

TABLE OF CONTENTS

VOLUME III. THE PHYSICAL PROCESSES OF WEATHER

LIST OF ILLUSTRATIONS	<i>page</i> xiv
TABLE OF SYMBOLS USED IN THIS AND OTHER VOLUMES	<i>page</i> xix
LIST OF WORDS USED IN SPECIAL SENSES	<i>page</i> xxvii
THE PHYSICAL PROCESSES OF WEATHER	<i>page</i> i
Wave-motion.	
Polarisation.	
Rectilinear transmission of energy by waves and the law of inverse square.	
The physics of the atmosphere.	
* * * Acknowledgments.	
<i>Chapter I. GRAVITY-WAVES IN WATER AND AIR</i>	<i>page</i> 10
Tidal waves.	
Water-waves.	
The energy of waves.	
The rollers of Ascension.	
Wave-velocity and group-velocity.	
The height of waves.	
Standing waves in running water.	
The tinkling of the brook.	
Obstructions in the path of waves.	
Oblique reflexion.	
The effect of smaller obstructions upon wave-motion.	
Diminishing waves. Damping.	
Curling waves and breakers.	
Gravity-waves in air.	
Other atmospheric waves.	
Diurnal waves of pressure.	
<i>Chapter II. SOUND-WAVES :</i>	<i>page</i> 35
Variation of wave-front during transmission.	
Reflexion.	
Refraction.	
Diffraction. .	
Wave-fronts in the atmosphere.	
The effect of temperature.	
The effect of wind.	

TABLE OF CONTENTS

Transmission in an irregular atmosphere.
 Transmission in a counterlapse.
 Limits of audibility. Zones of silence.
 Explosions at la Courtine.
 Explosions at Jüterbog.
 Theories of abnormal audibility.
 The irregular transmission of sound.
 Sounds of meteorological origin.

Chapter III. ATMOSPHERIC OPTICS page 53

Refraction, dispersion and astronomical refraction.
 The geometrical horizon.
 Looming and superior mirage.
 Artificial mirage.
 Inferior mirage.
 Fata Morgana.
 The relation of temperature to refraction.
 Dispersion in relation to refraction. The green ray or green flash.
 Scintillation of the stars.
 The shape of the sky.
 The effect of solid and liquid particles.
 Reflexion and scattering.
 The blue of the sky.
 Artificial "blue sky."
 Blue shadows.
 The dissipation of energy by scattering
 Diffuse reflexion.
 Daylight and twilight.
 Twilight colours.
 Sunset colours.
 The effect of water-drops.
 Diffraction of light.
 Solar and lunar coronas.
 An artificial corona.
 The age of coronal clouds.
 Iridescent clouds.
 Glories.
 Water-drops or ice-crystals.
 Refraction of light. The rainbow.
 The formation of rainbows.
 The darkness of clouds.
 The effect of snow and ice-crystals.
 Artificial and natural haloes.
 Other optical phenomena.

Chapter IV. RADIATION AND ITS PROBLEMS page 103

The atmosphere as a natural engine.
 The heat-balance.
 Radiation and its laws.
 Universal radiation.
 Transmission in straight lines.
 The general physical laws of radiation.

TABLE OF CONTENTS

ix

The supply of energy from the sun.	
The fraction which reaches the earth's surface.	
Standard scale for a "black body."	
The solar constant.	
The local intensity of sunbeams.	
Seasonal and diurnal variation of the intensity of sunbeams.	
Accidental influences—the dust of volcanoes.	
Total radiation upon a horizontal surface.	
Indirect short waves: Sky-radiation.	
Cloudless days.	
The effect of cloudiness on total radiation.	
Clouds as sky-radiators.	
Sky-searching for short waves: Mr Dines's observations.	
Analysis of the effect of the atmosphere on the radiation from the sun. The earth's albedo.	
The reflexion of solar energy by different surfaces.	
The analysis of radiant energy according to wave-length.	
The laws of absorption and of scattering.	
Absorption.	
Selective absorption of solar radiation: Oxygen, ozone and carbon dioxide.	
Scattering or diffuse reflexion.	
Molecular scattering and atmospheric absorption.	
The human body as radiator.	
Selective absorption of long-wave radiation: Water-vapour, carbon dioxide, water.	
Long-wave radiation from earth and air.	
Long-wave radiation from the atmosphere.	
Sky-searching for long waves.	
Actual radiating surfaces.	
The achievement of the physical study of radiation.	
<i>Chapter V. THE CONTROLLING INFLUENCES OF RADIATION . . .</i>	<i>page 171</i>
Radiation and climate.	
Black bulb <i>in vacuo</i> .	
Wilson's radio-integrator.	
The grass minimum thermometer.	
The sunshine recorder.	
Ultra-violet radiation as a climatic factor.	
Radiation in relation to atmospheric structure.	
Primary and auxiliary assumptions.	
The selective absorption by water-vapour.	
Ozone in atmospheric structure.	
Radiation and weather.	
Clayton's "World Weather."	
The influence of the sun upon clouds.	
The recognised effects of solar radiation. Spontaneous physical integration.	
Diurnal variation of temperature at sea.	
Diurnal variation over the land.	
The corresponding sequence of changes in the upper air.	
The effect of radiation on mountain summits.	
Counterlapse without radiation.	
The problem of the heat-engine.	
An author's questions.	

Chapter VI. AIR AS WORKER *page 205*

- The conservation of mass and energy in physical processes.
 - Work and the representation of work by area.
 - Heat as a form of energy.
 - Units in the expression of energy.
- Algebraical symbols of quantities and units.
- The magnitude of atmospheric energy.
- Physical liability.
- Dry air, moist air, damp air and saturated air.
- The postulate of a quiescent atmosphere.
- The laws of gases and vapours.
- The relation of heat to the properties of gaseous air.
 - The effects produced by measured quantities of heat.
 - Specific heat at constant volume, Specific heat at constant pressure.
 - Isothermal operations.
 - Isentropic operations—adiabatic changes.
- Temperature as the index of energy of a gas.
 - Entropy as an index of the dilution of energy.
 - Entropy as a proper fraction.
- Graphic representation of the process of working by gaseous air.
 - The quantitative relations.
 - Potential temperature, potential pressure or entropy.
 - The tolerance of an approximate formula.
 - Representation of isothermal and adiabatic changes on a pv diagram.
 - The same on an entropy-temperature diagram.
 - Carnot's cycle and its implications.
- Thermal properties of saturated air.
 - Isothermal lines for the transition from water to vapour and *vice versa*.
 - Latent heat and its influence in pure vapour and in moist air.
 - The relation between temperature and the saturation pressure of water-vapour.
- Physical constants for a mixture of air and water-vapour.
 - Vapour-pressure and vapour-density for saturation and the corresponding gas-constant.
 - Density.
 - Water required for the saturation of a gramme of dry air.
 - The constant of the characteristic equation for $(1 + x)$ grammes of gaseous air.
- The diagrammatic representation of the properties of working air.
 - Lines of equal pressure, volume, vapour-content and saturation adiabatics on an entropy-temperature diagram.
 - Working diagrams on the basis of entropy and temperature.
- A hypothetical cycle of atmospheric operations.
 - The efficiency of the cycle.
- Downward convection.
- Weather-maps drawn on an isentropic surface.
- Novum Organum Meteoricum*.
 - On the employment of entropy as a meteorological element.
- Addendum.
 - Neuhoff's equations for the adiabatics of saturated air referred to pressure and temperature.

TABLE OF CONTENTS

xi

Chapter VII. THE LIABILITY OF THE ENVIRONMENT page 269

- Tables for calculating the entropy of air from the measures of its temperature and pressure.
- The tephigram and the liability diagram.
 - Plotting the figures.
 - Liability diagram on millimetre paper.
 - The surplus of energy indicated by the tephigram.
 - The representation of humidity.
 - Energy in relation to isentropic surfaces.
- Trigger-action in the atmosphere.
- The synthesis of the tephigram.
 - Trunk, limb and foot.
 - Classification of tephigrams:
 - Polar and equatorial types.
 - Rectilinear types.
 - Saturation type.
- The completion of representation of atmospheric structure.
 - The clothes-line graph for winds.
- The expression of height on the liability diagram.
 - The apparent convergence of the lines of equal pressure at low temperatures.

Chapter VIII. SIDE-LIGHT ON CONVEXION AND CLOUD page 301

- Entropy the controlling spirit of the air.
 - Entropy as a stratifying agency.
 - Convective equilibrium.
 - Reaching the place of equilibrium.
 - Slip surfaces.
 - Unsistible conditions and their consequences.
 - Penetrative convexion.
 - Viscosity, thermal conductivity and diffusion.
 - Cumulative convexion.
 - The resilience of the atmosphere.
 - The counteracting influence of water-vapour.
 - The limits of convexion of saturated air.
 - The perturbations of the stratosphere.
 - The separation of the atmosphere into underworld and overworld.
 - Orographic features.
 - Föhn winds.
 - Land- and sea-breezes.
 - Land- and sea-breezes as "slope-effects."
 - Different appreciations of entropy.
- Condensation and evaporation in the atmosphere.
- Condensation on solid surfaces.
 - Dew, hoar-frost and rime.
 - Ice-storms.
- Evaporation and condensation in the free air.
 - Nuclei for condensation.
 - Dust-particles which are not nuclei.
 - Condensation in unsaturated air.
 - The size of nuclei.
- Water-drops.

TABLE OF CONTENTS

Raindrops.

- The instability of a cloud of drops.
- Large drops and hailstones.
- Coalescence of water-drops and the reciprocal breaking of raindrops.
- The action of electricity upon raindrops and other particles.
- The formation and disappearance of cloud.
 - Flowing contact with a cooled surface.
 - Spontaneous cooling and warming by radiation.
 - Dynamical cooling by reduction of pressure during motion in an isentropic surface.
 - Dynamical cooling by reduction of pressure in thermal convection.
 - Dynamical cooling by cumulative convection.
 - Dynamical cooling due to eddy-convection over a warm surface.
 - The forms of cirrus.
- “The physical conditions of the formation of cloud.”

Chapter IX. ELECTRICAL ENERGY IN THE ATMOSPHERE . . . *page 357*

- Statical electricity.
 - Statical electricity in the atmosphere.
- Statical charges as the terminals of tubes of electric stress.
 - The earth's normal electric field.
 - The perturbations of the earth's field by electric charges in the atmosphere.
- The relations of quantity between statical and commercial electricity.
 - The automatic generation of statical electricity.
 - Lightning flashes.
 - Natural sources of electricity.
- The life-history of a model thunderstorm.
 - General meteorological conditions in a thunderstorm.
 - General electrical conditions.
- Convexio in excelsis.*
- Electrical forces in the region of a thunderstorm.
 - Potential gradients associated with showers and thunderstorms.
 - The effect of clouds and rain.
 - Measurement of wet weather effects.
 - Transference of electricity between the atmosphere and the earth in showers and thunderstorms.
 - Lightning.
 - Continuous currents.
 - Electricity of rain.
 - Some unconsidered aspects of the physical processes of thunderstorms.
 - The roll of thunder.
 - Forms of lightning.
 - Protection against lightning.
 - The utilisation of lightning.
 - The nature of the discharge—oscillatory or continuous.
 - Thunderstorms in meteorological practice.

TABLE OF CONTENTS

xiii

<i>Chapter X. CONVEXION IN THE GENERAL CIRCULATION</i>	. . .	<i>page 398</i>
Advective influence and divective influence.		
The complementary unitary elements of the dynamic of weather.		
The part played by convection.		
Rainfall as a criterion of convection.		
Advective regions.		
Divective regions.		
<i>Regiones intervenientes.</i>		
Prevailing winds.		
Relation with the upper air.		
The divisions of the <i>orbis terrarum.</i>		
The general circulation.		
The seasonal movements of the advective regions.		
The relation of the regions of convection to the circulation at the surface and in the upper air.		
The surface currents of the <i>regiones intervenientes.</i>		
The isentropic lines of the underworld.		
 <i>Index</i>	 <i>page 423</i>