DESCHANEL'S
NATURAL PHILOSOPHY.
BY PROFESSOR EVERETT.

PART I.

MECHANICS, HYDROSTATICS, AND PNEUMATICS.

E#8 E#178.

Jenaro d'Avila

Boston Mass.

October 1st 1896.

Standard Air

0°C

Sea level

Latitude 45° —

$P\varepsilon = 1$

14

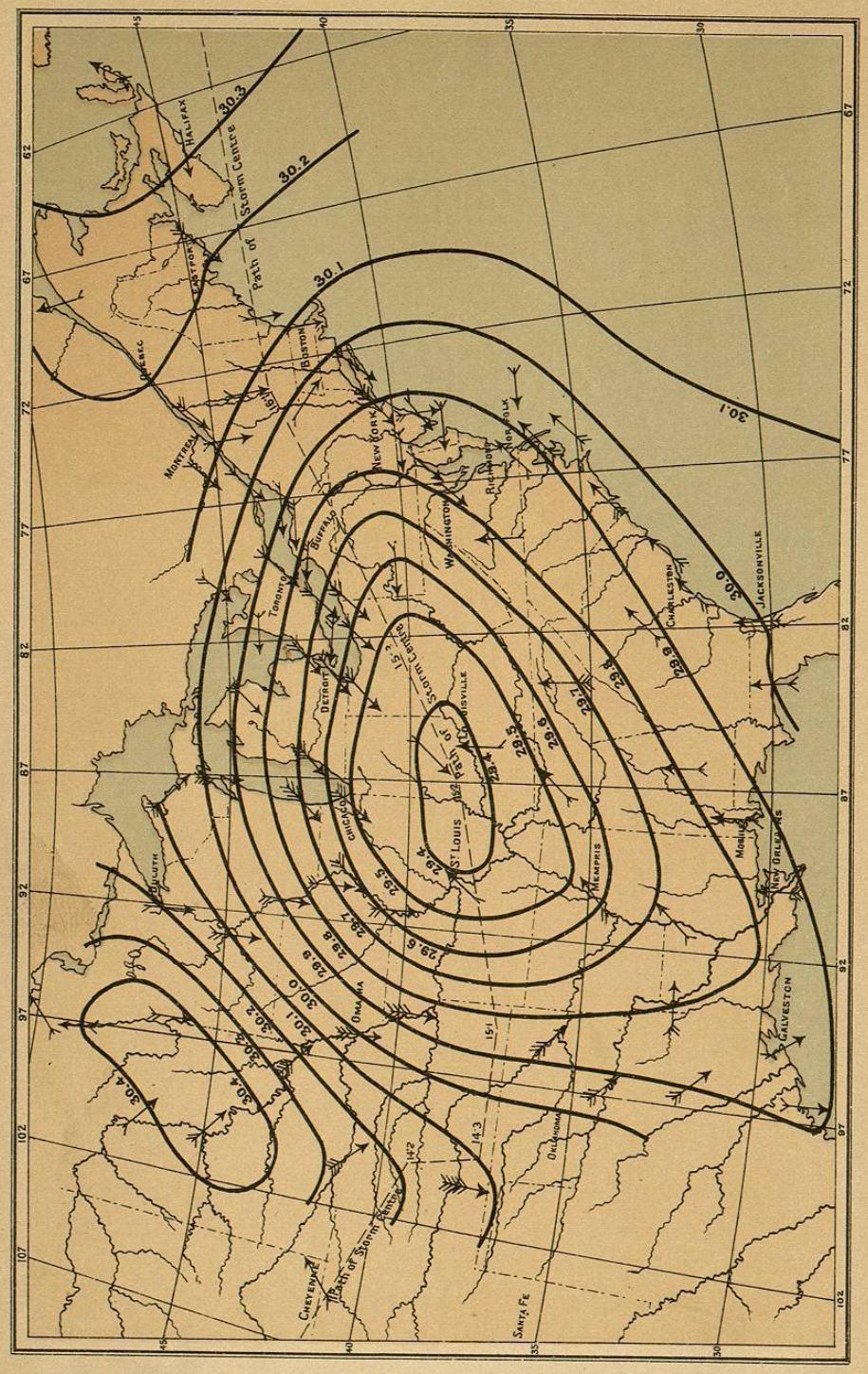

CHART OF PRESSURE AND WIND FOR THE STORM OF JAN. 15, 1877.

DRAWN BY PROFESSOR LOOMIS.

For explanation see page 165.

ELEMENTARY TREATISE

ON

NATURAL PHILOSOPHY

BASED ON THE TRAITÉ DE PHYSIQUE OF

A. PRIVAT DESCHANEL

FORMERLY PROFESSOR OF PHYSICS IN THE LYCÉE LOUIS-LE-GRAND,
INSPECTOR OF THE ACADEMY OF PARIS.

BY

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PART I.

MECHANICS, HYDROSTATICS, AND PNEUMATICS.

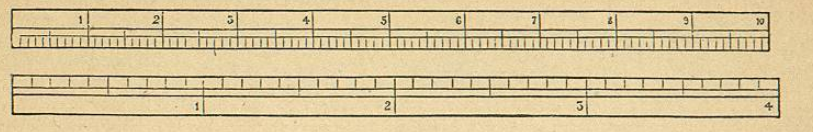
THIRTEENTH EDITION.

NEW YORK:
D. APPLETON AND COMPANY,
1895.

Authorised Edition.

FRENCH AND ENGLISH MEASURES.

A DECIMETRE DIVIDED INTO CENTIMETRES AND MILLIMETRES.



INCHES AND TENTHS.

REDUCTION OF FRENCH TO ENGLISH MEASURES.

Length.

1 millimetre = ·03937 inch, or about $\frac{1}{25}$ inch.
1 centimetre = ·3937 inch.
1 decimetre = 3·937 inch.
1 metre = 39·37 inch = 3·281 ft. = 1·0936 yd.
1 kilometre = 1093·6 yds., or about $\frac{5}{8}$ mile.
More accurately, 1 metre = 39·370432 in. = 3·2808693 ft. = 1·09362311 yd.

Area.

1 sq. millim. = ·00155 sq. in.
1 sq. centim. = ·155 sq. in.
1 sq. decim. = 15·5 sq. in.
1 sq. metre = 1550 sq. in. = 10·764 sq. ft. = 1·196 sq. yd.

Volume.

1 cub. millim. = ·000061 cub. in.
1 cub. centim. = ·061025 cub. in.
1 cub. decim. = 61·0254 cub. in.
cub. metre = 61025 cub. in. = 35·3156 cub. ft. = 1·308 cub. yd.

The Litre (used for liquids) is the same as the cubic decimetre, and is equal to 1·7617 pint, or ·22021 gallon.

Mass and Weight.

1 milligramme = ·01543 grain.
1 gramme = 15·432 grain.
1 kilogramme = 15432 grains = 2·205 lbs. avoir.
More accurately, the kilogramme is 2·20462125 lbs.

Miscellaneous.

1 gramme per sq. centim. = 2·0481 lbs. per sq. ft.
1 kilogramme per sq. centim. = 14·223 lbs. per sq. in.
1 kilogrammetre = 7·2331 foot-pounds.
1 force de cheval = 75 kilogrammetres per second, or 542½ foot-pounds per second nearly, whereas 1 horse-power (English) = 550 foot-pounds per second.

REDUCTION TO C.G.S. MEASURES. (See page 48.)

[*cm.* denotes centimetre(s); *gm.* denotes gramme(s).]

Length.

1 inch = 2·54 centimetres, nearly.
1 foot = 30·48 centimetres, nearly.
1 yard = 91·44 centimetres, nearly.
1 statute mile = 160933 centimetres, nearly.
More accurately, 1 inch = 2·5399772 centimetres.

Area.

1 sq. inch = 6·45 sq. cm., nearly.
1 sq. foot = 929 sq. cm., nearly.
1 sq. yard = 8361 sq. cm., nearly.
1 sq. mile = $2·59 \times 10^{10}$ sq. cm., nearly.

Volume.

1 cub. inch = 16·39 cub. cm., nearly.
1 cub. foot = 28316 cub. cm., nearly.
1 cub. yard = 764535 cub. cm., nearly.
1 gallon = 4541 cub. cm., nearly.

Mass.

1 grain = ·0648 gramme, nearly.
1 oz. avoir. = 28·35 gramme, nearly.
1 lb. avoir. = 453·6 gramme, nearly.
1 ton = $1·016 \times 10^6$ gramme, nearly.
More accurately, 1 lb. avoir. = 453·59265 gm.

Velocity.

1 mile per hour = 44·704 cm. per sec.
1 kilometre per hour = 27·7 cm. per sec.

Density.

1 lb. per cub. foot = ·016019 gm. per cub. cm.
62·4 lbs. per cub. ft. = 1 gm. per cub. cm.

FORCE (assuming $g=981$). (See p. 48.)

Weight of 1 grain $=63{\cdot}57$ dynes, nearly.
" 1 oz. avoir. $=2{\cdot}78\times10^4$ dynes, nearly.
" 1 lb. avoir. $=4{\cdot}45\times10^5$ dynes, nearly.
" 1 ton $=9{\cdot}97\times10^8$ dynes, nearly.
" 1 gramme $=981$ dynes, nearly.
" 1 kilogramme $=9{\cdot}81\times10^5$ dynes, nearly.

WORK (assuming $g=981$). (See p. 48.)

1 foot-pound $=1{\cdot}356\times10^7$ ergs, nearly.
1 kilogrammetre $=9{\cdot}81\times10^7$ ergs, nearly.
Work in a second by one theoretical "horse." $=7{\cdot}46\times10^9$ ergs, nearly.

STRESS (assuming $g=981$).

1 lb. per sq. ft. $=479$ dynes per sq. cm., nearly.
1 lb. per sq. inch $=6{\cdot}9\times10^4$ dynes per sq. cm., nearly.
1 kilog. per sq. cm. $=9{\cdot}81\times10^5$ dynes per sq. cm., nearly.
760 mm. of mercury at 0° C. $=1{\cdot}014\times10^6$ dynes per sq. cm., nearly.
30 inches of mercury at 0° C. $=1{\cdot}0163\times10^6$ dynes per sq. cm., nearly.
1 inch of mercury at 0° C. $=3{\cdot}388\times10^4$ dynes per sq. cm., nearly.

TABLE OF DENSITIES, IN GRAMMES PER CUBIC CENTIMETRE.

LIQUIDS.

Pure water at 4° C.,	1·000
Sea water, ordinary,	1·026
Alcohol, pure,	·791
" proof spirit,	·916
Ether,	·716
Mercury at 0° C.,	13·596
Naphtha,	·848

SOLIDS.

Brass, cast,	7·8 to 8·4
" wire,	8·54
Bronze,	8·4
Copper, cast,	8·6
" sheet,	8·8
" hammered,	8·9
Gold,	19 to 19·6
Iron, cast,	6·95 to 7·3
" wrought,	7·6 to 7·8
Lead,	11·4
Platinum,	21 to 22
Silver,	10·5
Steel,	7·8 to 7·9
Tin,	7·3 to 7·5
Zinc,	6·8 to 7·2
Ice,	·92
Basalt,	3·00
Brick,	2 to 2·17
Brickwork,	1·8
Chalk,	1·8 to 2·8
Clay,	1·92
Glass, crown,	2·5
" flint,	3·0
Quartz (rock-crystal),	2·65
Sand,	1·42
Fir, spruce,	·48 to ·7
Oak, European,	·69 to ·99
Lignum-vitæ,	·65 to 1·33
Sulphur, octahedral,	2·05
" prismatic,	1·98

GASES, at 0° C. and a pressure of a million dynes per sq. cm. (see p. 142).

Air, dry,	·0012759
Oxygen,	·0014107
Nitrogen,	·0012393
Hydrogen,	·00008837
Carbonic acid,	·0019509

ELEMENTARY TREATISE
ON
NATURAL PHILOSOPHY.

CHAPTER I.

INTRODUCTORY.

1. Natural Science, in the widest sense of the term, comprises all the phenomena of the material world. In so far as it merely describes and classifies these phenomena, it may be called Natural History; in so far as it furnishes accurate quantitative knowledge of the relations between causes and effects it is called Natural Philosophy. Many subjects of study pass through the natural history stage before they attain the natural philosophy stage; the phenomena being observed and compared for many years before the quantitative laws which govern them are disclosed.

2. There are two extensive groups of phenomena which are conventionally excluded from the domain of Natural Philosophy, and regarded as constituting separate branches of science in themselves; namely:—

First. Those phenomena which depend on vital forces; such phenomena, for example, as the growth of animals and plants. These constitute the domain of Biology.

Secondly. Those which depend on elective attractions between the atoms of particular substances, attractions which are known by the name of chemical affinities. These phenomena are relegated to the special science of Chemistry.

Again, Astronomy, which treats of the nature and movements of the heavenly bodies, is, like Chemistry, so vast a subject, that it forms a special science of itself; though certain general laws, which its phenomena exemplify, are still included in the study of Natural Philosophy.