGED, WITH ADDITIONAL MATTER AND PLATES, SELECTIONS FROM AND EXAMPLES OF
THE MOST USEFUL AND GENERALLY EMPLOYED MECHANISM OF THE DAY.

BY

WILLIAM JOHNSON, ASSOQ. INST., C.E.,

EDITOR OF "THE PRACTICAL MECHANIC'S JOURNAL."

"The PHILOSOPHER may very justly be delighted with the extent of his views, and the ARTIST with the readiness of his hands: but let the one remember, that without MECHANICAL performance, refined speculation is an empty dream; and the other, that without THEORETICAL reasoning, dexterity is little more than a brute instinct."—*Johansen.*

"The weakness of APOCANT is strong, where the strength of DESIGN is weak."—*Flupper.*

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1854.

P R E F A C E .

INDUSTRIAL DESIGN is destined to become a universal language; for in our material age of rapid transition from abstract, to applied, Science—in the midst of our extraordinary tendency towards the perfection of the means of conversion, or manufacturing production—it must soon pass current in every land. It is, indeed, the medium between Thought and Execution; by it alone can the genius of Conception convey its meaning to the skill which executes—or suggestive ideas become living, practical realities. It is emphatically the exponent of the projected works of the Practical Engineer, the Manufacturer, and the Builder; and by its aid only, is the Inventor enabled to express his views before he attempts to realise them.

Boyle has remarked, in his early times, that the excellence of manufactures, and the facility of labour, would be much promoted, if the various expedients and contrivances which lie concealed in private hands, were, by reciprocal communications, made generally known; for there are few operations that are not performed by one or other with some peculiar advantages, which, though singly of little importance, would, by conjunction and concurrence, open new inlets to knowledge, and give new powers to diligence; and Herschel, in our own days, has told us that, next to the establishment of scientific institutions, nothing has exercised so powerful an influence on the progress of modern science, as the publication of scientific periodicals, in directing the course of general observation, and holding conspicuously forward models for emulative imitation. Yet, without the aid of Drawing, how can this desired reciprocity of information be attained; or how would our scientific literature fulfil its purpose, if denied the benefit of the graphic labours of the Draughtsman? Our verbal interchanges would, in truth, be vague and barren details, and our printed knowledge, misty and unconvincing.

Independently of its utility as a precise art, Drawing really interests the student, whilst it instructs him. It instils sound and accurate ideas into his mind, and develops his intellectual powers in compelling him to observe—as if the objects he delineates were really before his eyes. Besides, he always does that the best, which he best understands; and in this respect, the art of Drawing operates as a powerful stimulant to progress, in continually yielding new and varied results.

A chance sketch—a rude combination of carelessly considered pencillings—the jotted memoranda of a contemplative brain, prying into the corners of contrivance—often form the nucleus of a splendid invention. An idea thus preserved at the moment of its birth, may become of incalculable value, when rescued from the desultory train of fancy, and treated as the sober offspring of reason. In nice gradations, it receives the refining touches of leisure—becoming, first, a finished sketch,—then a drawing by the practised hand—so that many minds may find easy access to it, for their joint counsellings to improvement—until it finally emerges from the workshop, as a practical triumph of mechanical invention—an illustrious example of a happy combination opportunely noticed. Yet many ingenious men are hardly able even to start this train of production, purely from inability to adequately delineate their early conceptions, or

furnish that transcript of their minds which might make their thoughts immortal. If the present Treatise succeeds only in mitigating this evil, it will not entirely fail in its object; for it will at least add a few steps to the ladder of Intelligence, and form a few more approaches to the goal of Perfection—

"Thou hast not lost an hour whereof there is a record;
A written thought at midnight will redeem the livelong day."

The study of Industrial Design is really as indispensably necessary as the ordinary rudiments of learning. It ought to form an essential feature in the education of young persons for whatever profession or employment they may intend to select, as the great business of their lives; for without a knowledge of Drawing, no scientific work, whether relating to Mechanics, Agriculture, or Manufactures, can be advantageously studied. This is now beginning to receive acknowledgment, and the routines of study in all varieties of educational establishments are being benefited by the introduction of the art.

The special mission of the *Practical Draughtsman's Book of Industrial Design* may almost be gathered from its title-page. It is intended to furnish gradually developed lessons in Geometrical Drawing, applied directly to the various branches of the Industrial Arts: comprehending Linear Design proper; Isometrical Perspective, or the study of Projections; the Drawing of Toothed Wheels and Eccentrics; with Shadowing and Colouring; Oblique Projections; and the study of parallel and exact Perspective; each division being accompanied by special applications to the extensive ranges of Mechanics, Architecture, Foundry-Works, Carpentry, Joinery, Metal Manufactures generally, Hydraulics, the construction of Steam Engines, and Mill-Work. In its compilation, the feeble attraction generally offered to students in elementary form has been carefully considered; and after every geometrical problem, a practical example of its application has been added, to facilitate its comprehension and increase its value.

The work is comprised within nine divisions, appropriated to the different branches of Industrial Design. The first, which concerns Linear Drawing only, treats particularly of straight lines—of circles—and their application to the delineation of Mouldings, Ceilings, Floors, Balconies, Cusps, Rosettes, and other forms, to accustom the student to the proper use of the Square, Angle, and Compasses. In addition to this, it affords examples of different methods of constructing plain curves, such as are of frequent occurrence in the arts, and in mechanical combinations—as the ellipse, the oval, the parabola, and the volute; and certain figures, accurately shaded, to represent reliefs, exemplifying cases where these curves are employed.

The second division illustrates the geometrical representation of objects, or the study of projections. This forms the basis of all descriptive geometry, practically considered. It shows that a single figure is insufficient for the determination of all the outlines and dimensions of a given subject; but that two projections, and one or more sections, are always necessary for the due interpretation of internal forms.

The third division points out the conventional colours and tints for the expression of the sectional details of objects, according to their nature; furnishing, at the same time, simple and easy examples, which may at once interest the pupil, and familiarise him with the use of the pencil.

In the fourth division are given drawings of various essentially valuable curves, as Helices, and different kinds of Spirals and Serpentine, with the intersection of surfaces and their development, and workshop applications to Pipes, Coppers, Boilers, and Cocks. This study is obviously of importance in many professions, and clearly so to Ironplate-workers, as Shipbuilders and Boiler-makers, Tinmen and Copper-smiths.

The fifth division is devoted to special classes of curves relating to the teeth of Spur Wheels, Screws and Racks, and the details of the construction of their patterns. The latter branch is of peculiar importance here, inasmuch as it

has not been fully treated of in any existing work, whilst it is of the highest value to the pattern-maker, who ought to be acquainted with the most workmanlike plan of cutting his wood, and effecting the necessary junctions, as well as the general course to take in executing his pattern, for facilitating the moulding process.

The sixth division is, in effect, a continuation of the fifth. It comprises the theory and practice of drawing Bevil, Conical, or Angular Wheels, with details of the construction of the wood patterns, and notices of peculiar forms of some gearing, as well as the eccentrics employed in mechanical construction.

The seventh division comprises the studies of the shading and shadows of the principal solids—Prisms, Pyramids, Cylinders, and Spheres, together with their applications to mechanical and architectural details, as screws, spur and bevil wheels, coppers and furnaces, columns and entablatures. These studies naturally lead to that of colours—single, as those of China Ink or Sepia, or varied; also of graduated shades produced by successive flat tints, according to one method, or by the softening manipulation of the brush, according to another.

The pupil may now undertake designs of greater complexity, leading him in the eighth division to various figures representing combined or general elevations, as well as sections and details of various complete machines, to which are added some geometrical drawings, explanatory of the action of the moving parts of machinery.

The ninth completes the study of Industrial Design, with oblique projections and parallels, and exact perspective. In the study of exact perspective, special applications of its rules are made to architecture and machinery by the aid of a perspective elevation of a corn mill supported on columns, and fitted up with all the necessary gearing. A series of Plates, marked A, B, &c., are also interspersed throughout the work, as examples of finished drawings of machinery. The Letterpress relating to these Plates, together with an illustrated chapter on Drawing Instruments, will form an appropriate Appendix to the Volume. The general explanatory text embraces not only a description of the objects and their movements, but also tables and practical rules, more particularly those relating to the dimensions of the principal details of machinery, as facilitating actual construction.

Such is the scope, and such are the objects, of the PRACTICAL DRAUGHTSMAN'S BOOK OF INDUSTRIAL DESIGN.

Such is the course now submitted to the consideration of all who are in the slightest degree connected with the Constructive Arts. It aims at the dissemination of those fundamental teachings which are so essentially necessary at every stage in the application of the forces lent to us by Nature for the conversion of her materials. For "man can only act upon Nature, and appropriate her forces to his use, by comprehending her laws, and knowing those forces in relative value and measure." All art is the true application of knowledge to a practical end. We have outlived the times of random construction, and the mere heaping together of natural substances. We must now design carefully and delineate accurately before we proceed to execute—and the quick pencil of the ready draughtsman is a proud possession for our purpose. Let the youthful student think on this; and whether in the workshop of the Engineer, the studio of the Architect, or the factory of the Manufacturer, let him remember that, to spare the blighting of his fondest hopes, and the marring of his fairest prospects—to achieve, indeed, his higher aspirations, and verify his loftier thoughts, which point to eminence—he must give his days and nights, his business and his leisure, to the study of

Industrial Design.

ABBREVIATIONS AND CONVENTIONAL SIGNS.

In order to simplify the language or expression of arithmetical and geometrical operations, the following conventional signs are used:—

The sign $+$ signifies *plus* or *more*, and is placed between two or more terms to indicate addition.

EXAMPLE: $4 + 3$, is 4 plus 3, that is, 4 added to 3, or 7.

The sign $-$ signifies *minus* or *less*, and indicates subtraction.

EX. : $4 - 3$, is 4 minus 3, that is, 3 taken from 4, or 1.

The sign \times signifies *multiplied by*, and, placed between two terms, indicates multiplication.

EX. : 5×3 , is 5 multiplied by 3, or 15.

When quantities are expressed by letters, the sign may be suppressed. Thus we write, indifferently—

$$a \times b, \text{ or } ab.$$

The sign \div or (as it is more commonly used) \div , signifies *divided by*, and, placed between two quantities, indicates division.

EX. : $12 \div 4$, or $12 \div 4$, or $\frac{12}{4}$, is 12 divided by 4.

The sign $=$ signifies *equals* or *equal to*, and is placed between two expressions to indicate their equality.

EX. : $6 + 2 = 8$, meaning, that 6 plus 2 is equal to 8.

The union of these signs, $::$ indicates geometrical proportion.

EX. : $2 : 3 :: 4 : 6$, meaning, that 2 is to 3 as 4 is to 6.

The sign $\sqrt{\quad}$ indicates the extraction of a root; as,

$$\sqrt{9} = 3, \text{ meaning, that the square root of 9 is equal to 3.}$$

The interposition of a numeral between the opening of this sign, $\sqrt{\quad}$, indicates the degree of the root. Thus—

$$\sqrt[3]{27} = 3, \text{ expresses that the cube root of 27 is equal to 3.}$$

The signs \angle and \succ indicate respectively, *smaller than* and *greater than*.

EX. : $3 \angle 4$, = 3 smaller than 4; and, reciprocally, $4 \succ 3$, = 4 greater than 3.

Fig. signifies figure; and pl., plate.

FRENCH AND ENGLISH LINEAR MEASURES COMPARED.

French.	English.	English.	French.
1 Millimètre	= 0.0394 Inches.	1 Inch	= 25.400 Millimètres.
10 Millimètres	= 0.3937 "		{ 2.540 Centimètres.
10 Centimètres	= 3.9371 "		= 3.948 Decimètres.
10 Decimètres	= 3.2809 Feet.	12 Inches	= 1 Foot
	{ 1.0936 Yards.	3 Feet	= 1 Yard
10 Mètres	= 1.0936 Yards.	5½ Yards	= 1 Pole or Rod
10 Mètres	= 1 Decamètre	40 Poles	= 1 Furlong
10 Decamètres	= 1 Hectomètre	8 Furlongs }	= 1 Mile
10 Hectomètres	= 1 Kilomètre	{ 1760 Yards }	= 1.610 Hectomètres.
10 Kilomètres	= 1 Myriamètre		

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